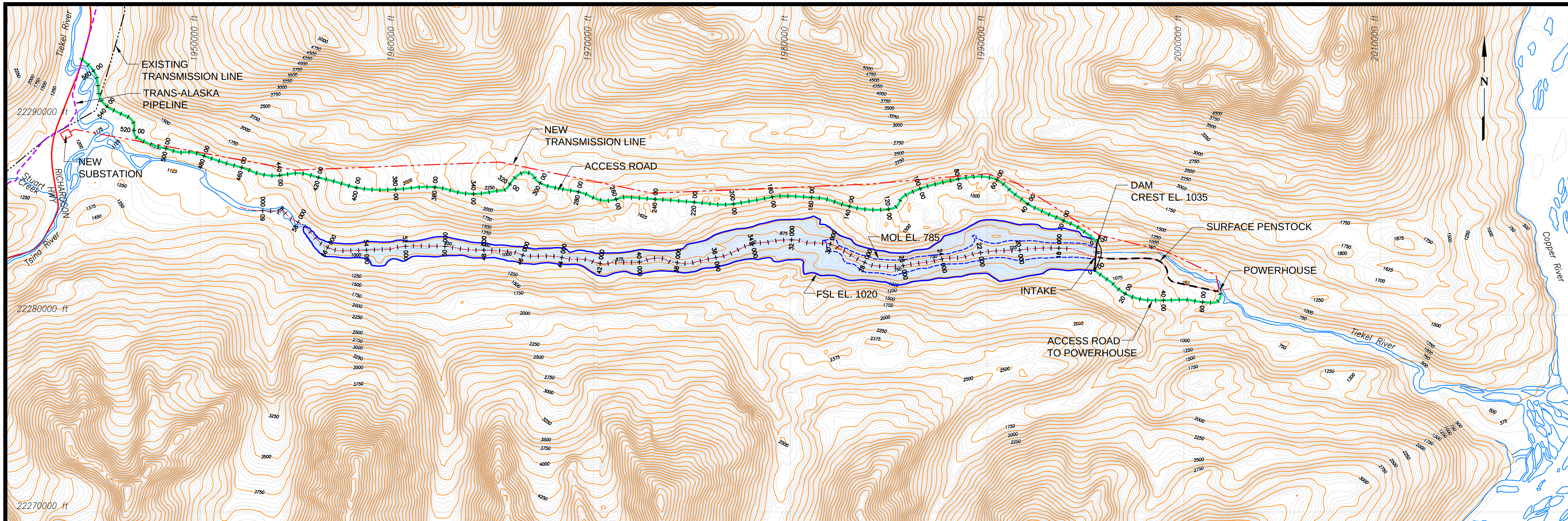
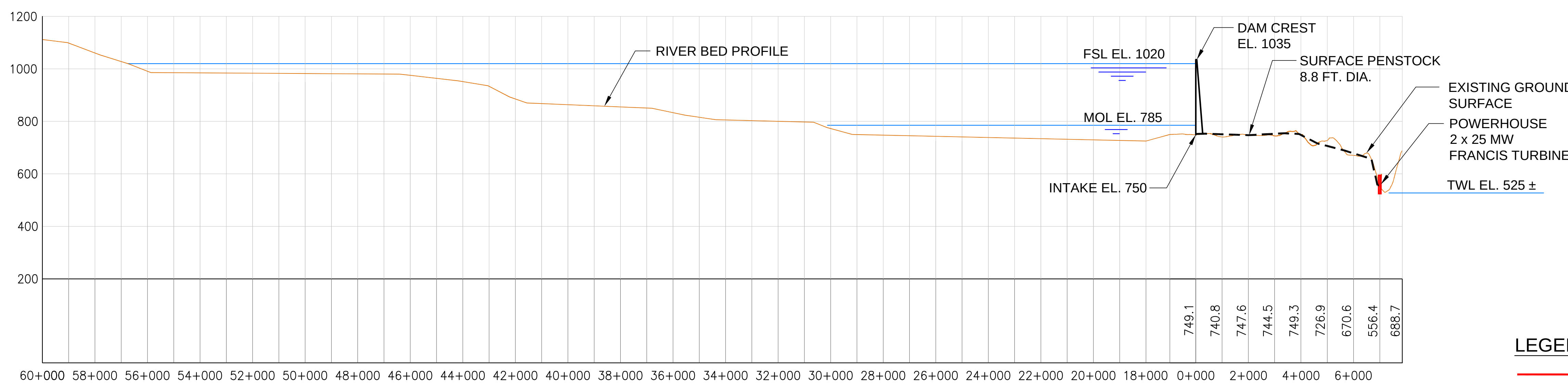


PLAN



PROFILE

LEGEND:

- EXISTING MAJOR ROAD / HIGHWAY
- TRANS-ALASKA PIPELINE
- EXISTING TRANSMISSION LINE
- NEW TRANSMISSION LINE

NOTE:
THIS IS A PRELIMINARY CONCEPT SKETCH FOR FEASIBILITY STUDY PURPOSES ONLY. ALL DIMENSIONS AND ELEVATIONS ARE APPROXIMATE, AND WILL BE UPDATED AS PROJECT DESIGN STUDIES CONTINUE. ALL CONCEPTS AND DETAILS, SUCH AS DIMENSIONS AND ELEVATIONS, DEFINED ON DRAWINGS WOULD REQUIRE FURTHER REFINEMENT DURING A SUBSEQUENT DESIGN PHASE.

HORIZONTAL SCALE 2500 0 2500 5000 FT

VERTICAL SCALE 250 0 250 500 FT

NOTES:

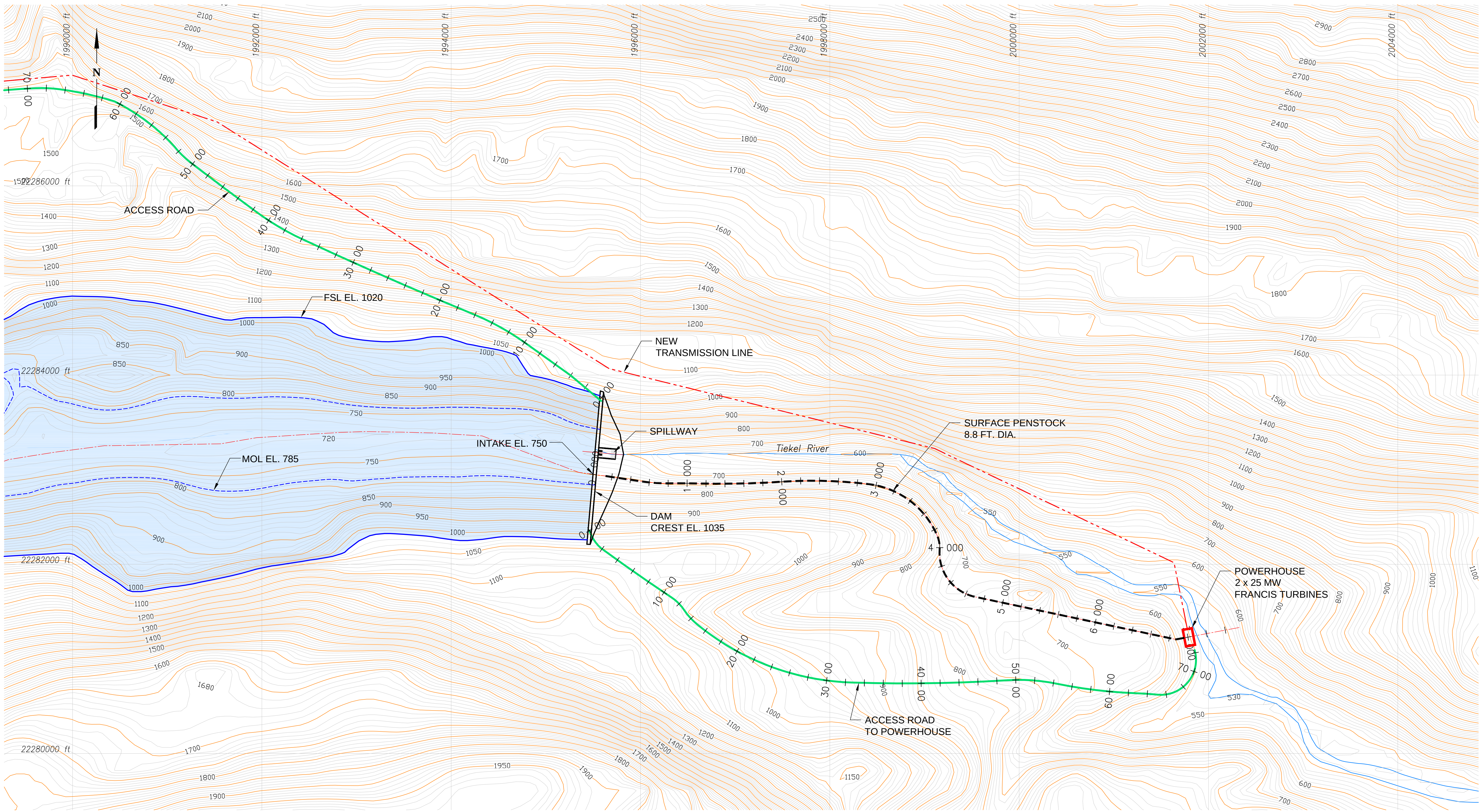
1. TOPOGRAPHY FROM USGS 15 MINUTE DIGITAL ELEVATION MODEL FOR VALDEZ A-3, A-4, B-3 AND B-4, AK.
2. SPATIAL REFERENCE: UTM ZONE 6, NAD83, FEET.
3. VERTICAL DATUM IS NGVD.
4. 25-FT CONTOUR INTERVAL WITH 125-FT INDEX CONTOURS.

COPPER VALLEY ELECTRIC ASSOCIATION
TIEKEL RIVER RECONNAISSANCE

SCENARIO 3A
PLAN AND WATERWAY PROFILE

MWH

JOB No: 10506419	DATE: NOVEMBER 2015
DRAWING No: Exhibit 10 SKC-207	



PLAN

500 0 500 1000 FT

NOTE:

THIS IS A PRELIMINARY CONCEPT SKETCH FOR FEASIBILITY STUDY PURPOSES ONLY. ALL DIMENSIONS AND ELEVATIONS ARE APPROXIMATE, AND WILL BE UPDATED AS PROJECT DESIGN STUDIES CONTINUE. ALL CONCEPTS AND DETAILS, SUCH AS DIMENSIONS AND ELEVATIONS, DEFINED ON DRAWINGS WOULD REQUIRE FURTHER REFINEMENT DURING A SUBSEQUENT DESIGN PHASE.

NOTES:

1. TOPOGRAPHY FROM USGS 15 MINUTE DIGITAL ELEVATION MODEL FOR VALDEZ A-3, A-4, B-3 AND B-4, AK.
2. SPATIAL REFERENCE: UTM ZONE 6, NAD83, FEET.
3. VERTICAL DATUM IS NGVD.
4. 10-FT CONTOUR INTERVAL WITH 50-FT INDEX CONTOURS.

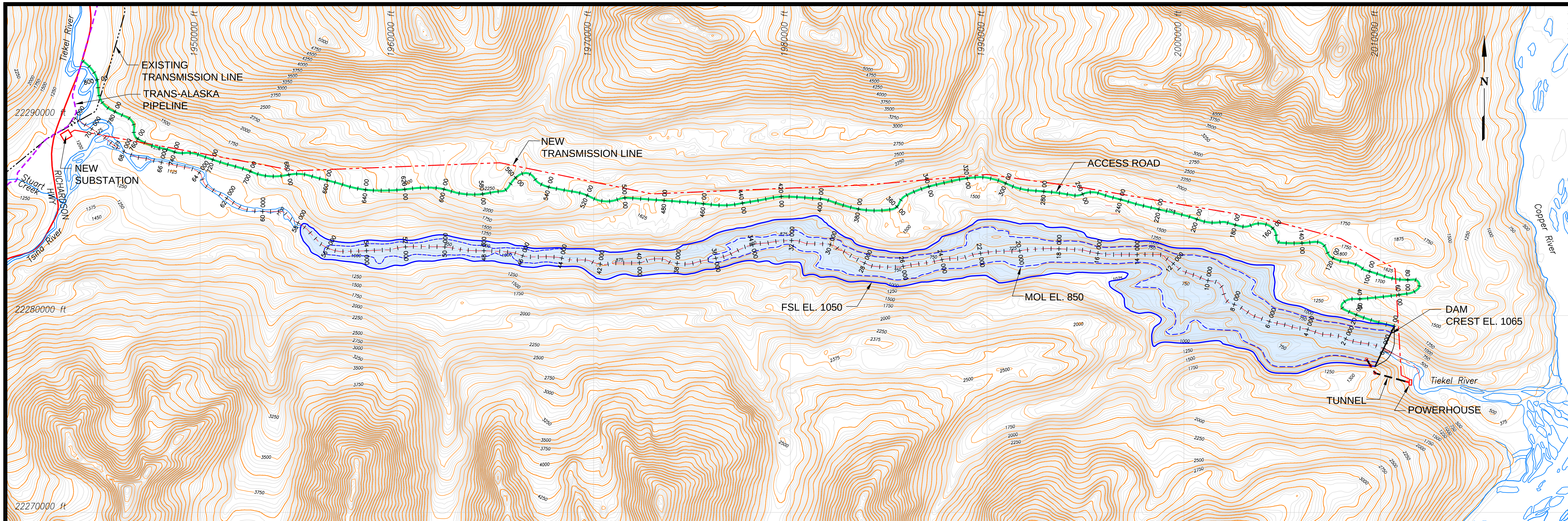
COPPER VALLEY ELECTRIC ASSOCIATION
TIEKEL RIVER RECONNAISSANCE

SCENARIO 3A
PLAN DETAIL

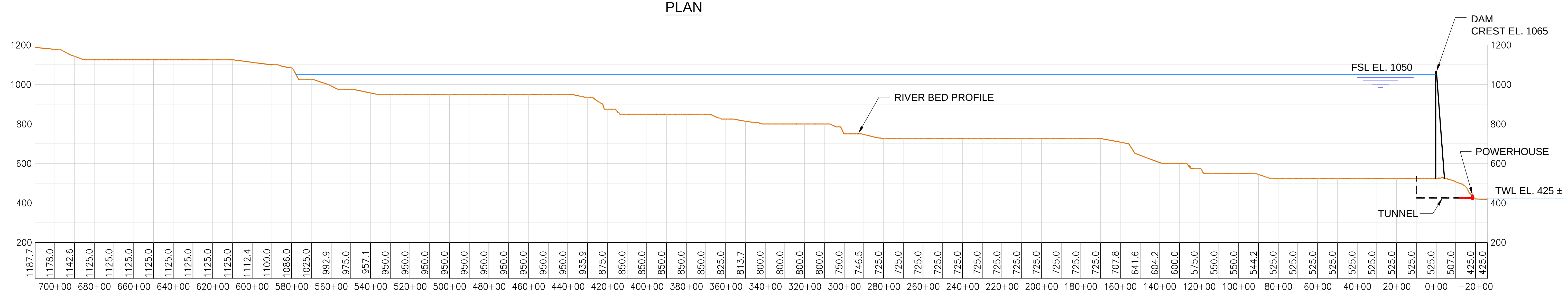
MWH

JOB No: 10506419 DATE: NOVEMBER 2015

DRAWING No: Exhibit 11 SKC-208



PLAN



RIVER BED PROFILE

HORIZONTAL SCALE: 2500 0 2500 5000 FT

VERTICAL SCALE: 250 0 250 500 FT

LEGEND:

- EXISTING MAJOR ROAD / HIGHWAY
- TRANS-ALASKA PIPELINE
- EXISTING TRANSMISSION LINE
- NEW TRANSMISSION LINE

NOTE:

THIS IS A PRELIMINARY CONCEPT SKETCH FOR FEASIBILITY STUDY PURPOSES ONLY. ALL DIMENSIONS AND ELEVATIONS ARE APPROXIMATE, AND WILL BE UPDATED AS PROJECT DESIGN STUDIES CONTINUE. ALL CONCEPTS AND DETAILS, SUCH AS DIMENSIONS AND ELEVATIONS, DEFINED ON DRAWINGS WOULD REQUIRE FURTHER REFINEMENT DURING A SUBSEQUENT DESIGN PHASE.

NOTES:

1. TOPOGRAPHY FROM USGS 15 MINUTE DIGITAL ELEVATION MODEL FOR VALDEZ A-3, A-4, B-3 AND B-4, AK.
2. SPATIAL REFERENCE: UTM ZONE 6, NAD83, FEET.
3. VERTICAL DATUM IS NGVD.
4. 25-FT CONTOUR INTERVAL WITH 125-FT INDEX CONTOURS.

COPPER VALLEY ELECTRIC ASSOCIATION
TIEKEL RIVER RECONNAISSANCE

SCENARIO 3B
PLAN AND RIVER PROFILE

MWH

JOB No: 10506419 DATE: NOVEMBER 2015

DRAWING No: Exhibit 12 SKC-209

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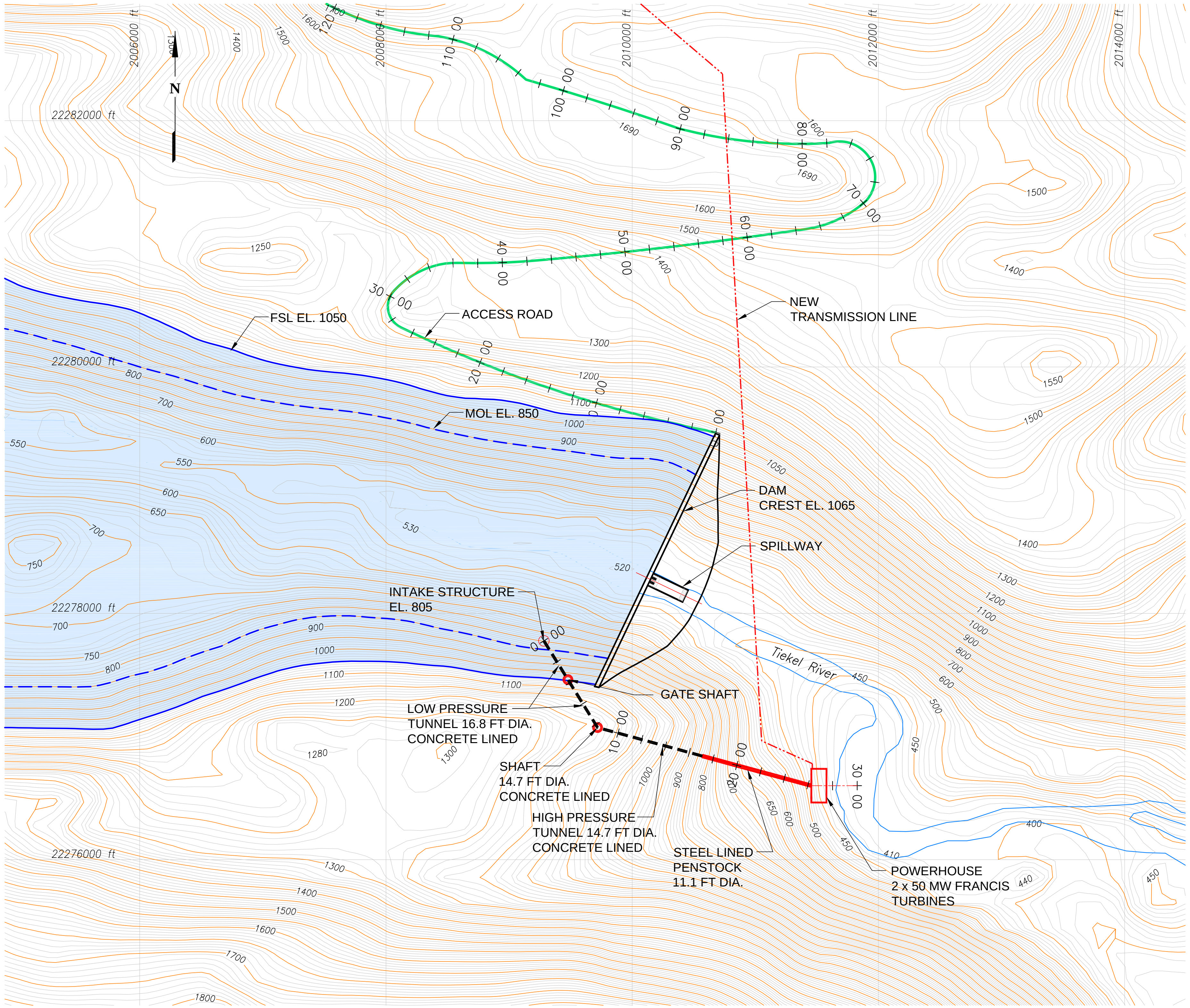
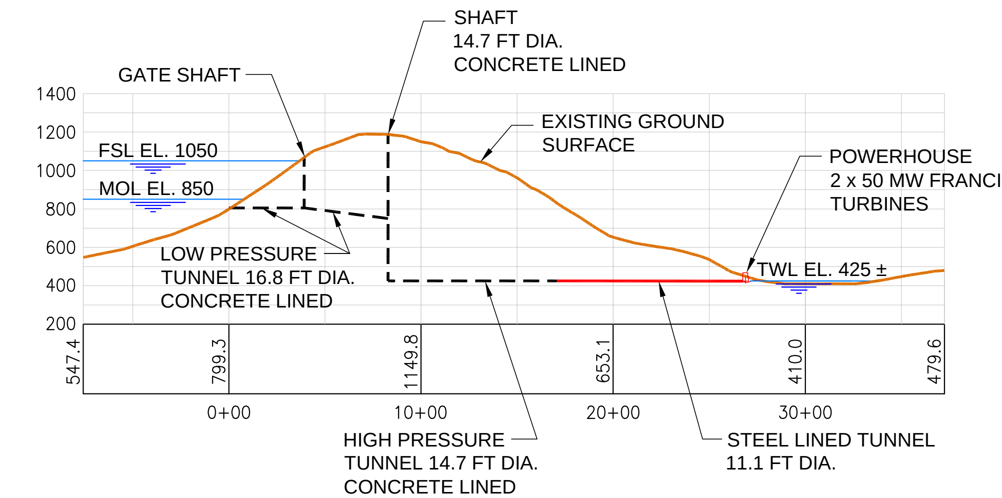


PLAN



WATERWAY PROFILE

500 0 500 1000 FT

NOTE:
THIS IS A PRELIMINARY CONCEPT SKETCH FOR FEASIBILITY STUDY PURPOSES ONLY. ALL DIMENSIONS AND ELEVATIONS ARE APPROXIMATE, AND WILL BE UPDATED AS PROJECT DESIGN STUDIES CONTINUE. ALL CONCEPTS AND DETAILS, SUCH AS DIMENSIONS AND ELEVATIONS, DEFINED ON DRAWINGS WOULD REQUIRE FURTHER REFINEMENT DURING A SUBSEQUENT DESIGN PHASE.

NOTES:

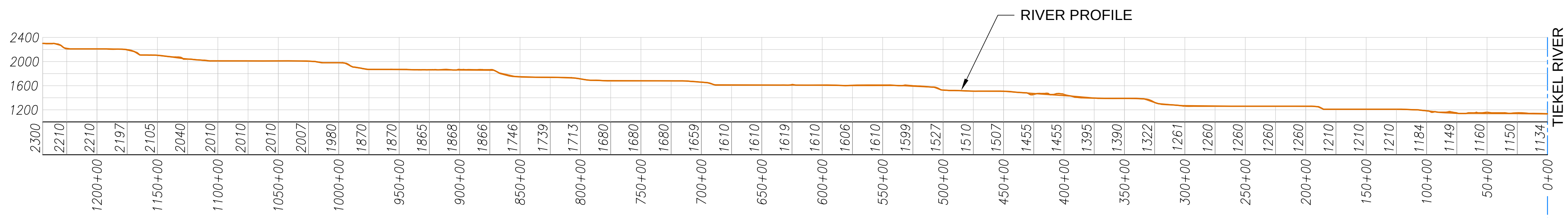
1. TOPOGRAPHY FROM USGS 15 MINUTE DIGITAL ELEVATION MODEL FOR VALDEZ A-3, A-4, B-3 AND B-4, AK.
2. SPATIAL REFERENCE: UTM ZONE 6, NAD83, FEET.
3. VERTICAL DATUM IS NGVD.
4. 10-FT CONTOUR INTERVAL WITH 50-FT INDEX CONTOURS.

COPPER VALLEY ELECTRIC ASSOCIATION
TIEKEL RIVER RECONNAISSANCE

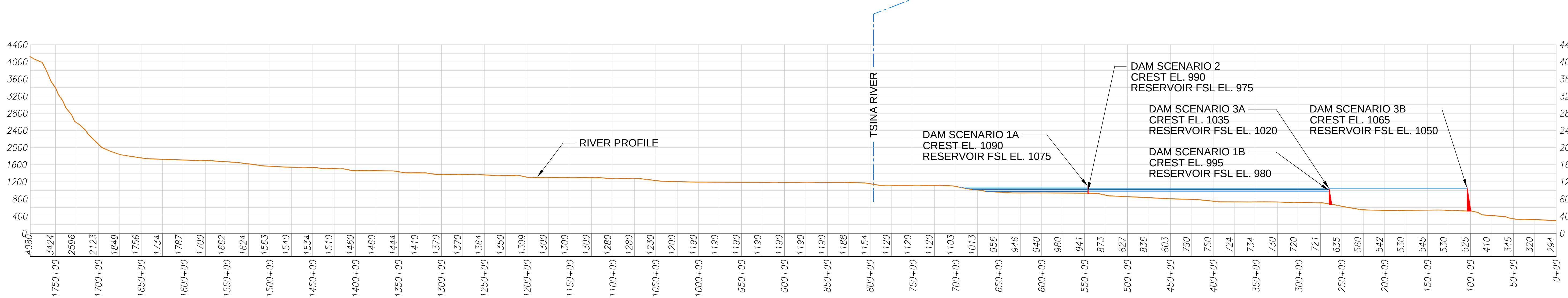
SCENARIO 3B PLAN DETAIL AND WATERWAY PROFILE

MWH

JOB No: 10506419	DATE: NOVEMBER 2015
DRAWING No: Exhibit 13 SKC-210	



TSINA RIVER PROFILE



TIEKEL RIVER PROFILE

NOTE:
THIS IS A PRELIMINARY CONCEPT SKETCH FOR FEASIBILITY STUDY PURPOSES ONLY. ALL DIMENSIONS AND ELEVATIONS ARE APPROXIMATE, AND WILL BE UPDATED AS PROJECT DESIGN STUDIES CONTINUE. ALL CONCEPTS AND DETAILS, SUCH AS DIMENSIONS AND ELEVATIONS, DEFINED ON DRAWINGS WOULD REQUIRE FURTHER REFINEMENT DURING A SUBSEQUENT DESIGN PHASE.

HORIZONTAL SCALE: 6000 0 6000 12000 FT

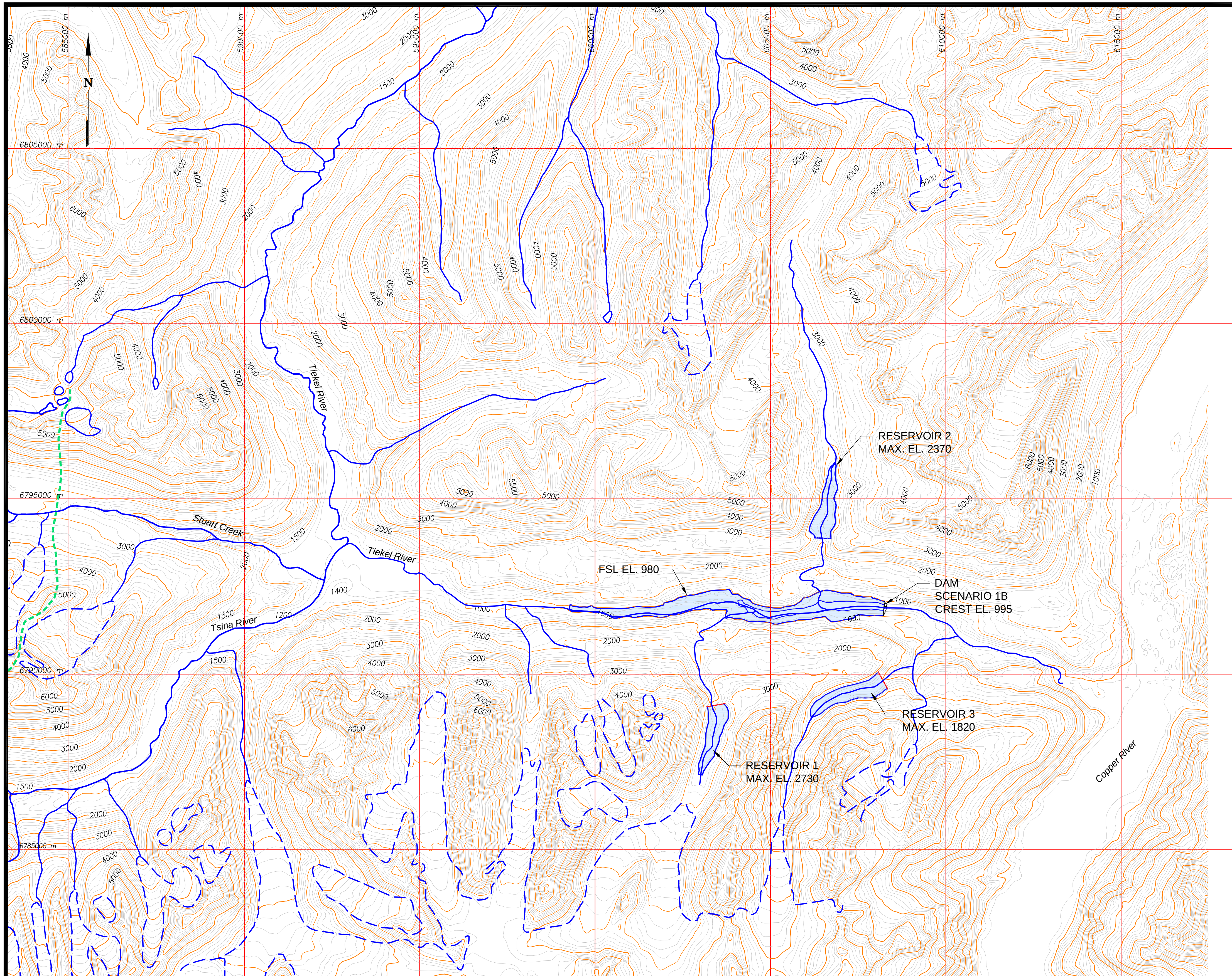
VERTICAL SCALE: 1200 0 1200 2400 FT

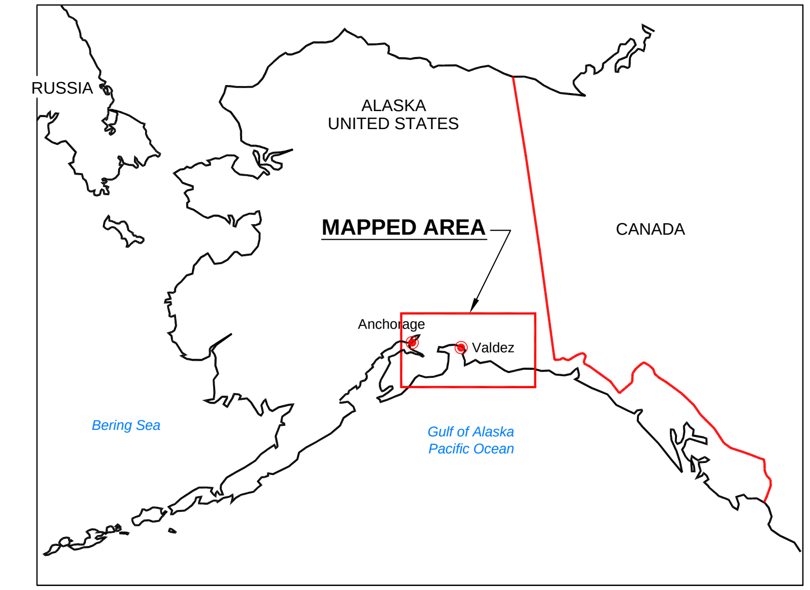
COPPER VALLEY ELECTRIC ASSOCIATION
TIEKEL RIVER RECONNAISSANCE

TSINA RIVER AND TIEKEL RIVER RIVER PROFILES

MWH

JOB No: 10506419	DATE: NOVEMBER 2015
DRAWING No: **Exhibit 14 SKC-009**	





LOCATION MAP

5000 0 5000 10000 FT

NOTE:
THIS IS A PRELIMINARY CONCEPT SKETCH FOR FEASIBILITY STUDY PURPOSES ONLY. ALL DIMENSIONS AND ELEVATIONS ARE APPROXIMATE, AND WILL BE UPDATED AS PROJECT DESIGN STUDIES CONTINUE. ALL CONCEPTS AND DETAILS, SUCH AS DIMENSIONS AND ELEVATIONS, DEFINED ON DRAWINGS WOULD REQUIRE FURTHER REFINEMENT DURING A SUBSEQUENT DESIGN PHASE.

NOTES:

1. TOPOGRAPHY FROM USGS 15 MINUTE DIGITAL ELEVATION MODEL FOR VALDEZ A-3, A-4, B-3 AND B-4, AK.
2. SPATIAL REFERENCE: UTM ZONE 6, NAD83, FEET.
3. VERTICAL DATUM IS NGVD.
4. 100-FT CONTOUR INTERVAL WITH 500-FT INDEX CONTOURS.

COPPER VALLEY ELECTRIC ASSOCIATION
TIEKEL RIVER RECONNAISSANCE

TIEKEL RIVER OFF-STREAM STORAGE LOCATIONS

MWH

JOB No: 10506419 DATE: NOVEMBER 2015
DRAWING No: Exhibit 15 SKC-401

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APPENDIX B

Opinion of Probable Construction Cost

MWH

Tiekel River - Scenario 1A

1/9/2013

Item	Description	Quantity	UOM	Unit Price	Amount
A	**Roads**				$ 8,980,250
1	Clearing and Grubbing	28	AC	7,500.00	$ 210,000
2	Site Roads Excavation Rock	242,000	CY	18.00	$ 4,356,000
3	Site Roads Excavation Overburden	43,500	CY	10.00	$ 435,000
4	Site Roads Embankment	30,500	CY	5.00	$ 152,500
5	Gravel Surfacing	27,500	TN	63.00	$ 1,732,500
6	Drainage Ditch	39,000	LF	3.00	$ 117,000
7	Relief Culverts (18-inch)	3,300	LF	150.00	$ 495,000
8	Drainage Culverts (36-inch)	600	LF	210.00	$ 126,000
9	Large Drainage Arch Culverts (20ft span, 40 ft long, steel plate, concrete strip footings)	2	EA	350,000.00	$ 700,000
10	Tributary Crossings (50 ft span, structural plate culverts)	1	LS	468,750.00	$ 468,750
11	Powerhouse Staging Area and Helipad	1	LS	62,500.00	$ 62,500
12	Dam Staging Area and Helipad	1	LS	62,500.00	$ 62,500
13	Richardson Highway Staging Area and Helipad	1	LS	62,500.00	$ 62,500
B	**Construction Facilities**				$ 9,200,000
14	Quarry Development	1	LS	8,000,000.00	$ 8,000,000
15	Concrete Plant	1	LS	1,200,000.00	$ 1,200,000
16					
C	**Dam**				$ 45,012,260
17	Reservoir Clearing	350	AC	7,500.00	$ 2,625,000
18	Common Excavation	0	CY	9.00	$ -
19	Rock Excavation	17,000	CY	17.00	$ 289,000
20	Foundation Preparation	9,750	SY	35.00	$ 341,250
C1	**Roller Compacted Concrete**	**225,000**	**CY**	185.59	**$ 41,757,010**
21	Excavate & Produce and Stockpile Aggregates	458,600	TN	10.00	$ 4,586,000
22	RCC Cement	14,070	TN	238.00	$ 3,348,660
23	RCC Pozzolan	22,500	TN	210.00	$ 4,725,000
24	Retarding Admixture for RCC	22,500	GAL	7.50	$ 168,750
25	Mix, Convey and Place RCC	225,000	CY	19.00	$ 4,275,000
26	Bedding Mix	1,260	CY	150.00	$ 189,000
27	Upstream Forming & 2 ft Concrete Facing	107,500	SF	122.00	$ 13,115,000
28	Downstream Forming	106,500	SF	63.00	$ 6,709,500
29	Consolidation Drill & Grouting	22,900	LF	100.00	$ 2,290,000
30	Drain Holes	1,450	LF	38.00	$ 55,100
31	Curtain Drill & Grout - 440 holes - 2" AW	27,000	LF	85.00	$ 2,295,000
32					
D	**Power Intake and Tunnel**		LS		$ 68,521,375
33	Concrete structure within reservoir to supply 7.7 ft ID concrete lined tunnel. Inc trashracks	1	EA	2,475,000.00	$ 2,475,000
34	Rock excavation. 9.7 ft ID tunnel. 40500 LF Finish Dia 7.7 ft	110,850	CY	210.00	$ 23,278,500
35	Tunnel - Concrete lining 1 ft thick. 40500 LF	41,000	CY	875.00	$ 35,875,000
	Rock excavation. 9.7 ft ID tunnel. 3030 LF Finish Dia 6.7 ft	8,300	CY	210.00	$ 1,743,000
	Tunnel - Concrete lining 1.5 ft thick. 3030 LF	4,345	CY	875.00	$ 3,801,875
	Rock excavation. 7.1 ft ID tunnel. 970 LF Finish Dia 5.1 ft	1,420	CY	210.00	$ 298,200
	Tunnel - Concrete lining 1 ft thick. 970 LF	690	CY	875.00	$ 603,750
36	Rock excavation. Gate shaft 9.7 ft dia. 180 LF	490	CY	565.00	$ 276,850
37	Gate shaft concrete lining. 1 ft thick. 180 LF	180	CY	940.00	$ 169,200
E	**Penstock**		LS		$ 495,000
38	Steel penstock in tunnel. Horizontal. 5.09 ft ID. 970LF	99	TNS	5,000.00	$ 495,000
39					
40					
41					
F	**Powerhouse**				$ 5,430,000
42	Excavation	10,000	CY	15.00	$ 150,000
43	Concrete	6,600	CY	800.00	$ 5,280,000
G	**Equipment**				$ 22,600,000
44	Power train and miscellaneous powerhouse equipment, including				$ 17,100,000
45	Turbines, generators, TIV, governor, exitation, bus, controls, protection, transformers				Included
46	Miscellaneous Powerhouse Mechanical Equipment				Included
47	Miscellaneous Powerhouse Electrical Equipment				Included
48	Powerhouse Crane				Included
49	Powerhouse Draft Tube Gates and Cranes				Included
50	Shipping and installation				Included
51	Spillway Gate Equipment, shipped and installed (radial 30W x 37H)	1	LS	3,000,000.00	$ 3,000,000
52	Intake gate, shipped and installed (wheeled 6.0W x 7.7H)	1	LS	2,500,000.00	$ 2,500,000
H	**Transmission**				$ 27,494,530
53	Site Distribution System	1	LS	1,000,000.00	$ 1,000,000
54	Powerhouse Switchyard Civil Structures and Equipment, Installed	1	LS	4,200,000.00	$ 4,200,000
55	Transmission Lines	14	MILES	1,283,300.00	$ 18,094,530
56	New Substation	1	LS	4,200,000.00	$ 4,200,000
I	**Indirect Costs**				$ 43,543,354
900	Civil Contractor's Indirect Costs % of Civil	25.0%			$ 41,283,353.75
910	Civil Contractor's Indirect Costs % of Equipment	10.0%			$ 2,260,000
	Unlisted Items and Unknown Scope				$ 41,225,790
950	Unlisted Items and Unknown Scope Allowance - Dam	25.0%			$ 11,253,065
951	Unlisted Items and Unknown Scope Allowance - Tunnel	30.0%			$ 20,556,413
952	Unlisted Items and Unknown Scope Allowance - All Other Civil	25.0%			$ 6,026,313
953	Unlisted Items and Unknown Scope Allowance - All Equipment	15.0%			$ 3,390,000

Item	Description	Quantity	UOM	Unit Price	Amount
	Markups				
	Prime Contractor Markups on Subcontracted Work			**Intended to be incl in unit costs**	
	OH&P			**Intended to be incl in unit costs**	
	Insurance			**Intended to be incl in unit costs**	
	Taxes				**Not included**
	Escalation				**Not included**
	Running Subtotal (intended to be Civil Construction and Equipment Procurement Contracts at present day price levels):				**$ 272,502,559**
	Owner and Third Party Services ALLOWANCES				**$ 82,074,455**
	FERC LICENSING AND ENVIRONMENTAL STUDIES				$ 6,000,000
	OWNER COST ADMIN & LEGAL	6%			$ 16,350,154
	LAND AND LAND RIGHTS				$ 1,000,000
	ENGINEERING DESIGN FOR LICENSING	1%			$ 2,725,026
	ENGINEERING FINAL DESIGN	9%			$ 24,525,230
	ENGINEERING DURING CONSTRUCTION	0.3%			$ 817,508
	GEOTECHNICAL INVESTIGATION	2.5%			$ 6,812,564
	CONSTRUCTION MANAGEMENT	4%			$ 10,900,102
	ENVIRONMENTAL MONITORING DURING CONSTRUCTION	1%			$ 2,725,026
	QUALITY CONTROL & INSPECTION	2%			$ 5,450,051
	PERMITTING	0.75%			$ 2,043,769.19
	ENVIRONMENTAL MITIGATION MEASURES	1%			$ 2,725,026
	Scope, Market Condition, Change Order and Management Reserve				**Not included**
	Grand Total (Engineering, permitting, environmental, equipment and construction) :				**$354,577,014**
			Cost Range:	**$283,660,000**	**$531,870,000**
				-20%	**50%**

Notes:

1	This OPCC is classified as a Class 5 cost estimate per AACE guidelines.
2	Pricing basis = 4TH Qtr 2012, escalation to midpoint of construction is not included.
3	Pricing assumes competitive market conditions at time of tender (+3 bidders/trade).
4	Owner soft costs and project management expenses excluded.
5	Finance costs have not been included

Estimating Disclaimer - Engineer's Opinion of Probable Construction Costs

The client hereby acknowledges that MWH has no control over the costs of labor, materials, competitive bidding environments, unidentified field conditions, financial and/or commodity market conditions, or any other factors likely to affect the OPCC of this project, all of which are and will unavoidably remain in a state of change, especially in light of high market volatility attributable to Acts of God and other market forces or events beyond the control of the parties. As such, Client recognizes that this OPCC deliverable is based on normal market conditions, defined by stable resource supply/demand relationships, and does not account for extreme inflationary or deflationary market cycles. Client further acknowledges that this OPCC is a "snapshot in time" and that the reliability of this OPCC will degrade over time. Client agrees that MWH cannot and does not make any warranty, promise, guarantee or representation, either express or implied that proposals, bids, project construction costs, or cost of O&M functions will not vary significantly from MWH's good faith Class 5 OPCC

AACE International CLASS 5 Cost Estimate – Class 5 estimates are generally prepared based on very limited information, and subsequently have wide accuracy ranges. Typically, engineering is from 0% to 2% complete. They are often prepared for strategic planning purposes, market studies, assessment of viability, project location studies, and long range capital planning. Virtually all Class 5 estimates use stochastic estimating methods such as cost curves, capacity factors, and other parametric techniques. Expected accuracy ranges are from –20% to –50% on the low side and +30% to 100% on the high side, depending on technological complexity of the project, appropriate reference information, and the inclusion of an appropriate contingency determination. Ranges could exceed those shown in unusual circumstances.(AACE International Recommended Practices and Standards).

MWH

Tiekel River - Scenario 1B

1/9/2013

Item	Description	Quantity	UOM	Unit Price	Amount
A	**Roads**				$ 14,402,000
1	Clearing and Grubbing	46	AC	7,500.00	$ 345,000
2	Site Roads Excavation Rock	400,000	CY	18.00	$ 7,200,000
3	Site Roads Excavation Overburden	72,000	CY	10.00	$ 720,000
4	Site Roads Embankment	50,000	CY	5.00	$ 250,000
5	Gravel Surfacing	45,000	TN	63.00	$ 2,835,000
6	Drainage Ditch	64,000	LF	3.00	$ 192,000
7	Relief Culverts (18-inch)	5,500	LF	150.00	$ 825,000
8	Drainage Culverts (36-inch)	1,000	LF	210.00	$ 210,000
9	Large Drainage Arch Culverts (20ft span, 40 ft long, steel plate, concrete strip footings)	2	EA	350,000.00	$ 700,000
10	Tributary Crossings (50 ft span, structural plate culverts)	2	LS	468,750.00	$ 937,500
11	Powerhouse Staging Area and Helipad	1	LS	62,500.00	$ 62,500
12	Dam Staging Area and Helipad	1	LS	62,500.00	$ 62,500
13	Richardson Highway Staging Area and Helipad	1	LS	62,500.00	$ 62,500
B	**Construction Facilities**				$ 9,200,000
14	Quarry Development	1	LS	8,000,000.00	$ 8,000,000
15	Concrete Plant	1	LS	1,200,000.00	$ 1,200,000
16					
C	**Dam**				$ 142,099,930
17	Reservoir Clearing	950	AC	7,500.00	$ 7,125,000
18	Common Excavation	56,000	CY	9.00	$ 504,000
19	Rock Excavation	76,000	CY	17.00	$ 1,292,000
20	Foundation Preparation	22,250	SY	35.00	$ 778,750
C1	**Roller Compacted Concrete**	**905,000**	**CY**	146.30	**$ 132,400,180**
21	Excavate & Produce and Stockpile Aggregates	1,845,000	TN	10.00	$ 18,450,000
22	RCC Cement	56,560	TN	238.00	$ 13,461,280
23	RCC Pozzolan	90,500	TN	210.00	$ 19,005,000
24	Retarding Admixture for RCC	90,500	GAL	7.50	$ 678,750
25	Mix, Convey and Place RCC	905,000	CY	19.00	$ 17,195,000
26	Bedding Mix	5,000	CY	150.00	$ 750,000
27	Upstream Forming & 2 ft Concrete Facing	251,000	SF	122.00	$ 30,622,000
28	Downstream Forming	251,000	SF	63.00	$ 15,813,000
29	Consolidation Drill & Grouting	96,300	LF	100.00	$ 9,630,000
30	Drain Holes	3,675	LF	38.00	$ 139,650
31	Curtain Drill & Grout - 550 holes - 2" AW	78,300	LF	85.00	$ 6,655,500
32					
D	**Power Intake and Tunnel**		LS		$ 3,500,000
33	Concrete structure within reservoir to supply 10.9 ft ID penstock. Inc trashracks	1	EA	3,500,000.00	$ 3,500,000
34	Rock excavation. 12.9 ft ID tunnel. 0 LF Finish Dia 10.9 ft				
35	Tunnel - Concrete lining 1 ft thick. 0 LF				
36	Rock excavation. Gate shaft 12.9 ft dia. 0 LF				
37	Gate shaft concrete lining. 1 ft thick. 0 LF				
E	**Penstock**		LS		$ 6,062,500
38	Steel penstock above ground supported on concrete piers every 30 feet. Horizontal. 7.2 ft ID. 6600LF	958	TNS	5,000.00	$ 4,790,000
39	Steel penstock above ground supported on concrete piers every 30 feet. Inclined. 7.2 ft ID. 320LF	46	TNS	5,000.00	$ 230,000
40	Concrete piers beneath horizontal penstock. 220 No	1,320	CY	750.00	$ 990,000
41	Concrete piers beneath inclined penstock. 11 No	70	CY	750.00	$ 52,500
F	**Powerhouse**				$ 7,425,000
42	Excavation	15,000	CY	15.00	$ 225,000
43	Concrete	9,000	CY	800.00	$ 7,200,000
G	**Equipment**				$ 33,600,000
44	Power train and miscellaneous powerhouse equipment, including				$ 25,600,000
45	Turbines, generators, TIV, governor, exitation, bus, controls, protection, transformers				Included
46	Miscellaneous Powerhouse Mechanical Equipment				Included
47	Miscellaneous Powerhouse Electrical Equipment				Included
48	Powerhouse Crane				Included
49	Powerhouse Draft Tube Gates and Cranes				Included
50	Shipping and installation				Included
51	Spillway Gate Equipment, shipped and installed (radial 30W x 37H)	1	LS	3,000,000.00	$ 3,000,000
52	Intake gate, shipped and installed (wheeled 8.5W x 10.9H)	1	LS	5,000,000.00	$ 5,000,000
H	**Transmission**				$ 24,799,600
53	Site Distribution System	1	LS	1,000,000.00	$ 1,000,000
54	Powerhouse Switchyard Civil Structures and Equipment, Installed	1	LS	4,200,000.00	$ 4,200,000
55	Transmission Lines	12	MILES	1,283,300.00	$ 15,399,600
56	New Substation	1	LS	4,200,000.00	$ 4,200,000
I	**Indirect Costs**				$ 55,232,258
900	Civil Contractor's Indirect Costs % of Civil	25.0%			$ 51,872,257.50
910	Civil Contractor's Indirect Costs % of Equipment	10.0%			$ 3,360,000
	Unlisted Items and Unknown Scope				$ 50,887,358
950	Unlisted Items and Unknown Scope Allowance - Dam	25.0%			$ 35,524,983
951	Unlisted Items and Unknown Scope Allowance - Tunnel	30.0%			$ 1,050,000
952	Unlisted Items and Unknown Scope Allowance - All Other Civil	25.0%			$ 9,272,375
953	Unlisted Items and Unknown Scope Allowance - All Equipment	15.0%			$ 5,040,000

Item	Description	Quantity	UOM	Unit Price	Amount
	Markups				
	Prime Contractor Markups on Subcontracted Work				**Intended to be incl in unit costs**
	OH&P				**Intended to be incl in unit costs**
	Insurance				**Intended to be incl in unit costs**
	Taxes				**Not included**
	Escalation				**Not included**
	Running Subtotal (intended to be Civil Construction and Equipment Procurement Contracts at present day price levels):				**$ 347,208,645**
	Owner and Third Party Services ALLOWANCES				**$ 102,655,982**
	FERC LICENSING AND ENVIRONMENTAL STUDIES				$ 6,000,000
	OWNER COST ADMIN & LEGAL	6%			$ 20,832,519
	LAND AND LAND RIGHTS				$ 1,000,000
	ENGINEERING DESIGN FOR LICENSING	1%			$ 3,472,086
	ENGINEERING FINAL DESIGN	9%			$ 31,248,778
	ENGINEERING DURING CONSTRUCTION	0.3%			$ 1,041,626
	GEOTECHNICAL INVESTIGATION	2.5%			$ 8,680,216
	CONSTRUCTION MANAGEMENT	4%			$ 13,888,346
	ENVIRONMENTAL MONITORING DURING AND AFTER CONSTRUCTION	1%			$ 3,472,086
	QUALITY CONTROL & INSPECTION	2%			$ 6,944,173
	PERMITTING	0.75%			$ 2,604,064.84
	ENVIRONMENTAL MITIGATION MEASURES	1%			$ 3,472,086
	Scope, Market Condition, Change Order and Management Reserve				**Not included**
	Grand Total (Engineering, permitting, environmental, equipment and construction) :				**$449,864,627**
			Cost Range:	**$359,890,000**	**$674,800,000**
				-20%	**50%**

Notes:

1	This OPCC is classified as a Class 5 cost estimate per AACE guidelines.
2	Pricing basis = 4TH Qtr 2012, escalation to midpoint of construction is not included.
3	Pricing assumes competitive market conditions at time of tender (+3 bidders/trade).
4	Owner soft costs and project management expenses excluded.
5	Finance costs have not been included

Estimating Disclaimer - Engineer's Opinion of Probable Construction Costs

The client hereby acknowledges that MWH has no control over the costs of labor, materials, competitive bidding environments, unidentified field conditions, financial and/or commodity market conditions, or any other factors likely to affect the OPCC of this project, all of which are and will unavoidably remain in a state of change, especially in light of high market volatility attributable to Acts of God and other market forces or events beyond the control of the parties. As such, Client recognizes that this OPCC deliverable is based on normal market conditions, defined by stable resource supply/demand relationships, and does not account for extreme inflationary or deflationary market cycles. Client further acknowledges that this OPCC is a "snapshot in time" and that the reliability of this OPCC will degrade over time. Client agrees that MWH cannot and does not make any warranty, promise, guarantee or representation, either express or implied that proposals, bids, project construction costs, or cost of O&M functions will not vary significantly from MWH's good faith Class 5 OPCC

AACE International CLASS 5 Cost Estimate – Class 5 estimates are generally prepared based on very limited information, and subsequently have wide accuracy ranges. Typically, engineering is from 0% to 2% complete. They are often prepared for strategic planning purposes, market studies, assessment of viability, project location studies, and long range capital planning. Virtually all Class 5 estimates use stochastic estimating methods such as cost curves, capacity factors, and other parametric techniques. Expected accuracy ranges are from –20% to –50% on the low side and +30% to 100% on the high side, depending on technological complexity of the project, appropriate reference information, and the inclusion of an appropriate contingency determination. Ranges could exceed those shown in unusual circumstances.(AACE International Recommended Practices and Standards).

MWH

Tiekel River - Scenario 2

1/9/2013

Item	Description	Quantity	UOM	Unit Price	Amount
A	**Roads**				$ 8,980,250
1	Clearing and Grubbing	28	AC	7,500.00	$ 210,000
2	Site Roads Excavation Rock	242,000	CY	18.00	$ 4,356,000
3	Site Roads Excavation Overburden	43,500	CY	10.00	$ 435,000
4	Site Roads Embankment	30,500	CY	5.00	$ 152,500
5	Gravel Surfacing	27,500	TN	63.00	$ 1,732,500
6	Drainage Ditch	39,000	LF	3.00	$ 117,000
7	Relief Culverts (18-inch)	3,300	LF	150.00	$ 495,000
8	Drainage Culverts (36-inch)	600	LF	210.00	$ 126,000
9	Large Drainage Arch Culverts (20ft span, 40 ft long, steel plate, concrete strip footings)	2	EA	350,000.00	$ 700,000
10	Tributary Crossings (50 ft span, structural plate culverts)	1	LS	468,750.00	$ 468,750
11	Powerhouse Staging Area and Helipad	1	LS	62,500.00	$ 62,500
12	Dam Staging Area and Helipad	1	LS	62,500.00	$ 62,500
13	Richardson Highway Staging Area and Helipad	1	LS	62,500.00	$ 62,500
B	**Construction Facilities**				$ 9,200,000
14	Quarry Development	1	LS	8,000,000.00	$ 8,000,000
15	Concrete Plant	1	LS	1,200,000.00	$ 1,200,000
16					
C	**Dam**				$ 8,547,140
17	Reservoir Clearing	280	AC	7,500.00	$ 2,100,000
18	Common Excavation	0	CY	9.00	$ -
19	Rock Excavation	4,000	CY	17.00	$ 68,000
20	Foundation Preparation	2,150	SY	35.00	$ 75,250
C1	**Roller Compacted Concrete**	**29,000**	**CY**	217.38	**$ 6,303,890**
21	Excavate & Produce and Stockpile Aggregates	59,100	TN	10.00	$ 591,000
22	RCC Cement	1,810	TN	238.00	$ 430,780
23	RCC Pozzolan	2,900	TN	210.00	$ 609,000
24	Retarding Admixture for RCC	2,900	GAL	7.50	$ 21,750
25	Mix, Convey and Place RCC	29,000	CY	19.00	$ 551,000
26	Bedding Mix	175	CY	150.00	$ 26,250
27	Upstream Forming & 2 ft Concrete Facing	18,500	SF	122.00	$ 2,257,000
28	Downstream Forming	19,700	SF	63.00	$ 1,241,100
29	Consolidation Drill & Grouting	2,200	LF	100.00	$ 220,000
30	Drain Holes	220	LF	38.00	$ 8,360
31	Curtain Drill & Grout - 184 holes - 2" AW	4,090	LF	85.00	$ 347,650
32					
D	**Power Intake and Tunnel**		LS		$ 50,617,600
33	Concrete structure within reservoir to supply 6.0ft ID concrete lined tunnel. Inc trashracks	1	EA	1,925,000.00	$ 1,925,000
34	Rock excavation. 8.0 ft ID tunnel. 40500 LF Finish Dia 6.0 ft	75,400	CY	210.00	$ 15,834,000
35	Tunnel - Concrete lining 1 ft thick. 40500 LF	33,000	CY	875.00	$ 28,875,000
	Rock excavation. 8.2 ft ID tunnel. 1750 LF Finish Dia 5.2 ft	3,425	CY	210.00	$ 719,250
	Tunnel - Concrete lining 1.5 ft thick. 1750 LF	2,050	CY	875.00	$ 1,793,750
	Rock excavation. 6.0 ft ID tunnel. 1770 LF Finish Dia 3.9 ft	1,850	CY	210.00	$ 388,500
	Tunnel - Concrete lining 1 ft thick. 1770 LF	1,070	CY	875.00	$ 936,250
36	Rock excavation. Gate shaft 8 ft dia. 80 LF	150	CY	565.00	$ 84,750
37	Gate shaft concrete lining. 1 ft thick. 80 LF	65	CY	940.00	$ 61,100
E	**Penstock**		LS		$ 565,000
38	Steel penstock in tunnel. Horizontal. 3.9 ft ID. 1770LF	113	TNS	5,000.00	$ 565,000
39					
40					
41					
F	**Powerhouse**				$ 2,915,000
42	Excavation	5,000	CY	15.00	$ 75,000
43	Concrete	3,550	CY	800.00	$ 2,840,000
G	**Equipment**				$ 13,050,000
44	Power train and miscellaneous powerhouse equipment, including				$ 8,550,000
45	Turbines, generators, TIV, governor, exitation, bus, controls, protection, transformers				Included
46	Miscellaneous Powerhouse Mechanical Equipment				Included
47	Miscellaneous Powerhouse Electrical Equipment				Included
48	Powerhouse Crane				Included
49	Powerhouse Draft Tube Gates and Cranes				Included
50	Shipping and installation				Included
51	Spillway Gate Equipment, shipped and installed (radial 30W x 37H)	1	LS	3,000,000.00	$ 3,000,000
52	Intake gate, shipped and installed (wheeled 4.7W x 6.0H)	1	LS	1,500,000.00	$ 1,500,000
H	**Transmission**				$ 27,494,530
53	Site Distribution System	1	LS	1,000,000.00	$ 1,000,000
54	Powerhouse Switchyard Civil Structures and Equipment, Installed	1	LS	4,200,000.00	$ 4,200,000
55	Transmission Lines	14	MILES	1,283,300.00	$ 18,094,530
56	New Substation	1	LS	4,200,000.00	$ 4,200,000
I	**Indirect Costs**				$ 28,384,880
900	Civil Contractor's Indirect Costs % of Civil	25.0%			$ 27,079,880.00
910	Civil Contractor's Indirect Costs % of Equipment	10.0%			$ 1,305,000
	Unlisted Items and Unknown Scope				$ 24,694,628
950	Unlisted Items and Unknown Scope Allowance - Dam	25.0%			$ 2,136,785
951	Unlisted Items and Unknown Scope Allowance - Tunnel	30.0%			$ 15,185,280
952	Unlisted Items and Unknown Scope Allowance - All Other Civil	25.0%			$ 5,415,063
953	Unlisted Items and Unknown Scope Allowance - All Equipment	15.0%			$ 1,957,500

Item	Description	Quantity	UOM	Unit Price	Amount
	Markups				
	Prime Contractor Markups on Subcontracted Work				**Intended to be incl in unit costs**
	OH&P				**Intended to be incl in unit costs**
	Insurance				**Intended to be incl in unit costs**
	Taxes				**Not included**
	Escalation				**Not included**
	Running Subtotal (intended to be Civil Construction and Equipment Procurement Contracts at present day price levels):				**$ 174,449,028**
	Owner and Third Party Services ALLOWANCES				**$ 55,060,707**
	FERC LICENSING AND ENVIRONMENTAL STUDIES				$ 6,000,000
	OWNER COST ADMIN & LEGAL	6%			$ 10,466,942
	LAND AND LAND RIGHTS				$ 1,000,000
	ENGINEERING DESIGN FOR LICENSING	1%			$ 1,744,490
	ENGINEERING FINAL DESIGN	9%			$ 15,700,412
	ENGINEERING DURING CONSTRUCTION	0.3%			$ 523,347
	GEOTECHNICAL INVESTIGATION	2.5%			$ 4,361,226
	CONSTRUCTION MANAGEMENT	4%			$ 6,977,961
	ENVIRONMENTAL MONITORING DURING CONSTRUCTION	1%			$ 1,744,490
	QUALITY CONTROL & INSPECTION	2%			$ 3,488,981
	PERMITTING	0.75%			$ 1,308,367.71
	ENVIRONMENTAL MITIGATION MEASURES	1%			$ 1,744,490
	Scope, Market Condition, Change Order and Management Reserve				**Not included**
	Grand Total (Engineering, permitting, environmental, equipment and construction) :				**$229,509,735**
			Cost Range:	**$183,610,000**	**$344,260,000**
				-20%	**50%**

Notes:

1	This OPCC is classified as a Class 5 cost estimate per AACE guidelines.
2	Pricing basis = 4TH Qtr 2012, escalation to midpoint of construction is <u>not</u> included.
3	Pricing assumes competitive market conditions at time of tender (+3 bidders/trade).
4	Owner soft costs and project management expenses excluded.
5	Finance costs have not been included

<u>Estimating Disclaimer - Engineer's Opinion of Probable Construction Costs</u>

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MWH

Tiekel River - Scenario 3A

1/9/2013

Item	Description	Quantity	UOM	Unit Price	Amount
A	**Roads**				$ 14,402,000
1	Clearing and Grubbing	46	AC	7,500.00	$ 345,000
2	Site Roads Excavation Rock	400,000	CY	18.00	$ 7,200,000
3	Site Roads Excavation Overburden	72,000	CY	10.00	$ 720,000
4	Site Roads Embankment	50,000	CY	5.00	$ 250,000
5	Gravel Surfacing	45,000	TN	63.00	$ 2,835,000
6	Drainage Ditch	64,000	LF	3.00	$ 192,000
7	Relief Culverts (18-inch)	5,500	LF	150.00	$ 825,000
8	Drainage Culverts (36-inch)	1,000	LF	210.00	$ 210,000
9	Large Drainage Arch Culverts (20ft span, 40 ft long, steel plate, concrete strip footings)	2	EA	350,000.00	$ 700,000
10	Tributary Crossings (50 ft span, structural plate culverts)	2	LS	468,750.00	$ 937,500
11	Powerhouse Staging Area and Helipad	1	LS	62,500.00	$ 62,500
12	Dam Staging Area and Helipad	1	LS	62,500.00	$ 62,500
13	Richardson Highway Staging Area and Helipad	1	LS	62,500.00	$ 62,500
B	**Construction Facilities**				$ 9,200,000
14	Quarry Development	1	LS	8,000,000.00	$ 8,000,000
15	Concrete Plant	1	LS	1,200,000.00	$ 1,200,000
16					
C	**Dam**				$ 164,320,300
17	Reservoir Clearing	990	AC	7,500.00	$ 7,425,000
18	Common Excavation	78,000	CY	9.00	$ 702,000
19	Rock Excavation	96,000	CY	17.00	$ 1,632,000
20	Foundation Preparation	28,100	SY	35.00	$ 983,500
C1	**Roller Compacted Concrete**	1,286,000	CY	119.42	$ 153,577,800
21	Excavate & Produce and Stockpile Aggregates	2,620,900	TN	10.00	$ 26,209,000
22	RCC Cement	80,375	TN	238.00	$ 19,129,250
23	RCC Pozzolan	12,860	TN	210.00	$ 2,700,600
24	Retarding Admixture for RCC	12,860	GAL	7.50	$ 96,450
25	Mix, Convey and Place RCC	1,286,000	CY	19.00	$ 24,434,000
26	Bedding Mix	7,050	CY	150.00	$ 1,057,500
27	Upstream Forming & 2 ft Concrete Facing	312,000	SF	122.00	$ 38,064,000
28	Downstream Forming	307,300	SF	63.00	$ 19,359,900
29	Consolidation Drill & Grouting	138,400	LF	100.00	$ 13,840,000
30	Drain Holes	4,700	LF	38.00	$ 178,600
31	Curtain Drill & Grout - 620 holes - 2" AW	100,100	LF	85.00	$ 8,508,500
32					
D	**Power Intake and Tunnel**		LS		$ 3,500,000
33	Concrete structure within reservoir to supply 13.4 ft ID penstock. Inc trashracks	1	EA	3,500,000.00	$ 3,500,000
34					
35					
36					
37					
E	**Penstock**		LS		$ 8,641,250
38	Steel penstock above ground supported on concrete piers every 30 feet. Horizontal. 8.8 ft ID. 6530LF	1,388	TNS	5,000.00	$ 6,940,000
39	Steel penstock above ground supported on concrete piers every 30 feet. Inclined. 8.8 ft ID. 390LF	83	TNS	5,000.00	$ 415,000
40	Concrete piers beneath horizontal penstock. 220 No	1,610	CY	750.00	$ 1,207,500
41	Concrete piers beneath inclined penstock. 14 No	105	CY	750.00	$ 78,750
F	**Powerhouse**				$ 11,971,250
42	Excavation	24,750	CY	15.00	$ 371,250
43	Concrete	14,500	CY	800.00	$ 11,600,000
G	**Equipment**				$ 48,960,000
44	Power train and miscellaneous powerhouse equipment, including				$ 42,660,000
45	Turbines, generators, TIV, governor, exitation, bus, controls, protection, transformers				Included
46	Miscellaneous Powerhouse Mechanical Equipment				Included
47	Miscellaneous Powerhouse Electrical Equipment				Included
48	Powerhouse Crane				Included
49	Powerhouse Draft Tube Gates and Cranes				Included
50	Shipping and installation				Included
51	Spillway Gate Equipment, shipped and installed (radial 30W x 37H)	1	LS	3,000,000.00	$ 3,000,000
52	Intake gate, shipped and installed (wheeled 6.9W x 8.8H)	1	LS	3,300,000.00	$ 3,300,000
H	**Transmission**				$ 24,799,600
53	Site Distribution System	1	LS	1,000,000.00	$ 1,000,000
54	Powerhouse Switchyard Civil Structures and Equipment, Installed	1	LS	4,200,000.00	$ 4,200,000
55	Transmission Lines	12	MILES	1,283,300.00	$ 15,399,600
56	New Substation	1	LS	4,200,000.00	$ 4,200,000
I	**Indirect Costs**				$ 64,104,600
900	Civil Contractor's Indirect Costs % of Civil	25.0%			$ 59,208,600.00
910	Civil Contractor's Indirect Costs % of Equipment	10.0%			$ 4,896,000
	Unlisted Items and Unknown Scope				$ 60,527,700
950	Unlisted Items and Unknown Scope Allowance - Dam	25.0%			$ 41,080,075
951	Unlisted Items and Unknown Scope Allowance - Tunnel	30.0%			$ 1,050,000
952	Unlisted Items and Unknown Scope Allowance - All Other Civil	25.0%			$ 11,053,625
953	Unlisted Items and Unknown Scope Allowance - All Equipment	15.0%			$ 7,344,000

Item	Description	Quantity	UOM	Unit Price	Amount
	Markups				
	Prime Contractor Markups on Subcontracted Work				**Intended to be incl in unit costs**
	OH&P				**Intended to be incl in unit costs**
	Insurance				**Intended to be incl in unit costs**
	Taxes				**Not included**
	Escalation				**Not included**
	Running Subtotal (intended to be Civil Construction and Equipment Procurement Contracts at present day price levels):				**$ 410,426,700**
	Owner and Third Party Services ALLOWANCES				**$ 120,072,556**
	FERC LICENSING AND ENVIRONMENTAL STUDIES				$ 6,000,000
	OWNER COST ADMIN & LEGAL	6%			$ 24,625,602
	LAND AND LAND RIGHTS				$ 1,000,000
	ENGINEERING DESIGN FOR LICENSING	1%			$ 4,104,267
	ENGINEERING FINAL DESIGN	9%			$ 36,938,403
	ENGINEERING DURING CONSTRUCTION	0.3%			$ 1,231,280
	GEOTECHNICAL INVESTIGATION	2.5%			$ 10,260,668
	CONSTRUCTION MANAGEMENT	4%			$ 16,417,068
	ENVIRONMENTAL MONITORING DURING CONSTRUCTION	1%			$ 4,104,267
	QUALITY CONTROL & INSPECTION	2%			$ 8,208,534
	PERMITTING	0.75%			$ 3,078,200.25
	ENVIRONMENTAL MITIGATION MEASURES	1%			$ 4,104,267
	Scope, Market Condition, Change Order and Management Reserve				**Not included**
	Grand Total (Engineering, permitting, environmental, equipment and construction) :				**$530,499,256**
			Cost Range:	**$424,400,000**	**$795,750,000**
				-20%	**50%**

Notes:

1	This OPCC is classified as a Class 5 cost estimate per AACE guidelines.
2	Pricing basis = 4TH Qtr 2012, escalation to midpoint of construction is not included.
3	Pricing assumes competitive market conditions at time of tender (+3 bidders/trade).
4	Owner soft costs and project management expenses excluded.
5	Finance costs have not been included

Estimating Disclaimer - Engineer's Opinion of Probable Construction Costs

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MWH

Tiekel River - Scenario 3B

1/9/2013

Item	Description	Quantity	UOM	Unit Price	Amount
A	**Roads**				$ 17,251,500
1	Clearing and Grubbing	59	AC	7,500.00	$ 442,500
2	Site Roads Excavation Rock	509,000	CY	18.00	$ 9,162,000
3	Site Roads Excavation Overburden	92,000	CY	10.00	$ 920,000
4	Site Roads Embankment	64,000	CY	5.00	$ 320,000
5	Gravel Surfacing	57,500	TN	3.00	$ 172,500
6	Drainage Ditch	81,500	LF	38.00	$ 3,097,000
7	Relief Culverts (18-inch)	7,000	LF	150.00	$ 1,050,000
8	Drainage Culverts (36-inch)	1,250	LF	210.00	$ 262,500
9	Large Drainage Arch Culverts (20ft span, 40 ft long, steel plate, concrete strip footings)	2	EA	350,000.00	$ 700,000
10	Tributary Crossings (50 ft span, structural plate culverts)	2	LS	468,750.00	$ 937,500
11	Powerhouse Staging Area and Helipad	1	LS	62,500.00	$ 62,500
12	Dam Staging Area and Helipad	1	LS	62,500.00	$ 62,500
13	Richardson Highway Staging Area and Helipad	1	LS	62,500.00	$ 62,500
B	**Construction Facilities**				$ 9,200,000
14	Quarry Development	1	LS	8,000,000.00	$ 8,000,000
15	Concrete Plant	1	LS	1,200,000.00	$ 1,200,000
16					
C	**Dam**				$ 637,396,425
17	Reservoir Clearing	1,500	AC	7,500.00	$ 11,250,000
18	Common Excavation	186,000	CY	9.00	$ 1,674,000
19	Rock Excavation	231,000	CY	17.00	$ 3,927,000
20	Foundation Preparation	68,500	SY	35.00	$ 2,397,500
C1	**Roller Compacted Concrete**	**5,189,000**	**CY**	119.13	**$ 618,147,925**
21	Excavate & Produce and Stockpile Aggregates	10,575,000	TN	10.00	$ 105,750,000
22	RCC Cement	324,300	TN	238.00	$ 77,183,400
23	RCC Pozzolan	518,900	TN	210.00	$ 108,969,000
24	Retarding Admixture for RCC	518,900	GAL	7.50	$ 3,891,750
25	Mix, Convey and Place RCC	5,189,000	CY	19.00	$ 98,591,000
26	Bedding Mix	27,800	CY	150.00	$ 4,170,000
27	Upstream Forming & 2 ft Concrete Facing	808,000	SF	122.00	$ 98,576,000
28	Downstream Forming	787,500	SF	63.00	$ 49,612,500
29	Consolidation Drill & Grouting	557,600	LF	100.00	$ 55,760,000
30	Drain Holes	11,800	LF	38.00	$ 448,400
31	Curtain Drill & Grout - 888 holes - 2" AW	178,775	LF	85.00	$ 15,195,875
32					
D	**Power Intake and Tunnel**		LS		$ 18,384,325
33	Concrete structure within reservoir to supply 16.8 ft ID concrete lined tunnel. Inc trashracks	1	EA	5,400,000.00	$ 5,400,000
34	Rock excavation. 18.8 ft ID tunnel. 750 LF Finish Dia 16.8 ft	7,720	CY	210.00	$ 1,621,200
35	Tunnel - Concrete lining 1 ft thick. 750 LF	1,550	CY	875.00	$ 1,356,250
	Rock excavation. 17.7 ft ID tunnel. 1250 LF Finish Dia 14.7 ft	11,390	CY	210.00	$ 2,391,900
	Tunnel - Concrete lining 1.5 ft thick. 1250 LF	3,540	CY	875.00	$ 3,097,500
	Rock excavation. 13.1 ft ID tunnel. 870 LF Finish Dia 11.1 ft	4,400	CY	210.00	$ 924,000
	Tunnel - Concrete lining 1 ft thick. 870 LF	1,225	CY	875.00	$ 1,071,875
36	Rock excavation. Gate shaft 18.8 ft dia. 325 LF	3,340	CY	565.00	$ 1,887,100
37	Gate shaft concrete lining. 1 ft thick. 325 LF	675	CY	940.00	$ 634,500
E	**Penstock**		LS		$ 2,000,000
38	Steel penstock in tunnel. Horizontal. 11.1 ft ID. 900LF	400	TNS	5,000.00	$ 2,000,000
39					
40					
41					
F	**Powerhouse**				$ 21,550,000
42	Excavation	50,000	CY	15.00	$ 750,000
43	Concrete	26,000	CY	800.00	$ 20,800,000
G	**Equipment**				$ 100,350,000
44	Power train and miscellaneous powerhouse equipment, including				$ 85,350,000
45	Turbines, generators, TIV, governor, exitation, bus, controls, protection, transformers				Included
46	Miscellaneous Powerhouse Mechanical Equipment				Included
47	Miscellaneous Powerhouse Electrical Equipment				Included
48	Powerhouse Crane				Included
49	Powerhouse Draft Tube Gates and Cranes				Included
50	Shipping and installation				Included
51	Spillway Gate Equipment, shipped and installed (radial 30W x 37H)	1	LS	3,000,000.00	$ 3,000,000
52	Intake gate, shipped and installed (wheeled 13.2W x 16.8H)	1	LS	12,000,000.00	$ 12,000,000
H	**Transmission**				$ 27,494,530
53	Site Distribution System	1	LS	1,000,000.00	$ 1,000,000
54	Powerhouse Switchyard Civil Structures and Equipment, Installed	1	LS	4,200,000.00	$ 4,200,000
55	Transmission Lines	14	MILES	1,283,300.00	$ 18,094,530
56	New Substation	1	LS	4,200,000.00	$ 4,200,000
I	**Indirect Costs**				$ 193,354,195
900	Civil Contractor's Indirect Costs % of Civil	25.0%			$ 183,319,195.00
910	Civil Contractor's Indirect Costs % of Equipment	10.0%			$ 10,035,000.00
	Unlisted Items and Unknown Scope				$ 192,417,279
950	Unlisted Items and Unknown Scope Allowance - Dam	25.0%			$ 159,349,106
951	Unlisted Items and Unknown Scope Allowance - Tunnel	30.0%			$ 5,515,298
952	Unlisted Items and Unknown Scope Allowance - All Other Civil	25.0%			$ 12,500,375
953	Unlisted Items and Unknown Scope Allowance - All Equipment	15.0%			$ 15,052,500

Item	Description	Quantity	UOM	Unit Price	Amount
	Markups				
	Prime Contractor Markups on Subcontracted Work				**Intended to be incl in unit costs**
	OH&P				**Intended to be incl in unit costs**
	Insurance				**Intended to be incl in unit costs**
	Taxes				**Not included**
	Escalation				**Not included**
	Running Subtotal (intended to be Civil Construction and Equipment Procurement Contracts at present day price levels):				**$ 1,219,398,254**
	Owner and Third Party Services ALLOWANCES				**$ 344,944,219**
	FERC LICENSING AND ENVIRONMENTAL STUDIES				$ 8,000,000
	OWNER COST ADMIN & LEGAL	6%			$ 73,163,895
	LAND AND LAND RIGHTS				$ 1,000,000
	ENGINEERING DESIGN FOR LICENSING	1%			$ 12,193,983
	ENGINEERING FINAL DESIGN	9%			$ 109,745,843
	ENGINEERING DURING CONSTRUCTION	0.3%			$ 3,658,195
	GEOTECHNICAL INVESTIGATION	2.5%			$ 30,484,956
	CONSTRUCTION MANAGEMENT	4%			$ 48,775,930
	ENVIRONMENTAL MONITORING DURING CONSTRUCTION	1%			$ 12,193,983
	QUALITY CONTROL & INSPECTION	2%			$ 24,387,965
	PERMITTING	0.75%			$ 9,145,486.90
	ENVIRONMENTAL MITIGATION MEASURES	1%			$ 12,193,983
	Scope, Market Condition, Change Order and Management Reserve				**Not included**
	Grand Total (Engineering, permitting, environmental, equipment and construction) :				**$1,564,342,473**
			Cost Range:	**$1,251,470,000**	**$2,346,510,000**
				-20%	**50%**

Notes:

1 This OPCC is classified as a Class 5 cost estimate per AACE guidelines.
2 Pricing basis = 4TH Qtr 2012, escalation to midpoint of construction is not included.
3 Pricing assumes competitive market conditions at time of tender (+3 bidders/trade).
4 Owner soft costs and project management expenses excluded.
5 Finance costs have not been included

Estimating Disclaimer - Engineer's Opinion of Probable Construction Costs

The client hereby acknowledges that MWH has no control over the costs of labor, materials, competitive bidding environments, unidentified field conditions, financial and/or commodity market conditions, or any other factors likely to affect the OPCC of this project, all of which are and will unavoidably remain in a state of change, especially in light of high market volatility attributable to Acts of God and other market forces or events beyond the control of the parties. As such, Client recognizes that this OPCC deliverable is based on normal market conditions, defined by stable resource supply/demand relationships, and does not account for extreme inflationary or deflationary market cycles. Client further acknowledges that this OPCC is a "snapshot in time" and that the reliability of this OPCC will degrade over time. Client agrees that MWH cannot and does not make any warranty, promise, guarantee or representation, either express or implied that proposals, bids, project construction costs, or cost of O&M functions will not vary significantly from MWH's good faith Class 5 OPCC

AACE International CLASS 5 Cost Estimate – Class 5 estimates are generally prepared based on very limited information, and subsequently have wide accuracy ranges. Typically, engineering is from 0% to 2% complete. They are often prepared for strategic planning purposes, market studies, assessment of viability, project location studies, and long range capital planning. Virtually all Class 5 estimates use stochastic estimating methods such as cost curves, capacity factors, and other parametric techniques. Expected accuracy ranges are from –20% to –50% on the low side and +30% to 100% on the high side, depending on technological complexity of the project, appropriate reference information, and the inclusion of an appropriate contingency determination. Ranges could exceed those shown in unusual circumstances.(AACE International Recommended Practices and Standards).

APPENDIX C

Stakeholder Contact

RECORD OF TELEPHONE CONVERSATION

MWH Party		Other Party	
Name:	*Amanda Henry & Heather Williams*	**Name:**	John Brievogal
Project:	*Tiekel River Recon*	**Organization:**	
Job Number:	*10501148*	**Phone Number:**	*(907) 822-5870*
Date:	*August 15, 2012*	**Time:**	
Call Placed by: [X] MWH [ ] Other Party			

Subject:

Mr. Brievogal asked Copper Valley Electric Association (CVEA) to contact him when the study started. The client has stated that Mr. Brievogal knows quite a bit about the Tiekel River from a recreation and environmental point of view. CVEA further suggested that it would be worthwhile for someone from MWH to contact him at some point to get a local point of view on the resource. The following are notes that were taken in the course of a telephone conversation with Mr. Brievogal.

Discussion:

- Mr. Brievogal stated that he ran a riverboat service for 25 years. He ran tourists and some logistics/freight service on the Copper River, but did not regularly travel the Tiekel. He stated that his son currently runs a riverboat service on the Copper River and may occasionally go up the Tiekel River.
- With regard to the Tiekel River, he stated that a 22 to 24-foot Jetline boat can travel approximately 4 miles upriver.
  - There is a velocity barrier that keeps boats and potentially fish from traveling past this point.
  - This point is approximately ¼- to ½-mile downstream of the prominent 100-foot waterfall (on a tributary, not the mainstem).
- Mr. Brievogal seemed to remember perhaps picking up Dr. Embeck (an expert in river kayaking who may have run the Tiekel River starting well upstream of the prominent waterfall) in the middle of May one time, perhaps after Embeck ran the river.
- He does not recall any public opposition from boaters to any previous proposals for development of the Tiekel.
- He stated that he was not sure if the river flows are sustainable for electrical generation.
- He stated that the Tiekel is approximately 30 miles down the Copper River from the Chitina Bridge.
- He stated the project might receive opposition from prospectors. He has transported placer miners approximately 1.5 miles upriver to investigate potential claims
- ADF&G researcher, Roberson, discussed a velocity barrier for fish on the Tiekel with Mr. Brievogal.
- When Mr. Brievogal was asked about historic barge traffic on the Copper River he stated:
  - A sternwheeler used to run upriver from Cordova, but was very slow and ran aground frequently.
  - It would be possible to run barges downstream from Chitina, but stout jetboats or landing craft would be needed.
- He stated that there is an “illegal” airstrip located near the Tiekel that was built by Gene Needles in approximately 1978-79, during Governor Hickel’s plan to reopen the highway.

- The Copper River freezes in the winter, and it might be possible to build an ice road. The person to speak with would be David Bruss, who lives in Valdez, and works for Shell.
- The onshore ownership includes Chugach and Eyak Corporations.
- Fall is the easier time of the year to navigate the Copper River
- The Tiekel River is on the boundary to a walk-in area for moose and sheep hunting. A reservoir and/or road could provide increased accessibility to the south side of the river for hunting; this could have a large impact on hunting and game populations.
- When asked about subsistence use on the Tiekel, he was unsure of any ongoing use, but suggested that inquiries be made in Chitina; a gentleman named Martin Finesain (?) in Chitina would be a good resource.
- An archaeological study was conducted along the Copper River (by SHPO?) in response to Hickel's highway project.
- With regard to trails, he stated that prospectors built a foot-trail on the north side of the river in the canyon area and carried in dredge equipment.
- Finally he stated that there are heavy sediment loads carried by the Tsina River.

Comments or Actions Required:

None.

M E E T I N G   N O T E S

MWH
BUILDING A BETTER WORLD

To:	*Attendees*	**Date:**	*November 1, 2012*
Client:	*Copper Valley Electric Association*	**By:**	*Heather Williams*
Project:	*Tiekel River Hydropower Project*	**PM:**	*Heather Williams*
Subject:	*Tiekel River Hydropower Reconnaissance Introduction*		

Attendees:	CVEA – John Duhamel (telephone) ADF&G – Monte Miller, Megan Marie, Jason Mouw, Sam Hochhalter MWH – Heather Williams Northern Ecological Services – John Morsell (telephone)
Discussions:	**The meeting was held on November 1, 2012, in Alaska Department of Fish & Game's (ADF&G's) Anchorage office from approximately 1:30 PM through 2:30 PM. The notes of discussions were as follows:**

1. Participant Intros:
   a. John Duhamel – Copper Valley Electric Association (CVEA) Project Manager
   b. Heather Williams – MWH Project Manager
   c. John Morsell – MWH Team Aquatic Resource Specialist, also representing the Terrestrial Resource Specialist who could not make the call
   d. Monte Miller – ADF&G Statewide Hydropower Coordinator
   e. Megan Marie – ADF&G
   f. Jason Mouw – ADF&G Sportfish
   g. Sam Hochhalter – ADF&G Sportfish
2. Reconnaissance Study Intro (Duhamel):
   a. CVEA is investigating hydropower potential of the Tiekel River watershed.
   b. CVEA has hired MWH to conduct reconnaissance-level study.
   c. CVEA wants to engage ADF&G early in the process.
3. Project Vicinity Map and Preliminary Project Concept Layouts (Williams):
   a. The project is located on the north side of Thompson Pass between Glennallen and Valdez (provided map).
   b. The Tiekel River runs south and then east into the Copper River.
   c. A range of hydropower schemes are being considered (provided layout showing the current maximum development scheme).
   d. Mostly state land, some private.
4. CVEA Team Questions:
   a. Does ADF&G have unpublished info in files regarding the project area?
      i. Not aware of any, will check.
   b. Wildlife:
      i. Recent/current/ongoing wildlife surveys for moose, bear, mountain goats, etc.? **ANSWER**: Dave Crowley flies goat surveys, check with Rebecca Schwanke in Glennallen.

   ii. Swan surveys (usually done by U.S. Fish and Wildlife Service [FWS])? **ANSWER**: Not aware of any.
   iii. Eagle surveys (usually done by FWS)? **ANSWER**: Not aware of any.
   iv. Any known big game travel routes since reservoirs might impact summer travel? **ANSWER**: Unknown.

c. Aquatic Resources:
   i. Any documented use of the lower Tiekel River by adult salmon, especially Chinook? **ANSWER**: Anadromous waters catalog does not show any beyond the mouth; however, sampling may not have been done on the entire reach.
   ii. Any current or recent salmon radio tracking surveys in the Copper River that would be pertinent? **ANSWER**: Some surveys from Haily Creek down to Prince William Sound (Hochhalter). Not much in the last couple of decades. Glennallen office studied Chinook in the late 1990s. Check with James Saveride in Fairbanks.
   iii. Any plans by ADF&G or other entities to look at detailed spawning distribution of salmon in the Copper River drainage in 2013? **ANSWER**: No.
   iv. Do fish populations matter? Or just presence/absence? **ANSWER**: Most projects don't need population data (Mouw). Typically do presence/absence first and then determine need for additional data include reach of anadromous fish, seasonal habitat association, flow/habitat changes, etc.

5. ADF&G Questions / Comments:
   a. Appreciate the early information.
   b. Goal is to find good hydropower sites above anadromous fish habitat.
   c. This site likely to need a wide project study area, to include portions of the Copper River due to potential thermal and turbidity impacts (Mouw).
   d. Will likely need to study resident fish along the Richardson Highway (Marie).
   e. Likely need to address data gap near the mouth of the river.
   f. Transmission lines and substation design need to consider wildlife (overhead vs. buried, etc.).
   g. Will access road be open to the public? **ANSWER**: Not yet determined. Would be considered during the licensing process.
   h. Baseline inundation loss evaluation.
   i. Stream gaging, earlier the better (need 5 years of data). Likely one below dam, one in upper reaches to determine accretion.
   j. Road design needs to consider sloughing/erosion.
   k. Consider hydraulic connections in addition to surface connections, particularly in the delta area.
   l. Ann Rappaport or Betsy McCracken for FWS questions.
   m. Share pictures and videos, if possible.

6. Next Steps (Duhamel):
   a. The CVEA BOD will be reviewing reconnaissance results in late 2012 or early 2013. Depending on study results and BOD decision, agency contact would continue.

APPENDIX D

Transmission Line and Land Status Report

MWH

Tiekel River Hydro Plant

Substation, Transmission System, and Lands

Final Report

November 28, 2012

Daniel C. Rogers. P.E
Greg Huffman, P.E.
Dan Beardsley

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WWW.EPSINC.COM

Summary of Changes

Revision Number	Revision Date	Revision Description
1	2012-11-28	Issued for Review

Table of Contents

1 Executive Summary

1.1 Scope

Electric Power Systems, Inc. of Anchorage, Alaska ("EPS") was contracted by MWH-Americas ("MWH") to perform rough order of magnitude cost estimates for supporting infrastructure for the Tiekel River Hydroelectric project. Specific work consisted of cost development of the electrical infrastructure connecting the hydro plant to the existing Copper Valley Electric Association ("CVEA") 138 kV transmission network.

In addition to the substation and line costs, EPS provided an "allowance" cost for future system improvements likely to be required by the addition of the hydro plant. These improvements cannot be defined at this time, as the loads to support this project are not sufficiently known. When the loads are defined for the cases, the additional stability and power flow work can commence. Based on EPS' work with other projects in stability limited systems, we are reasonably confident that the allowances provided are representative of what will be required, should the project proceed to that stage.

In addition to the electrical infrastructure work, MWH requested that EPS analyze land use issues along the transmission corridor and at the substation location in the vicinity of the existing line. A summary of this work is also contained in this report.

EPS and MWH personnel developed a scope of work for the project as follows:

- Develop conceptual transmission line options for MWH Scenario 1 (20MW capacity), MWH Scenario 2 (10MW capacity), and MWH Scenario 3 (100MW capacity). Develop a cost basis on a "dollars per line mile" basis, so the results can be scaled, if routing or plant location change during the project development.
- Develop substation interconnection options to the existing 138 kV network along the Richardson Highway.
- Develop ±15% Rough Order of Magnitude ("ROM") cost estimates for the line and station solutions developed.
- Investigate land use issues along the transmission line route and the substation site.
- Develop a report with recommendations from the above work.

1.2 Summary of Results

Table 1 summarizes the results of the cost estimates performed for the Tiekel River Electrical Infrastructure. Discussion is included in Section 2, and the details of the line and substation estimates are included in the Appendices.

Summary Cost - Tiekel River Electrical Infrastructure					
Case	Capacity	Line	Substation	System	Total
Scenario 1	20MW	$ 17,726,000	$ 4,177,000	$ 625,000	$ 21,903,000
Scenario 2	10MW	$ 17,726,000	$ 4,177,000	$ 350,000	$ 21,903,000
Scenario 3	100MW	$ 16,684,000	$ 4,177,000	$ 2,250,000	$ 20,861,000

Table 1 – Summary of Costs – Electrical Infrastructure

2 Project Configuration

2.1 Scenarios Under Study

A wide range of power plant locations and output powers have been discussed in the past. The scope of this project limited the number of Scenarios under study. Three Scenarios were specified to be considered:

Scenario 1 – A3R2

The installed capacity for Scenario 1 is 20MW (83A at 138kV). An access road will be built to the dam. The transmission line will be built along the road, as much as possible between the dam and the Tiekel River Substation ("TRSS"), located along the existing Glennallen-Valdez 138kV line. From the powerhouse, near the confluence of the Copper and Tiekel Rivers, to the dam, the line will be located along the north side of the river, but will not have road access.

Scenario 2 – A3R1

The installed capacity for Scenario 2 is 10MW (42A at 138kV). An access road will be built to the dam. The transmission line will be built along the road, as much as possible between the dam and the Tiekel River Substation ("TRSS"), located along the existing Glennallen-Valdez 138kV line. From the powerhouse, near the confluence of the Copper and Tiekel Rivers, to the dam, the line will be located along the north side of the river, but will not have road access.

Scenario 3 – A1R1 (100 MW)

The installed capacity for Scenario 3 is 100MW (418A at 138kV). An access road will be built to the dam, which will be located close to the powerhouse, near the confluence of the Copper and Tiekel Rivers. The transmission line will be built along the road, as much as possible between the dam and the Tiekel River Substation ("TRSS"), located along the existing Glennallen-Valdez 138kV line. All of the line construction will be accessed from the road, in this scenario.

2.2 Line and Substation Construction

The system was designed at 138kV to mitigate the need for a power transformer at the TRSS. The incremental cost benefit realized for reducing the voltage of the line, given the power levels under consideration, would not justify the addition station and transformer costs at Tiekel River Substation. Additionally, the connection of the plant at 138kV should help future system stability issues, by eliminating additional impedance between the Tiekel River generators and the existing CVEA system.

No costs are included in the estimates for power plant equipment. This is assumed included within MWH's power plant design scope.

2.2.1 Line Construction

In the Scenarios where there is a road, it is assumed that the road is in place, prior to the line construction, to allow contractor access, and limit construction alternative techniques.

Line construction utilizes steel structures, and 556 ACSR conductor. The conductor is sufficient to handle any of the electrical loads, and mechanically sufficient to accommodate local conditions and spans. The line is constructed, for all cases at 138kV.

A summary of line construction cost is shown in Table 2. The details of the estimate are included in Appendix A.

Line Construction Cost Summary		
Scenario 1	20MW	$ 17,726,000
Scenario 2	10MW	$ 17,726,000
Scenario 3	100MW	$ 16,684,000

Table 2 – Line Construction Cost Summary

2.2.2 *Substation Construction*

The substation is configured as a three breaker ring, with a position to allow for a future fourth position. The fourth position could be utilized to serve a future station transformer, should local load develop, or to allow another line connection, should that be required in the future. In this estimate, no station for the service of local distribution load is included. Station service is accommodated by utilizing two station power PT's.

The substation construction cost for all three scenarios is the same, and is estimated to be $4,177,000. The details of the estimate are included in Appendix B.

2.3 *Potential Future System Issues*

At this stage of the project development, additional loads are not established, neither with regards to load level, nor location. If the project develops past the conceptual stage, and the load locations and load types are established, power flow and stability studies should be completed, to assess the steady state and dynamic responses of the system to the additional generation and new loads.

Once the loads are determined for the future system, control parameters can be established for both the existing units, as well as the new Tiekel River units. In addition, the requirements for shunt compensation can be defined, and accommodated in the project budget.

In the current estimate, allowances ranging from $100,000 to $250,000 are provided for the system studies, and $250,000 to $2.5M for potential system improvements associated with shunt compensation and unit controls. These numbers should be considered representative, but only as allowances, until the capacity of the power plant and location and type of additional system loads are established.

A summary of line construction cost is shown in Table 3.

Future System Cost Allowances				
Case	Capacity	Studies	System	Total
Scenario 1	20MW	$ 125,000	$ 500,000	$ 625,000
Scenario 2	10MW	$ 100,000	$ 250,000	$ 350,000
Scenario 3	100MW	$ 250,000	$ 2,000,000	$ 2,250,000

Table 3 – Future System Cost Allowances

3 Land Use

3.1 Land Status Research

EPS conducted a preliminary title research of lands within the three townships surrounding the Tiekel River corridor between the Richardson Highway and the Copper River. Those townships are T. 7 S., R. 1 E., through T. 7 S., R. 3 E., of the Copper River Meridian. The land ownerships within that corridor have been identified as either United States of America-State Selected, State of Alaska-Tentative Approval, State of Alaska Department of Transportation and Public Facilities or Private.

The preliminary research consisted of a review of the U.S. Department of the Interior, Bureau of Land Management Master Title Plats (MTPs) and State of Alaska Department of Natural Resources Status Plats and Alaska Mapper Lands records for all lands within the corridor. BLM and DNR on-line case file abstracts for all lands remaining in state or federal ownership were reviewed. Individual case file research was not conducted. From this preliminary research the four land ownership categories were identified. Third party interests within the four land ownership categories, such as mineral sites and rights of way, have not been incorporated into the title research or portrayed in the GIS shape file prepared for this effort.

<u>United States of America-State Selected Lands</u>

All of the lands east of the Richardson Highway within Sections 4, 5, 8, 9, 17, 19 and 20, T.7S., R.1E., CRM (except for those portions of U.S. Survey 5687 within Section 17 and a five acre State of Alaska DOTPF site on the south end of U.S. Survey 5687) are under the jurisdiction of the United States of America and managed by the BLM. These lands are withdrawn under Public Land Order (PLO) 5180 for classification and for public interest as well as PLOs 5150 and 5151 for the Pipeline Corridor. They are subject to a selection by the State of Alaska. The State selection case file abstracts (serial number AA-76028 for Sections 4 and 9, and AA-60971 for Sections 5, 8, 17, 19 and 20) both indicate these lands are priority one for conveyance to the State of Alaska.

<u>State of Alaska-Tentative Approval Lands</u>

The great majority of the lands within the corridor are under the management of the State of Alaska Department of Natural Resources (Division of Mining, Land and Water) by virtue of tentative approvals. Those lands with tentative approvals are as follows:

TA AA 60971 T.7S., R.1E., CRM, Sections 13-16 & 21-36

TA AA 76028 T.7S., R.1E., CRM, Sections 1-3 & 10-12

TA 2002-0017 T.7S., R.2E., CRM, Sections 1-36

TA 2002-0022 T.7S., R.3E., CRM, Sections 3-10; 15-22 & 27-34 excluding U.S. 3574 and Portions of Section 15,22 & 34 within Wrangell St. Elias National Park and Wilderness

<u>State of Alaska Department of Transportation & Public Facilities Lands</u>

A five acre communications site tract on the east side of the Richardson Highway abutting the south boundary of U.S. Survey 5687 was conveyed to the State of Alaska by the Omnibus Act Quitclaim Deed. The Department of Transportation and Public Facilities has management authority over the site.

Private Lands

Two U.S. Surveys are located within the search area, U.S. Survey 5687 and U.S. Survey 3574. That portion of U.S. Survey 5687 located east of the Richardson Highway in Section 17 of T. 7 S., R. 1 E, is Serendipity Subdivision Addition No. 2 which comprises 26 lots. U.S. Survey 3574 (located within Sections 33 and 34 of T. 7 S., R. 3 E., CRM) was subdivided as the Tiekel Station Subdivision and contains 25 lots. It is located on the south side of the mouth of the Tiekel River. State of Alaska Recorder's Office research efforts were limited to verification of the private ownerships up to subdivision platting. Research for individual lot ownership within the subdivisions was not performed.

3.2 Assessment of Preliminary Land Status Research

The land ownership and land use classifications for the lands within the corridor do not present any "fatal flaws" from a title perspective. From a project permitting standpoint, the federal lands adjacent to the Richardson Highway increase the permitting requirements and durations. Unless the financial impact of the increased permitting obligations impact the viability of the project, obtaining the necessary land interests should not prevent the project from going forward.

3.3 Federal Lands

As indicated above there are currently federal lands for at least three quarters of one mile at the west end of the project. Transmission lines and an access road will need to cross this segment to connect with the Solomon Gulch Hydroelectric Project and the Richardson Highway, respectively. These lands are priority 1 state selections. Whether these lands will be tentatively approved in the near term is currently unknown, but would be worth pursuing if the project moves forward. Routing around the federal lands is not currently an option as the lands along the Richardson Highway in the townships both south and north of this location remain in federal ownership.

3.4 Recommended Future Study/Data Gaps

Research to this point has been preliminary to identify ownerships and determine if there are significant land issues that may impede project development. A more thorough research of the case files supporting the different ownerships will identify any latent defects in title and should be performed as the project moves toward the permitting stage. Depending upon final routing of the transmission line and road there may be third party interests involved in the vicinity of Richardson Highway. Since these lands are not within an organized borough individual property interests in the subdivisions at either end of the project will need to be researched. At a minimum, research to identify current owners and addresses for notification and possible project permitting requirements should be conducted. However; complete development of a chain of title and title examination will not substantially change the work effort required. Neither the research of the case files, nor researching the chain of title for a maximum of 51 private lots represents a significant impact on budget or schedule.

4 Appendix A – Line Construction Estimates

Following are the details of the transmission line cost estimate development.

Tiekel River
138 KV TRANSMISSION LINE
PRE-DESIGN CONSTRUCTION COST ESTIMATE

OPTION: STEEL TOWERS ALONG ROAD

	Quantity	Unit	Material	Labor	Total Unit Price	Extended Material	Extended Labor	Total Cost		wt
New Steel Structures									$5,446,000	
tangent	78	ea.	$34,500	$18,000	$52,500	$2,691,000	$1,404,000	$4,095,000		11,500
light running angle	6	ea.	$42,000	$20,000	$62,000	$252,000	$120,000	$372,000		14,000
heavy running angle	4	ea.	$54,000	$22,000	$76,000	$216,000	$88,000	$304,000		18,000
deadend or long span	5	ea.	$105,000	$30,000	$135,000	$525,000	$150,000	$675,000		35,000
	93									
Foundations									$2,214,000	
tangent	156	ea.	$500	$10,000	$10,500	$78,000	$1,560,000	$1,638,000		
running angle	20	ea.	$800	$12,000	$12,800	$16,000	$240,000	$256,000		
deadend	20	ea.	$1,000	$15,000	$16,000	$20,000	$300,000	$320,000		
									$756,800	
Guys	352	ea.	$200	$500	$700	$70,400	$176,000	$246,400		
Anchors	176	ea.	$400	$2,500	$2,900	$70,400	$440,000	$510,400		
Framing									$444,400	
tangent	78	ea.	$1,800	$2,500	$4,300	$140,400	$195,000	$335,400		
running angle	10	ea.	$2,100	$2,800	$4,900	$21,000	$28,000	$49,000		
deadend	5	ea.	$4,000	$8,000	$12,000	$20,000	$40,000	$60,000		
WIRE										
556 kcmil ACSR	225	1000 ft.	$1,500	$10,000	$11,500	$337,500	$2,250,000	$2,587,500	$2,587,500	
Clearing and Access									$1,500,000	
close to access road	75	1000 ft.	$0	$20,000	$20,000	$0	$1,500,000	$1,500,000		
far from access road	0	1000 ft.	$0	$30,000	$30,000	$0	$0	$0		
					Subtotal	$4,457,700	$8,491,000	$12,948,700		
							Mobilization/demobilization	$400,000		
						Contingency:	10%	$1,334,870		
							Total Construction	**$14,683,570**	cost/mile	$1,033,723
							Permitting/environmental	$300,000		
							Engineering, surveying, geotech	$1,000,000		
							Construction Management	$700,000		
							Perm, Eng, Mgmt	**$2,000,000**		
							Total Project Cost	**$16,683,570**	cost/mile	$1,174,523

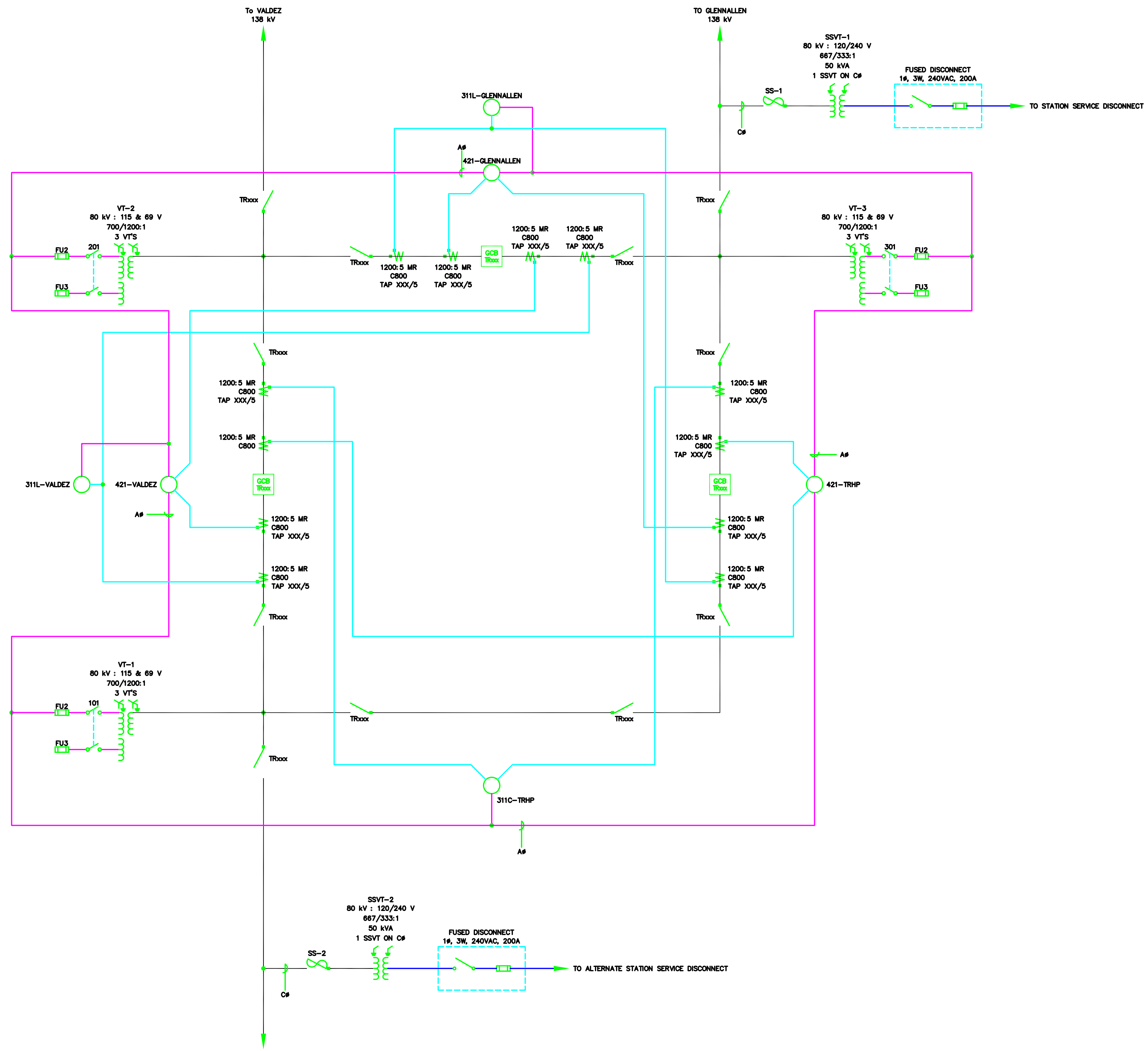
Tiekel River
138 KV TRANSMISSION LINE
PRE-DESIGN CONSTRUCTION COST ESTIMATE

OPTION: STEEL TOWERS ALONG PARTIAL ROAD

	Quantity	Unit	Material	Labor	Total Unit Price	Extended Material	Extended Labor	Total Cost		wt
New Steel Structures									$5,446,000	
tangent	78	ea.	$34,500	$18,000	$52,500	$2,691,000	$1,404,000	$4,095,000		11,500
light running angle	6	ea.	$42,000	$20,000	$62,000	$252,000	$120,000	$372,000		14,000
heavy running angle	4	ea.	$54,000	$22,000	$76,000	$216,000	$88,000	$304,000		18,000
deadend or long span	5	ea.	$105,000	$30,000	$135,000	$525,000	$150,000	$675,000		35,000
	93									
Foundations									$2,214,000	
tangent	156	ea.	$500	$10,000	$10,500	$78,000	$1,560,000	$1,638,000		
running angle	20	ea.	$800	$12,000	$12,800	$16,000	$240,000	$256,000		
deadend	20	ea.	$1,000	$15,000	$16,000	$20,000	$300,000	$320,000		
									$756,800	
Guys	352	ea.	$200	$500	$700	$70,400	$176,000	$246,400		
Anchors	176	ea.	$400	$2,500	$2,900	$70,400	$440,000	$510,400		
Framing									$444,400	
tangent	78	ea.	$1,800	$2,500	$4,300	$140,400	$195,000	$335,400		
running angle	10	ea.	$2,100	$2,800	$4,900	$21,000	$28,000	$49,000		
deadend	5	ea.	$4,000	$8,000	$12,000	$20,000	$40,000	$60,000		
WIRE										
556 kcmil ACSR	225	1000 ft.	$1,500	$10,000	$11,500	$337,500	$2,250,000	$2,587,500	$2,587,500	
Clearing and Access									$2,175,000	
close to access road	30	1000 ft.	$0	$20,000	$20,000	$0	$600,000	$600,000		
far from access road	45	1000 ft.	$0	$35,000	$35,000	$0	$1,575,000	$1,575,000		
					Subtotal	$4,457,700	$9,166,000	$13,623,700		
							Mobilization/demobilization	$400,000		
						Contingency:	10%	$1,402,370		
							Total Construction	**$15,426,070**	cost/mile	$1,085,995
							Permitting/environmental	$350,000		
							Engineering, surveying, geotech	$1,200,000		
							Construction Management	$750,000		
							Perm, Eng, Mgmt	**$2,300,000**		
							Total Project Cost	**$17,726,070**	cost/mile	$1,247,915

5 Appendix B – Station Construction Estimates

Following are the details of the Tiekel River Substation cost estimate development.



PROJECT: TIEKEL RIVER SUBSTATION

DESIGNER/PROJECT ENGINEER: DAN ROGERS/EPS — JOB #: MWH 12-0464

NO.	DESIGN/CONSTRUCTION/ASBUILT REVISION	DWN BY/DATE	REVIEWED BY/DATE
A	CONCEPTUAL DESIGN ONLY		DCR/

ENG. STAMP

Electric Power Systems Inc.
Consulting Engineers
TEL: (907) 522-1953
FAX: (907) 522-1182
WEB: WWW.EPSINC.COM

NO.	DRAWING NO./SHEET	REFERENCE DRAWING/DETAIL/PLAN/SECTION DESCRIPTION

DRAWING NAME:

TIEKEL RIVER SUBSTATION
138 kV
ONE-LINE DIAGRAM

trss-el-0010_1.dwg

REF DWG(S):

DRAWING NO.: TRSS-EL-0010

SHEET 1 OF 1

Project Name	Tiekel River Conceptual Construction Estimate (Engineering)
Base Currency	US Dollars
Report Currency	USD
Type	Budgetary
Status	Draft
Labor Rate Table	2012 ESG Fee Schedule - Standard
Client	MWH Americas

Tiekel River Substation
Conceptual Construction Estimate Summary (Engineer)

Item Description	Extended Contractor Labor	Extended Contractor Material	Extended OFM	Grand Total
GROUP A: STRUCTURES	174,150.00	15,000.00	205,795.00	394,945
GROUP B: SWITCHING	57,780.00	2,875.00	186,409.20	247,064
GROUP C: CIRCUITS AND BUSWORK	97,092.00	91,934.00		189,026
GROUP E: CIRCUIT BREAKERS	48,600.00	900.00	206,982.00	256,482
GROUP F: FOUNDATIONS	139,939.00	223,204.00		363,143
GROUP G: TRANSFORMERS	26,190.00	8,350.00	259,810.00	294,350
GROUP K: CONDUIT AND CABLE	92,401.92	33,693.60		126,096
GROUP M: SITE WORK	379,086.68			379,087
GROUP N: FENCE AND SIGNS	29,562.00	80,854.00		110,416
GROUP O: GROUNDING	142,843.50	85,601.00		228,444
GROUP P: ENCLOSURES	18,720.00	5,000.00	484,895.00	508,615
GROUP S: YARD LIGHTS	11,232.00	13,051.81	18,343.20	42,627
Grand Total	**1,217,597.10**	**560,463.41**	**1,362,234.40**	**3,140,295**

	Insurance	53,342
	Contingency	177,806
	Mobilization/Demobilization	44,452
	Heated Equipment Storage	48,067
	Project Management	53,342
	Subtotal	**3,517,304**
	Engineering	351,730
	Commissioning	281,384
	Subtotal	**4,150,418**
	Performance Bond	26,752
	Total Estimate	**4,177,170**

Tiekel River Substation
Conceptual Construction Estimate Detail (Engineer)

Bid Unit	Item Description	Takeoff Qty	Unit	Labor Total	Mat Price	Mat Total	OFM Total	Total $/Unit	Grand Total
	GROUP A: STRUCTURES			174,150.00		15,000.00	205,795.00		394,945.00
A01	STRUCTURE, TYPE A01, 1-BAY A-FRAME TERMINATION STRUCTURE	3.0	ea	48,600.00	500.00	1,500.00	117,051.00	55,717.00	167,151.00
A02	STRUCTURE, TYPE A02, DIAGONAL BUS SUPPORT STRUCTURE	4.0	ea	21,600.00	500.00	2,000.00	15,312.00	9,728.00	38,912.00
A03	STRUCTURE, TYPE A03,HIGH BUS SUPPORT STRUCTURE	9.0	ea	36,450.00	500.00	4,500.00	23,760.00	7,190.00	64,710.00
A04	STRUCTURE, TYPE A04, LOW BUS SUPPORT STRUCTURE	4.0	ea	16,200.00	500.00	2,000.00	9,744.00	6,986.00	27,944.00
A05	STRUCTURE, TYPE A05, DISCONNECT SWITCH SUPPORT STRUCTURE	8.0	ea	43,200.00	500.00	4,000.00	31,024.00	9,778.00	78,224.00
A06	STRUCTURE, TYPE A06, STATION SERVICE VT SUPPORT STRUCTURE	2.0	ea	8,100.00	500.00	1,000.00	8,904.00	9,002.00	18,004.00
	GROUP B: SWITCHING			57,780.00		2,875.00	186,409.20		247,064.20
B01	SWITCH, DOUBLE END BREAK, 138kV	11.0	ea	53,460.00	225.00	2,475.00	170,293.20	20,566.20	226,228.20
B02	POWER FUSE, 138 kV, 100A	2.0	ea	4,320.00	200.00	400.00	16,116.00	10,418.00	20,836.00
	GROUP C: CIRCUITS AND BUSWORK			97,092.00		91,934.00			189,026.00
C01	CIRCUIT, TRANSMISSION	1.0	lsum	6,366.60	3,609.00	3,609.00		9,975.60	9,975.60
C02	BUSWORK, FLEXIBLE	1.0	lsum	13,464.90	5,415.00	5,415.00		18,879.90	18,879.90
C03	BUSWORK, RIGID	1.0	lsum	77,260.50	82,910.00	82,910.00		160,170.50	160,170.50
	GROUP E: CIRCUIT BREAKERS			48,600.00		900.00	206,982.00		256,482.00
E01	CIRCUIT BREAKER, TRANSMISSION, 138 kV	3.0	ea	48,600.00	300.00	900.00	206,982.00	85,494.00	256,482.00
	GROUP F: FOUNDATIONS			139,939.00		223,204.00			363,143.00
F01	FOUNDATION, CIRCUIT BREAKER	3.0	ea	14,274.00	720.00	2,160.00		5,478.00	16,434.00
F02	FOUNDATION, 1-BAY A-FRAME	12.0	ea	20,592.00	3,125.00	37,500.00		4,841.00	58,092.00
F03	FOUNDATION, DIAGONAL BUS SUPPORT	8.0	ea	9,984.00	2,100.00	16,800.00		3,348.00	26,784.00
F04	FOUNDATION, LOW BUS SUPPORT	9.0	ea	11,232.00	2,100.00	18,900.00		3,348.00	30,132.00
F05	FOUNDATION, HIGH BUS SUPPORT	4.0	ea	4,992.00	2,100.00	8,400.00		3,348.00	13,392.00
F06	FOUNDATION, SWITCH SUPPORT	16.0	ea	19,968.00	2,100.00	33,600.00		3,348.00	53,568.00
F07	FOUNDATION, SSVT SUPPORT	2.0	ea	2,496.00	3,060.00	6,120.00		4,308.00	8,616.00
F08	FOUNDATION, LIGHT POLE	12.0	ea	14,976.00	2,100.00	25,200.00		3,348.00	40,176.00
F09	FOUNDATION, CONTROL ENCLOSURE	1.0	ea	28,697.00	16,619.00	16,619.00		45,316.00	45,316.00
F10	FOUNDATION, CONTROL ENCLOSURE ENTRANCE	2.0	ea	1,014.00	2,810.00	5,620.00		3,317.00	6,634.00
F11	FOUNDATION, HAND HOLE	1.0	ea	1,014.00	9,685.00	9,685.00		10,699.00	10,699.00

Tiekel River Substation
Conceptual Construction Estimate Detail (Engineer)

Bid Unit	Item Description	Takeoff Qty	Unit	Labor Total	Mat Price	Mat Total	OFM Total	Total $/Unit	Grand Total
F12	FOUNDATION, CABLE TRENCH	100.0	lf	10,700.00	426.00	42,600.00		533.00	53,300.00
	GROUP G: TRANSFORMERS			26,190.00		8,350.00	259,810.00		294,350.00
G01	VOLTAGE TRANSFORMER, 138 kV	9.0	ea	19,440.00	150.00	1,350.00	130,194.00	16,776.00	150,984.00
G02	VOLTAGE TRANSFORMER JUNCTION BOX	3.0	ea	2,430.00	1,900.00	5,700.00		2,710.00	8,130.00
G03	STATION SERVICE VOLTAGE TRANSFORMER	2.0	ea	4,320.00	650.00	1,300.00	129,616.00	67,618.00	135,236.00
	GROUP K: CONDUIT AND CABLE			92,401.92		33,693.60			126,095.52
K01	CONDUIT, 1" GRSC	900.0	lf	23,400.00	2.68	2,410.00		28.68	25,810.00
K02	CONDUIT, 2" GSRC	1,100.0	lf	39,000.00	5.85	6,430.00		41.30	45,430.00
K03	CABLE, POWER	2,060.0	lf	7,069.92	2.41	4,964.60		5.84	12,034.52
K04	CABLE, CONTROL	3,700.0	lf	12,698.40	2.76	10,209.00		6.19	22,907.40
K05	CABLE, STATION SERVICE	800.0	lf	3,993.60	12.10	9,680.00		17.09	13,673.60
K06	MANHOUR	40.0	ea	6,240.00				156.00	6,240.00
	GROUP M: SITE WORK			379,086.68					379,086.68
M01	CLEARING AND GRUBBING	5,664.0	sqyd	15,020.93				2.65	15,020.93
M02	EXCAVATION	3,676.0	cuyd	29,408.00				8.00	29,408.00
M03	CLASSIFIED FILL AND BACKFILL, TYPE II	5,514.0	cuyd	239,131.15				43.37	239,131.15
M04	CRUSHED ROCK SURFACE COURSE	950.0	cuyd	77,360.40				81.43	77,360.40
M05	GEOTEXTILE FABRIC	5,514.0	sqyd	6,021.29				1.09	6,021.29
M06	FINAL GRADE AND CLEANUP	100.0	cuyd	6,786.00				67.86	6,786.00
M07	TEMPORARY EROSION AND POLLUTION CONTROL	904.0	lf	5,358.91				5.93	5,358.91
	GROUP N: FENCE AND SIGNS			29,562.00		80,854.00			110,416.00
N01	FENCE AND SIGNS	880.0	lf	29,562.00	91.88	80,854.00		125.47	110,416.00
	GROUP O: GROUNDING			142,843.50		85,601.00			228,444.50
O01	GROUNDING, SUBSTATION	1.0	lsum	142,843.50	85,601.00	85,601.00		228,444.50	228,444.50
	GROUP P: ENCLOSURES			18,720.00		5,000.00	484,895.00		508,615.00
P01	CONTROL ENCLOSURE, INSTALLATION AND ASSEMBLY	1.0	lsum	18,720.00	5,000.00	5,000.00	484,895.00	508,615.00	508,615.00
	GROUP S: YARD LIGHTS			11,232.00		13,051.81	18,343.20		42,627.01

 10/31/2012

Bid Unit	Item Description	Takeoff Qty	Unit	Labor Total	Mat Price	Mat Total	OFM Total	Total $/Unit	Grand Total
S01	STATION YARD LIGHTS	1.0	lsum	11,232.00	13,051.81	13,051.81	18,343.20	42,627.01	42,627.01
	Grand Total			**1,217,597.10**		**560,463.41**	**1,362,234.40**		**3,140,294.91**

	Insurance	53,342
	Contingency	177,806
	Mobilization/Demobilization	44,452
	Heated Equipment Storage	48,067
	Project Management	53,342
	Subtotal	**3,517,304**
	Engineering	351,730
	Commissioning	281,384
	Subtotal	**4,150,418**
	Performance Bond	26,752
	Total Estimate	**4,177,170**

APPENDIX E

Cultural Resource Report (confidential – not for public distribution)

APPENDIX E

Cultural Resource Report (confidential – not for public distribution)

PRELIMINARY CULTURAL RESOURCES REPORT:

Literature Review

Tiekel River Hydroelectric Project

Prepared for

MWH Americas, Inc.
1835 S. Bragaw Street
Suite 350
Anchorage, AK 99508
(907) 248-8883

05 November 2012

Stephen R. Braund & Associates
P.O. Box 1480
Anchorage, Alaska
907-276-8222
907-276-6117 (fax)
srba@alaska.net

This document contains sensitive and confidential Alaska Heritage Resources Survey (AHRS) site information; it is not intended for public distribution and should not be placed in open circulation.

EXECUTIVE SUMMARY

The Tiekel River Hydroelectric Project is a proposed power generation project that the Copper Valley Electric Association (CVEA) is studying as a way to lessen its dependency on diesel-fueled generators when providing electricity to its customers in the Copper River Basin. The proposed project involves constructing a dam and reservoir in the lower reaches of the Tiekel River, located north of the city of Valdez in the Chugach Mountains of south-central Alaska. The proposed project is in an early reconnaissance phase. CVEA is evaluating and studying four dam and reservoir configurations.

MWH Americas, Inc. (MWH), under contract to CVEA, subcontracted Stephen R. Braund & Associates (SRB&A) to identify cultural resources in the project study area through a review of available literature regarding archaeological and cultural data and an examination of the Alaska Heritage Resources Survey (AHRS) database. The project study area used for the present report includes all lands within Township 007 South, Ranges 001 to 003 East of the Copper River Meridian (C007S001E, C007S002E, and C007S003E). This project study area is larger than the proposed footprints of the dam and reservoir configurations, but because the precise locations of these and other facilities and infrastructure associated with the proposed hydroelectric project are not yet known, a broad project study area is justified to provide MWH and CVEA with a comprehensive overview of cultural resources in the vicinity of the proposed project.

SRB&A's research results indicate that a total of 15 previously documented cultural resources sites are located within the project study area, although several additional resources have been reported from the area that lack precise location information. A majority of past research efforts in the area have focused on the Richardson Highway/Trans-Alaska Pipeline (TAPS) corridors at the western side of the project area and along the banks of the Copper River on the eastern side of the project area. Historic resources are well represented in these areas, a majority of which relate to the Copper River and Northwestern Railroad which operated between Cordova and Chitina in the early 20th century. Periodic compliance-driven surveys along the TAPS and Richardson Highway have revealed additional historic materials relating to the construction of the Valdez Trail and the Washington-Alaska Military Cable and Telegraph System (WAMCATS). In contrast, little archaeological investigation has taken place within the lower Tiekel River valley itself, and while the project area contains only one or two possible archaeological sites, other sites are known to exist outside of the project boundaries, and the absence of known sites in the project study area may be a result from a lack of examination rather than a lack of existence.

The present review of available literature and cultural resource information has demonstrated that overall the area of the proposed project has received only cursory examination. Areas near the major transportation corridors (Richardson Highway and Copper River) have been more intensively examined, resulting in the 15 documented sites clustering along these corridors.

As the proposed project moves forward beyond the literature review, and depending on funding and permitting, CVEA will likely be required to address and manage cultural resources in the proposed project area under a number of legal mandates, potentially including the National Historic Preservation Act of (NHPA), the National Environmental Policy Act, the Alaska State Historic Preservation Act, the Native American Graves Protection and Repatriation Act, American Indian Religious Freedom Act, and several Executive Orders pertaining to historic preservation and the recognition of indigenous sacred sites. At this stage, it is not possible to predict precisely what will be required to address cultural resources for the proposed hydroelectric project in the Tiekel River, but it may include archaeological surveys and/or excavation, collection of oral histories from indigenous communities in the region, archival research concerning the development of the region in the historic period, or other cultural resource research activities. Consulting with the State Historic Preservation Officer (SHPO), Native communities and tribal governments, Ahtna, Inc., all landowners whose property will be used or impacted by the proposed construction, other interested parties, and the public at large will be an integral part of addressing cultural resources as the project moves forward beyond the literature review. This consultation should begin as soon as the project enters into the feasibility stage to allow interested parties to be included in the process of determining how cultural resources might be affected by the proposed configurations and how they will be addressed during the life of the project. This early consultation will help prevent unnecessary delays in planning and development as the project moves forward.

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LIST OF ACRONYMS AND ABBREVIATIONS

ADNR	Alaska Department of Natural Resources
AHRS	Alaska Heritage Resources Survey
BIA	Bureau of Indian Affairs
BLM	Bureau of Land Management
BP	Before Present
CFR	Code of Federal Regulations
CR&NW	Copper River and Northwestern
CVEA	Copper Valley Electric Association
MWH	MWH Americas, Inc.
NHPA	National Historic Preservation Act
NPS	National Park Service
NRHP	National Register of Historic Places
OHA	Office of History and Archaeology
SRB&A	Stephen R. Braund & Associates
TAPS	Trans Alaska Pipeline System
WAMCATS	Washington Alaska Military Cable and Telegraph System
USDOI	U.S. Department of Interior
USGS	U.S. Geological Survey
USC	U.S. Code
USS	U.S. Survey

INTRODUCTION

The purpose of the present report is to provide MWH Americas, Inc. (MWH) with a summary of information regarding the known and documented cultural resources that are present in the area of a proposed hydroelectric energy project in the lower Tiekel River drainage near Valdez, Alaska (Map 1). MWH, under contract to Copper Valley Electric Association (CVEA), subcontracted Stephen R. Braund & Associates (SRB&A) to identify cultural resources in the project study area through a review of available literature regarding archaeological and cultural data and an examination of the Alaska Heritage Resources Survey (AHRS) database. The report identifies the project area used for the present review, a list of AHRS sites present in the project area, additional cultural resource sites identified from other sources, an assessment of the extent and completeness of these data, and short- and long-term recommendations for addressing cultural resources as the proposed project moves forward beyond the reconnaissance phase.

PROJECT DESCRIPTION AND AREA OF POTENTIAL EFFECTS

Project Description

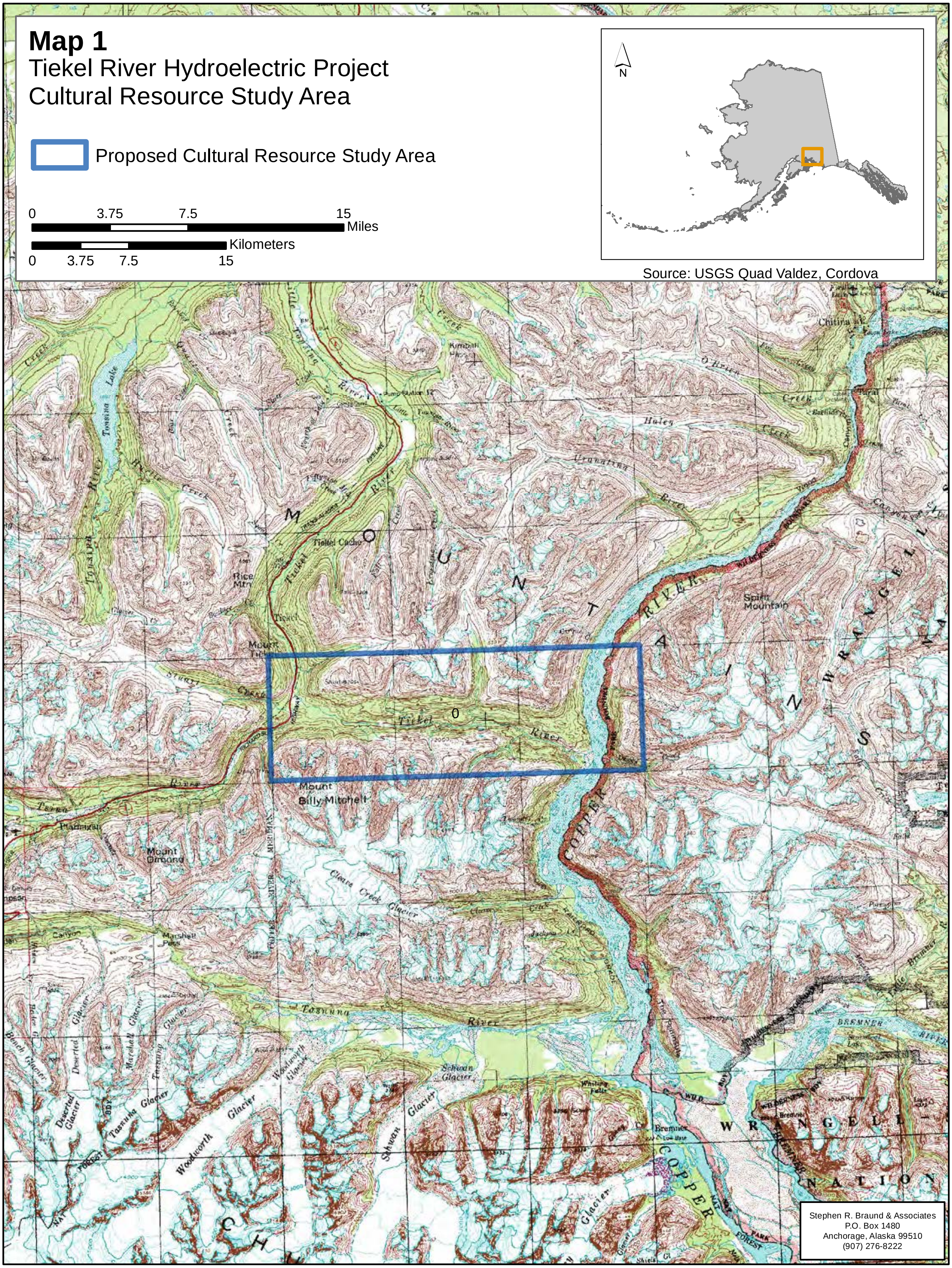
The Tiekel River Hydroelectric Project is a proposed power generation project that the CVEA is studying as a way to lessen its dependency on diesel-fueled generators when providing electricity to its customers in the Copper River Basin. The proposed project is in the lower reaches of the Tiekel River, located north of the city of Valdez in the Chugach Mountains of south-central Alaska (Map 1). The proposed project is in an early reconnaissance phase. CVEA is evaluating and studying four dam and reservoir configurations (Appendix A). The preliminary project designs propose constructing a dam across the Tiekel River to create a reservoir in the valley, and running the outflow of this dam through a series of turbines to generate electrical energy. This energy will be transmitted into the existing electrical transmission infrastructure along the Richardson Highway operated by the CVEA.

Project Environment

The area of the proposed hydroelectric system is located in the lower reaches of the Tiekel River watershed, a tributary of the Copper River in the heart of the Chugach Mountains in south-central Alaska. In the project area, the river flows through a narrow valley bounded by mountains on either side. The vegetation in the project area is characterized as needle leaf and deciduous forest. While the primary species in these forests are black and white spruce, paper birch, aspen, and cottonwood, willow and alder are noted to compose significant areas of tree canopy in certain conditions (U.S. Department of the Interior, Bureau of Land Management [USDOI, BLM] 2006:220). At higher elevations and in wetlands, herb and shrub tundra species are most prevalent (Sirkin and Tuthill 1987:376).

Project Proposed Cultural Resources Study Area

For the purposes of the present study, the project study area is defined as the entirety of Township 007 South, Ranges 001 to 003 East of the Copper River Meridian (C007S001E, C007S002E, and C007S003E) (Map 1). As many of the locations of specific project components (e.g., borrow sources, access roads, barge landings) have not yet been determined, a broad study area is justified to provide MWH with a comprehensive review of cultural resources that may be present in the area of the project to assist with current and future project planning.


Map 1
Tiekel River Hydroelectric Project
Cultural Resource Study Area
Proposed Cultural Resource Study Area
0 3.75 7.5 15 Miles
Kilometers
0 3.75 7.5 15
N
Source: USGS Quad Valdez, Cordova
Chitina
Spirit Mountain
Tiekel
Mount Billy Mitchell
Mount Dimond
Tonsina Lake
Bremner
Stephen R. Braund & Associates
P.O. Box 1480
Anchorage, Alaska 99510
(907) 276-8222

EXISTING KNOWLEDGE

Research Methods and Regulations

The SRB&A review of cultural resources included a review of the AHRS database maintained by the State of Alaska, Department of Natural Resources, Office of History and Archaeology (ADNR, OHA), and a review of reports on archaeological, anthropological, and historical investigations in the region and in the study area. ADNR, OHA maintains the AHRS database that is an inventory of all reported historic and prehistoric sites within the State of Alaska. The inventory includes objects, structures, buildings, sites, districts, and travel routes, with a general provision that they are over 50 years old. The AHRS is primarily a map-based system. ADNR, OHA assigns an individual designation consisting of three elements to each site: 49-, which indicates the State of Alaska; a unique trigraph for the U.S. Geological Survey (USGS) 1:250,000 scale quadrangle topographic map in which it is located; and, a unique sequential number within that quadrangle. For example, 49-ANC-00010 is the AHRS number for the tenth site recorded within the Anchorage quadrangle. The "49" prefix indicates that the site is in the State of Alaska, the forty-ninth state. This number 49- is omitted, because it is understood that all the sites under discussion in this report are within Alaska.

Each individual site record contains information such as the site name, a description of the physical remains, data on the site's location, a list of bibliographic citations, site significance, affiliated cultures and dates, preservation status, site condition, property owner, and other associated site numbers. Access to site location information contained in the AHRS is closed to the general public (Public Law 96-95; Alaska Statute 9.25.120, exception 4; Policy and Procedure No. 50200). ADNR, OHA maintains a list of authorized users of AHRS information. Such users include representatives of federal, state, or local governments on official business; researchers engaged in legitimate scientific research; individuals or representatives of organizations conducting cultural resource surveys aimed at protection of such information or sites; or such individuals determined by ADNR, OHA as having a legitimate need for access. The fundamental use of the AHRS is to protect cultural resource sites from adverse impacts. By using the AHRS as a planning tool, the location of cultural resources allows agencies to avoid project delays and prevent unnecessary destruction of these non-renewable resources. Listing on the AHRS does not, in and of itself, provide protection for sites; however, it does allow agencies to make knowledgeable decisions regarding the future of these sites.

SRB&A also reviewed the National Register of Historic Places (NRHP) for cultural resources in the study area. Section 101 of the National Historic Preservation Act (NHPA) (16 U.S. Code [USC] 470a[a]) established the NRHP as a means to catalog historic properties significant in American history, architecture, archaeology, engineering, and culture. The NHPA defines "historic properties" as prehistoric and historic districts, sites, buildings, structures, and objects listed or eligible for inclusion on the NRHP including artifacts, records, and material remains related to the property (16 USC 470w, Sec. 301.5). A Determination of Eligibility for the NRHP is based on a description and evaluation of a property; a statement of significance; a selected list of sources; and maps, photographs, or other illustrations. Consideration is given to both the criteria of significance and integrity of the site condition. The evaluation should consider the historic context of the property, including its relation to other known historic properties (ADNR, OHA 2003). The NRHP (36 Code of Federal Regulations [CFR] 60.4) outlines the criteria (A-D) for determining the eligibility for a historic property as follows:

> The quality of significance in American history, architecture, archeology, engineering, and culture is present in districts, sites, buildings, structures, and objects that possess integrity of location, design, setting, materials, workmanship, feeling, and association and

(a) that are associated with events that have made a significant contribution to the broad patterns of our history; or
(b) that are associated with the lives of persons significant in our past; or
(c) that embody the distinctive characteristics of a type, period, or method of construction, or that represent the work of a master, or that possess high artistic values, or that represent a significant and distinguishable entity whose components may lack individual distinction; or
(d) that have yielded, or may be likely to yield, information important in prehistory or history. (36 CFR 60.4)

Certain classes of cultural resources that are not ordinarily eligible for the NRHP, but may be determined eligible under certain circumstances include cemeteries, birthplaces or graves of important people, religious properties, moved structures, reconstructed buildings, commemorative properties or properties achieving significance within the last fifty years (36 CFR 60.4).

In addition to consulting the AHRS and NRHP, SRB&A staff reviewed information regarding archaeological, anthropological, ethnographic, historic, and/or cultural data generated by government agencies, academic institutions, and other organizations housed at various repositories and on the internet in an effort to place any identified or documented cultural resources in the proposed project study area within broader cultural and historic contexts. The sources consulted include archaeological reports, studies of Alaska Native place-names, publications and reports from federal and state agencies, academic publications, journals and travel accounts, and reports from previous environmental work in the area.

Limitations of Data

While SRB&A has examined the available literature regarding cultural resources that may be present within the proposed project study area, MWH should be aware that even the most rigorous search for information sources regarding the archaeological, historic, and cultural characterization of a given location can fail to locate all pertinent information. Data sources are often scattered and dispersed across numerous institutions and repositories and are often part of disparate collections of information within these locations. This report presents the best available summary of data at the time of its submittal. Previously unknown or unavailable information and/or material can become available or be discovered at any time. Before using the information contained in this report for any compliance or regulatory purpose, MWH should seek verification that no new AHRS sites have been documented or discovered within the project study area, and that no collections of substantial information have been added to the available literature. This report should not be considered to be an identification of historic properties as defined in 36 CFR 800.4 and has been prepared to aid preliminary reconnaissance studies of the Tiekel River Hydroelectric Project.

Previously Documented Cultural Resources within the Project study area

Archaeologically, little appears to be known about project study area. A review of available literature suggests that the small amount of archaeological information stems from a lack of previous investigations in the area, as prehistoric and proto-historic sites, in addition to abundant historic resources (see summary presented below) are known to exist in areas adjacent to the project area. In the region as a whole, concentrations of documented archaeological and historic resources tend to be clustered along highway and pipeline corridors, reflecting the development-driven sponsorship of archaeological work in the area (Kari and Tuttle 2005:19). Available literature indicates that a single archaeological survey of limited intensity has been undertaken in a small portion of the project study area away from the Richardson Highway corridor and the Copper River (ADNR, OHA 1993). Historic sites are densely packed along the Richardson Highway and the western bank of the Copper River.

A review of cultural resources that have been identified in the project study area is presented by data source below.

AHRS

The majority of documented AHRS sites within the project study area are concentrated near the Richardson Highway and the western bank of the Copper River. None of these cultural resources have nominations that are pending for the NRHP, although one site (VAL-00070) may be a contributing element of a property listed on the NRHP. Table 1 and Map 2 display and provide a summary of the previously documented AHRS sites within the project study area.

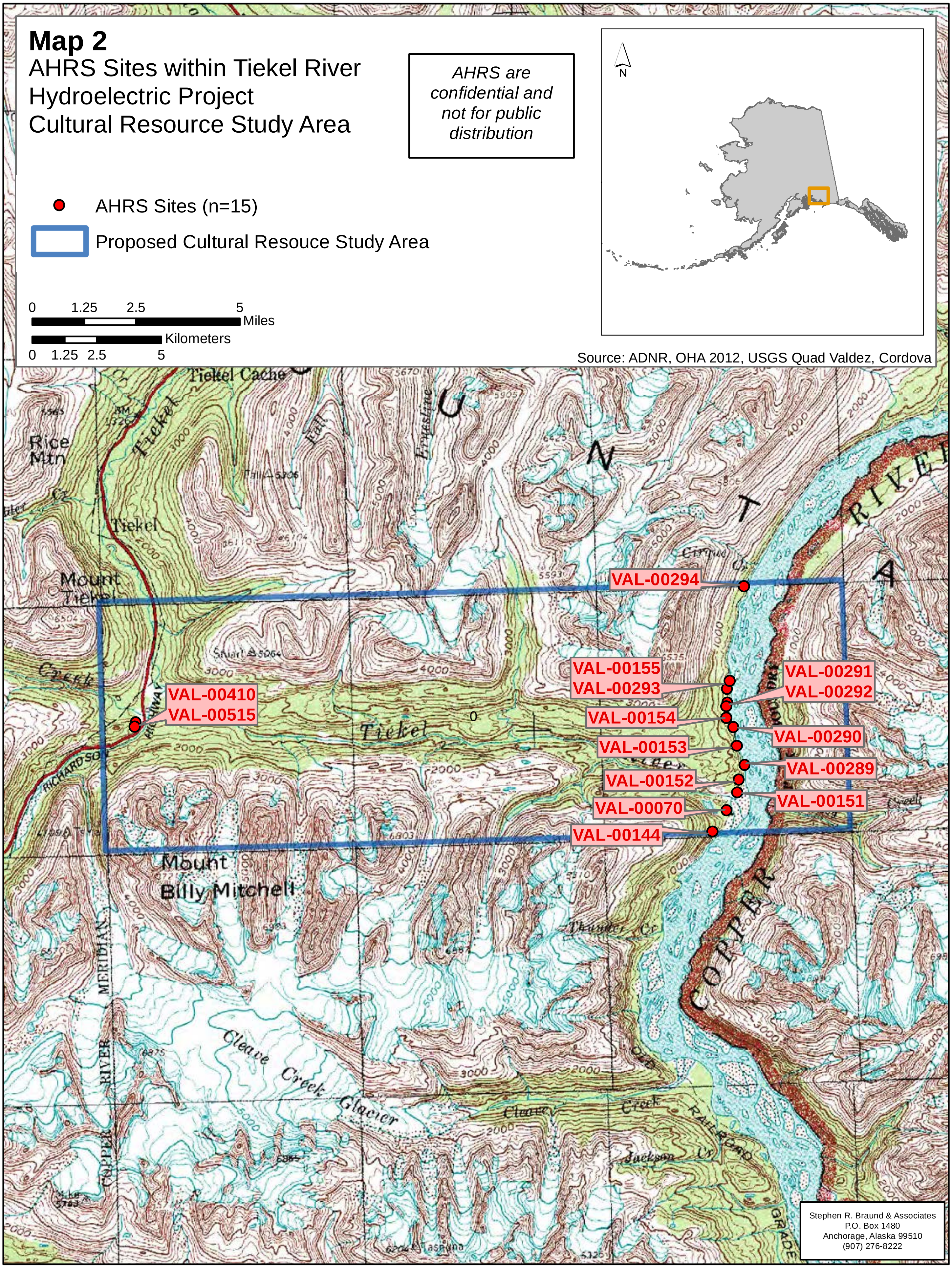
Table 1: Summary of Documented AHRS Sites within the Project Study Area

AHRS #	SITE NAME	SITE DESCRIPTION[1]	PERIOD	NRHP STATUS
VAL-00070	Tiekel R.R. Station	Tiekal Station site includes: railbed (ties, but no rails); a spur line (no rails) and a switch; a curved trench (183' long and 5'5" wide); small trestle on a turn around railbed loop; a rectangular building foundation depression (29'10" x 9'7"); a building foundation (3' x 9'10"); a collapsed woodframe cook/bunk house (30' x 60') with a brick chimney; a boardwalk; debris from a small collapsed structure; a partially collapsed woodframe water tower (22'4" x 8'2"); a partially collapsed woodframe building (12'5" x 14'5") next to the water tower; an outhouse; a boardwalk; garbage pits and miscellaneous wood and metal artifacts. Materials from some of these strucutres were salvaged and used to build the "Tiekel Palace," a privately owned lodge nearby. Threatened by highway construction.	Historic/ Railroad	Conflicting Info
VAL-00144	Mile 100.1 R.R. Trestle	This 32' long railroad trestle is oriented N-S and is associated with a causeway that spans a slough of the Copper River. Thetrestle is spported by 3 bents, each with 5 vertical pilings. One bent is located at each end of the trestle, and the third bent is in the middle. The rails and ties are in place. This trestle is in good condition, and is one of the best examples of a wood timber trestle that is still intact. The trestle has relatively little moss on the timbers. The ends are overgrown with alders. Threatened by highway construction.	Historic/ Railroad	NDE
VAL-00151	Tiekel River R.R. Trestle	This railroad trestle (built in 1909-1910) spanned the Tiekel River and was oriented NE-SW. Most of the trestle, which was about 0.3mi. long, has been destroyed by ice and flooding on the Tiekel River. At the N end, the broken off pilings of 3 bents, each with 2 sets of pilings, are still visible. Several timbers are still attached to the bent closest to the N shore. The N approach has been destroyed by recent road construction. Pilings from 15-16 bents are present in the central to S portion of the braided river bed. The caps are still attached to the top of 3 of these bents. There are no stringers or rails present. At the S end there are several bents with caps and a rail connecting them. The only remains of the trestle with stringers and ties is laying on the dry river bed partly covered with brush and debris. This section was washed downstream and is no longer in place. Threatened by highway construction.	Historic/ Railroad	NDE

AHRS #	SITE NAME	SITE DESCRIPTION[1]	PERIOD	NRHP STATUS
VAL-00152	Mile 101.6 R. R. Trestle	This NE-SW oriented testle spanned a shallow gully that drains a small estuary on the west side of the road bed. In 1975, a few bents were still present, but in 1992 very little remained of this trestle. The area has been heavily disturbed by recent road building activity. The site is now a shallow depression about 40-50' long and 21' wide. The gully is filled with gravel and the site serves as the present roadbed. A few timbers protrude from the fill on the side of the roadway. Part of a bent is visible at the SE end of the site. It consists of a single piling protruding from the fill. No remains of the trestle appear to be still in place. Threatened by highway construction.	Historic/ Railroad	NDE
VAL-00153	Mile 102.5 R. R. Tunnel	This 186' long railroad tunnel is oriented N-S and has a slight curve. It is 18'8" wide at the N end and 19'7" wide at the S end. The heighth of the tunnel is estimated to be 20-25ft. A wooden threaded insulator bracket for the telegraph line is attached to the inside wall at the NW end of the tunnel. The bracket is mounted on a steel rod embedded in the wall of the tunnel. The rails and ties have been removed and the tunnel is used for automobile traffic. The tunnel, which was built in 1910, was in fair condition in 1992. Threatened by road construction.	Historic/ Railroad	NDE
VAL-00154	Mile 103.3 R. R. Trestle	This trestle spanned a small creek and was oriented NW-SE. The trestle is almost completely destroyed and the stream channel it crossed has been filled in by gravel for a roadbed. The testle originally had 6 bents, but all that remains are pilings from 3 bents. The bents, which are 11'6" apart, appear to have been in couplets. Each bent had 2 rows of pillings adjacent to each other. Each set of couples pilings is 2' apart. Trestle aprts are protruding from the roadbed on the NW, NE, and SE sides of the roadbed at the trestle site. A stream channel 8' wide has washed out the roadbed in the approximate middle of the trestle feature. Road work in recent years appears to have destroyed what remained of the trestle.	Historic/ Railroad	NDE
VAL-00155	Mile 103.9 R. R. Trestle	This trestle linked two sides of a small causeway that spanned a small slough on the west side of the Copper River. The causeway and testle were oriented NW-SE. In 1975, the testle was estimated to be 25' long, 10' high, and in good condition. The historic integrity of the trestle and causeway were destroyed during road grading activities in the early 1990s. All that remains of the trestle are a few timbers protruding from the raodbed fill on the N and S sides of the E end of the metal culvert, which has replace the trestle. Threatened by highway construction.	Historic/ Railroad	NDE

AHRS #	SITE NAME	SITE DESCRIPTION[1]	PERIOD	NRHP STATUS
VAL-00289	Mile 101.90 and 101.95 Two Wood Culverts	The remains of 2 wooden culverts that were built into the railbed are located at Mile Posts 101.90 and 101.95. The culverts drained water from small streams through the railbed. The culverts have been damaged by recent road construction activity. All that remains of the culvert at Mile 101.90 are 2 8x18 stringer beams laying perpendicular across the roadbed and sunken into the gravel. The top cover of the culvert is missing and was probably removed when the railbed was graded and transformed into an automobile road. The culvert is 15'11" long. The wooden side beams of the culvert at Mile 101.95 are missing. A large shattered 13' long timber has been pushed off to the side of the roadbed. A notched 8x10 timber, probably the base of the culvert, is visible in the roadbed gravel. Broken pieces of timber are mixed with gravel on the E side of the roadbed. Rocks and gravel have spilled into the top of the open culverts, nearly filling them. Water flows over the road at both culvert sites. Threatened by highway construction.	Historic/ Railroad	NDE
VAL-00290	Mile 102.90 R. R. Trestle	This trestle spanned a small creek and was oriented N-S. It was destroyed by road construction activity in 1991 and replaced with a metal culvert. The opening that the trestle spanned has been filled with the new culvert and gravel. All that remains of the trestle are scattered debris. A large 8x18 timber from one of the trestle's stringers is located 30' south of the bridge site on the river (east) side of the roadbed. Several other shattered sections of bridge timbers are located nearby and 2 metal 4" washers or spacers are on the roadbed near the metal culvert.	Historic/ Railroad	NDE
VAL-00291	Mile 103.6 R. R. Culvert	This wooden culvert was originally imbeded in the railbed. During road building activitiy in the early 1990s the top of the culvert was removed when the railbed was graded to form a roadbed. The original purpose of the culvert was to divert water through the railbed. The remains of this culvert are mostly buried in silt and gravel. One of the 8x18 beams that made up the sides of the culvert is still visible in the roadbed. Additional elements of the culvert may be buried in the road bed. Water draining from the hillside west of the roadbed still flows across the road where the beam lies.	Historic/ Railroad	NDE
VAL-00292	Mile 103.70 Wooden R. R. Flume	This site consists of a 4x12 timber turned on edge embedded horizontally at the base of a hill side just west of the roadbed. This timber is about 10' long. It slants down hill to the northeast away from a small stream. The base is covered by soil. The uphill side is covered with soil and duff. It appears that this flume feature channeled water from a small stream to a specific point on the railbed, probably to a wooden culvert that has been destroyed by recent road construction activity. Threatened by highway construction.	Historic/ Railroad	NDE

AHRS #	SITE NAME	SITE DESCRIPTION[1]	PERIOD	NRHP STATUS
VAL-00293	Mile 104.1 R. R. Trestle "104A"	This trestle spanned a small creek and was oriented N-S. The trestle remains have been severely impacted by road construction activity in the early 1990s when fill was placed in the stream bed to create a roadbed. The remains of the trestle are buried in and are protruding from the new roadbed. The remains include partially buried trestle timbers, hardware, and a smashed piling. An 8x18 timber at least 15' long protrudes from the Copper River on the east side of the roadbed. Two 8x18 timbers, some alder and a 2x6 board with "104A" printed on it are in a pile 22' SW of the roadbed. Hardware typically found on trestle stringers is located at the site and includes 3/8" steel pins, several 1.5" nuts, and several 4" washers. The trestle has lost historic integrity as a site. Water from the small creek flows across the road at the bridge site, eroding the roadbed.	Historic/ Railroad	NDE
VAL-00294	Mile 106.75 R. R. Trestle	This trestle spanned a small stream and eddy of the Copper River. The trestle was oriented N-S. Most of the remains of the trestle have been destroyed by road building activity in recent years. The site is filled with gravel and the only remains of the trestle are several pilings from 2 bents in the gravel roadbed on the south end of the feature.	Historic/ Railroad	NDE
VAL-00410	Richardson Highway Roadside Sled Remains	Site is the remains of a wagon or freight sled, constructed of wood and hand forged iron fittings. The remains are approx. 13'4" in length x 4'3" in width. The remains are composed of a rectangular set of milled and decaying beams, varying in cross section from 10" x 6" to smaller than 1" x 4". These beams are fastened at each corner with iron fittings bolted to the beams with 1/2-inch and 9/10-inch square headed bolts and nuts. Hand forged iron hooks are located at each corner and measure approx 3" in diameter. Several cottonwood trees are growing through and around the remains with the largest cottonwood, 10-12" in diameter growing from within the western end of the remains. The remains are near a section of abandoned road, which is covered by 15 to 20-inch diameter cottonwood trees that are absent from other nearby sections of old road with decaying asphalt surfaces.	Historic	NDE
VAL-00515	WAMCATS MP 45-46	The site is a segment of the Washington to Alaska Military Cable and Telegraph System (WAMCATS) consisting of approximately 3284 feet of galvanized, heavy gauge wire strung between 7 collapsed spruce log tripods. The line is discontinuous over short sections, which may have been destroyed by rock falls or avalanches. The tripods are now only visible as rotted outlines of logs tied at their apexes by a length of galvanized wire and vary in length from 12 to 18 feet in length. Most of these tripods were anchored to nearby rock piles or large rocks with additional galvanized wire. Three tripods retained telegraph wire insulators, including two brown ceramic insulators and a single clear glass insulator.	Historic/ Military	NDE
[1]Site Descriptions are verbatim from AHRS cards downloaded from AHRS database				
NDE – No determination of eligibility				
Source: ADNR, OHA 2012				
Stephen R. Braund & Associates, 2012				



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Based on information from the AHRS, 15 AHRS sites are located within the project study area (Table 1 and Map 2). One of these cultural resources (VAL-00070) may have been found eligible for, or is listed, on the NRHP, although some confusion exists about the status of this resource; 14 of these cultural resources have not been assessed for eligibility for the NRHP.

Place Names

Place names in the Copper River Region generally refer to locations where locally important events or activities took place. Dr. James Kari has conducted collaborative studies in the Ahtna region to document place names, landmarks, traditional land use sites, travel routes, and significant locations memorialized by the Ahtna people through time (Kari 2008, Kari and Tuttle 2005). A review of the most current report of these place names and their locations has indicated that 97 place names are located in the lower Copper River region (i.e., south of Chitina to the Copper River mouth), with two of these place names occurring within the project study area (Map 3) (Kari 2008: Table 4). In addition, during archaeological surveys (Workman 1970) for the southern portion of the Trans-Alaska Pipeline System (TAPS), a Copper Center resident informed Dr. Workman that "*Tiekel*" in the Ahtna language translates to "no fish." See Table 2 for the place name, reference, location, and translation. Place names can represent irregularly shaped and not easy to delineate locations (e.g., Kari (2008:41) provides location information for *Łts'aay Na'* as a single set of coordinates, but the name is ascribed to the entire lower Tiekel River) or locations of specific activities that are more precise (e.g., Kari's (2008:41) specific coordinates for *Tsaa K'ae*).

Table 2: Ahtna Place Names in Project Study Area

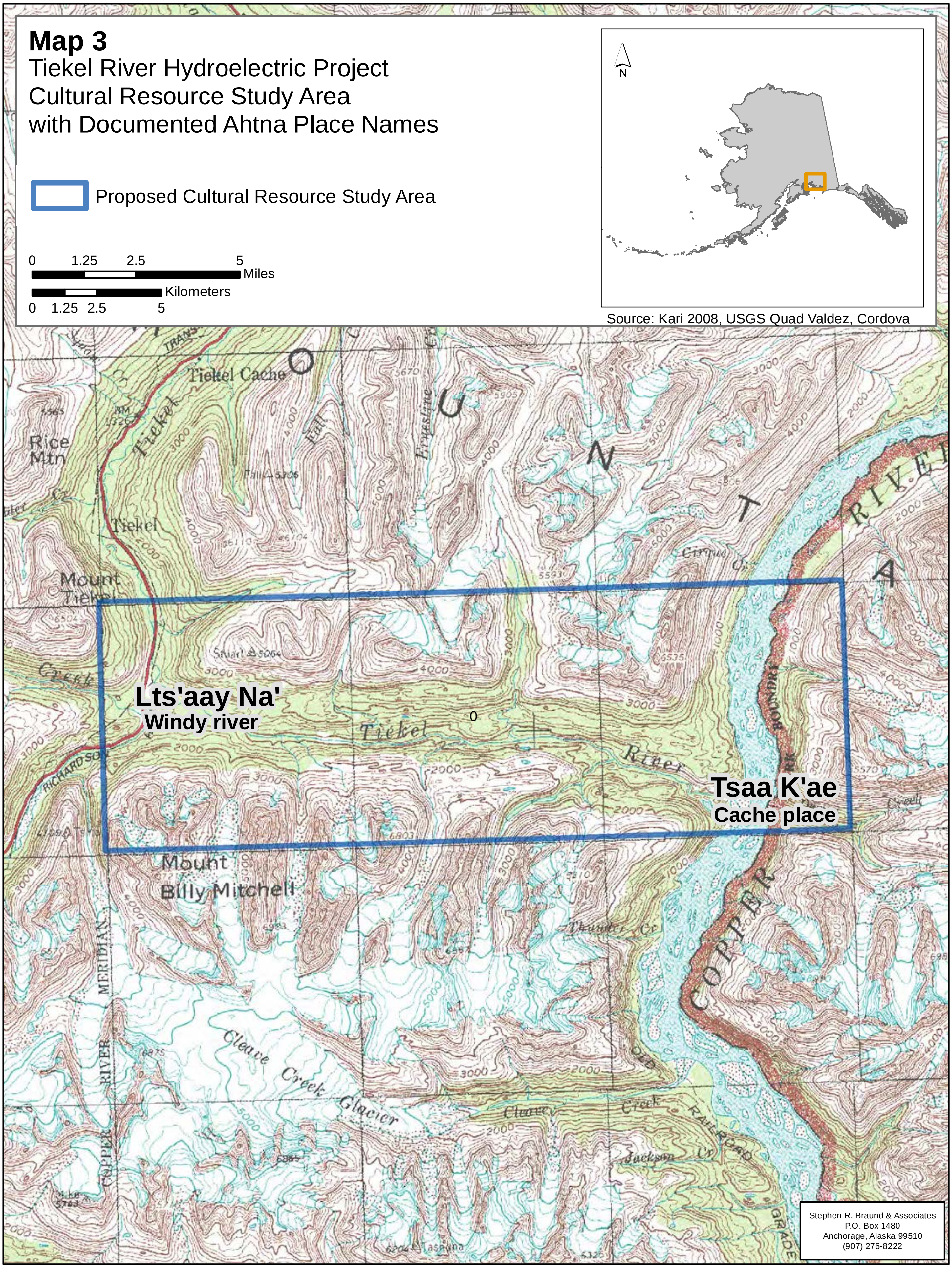
PLACE NAME NUMBER	PLACE NAME	SOURCE	LOCATION	TRANSLATION
58.3	*Tsaa K'ae*	Kari 2008:41	Opposite of Tiekel River Mouth	"Cache Place"
59	*Łts'aay Na'*	Kari 2008:41	Lower Tiekel River	"Windy River"(?)
n/a	*Tiekel*	Workman 1970	Tiekel River	"No Fish"
Stephen R. Braund & Associates, 2012				

U.S. Department of the Interior, Bureau of Indian Affairs

The U.S. Department of the Interior, Bureau of Indian Affairs (USDOI, BIA), Alaska Region has conducted a large amount of anthropological and archaeological work in nearly all areas of the state. This work includes surveying Native allotments prior to their sale, investigation of Historic and Cemetery sites under Section 14(h)(1) of the Alaska Native Claims Settlement Act of 1971, and collection of oral histories documenting traditional use of areas by indigenous communities. SRB&A staff reviewed the project study area for any records relating to USDOI, BIA activities described above. Records indicate that no surveys or investigations have been undertaken by the USDOI, BIA in the project study area.

National Register of Historic Properties

A review of the NRHP has revealed that there is some confusion regarding the eligibility status of VAL-0070. This location (the former Tiekel Railroad Station) lies along the Copper River and Northwestern (CR&NW) Railway, which has been found eligible for the NRHP (USDOI, National Park Service [NPS] 1973). The official paperwork listing the CR&NW Railway as being entered into the NRHP, VAL-0070 is listed as a property within the larger boundary of the district. However, the AHRS records associated with VAL-0070 does not indicate that this property has been evaluated for its eligibility for listing on the NRHP. The resolution of this discrepancy is beyond the scope of this report, but it would likely have to be addressed at a later stage in the development of the proposed hydroelectric project.



Map 3
Tiekel River Hydroelectric Project
Cultural Resource Study Area
with Documented Ahtna Place Names

Wrangell-Saint Elias National Park

The Wrangell-St. Elias National Park is located directly to the east of the project study area. SRB&A staff contacted the Cultural Resource staff for the park and inquired whether any historic photos, archival information, or other cultural resource related data was housed at the park office of in their archives. A review of these sources by the park staff did not locate any relevant information for the Tiekel River Hydro project study area.

Other

A review of USDOI, BLM Master Title Plat and U.S. Survey (USS) records near the confluence of the Tiekel and Copper Rivers indicated that as of 1958 there existed at least six historic structures associated with the CR&NW railroad in the area, likely components of VAL-00070. They are mapped onto the USS map produced by the USDOI, BLM, which should be consulted in the event that this area is chosen for any infrastructure or construction activities (Appendix B).

One possible archaeological site has been reported within the project study area, but was never given an AHRS number due to the inconclusive evidence recovered from the brief examination of the site (ADNR, OHA 1993). Minimal descriptive and location information is available for the site, except that it is located near the confluence of the Tiekel and Copper Rivers, on the north side of the Tiekel River, and consists of two surface depressions. Additionally, this report describes the Tiekel River as being used for beaver trapping during the historic period.

John Jangala of the USDOI, BLM's Glennallen field office reported that during a trip down the Copper River, an Ahtna resident of the region reported the existence of a village site near the mouth of the Tiekel River at its confluence with the Copper River (Jangala 2012, per. comm.).

Kari and Tuttle (2005:25) note that locations associated with Ahtna Clan origins are "highly symbolic of Ahtna prehistory and are considered to be sacred places." A map included with this report (ibid: Map 4) depicts the origins of the *Naltsiine* (Down from the Sky Clan) and the *Dits'i'iltsiine* (Out of Canyon People) in the lower Copper River region, apparently just south of the project study area.

Previous Cultural Resource Investigations in the Project study area

A review of available literature has identified several previous cultural resource field surveys conducted in the project study area, mostly relating to improvements to the Richardson Highway or studies relating to the construction of a proposed Copper River Highway (Table 3). Resources identified during the course of these surveys are related to the Copper River Railroad, the Valdez-Eagle Trail, goldrush-era roadhouses, and infrastructure related to the Washington-Alaska Military Cable and Telegraph System (WAMCATS). A summary of these surveys is presented below.

In the early and mid-1970s archaeologists conducted surveys for the TAPS. During the summers of 1969 and 1970, Workman (1970) conducted aerial and pedestrian survey of the proposed TAPS route from Hogan's Hill to Valdez, including the portion of the TAPS route within the project study area. Workman's (1970) work resulted in the identification of no cultural resources within the project study area. In 1974, Clark (1974) conducted additional pedestrian surveys in the proposed TAPS route and identified no cultural resources in the project study area.

The USDOI, BLM has conducted multiple cultural resource surveys in the project study area. USDOI, BLM (1985) surveyed 49 acres for a proposed timber disposal area that is between the TAPS and the western slope of Stuart Peak, north of the confluence of the Tiekel and Tsina rivers, and south of unnamed drainage that flows into the Tiekel River from the east. The survey of the timber disposal area did not identify any cultural resources (USDOI, BLM 1985). In 2002, USDOI, BLM (2002a) surveyed less than one acre for a gravel quarry expansion at the confluence of the Tiekel and Tsina rivers next to the TAPS Pipeline, which identified no cultural or paleontological resources. In addition, in 2002, USDOI, BLM (2002b) conducted a survey along the Richardson Highway, between mileposts 45.5 and 37, identifying one site (VAL-00410), a historic freight sled, in the project study area. Also, USDOI, BLM (2004) surveyed an area northwest of the Tiekel and Tsina rivers confluence near an existing gravel quarry in the project study area and identified no cultural resources.

During the summer of 1992, ADNR, OHA (1993) surveyed proposed routes of the Copper River Highway. One of the routes, known as the Tiekel River Route followed the north side of the Tiekel River between the Richardson Highway to the Copper River through the project study area. Field crews conducted an aerial survey over the entire Tiekel River valley and pedestrian survey of the eastern half starting at the halfway point and ending at the Copper River (ADNR, OHA 1993). The archaeologists recommended pedestrian survey of the western half of the Tiekel River valley from the halfway point to the Richardson Highway before ground disturbing activities (ADNR, OHA 1993). ADNR, OHA (1993) identified 13 historic AHRS sites associated with the Copper River & Northwestern Railroad and one possible site consisting of two 4x4m surface depressions that did not receive an AHRS number.

Northern Land Use Research, Inc. (NLUR) (2009) conducted cultural resource surveys along Richardson Highway between mileposts 10 and 79. NLUR (2009) did not identify any cultural sites beyond existing AHRS sites in the project study area.

Table 3: Previous Cultural Resource Investigations within Project Study Area

YEAR	LOCATION	LEVEL OF EFFORT	RESULT	REFERENCE(S)[1]
1970	TAPS Corridor	Reconnaissance Survey	Negative	Workman (1970)
1974	TAPS Corridor	Reconnaissance Survey	Negative	Clark (1974)
1985	Richardson Highway	Reconnaissance Survey	Negative	USDOI, BLM (1985)
1993	Copper River/Tiekel River	Literature Search, Reconnaissance Survey	Positive	ADNR, OHA (1993)
2002	Richardson Highway	Reconnaissance Survey	Negative	USDOI, BLM (2002a)
2002	Richardson Highway	Reconnaissance Survey	Positive	USDOI, BLM (2002b)
2004	Richardson Highway/TAPS	Reconnaissance Survey	Negative	USDOI, BLM (2004)
2009	Richardson Highway	Literature Search, Reconnaissance Survey	Negative	NLUR (2009)
[1]These references include only those cultural resources investigations reported in the AHRS database. The AHRS database is incomplete and does not contain citations related to all sites reported in the AHRS database.				
Source: ADNR, OHA 2012				
Stephen R. Braund & Associates, 2012.				

For a discussion of additional cultural resource investigations in the vicinity of the study area but not located within the project study area, see the sections on regional prehistoric and historic contexts below.

Regional Prehistoric and Historic Contexts

Prehistoric and Protohistoric Period

From a broad regional perspective, Clark (1981:110) interpreted the available evidence to suggest that microblade-producing people had reached the eastern portions of Alaska by around 9,000 years before present (BP), and that the sequence of technological succession in interior Alaska (including the Copper River Basin) led more-or-less directly from this tradition into prehistoric Athapaskan culture circa 2000 years ago (Clark 1981:117, Workman 1977). The glacial history of the Copper River basin indicates that the area may have been habitable sometime after 9500 BP (USDOI, BLM 2006:296), but the earliest known site components only date to approximately 2500 calibrated radiocarbon years before present (cal BP) (Potter 2008:188).

Archaeologically speaking, the vicinity of the project area has a meager number of documented sites. During the TAPs survey work in 1974, several areas along the Tiekel River and Little Tonsina River produced collections of chipped stone artifacts and waste flakes, including at least one definite microblade core, although most of the artifacts were non-diagnostic and not clearly attributable to any known technological culture or time period (Workman 1977:34). More recently, surveys by USDOI, BLM archaeologists have identified additional cultural material in these areas (USDOI, BLM 2010), but they have not contributed to any broader conclusions about the prehistoric period of the area. A chipped stone biface recovered from the Dakah De'nin Village Site hints at an earlier (i.e., pre-protohistoric) component of this area, located upstream along the Copper River from the project area (Workman 1977:28).

Documented archaeological sites tend to occur along rivers on elevated glacial features such as moraines and terraces, and in areas of soil deflation where surface visibility of artifacts is enhanced. As was the case in later prehistory and during the historic period (see below), the area in general may have existed as a sort of borderland between coastal and interior populations which may explain the lack of accumulated archaeological material in the region.

As noted above, in the Protohistoric and early historic period the project area occupies what might have been considered a semi-permeable boundary between the Ahtna Athabascans of the Lower Copper River region and the Chugach and Eyak Eskimo of eastern Prince William Sound and the North Pacific coast (BLM 2006:296, de Laguna and McClellan 1981:642, Kari and Tuttle 2005:Fig. 1). The southern boundary of Lower Ahtna Athabascan territory is somewhat disputed in the literature. De Laguna and McClellan (1981:642) and Kari and Tuttle (2005: Figure 1) place the southern boundary near Miles Lake, near the delta of the Copper River, and Workman (1977:22) places it at Wood Canyon, approximately 70 river-miles upstream from the lower boundary proposed by de Laguna, McClellan, Kari and Tuttle.

Archaeological evidence recovered from the Protohistoric (circa 1816-1822) site of Dakah De'nin's Village (Shinkwin 1974; Workman 1977:27), located several miles north of the project area along the Copper River suggests that coastal resources (i.e., mollusk shells, shell beads and labrets, and an ivory harpoon or arrowhead) were making their way upriver into Ahtna territory, either acquired directly by the inhabitants of the site, or through trade with coastal-dwelling people. The Lower Ahtna are known to have utilized both local and regional travel and trade routes, usually following the natural contours of the land, such as river corridors and accessible mountain passes (Bleakly 1996). De Laguna and McClellan (1981:642) note that the Ahtna considered the Eyak Eskimos as a friendly people, but oral histories recount the raiding of Ahtna villages by Chugach Eskimo groups, who moved up the Copper River as far as Batzulnetas, near present-day Slana, raiding villages along the way searching for copper, women, and dentalia.

Historic Period

The following section discusses historic themes starting with contact between the Ahtna and Europeans through World War II that effected people of the Copper River region.

Contact Period Ahtna

In the 19th and 20th centuries, there were four known Ahtna dialects; Upper, Central, Western, and Lower (de Laguna & McClellan 1981). With respect to the Copper River Valley, only the Lower Ahtna dialect is found with any regularity. This area is south and east of the Lower Tonsina River, leading east to the confluence of the Chitina River and Copper River, and following the Chitina River to its headwaters in the Wrangell Mountains. This range extends south along the Copper River toward the Gulf of Alaska until a large bend in the river just before it passes through the Chugach Mountains (de Laguna & McClellan 1981).

The Lower Ahtna were primarily nomadic hunters and fishers, but did occupy a major village site named Taral (VanStone 1955). For most Ahtna, this was a seasonal site, although it occupied year-round by some families. This village sits at the confluence of the Copper and Chitina Rivers, approximately 20 miles north along the Copper River from the project study area. In the late 19th century and early 20th century, Taral was inhabited year-round by Chief Nicolai, who managed to secure a monopoly on the copper sources in the Lower Copper River Basin. His influence spread as far south as Tlingit territory in southeast Alaska. Chief Nicolai's copper was also a sought after commodity for the Eyak, other Ahtna groups, and even the Chugach Eskimo (Cooper 2007). Chief Nicolai also traded with American explorers when they arrived in 1882 (see below). Trade with Euro-Americans was not new, as the Lower Ahtna had been trading with the Russians at Hickenbrook Island since before Alaska was a U.S. territory. De Laguna noted that "the movement of Native copper from the interior to the coast pre-dated the Russian fur trade" (Cooper 2007:52). This was later confirmed by her archaeological discoveries around Prince William Sound and Yakutat Bay (Cooper 2007).

By 1899, the lower Ahtna were facing a period of starvation. Needing food, Chief Nicoali traded the knowledge of his copper sources for a food cache to the prospector Ed Gates. This trade was to spark an unforeseen period of movement, money, and transportation technology through the area, as this source has since been noted to be "the single most valuable mineral deposit in Alaska to date" (ADNR, OHA 1993:13).

Russian Exploration

The contact period in the lower Copper River Valley region of Alaska began with the Russians in 1781 with the intent of verifying rumors of copper in the area. Nagaieff was the first European to discover and attempt exploration at the mouth of the Copper River. However, the swift river currents kept him at bay, as they did for two subsequent expedition attempts by Samoylof in 1796 and Lastochikin in 1798. It was not until 1819 that Andrei Il'ich Klimoffskii was able to reach the confluence of the Copper River with the Chitina River, and possibly even ventured as far north as the Gulkana River (VanStone 1955).

Once inland, Klimoffskii constructed an *odinatschka* (redoubt) on the west banks of the Copper River just across from the confluence with the Chitina River, possibly at or near the Ahtna village of Taral. The trading post remained in use until 1848 when the Russian-American Company agent Serebrannikof and three of his men were killed by the Ahtna. This shut down the post, and with this abandonment, the nearest Russian-American Company trading post to the Copper River then became Nuchek, located fifty miles to the west of the river's mouth on Hichenbrook Island in western Prince William Sound. This permanently took the Russian presence out of the Copper River Valley (ADNR, OHA 1993). The Russians still traded with the Ahtna, but they had the goods arrive at their established posts out of the valley. It was not until after the American purchase of Alaska from Russia did Western exploration come back to this area.

Early American Exploration

After the American purchase of Alaska in 1867, C. G. Holt was the first American to venture into the Copper River Valley in 1882. His objective was to prospect for copper in areas around the Chitina River and possibly establish a trading post. He stayed an entire summer at Taral but came back filled with disappointment as a result of his experiences. His reconnaissance barely extended a couple miles outside Taral. When he returned to Hichenbrook Island he reported the Ahtna were "treacherous and thievish" people (VanStone 1955:117). Per his advice, the Alaska Commercial Company did not put in the effort to establish an American trading post at the Copper and Chitina Rivers confluence as had been originally planned. Instead they traded with the Chugach Pacific Eskimo who traded with or raided the neighboring Lower Ahtna.

In 1885, H. T. Allen began his journey into the interior of Alaska. Before leaving Hichenbrook Island, he consulted with Holt who did not offer much optimism. Regardless of these words, Allen traversed 300 miles of the Copper River before moving on to the west-running Tanana River. During the early portions of this voyage, while in the Copper River Basin, Allen visited Taral, noting the dilapidated *odinatschka* left by the Russians forty years prior and also described the place as a "fishing rendezvous" during the salmon season (Allen 1887:117). He was able to trade with the locals and also ventured onto the other side of the Copper River to explore the Chitina River. His success opened up prospects for future American exploration and trade in the region.

Gold Rush

Following the discovery of gold in the Klondike region in 1896, the Copper River region became of much interest. A flood of people attempting to break into the interior of Alaska arrived in Valdez, looking for an all-American route to the Yukon. For many, the route took them from Valdez through the various passes in the Chugach Mountains, following the Copper River up to Gulkana, then through the break between the Alaska Range and Wrangell Mountains, eventually arriving in Dawson (Mendenhall 1905). With such a long journey, there were many opportunities for economic potential along the way.

Military Exploration

With the Klondike rush underway, the U.S. government decided to establish an all-American route through the Chugach Mountains via Valdez. Captain William R. Abercrombie first attempted to go up the Copper River in 1884, but was stopped at the rapids that now bear his name. Returning in the spring of 1898, Abercrombie came to Valdez and set out north where he and his crew found a trail from an old trade route running up the Lowe River Valley through Keystone Canyon. This trail took him up through Thompson Pass to the Tiekel River and down to the Copper River basin.

About half a mile below the confluence of Boulder Creek and the Tiekel River, Abercrombie came upon the ruins of a camp known as Tiekell City. This was a prospecting town that had a few shacks, some tents, and upwards of forty people, including a mayor (Abercrombie 1899:69). It was established the fall before Abercrombie's arrival, but there had recently been a devastating forest fire that destroyed all but two tents and scattered camping and mining debris. Abercrombie (1899) also commented that none of the tributaries of the Tiekel River appeared to have any salmon.

Further survey work by Abercrombie resulted in the establishment of a 93-mile packhorse trail leading from Valdez to the Tonsina River (USDOI, BLM 2006). Subsequent return trips allowed this trail to stretch to Eagle City by 1901. By 1910, this trail could be passable by more than just horse, but also wagon. In 1913, the first motorized vehicle came through the area (USDOI, BLM 2006).

Washington-Alaska Military Cable and Telegraph System (WAMCATS)

With the successful construction of a route, the U.S. government decided to implement an all-American telegraph line that would span from Valdez to Fort Egbert in Eagle. This system would later be known as the WAMCATS. Construction started from the north in 1900, and in the summer of 1901, the line was pushed down to Fort Liscum in Valdez along the route established by Abercrombie. In 1904 the cables from Seattle to Valdez were connected, which connected the Alaska to the rest of the mainland United States. This was the first successful long-distance radio operation in the world (USDOI, BLM 2003).

Copper River and Northwestern Railroad

In 1905, Daniel Guggenheim and J.P. Morgan gained controlling interests in the Copper River copper deposits, and with other holdings in the shipping, commercial fishing, and mining industries of Alaska, they created the "Alaska Syndicate" (ADNR, OHA 1993). By 1908 the Syndicate had devised and began implementing a plan of constructing a 195-mile railway that would follow the Copper River from the coast at Cordova to the mines at Kennecott. The railroad, to be known as the Copper River and Northwestern Railway (CR&NW) crossed the Copper River delta to the east from Cordova then crossed again in the heart of the Chugach Mountains near Miles Lake where it followed the west side of the valley, past Tasnuna and Tiekel valleys until the Chitina River confluence (Photograph C-1). Here the railroad crossed the Copper River again, this time just north of the confluence Chitina River. Then it stayed along the north flank of the Chitina River over to the Kennecott Glacier.

Railroad construction encountered many difficulties, including long river crossings, various sequential outcrops and canyons, swamp land, and glacial moraines. Of the 130 miles from Cordova to Chitina River there were 129 bridges, making up just over 8 miles of track (ADNR, OHA 1993). Causeways were often necessary, being constructed of gravel fill to keep the railway level and out of marshy areas. By 1910, the section of the CR&NW from Cordova north to Chitina had been completed. This made Chitina a much more popular destination than Taral, and as a result lured much of the Taral population to Chitina for continued work on the railway and at the mines (de Laguna & McClellan 1981).

Temporary construction camps, which later evolved into maintenance and fueling camps, became common along the railway, including one at the mouth of the Tiekel River (VAL-00070) (Photograph C-2). Tiekel became a large hub because the route between the mouth of the Tiekel River and Chitina required much more construction and engineering than other stretches of track. Fourteen trestles were required and a massive amount of blasting was needed to cut into Wood Canyon, just north of the Tiekel River.

Taking six thousand men approximately 3.5 years and costing $23.5 million dollars, the railway was completed at Kennecott on March 29, 1911, (ADNR, OHA 1993). Maintenance costs were high, and the entire system was almost completely rebuilt within the first three years. The United States government offered subsidies to defer the high costs of the upkeep. The Syndicate attempted to sell the CR&NW at face value to the federal government, but ended up retaining it, where it eventually became a private ore train for the Kennecott Corporation (ADNR, OHA 1993).

Kennecott Mine: Boom to Bust

During World War I, copper prices boomed, allowing CR&NW to net their first profits in 1916. This success, however, was short-lived. A series of setbacks spelled the end of the CR&NW as well as the Kennecott mines. In 1915, President Woodrow Wilson chose to sponsor the Seward-Fairbanks railway with federal money due to its better winter conditions and proximity to the Matanuska coal fields, depriving the CR&NW of the lucrative federal backing.

Regardless of this setback, the 1920s proved to be a lucrative decade for The Alaska Syndicate. Millions of dollars worth of ore was pulled out of the mines each month, and the train was running to Cordova six days a week (ADNR, OHA 1993). But by 1930, the boom had faded. The profits of the mine were not meeting the operating expenses, and the ten-year, tax-free status that was awarded to the railway for its first decade in operation had lapsed. The Copper River Basin population did not explode as hoped. There were four thousand people, but this was not enough to keep the train in business. During this time period, only five percent of the business done by CR&NW was not directly related to the hauling of ore (ADNR, OHA 1993).

With the onset of the Great Depression in 1929, copper prices dropped dramatically, further affecting the mine, which eventually closed in 1933. The mine reopened in 1934, only to have rail workers strike from 1935 to 1937. This series of events cost CR&NW approximately one million dollars a year, even when the mine was reopened (ADNR, OHA 1993). In 1938, the Kennecott mine closed permanently. The last train to run on the CR&NW railway arrived in Cordova on November 11, 1938. The sum total profits of the Kennecott Corporation are estimated to be $200 million (ADNR, OHA 1993).

World War II

Following the closure of the mine, local residents took advantage of the supplies left behind by the operation, and some abandoned buildings were put to permanent or seasonal use by hunters, trappers, and fishermen. Hand cars left on the railways helped hunters move along the line unless a collapsed tunnel or trestle impeded their path.

During World War II, the U.S. Army occupied the CR&NW right-of-way in an area from Cordova to an airbase that is presently the location of the Cordova Airport. Along this thirteen miles stretch, speeders and eventually a single diesel engine were used by the Army to create the "Civ Air Railroad" (ADNR, OHA 1993). Use of the CR&NW right-of-way by the U.S. Army ended in 1944, and in 1945, the Kennecott Corporation relinquished the right-of-way to the Territory of Alaska.

Corridor Improvement

Beginning in 1953 and continuing to the early 1960s, the U.S. government earmarked substantial amounts of funding to pave the CR&NW railway. A road from Cordova was constructed to the Nels Miller Slough. In 1961, the Million Dollar Bridge at Miles Lake was paved. However, in 1964, progress was greatly impeded by the Good Friday earthquake. Its epicenter was just ninety miles west of the railroad, resulting in considerable damage to the railroad grade, many of the line's bridges, and various causeways (ADNR, OHA 1993).

In the 1970s, the State of Alaska implemented road improvement projects on the Copper River Highway with federal money, including the replacement of the Copper River delta bridges and reconnecting the Million Dollar Bridge. With fishing still being a major draw to the area, a portion of the railway south of Chitina was converted into a one-lane road in the 1970s and again in 1991. This created easier access to a major fishing and recreation destination: Wood Canyon. The road now reaches Tiekel River (ADNR, OHA 1993).

RECOMMENDATIONS FOR FUTURE WORK

The review of the available literature and databases of archaeological, cultural, and historic information have revealed that known cultural resources are located within the Tiekel River Hydroelectric Project proposed cultural resources study area (Map 2 and Map 3), and that the level of effort to identify resources has been unevenly applied over the years to the area of the proposed study area. SRB&A has compared the results of the present review with the proposed project plans and tentative timeline and have compiled a list of short- and long-term recommendations that may be helpful when considering how to address cultural resources as the proposed Tiekel River Hydroelectric Project moves forward. The recommendations provided below are separated into short- and long-term categories, with short-term encompassing all activities until the construction of the dam and reservoir has been completed and long-term addressing how cultural resource may be managed during the operational life of the proposed hydroelectric project.

The items below are provided solely as a guide of typical steps in addressing cultural resources during the planning and construction of large-scale projects such as the Tiekel River Hydroelectric Project. As previously noted, the specific project components and their configuration in the drainage can affect how they may impact cultural resources.

Short Term

- Determine what laws pertaining to historic preservation will apply to the project based on sources of funding, land ownership, and permits that may be required (e.g. federal funding, Federal Energy Regulatory Commission, Army Corps of Engineers permits);
- Identify as closely as possible the footprints of project components (e.g., dams, reservoirs, roads, buildings) for all alternatives to establish areas of potential ground disturbance and inundation;
- Investigate and seek a formal/official resolution regarding the NRHP status of VAL-0070;
- Identify potential consulting parties that should be included in discussions regarding cultural resources in the project area;
- Initiate formal consultation under Section 106 of the NHPA with the parties identified as soon as feasibility studies begin;
- Implement any required surveys, interviews, investigations, or other research agreed upon during consultation with affected parties identified; and,
- Develop a Cultural Resource Management Plan (CRMP) for use during the development and construction phases of the proposed project that includes protocols for the inadvertent discovery of human remains and previously unknown archaeological or historic resources, including lists of pertinent points of contact in the event archaeological or historic material is encountered (e.g. SHPO, Alaska State Troopers, Ahtna, Inc.).

Long Term

- Establish regular consultation and/or meetings with affected parties to address any concerns regarding cultural resources that develop through the operation of the hydroelectric facility;
- Annual monitoring of the reservoir margins to inspect for eroding archaeological or historic sites;
- Annual monitoring of any archaeological, cultural, or historic sites identified and avoided during project construction activities; and,
- Implement any mitigation measures agreed upon during consultation with affected parties.

CONCLUSION

The literature review conducted by SRB&A for the proposed Tiekel River Hydroelectric Project has determined that 15 documented cultural resources are present within the boundaries of the project study area, in addition to two mapped Ahtna place names. The documented resources cluster around the margins of the project study area, mostly along the Richardson Highway and the Copper River, and relate to the Copper River and Northwestern Railroad from Chitina to Cordova, and the Valdez Trail and WAMCATS installation from Valdez to Eagle. Two archaeological sites have been reported within the lower Tiekel River valley, but precise location data for these sites is lacking.

The literature review conducted by SRB&A has determined that the project study area has only been subject to cursory investigations, mostly relating to improvements along the Richardson Highways and the TAPS corridor, and in preparations for the construction of the Copper River Highway from Cordova. Large areas of the project study area have not been formally evaluated or surveyed for cultural resources.

As the project moves beyond the literature review phase and the locations of the reservoir, dam, access roads, material sources, and additional infrastructure become more clearly defined, more rigorous identification efforts including, but not limited to a cultural resource field survey may be required to assess these areas for the presence of undocumented cultural resource sites. Any identified cultural resources that may be affected by the project will likely have to be addressed in consultation with the SHPO, affected tribes and Native corporations, landowners, and the interested public.

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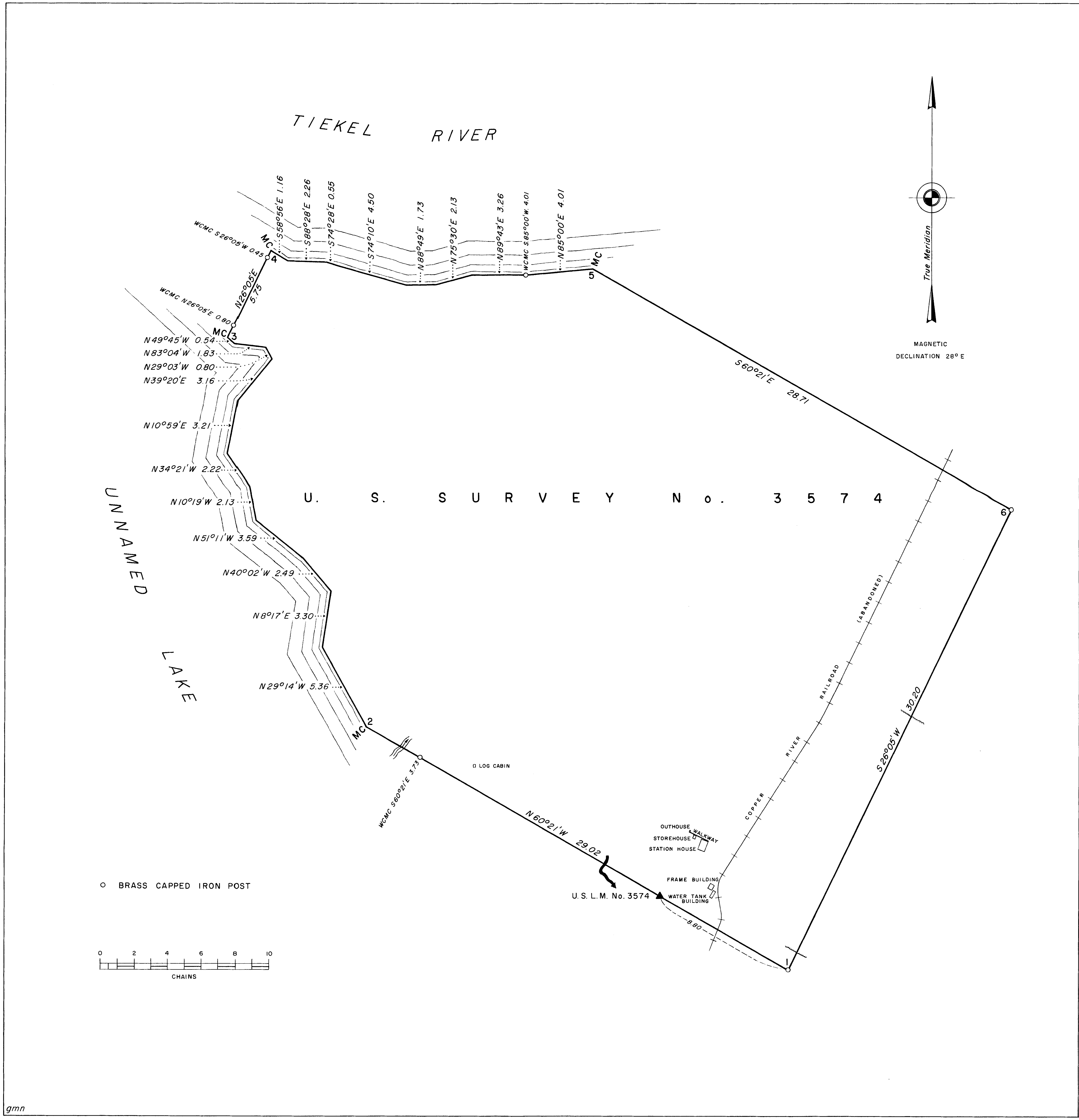
APPENDIX A: PROJECT SCENARIOS PROVIDED BY MWH

LAYOUTS INCLUDED IN ORIGINAL SRBA REPORT REMOVED BY MWH

SEE MWH TIEKEL RIVER HYDROPOWER RECONNAISSANCE STUDY REPORT FOR CURRENT LAYOUTS

APPENDIX B: U.S. SURVEY 3547 PLAT MAP

ORIGINAL



U. S. SURVEY
No. 3574, ALASKA

AND

ESTABLISHMENT OF U.S. LOCATION MONUMENT NO. 3574

SITUATED

SOUTHWESTERLY OF THE JUNCTION

OF THE TIEKEL AND COPPER RIVERS

APPROXIMATE GEOGRAPHIC POSITION

LATITUDE 61°13'00" N. LONGITUDE 144°51'30" W.

AT CORNER NO. 1

AREA: 118.54 ACRES

EXECUTED BY

JIM H. TYER, SUPERVISORY CADASTRAL SURVEYOR

SEPTEMBER 9 TO 14, 1961

UNDER SPECIAL INSTRUCTIONS

DATED JUNE 2, 1958

AND APPROVED JUNE 30, 1958

AND SUPPLEMENTAL SPECIAL

INSTRUCTIONS DATED JULY 14,

1958 AND APPROVED JULY

14, 1958

UNITED STATES DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT
Washington, D.C., September 21, 1962

This plat is strictly conformable to the approved field notes, and the survey, having been correctly executed in accordance with the requirements of law and the regulations of this Bureau, is hereby accepted.

For the Director

E. Remington

Chief, Division of Engineering

17857

Valdez (A-3)
CR6-5

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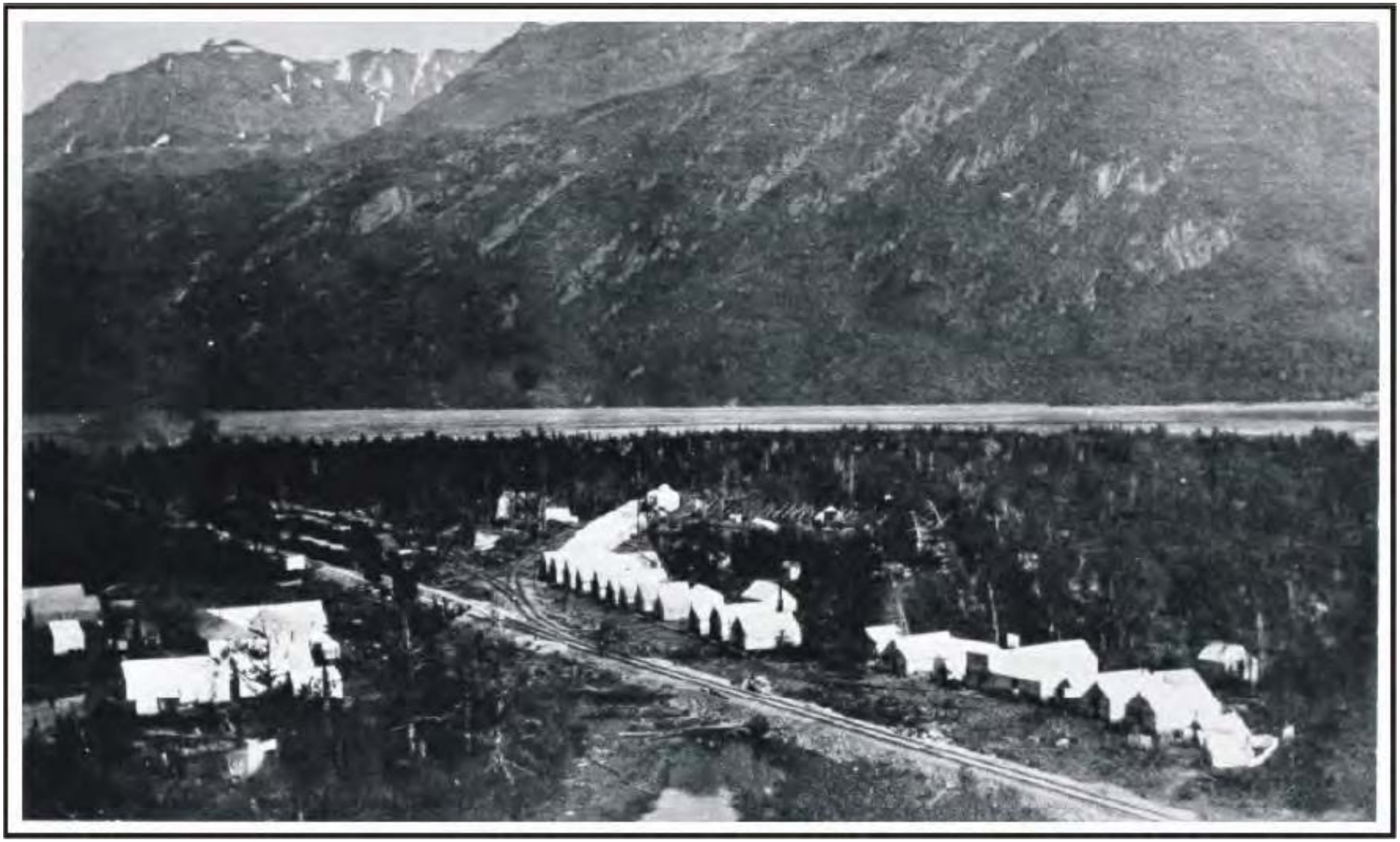
APPENDIX C: HISTORIC PHOTOGRAPHS

Photograph C-1: Mile 102 Tunnel, 1929 (VAL-00153) (Photograph from ADNR, OHA 1993)



Photograph C-2: Tiekel River Railroad Camp circa 19?? (Photograph from ADNR, OHA 1993)

APPENDIX F

Socioeconomic Impacts, Benefit-Cost Analyses

Tiekel River Power: Socioeconomic Impacts, Benefit-Cost Analyses

Prepared for

Copper Valley Electric Association

August 2015

Prepared by

Northern Economics

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Abbreviations

ADOLWD	Alaska Department of Labor and Workforce Development
AEA	Alaska Energy Authority
ANS	Alaska North Slope
APC	Alaska Power Company
BCA	Benefit-cost analysis
BCR	Benefit-cost ratio
CAPEX	Capital Expenditure
CDP	Census Designated Place
CEA	Chugach Electric Association
CRR	Capital Recovery Factor
CVEA	Copper Valley Electric Association
GWh	Gigawatt hour
G&T	Generating and Transmission
GVEA	Golden Valley Electric Association
HEA	Homer Electric Association
kV	Kilovolt
kW	Kilowatt
kWh	Kilowatt-hour
LCOE	Levelized Cost of Energy
MEA	Matanuska Electric Association
ML&P	Municipal Light & Power
MMBtu	Million British thermal units
MW	Megawatt
MWh	Megawatt-hour
NPV	Net present value
O&M	Operations and Maintenance
RCA	Regulatory Commission of Alaska
WACC	Weighted Average Cost of Capital

Executive Summary

Residents and businesses in Alaska's Railbelt have long enjoyed electricity prices that typically are far lower than those paid by customers in neighboring regions, including areas served by Copper Valley Electric Association (CVEA) and Alaska Power Company in and around Tok. The lack of relatively inexpensive natural gas-fired generation, coupled with substantial dependence on higher-cost diesel, contributes heavily to the higher power generation costs faced by these less densely populated regions. In the absence of a cost-effective means for transporting natural gas to the CVEA and Alaska Power Company (Tok) generation plants, utilities often consider Alaska's vast hydroelectric potential as the solution most likely to alleviate and, more importantly, stabilize their customers' high energy costs. Indeed, increased utilization of hydro-generated power lowers utilities' reliance on more expensive fuels (diesel), as well as on fuels whose long-term supply forecast, at least in Alaska, is somewhat uncertain (natural gas).

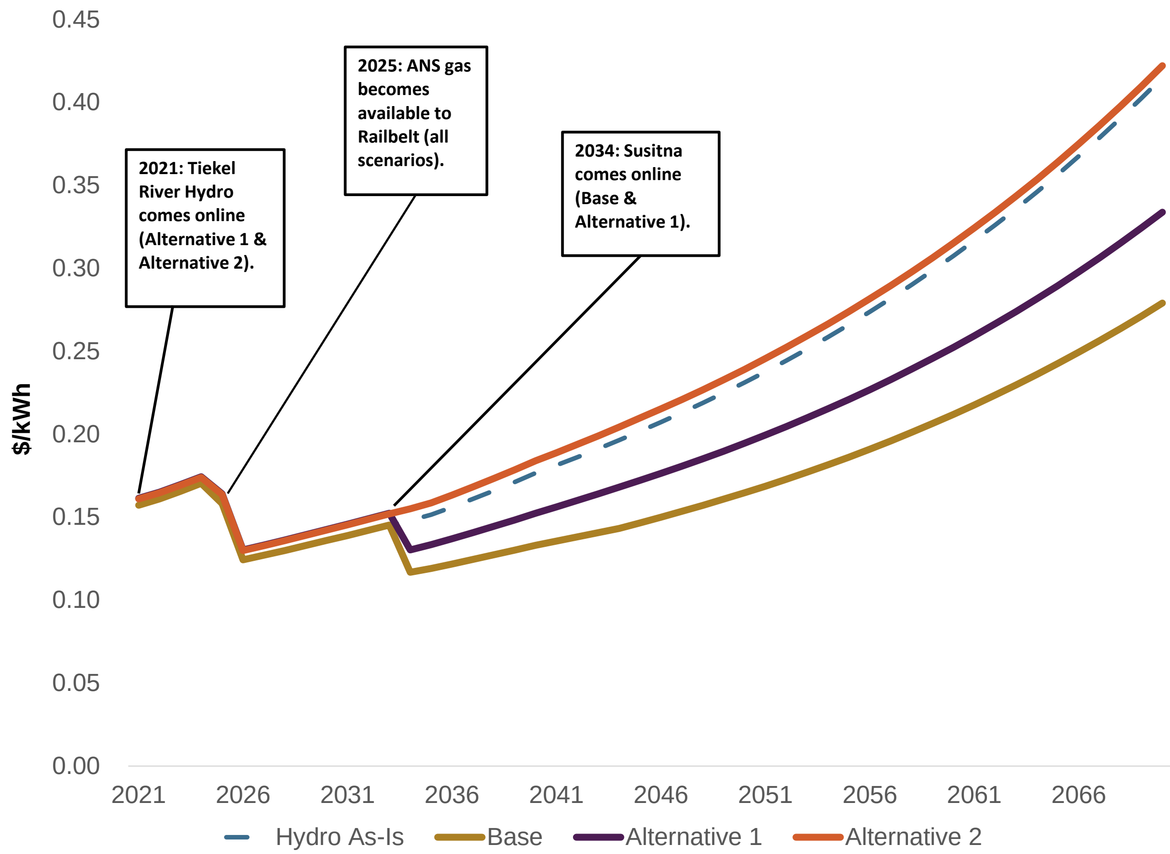
This analysis assessed the relative economic feasibility of various infrastructure scenarios over a 50-year horizon. These scenarios variably included two potential hydroelectric projects: the Tiekel River Hydroelectric project (Tiekel) and the Susitna-Watana Hydroelectric project (Susitna). Given the disproportionate energy output of Tiekel relative to projected CVEA demand, this analysis included the cost of an intertie between Glennallen and Sutton as part of the cost of Tiekel.

Among the key outputs of this analysis for four future scenarios was the estimated weighted cost of energy that combined predicted demand from the existing Railbelt and the CVEA service area. As illustrated in Figure ES-1, this analysis concluded that the weighted cost of energy (as measured in estimated 2021 dollars per kilowatt-hour [kWh]) would be lowest in a scenario in which Susitna comes online in 2034 and Tiekel is not built, and highest in a scenario in which Tiekel is built but Susitna is not.

This analysis also concluded that the scenario that would yield the second lowest cost of energy would include the construction of both Susitna and Tiekel, while the second highest cost of energy would result from a scenario in which neither Susitna nor Tiekel is built.

These results underscore the anticipated superior economic feasibility of Susitna over both Tiekel and an "As-Is" scenario, in which natural gas remains the preponderant generation fuel among Railbelt utilities. Importantly, these results also suggest that the weighted cost of energy would be higher with Tiekel than with natural gas alone. As indicated in Figure ES-1, all scenarios assume that natural gas from Alaska's North Slope will become available to Railbelt utilities beginning in 2025.

Figure ES-1. Estimated Weighted Cost of Energy under Four Scenarios (2021$/kWh)



Source: Northern Economics analysis.

The second important outcome of this analysis was a series of benefit-cost ratios (BCR) that also attest to the predicted economic infeasibility of Tiekel relative to other system-wide[1] options. In the benefit-cost analyses (BCAs), the base scenario assumed the construction of Susitna but not that of Tiekel; Alternative 1 assumed the construction of both Susitna and Tiekel; and Alternative 2 assumed the construction of Tiekel but not Susitna.

As indicated by the BCRs well under 1.0 in Table ES-1, the additional costs associated with the construction of Tiekel vastly outweigh the benefits that would accrue to CVEA ratepayers. This result holds even as the following sensitivity analyses are conducted: the discount rate is adjusted from 4 percent to 7 percent; the Tiekel capital cost is lowered by 50 percent; the Susitna capital cost is increased by 50 percent; and the Operations and Maintenance (O&M) cost for Tiekel in its first year of operations is lowered from 1.0 percent to 0.5 percent of the project's capital cost.

Observing the effects on the Alternative 1 BCR of altering the Tiekel capital cost and discount rate also provides an indirect assessment of the economic merits of a scenario in which Tiekel is built relative to the As-Is scenario, in which neither Tiekel nor Susitna is built. Keeping the Susitna capital cost constant while varying the Tiekel capital cost essentially illustrates how the cost of power from Tiekel compares to power from gas-fired generation over time. This analysis concludes that Railbelt system power costs

[1]Scenarios that assumed the construction of Tiekel include CVEA demand as a component of Railbelt demand. Regardless of the inclusion of Tiekel, the "system," as assessed in the BCAs, included demand from both the existing Railbelt and the CVEA service area.

with Susitna—including increased costs associated with higher volumes of gas-fired capacity—would be lower than costs without the 600 MW project, but total system costs would be higher in a scenario that includes Tiekel.

Table ES-1. Results, Benefit Cost Analyses

Scenario	Discount Rate (%)	Tiekel CapEx Adjustment	Susitna CapEx Adjustment	NPV Costs ($millions)	NPV Benefits ($millions)	BCR
Alternative 1	4.0	None	None	2,221.7	39.4	0.02
	4.0	- 50%	None	315.7	111.9	0.35
	4.0	None	+ 50%	1,903.1	39.4	0.02
	4.0	- 50%	+ 50%	1,344.0	111.9	0.08
	7.0	- 50%	None	85.9	66.7	0.78
Alternative 2	4.0	None	None	5,179.3	39.4	0.01
	4.0	- 50%	None	3,988.5	111.9	0.03
	4.0	None	+ 50%	1,903.1	39.4	0.01
	4.0	- 50%	+ 50%	2,841.7	111.9	0.04
	7.0	- 50%	+ 50%	1,117.7	66.7	0.06

Source: MWH, 2013; Alaska Energy Authority, 2015; Northern Economics analysis.
Note: CapEx = capital expenditure; NPV = net present value.

This analysis also assessed the economic feasibility of constructing an intertie from Glennallen to Tok that would provide for the transmission of power from Tiekel to Tok and nearby communities. However, the capital cost of the transmission line yielded an estimated cost of transmission well over $1 per kWh, rendering this piece of infrastructure economically infeasible.

Finally, a BCA was conducted for Alternative 1 and Alternative 2 under a high load growth scenario, as well as a scenario in which the O&M cost for Tiekel in the dam's first year of operations was lowered from the baseline 1.0 percent of the project's capital cost to 0.5 percent. However, both the higher assumed growth in demand and lower initial O&M rate minimally impacted the BCRs.

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1 Introduction

In 2009, the Copper Valley Electric Association (CVEA) secured ownership of the 12-megawatt (MW) Solomon Gulch hydroelectric (hydro) plant at Valdez, acquired from the Four Dam Pool Power Agency. CVEA is also seeking to bring a second hydro plant on line: Allison Creek, also at Valdez. Allison Creek, a 6.5 megawatt project, is scheduled for completion during the 2015 construction season, with first commercial hydropower planned for 2016.

Both hydro plants are part of CVEA's effort to reduce power cost to consumers in its service area. In 2011, CVEA reported 50 percent of its generation was hydro powered, 25 percent came from its cogeneration plant (Valdez) and the remaining 25 percent was diesel-powered at both Glennallen and Valdez (CVEA, 2011).

CVEA has continued to look for other hydro projects, working with the Alaska Energy Authority (AEA) and members of the State legislature as well as conducting its own field reconnaissance studies. The Tiekel River area, located south and east of Glennallen, is a strong candidate for hydropower and CVEA secured the engineering services of MWH to further evaluate the site.

1.1 Background

As noted by MWH (2013), the primary objective of the Tiekel River Hydropower Reconnaissance Study was to determine if potentially feasible hydropower project could be developed on the Tiekel River. MWH engineers and scientists focused on the Tiekel River reach between the Richardson Highway and its confluence with the Copper River.

1.1.1 Tiekel River Dam

MWH engineers published a draft final report on Tiekel River hydro potential in January 2013 (MWH 2013). Six scenarios were analyzed for power production, displacement of CVEA diesel and co-generation power production, and potential power that could be transmitted to larger markets, such as the Railbelt. MWH added additional combinations to allow for different dam heights (and reservoirs), power houses, and costs. Five combinations met objectives:

- Scenario 1A: small dam and storage reservoir at dam alternative 3 with an 8-mile tunnel to a 20-MW powerhouse, to be located near the Tiekel River confluence with the Copper River.
- Scenario 1B: moderate height dam and storage reservoir at dam alternative 2 with a 1-mil above-ground penstock to a 30-MW powerhouse to be located about 1 mile downstream of the dam site.
- Scenario 2: diversion (or "intake") dam upstream of dam alternative 3 with an 8-mile tunnel to a 10-MW powerhouse to be located near the Tiekel River confluence with the Copper River.
- Scenario 3A: moderate height dam and storage reservoir at dam alternative 2 with a 1 mile above ground penstock to a 50-MW power house to be located about 1 mile downstream of the dam site.
- Scenario 3B: high dam and storage reservoir at dam alternative 1 with a 1 mile tunnel to a 100-MW powerhouse located near the Tiekel River confluence with the Copper River.

These five scenarios are summarized in Table 1.

Table 1. Five Possible Hydropower Scenarios, with Class 5 Capital Costs, Levelized[1] Costs

Scenario	Capital Expenses ($millions)	Capacity (MW)	Average Power (MW)	Cost per kW[2] ($/kW)	Usable Annual Generation (GWh[3]/yr)	Potential Annual Average Generation (GWh/yr)	Levelized Cost per Usable kWh[4] ($/kWh)	Levelized Cost per Potential kWh ($/kWh)
1A	354.6	20	3.4	17,729	30	113	0.76	0.20
1B	449.9	30	7.2	14,995	63	150	0.45	0.19
2	229.5	10	1.6	22,951	14	71	1.03	0.21
3A	530.5	50	12.1	10,610	106	204	0.32	0.16
3B	1,564.3	100	43.8	15,632	384	384	0.26	0.26

Source: MWH, 2013, with revisions.
Notes: [1]Levelized costs calculated with 6% discount rate and 50 year period; [2]kW = kilowatt; [3]GWh = Gigawatt hour; [4]kWh = kilowatt hour

These cost estimates are considered a Class 5 cost estimate, using categories developed by the AACE International (formerly known as the Association for the Advancement of Cost Engineering). A Class 5 estimate is based on a concept or project feasibility statement, with a project definition from 0 to 2 percent (AACE 2003). Actual costs are projected within a range of -50 percent to +100 percent. Increased project definition will reduce cost variability.

After discussion with MWH, CVEA asked Northern Economics to conduct an economic analysis of Scenario 3B, a 100 MW capacity project with the lowest levelized cost of energy (LCOE) amongst the five scenarios.

1.1.2 Interties: Railbelt, Tok

Two interties are included within the project. First, there is an intertie (138-kilovolt [kV]) between Glennallen on the east and the town of Sutton, on the west; this intertie would connect power generated by Tiekel (or other hydro projects on the CVEA system) to the Railbelt markets north and south of Anchorage. Second, CVEA requested analysis based on an intertie from Glennallen north to the Tok area, currently served by Alaska Power Company (APC), a subsidiary of Alaska Power and Telephone.

1.2 Socioeconomic Implications of Higher Cost Energy

Primary among the anticipated benefits of Tiekel to CVEA ratepayers is the long-term assurance of lower cost electricity than would be available without the project. Conclusive analysis has not been conducted to date on the specific socioeconomic effects of either a short-term shock to or long-term increase in the cost of electricity to the CVEA region (or to Alaska as a whole), and accurate prediction of these effects would require a comprehensive modeling effort that extends beyond the scope of this analysis. However, existing literature from elsewhere in the U.S. suggests that responses by the residential, commercial, and industrial sectors would vary in degree and across time.

The level of responsiveness of demand to a change in the price of a good or service is called price elasticity of demand (elasticity). Economists often use elasticity to predict to what degree—and over what period of time—changes in prices of goods and services will affect demand for those goods and services and how these changes may filter through the economy in other ways. If, for example, households tend to be inelastic with regard to an increase in the price of an essential good (such as electricity), their consumption of that good will decrease only slightly relative to the price change. This relatively small change in consumption of the good will leave them with less disposable income for other purchases. Revenues among the commercial sectors where households would have spent their money will fall, which could negatively impact businesses' ability to retain employees or even keep their doors open. With fewer employment opportunities available locally (or regionally), residents are much more likely to migrate elsewhere, and so the cycle may continue.

In fact, existing literature does indicate that households tend to be price inelastic in the short term with regard to their consumption of electricity (Meier et al., 2013; Bernstein and Griffin, 2006). Specifically, Bernstein and Griffin (2006) showed that households exhibit slightly more price elasticity in their consumption of electricity than natural gas but are still fairly price inelastic, over both the short and long term.

The combination of the heavy reliance by CVEA ratepayers on diesel as a fuel source for the generation of electricity and the severity of the region's winters makes reasonable the assumption that CVEA customers are fairly price inelastic with regard to their demand for electricity. Compounding the reduction in consumers' real purchasing power likely would be higher prices for regional goods and services resulting from businesses' higher energy costs.

Bernstein and Griffin also showed that businesses tend to be price inelastic in the short run with regard to their purchases of electricity. Much higher long-run regional price elasticities for commercial electricity indicate either that businesses tend to find substitute energy sources to fulfill their electricity needs or that overall declines in commercial electricity expenditures reflect lower demand (i.e. the downsizing of the commercial sector). The latter scenario seems more plausible for a region that lacks access to natural gas.

1.3 Objectives

MWH's Task Order directs Northern Economics to:

a. Conduct socioeconomic and benefit cost analyses related to Scenario 3B.

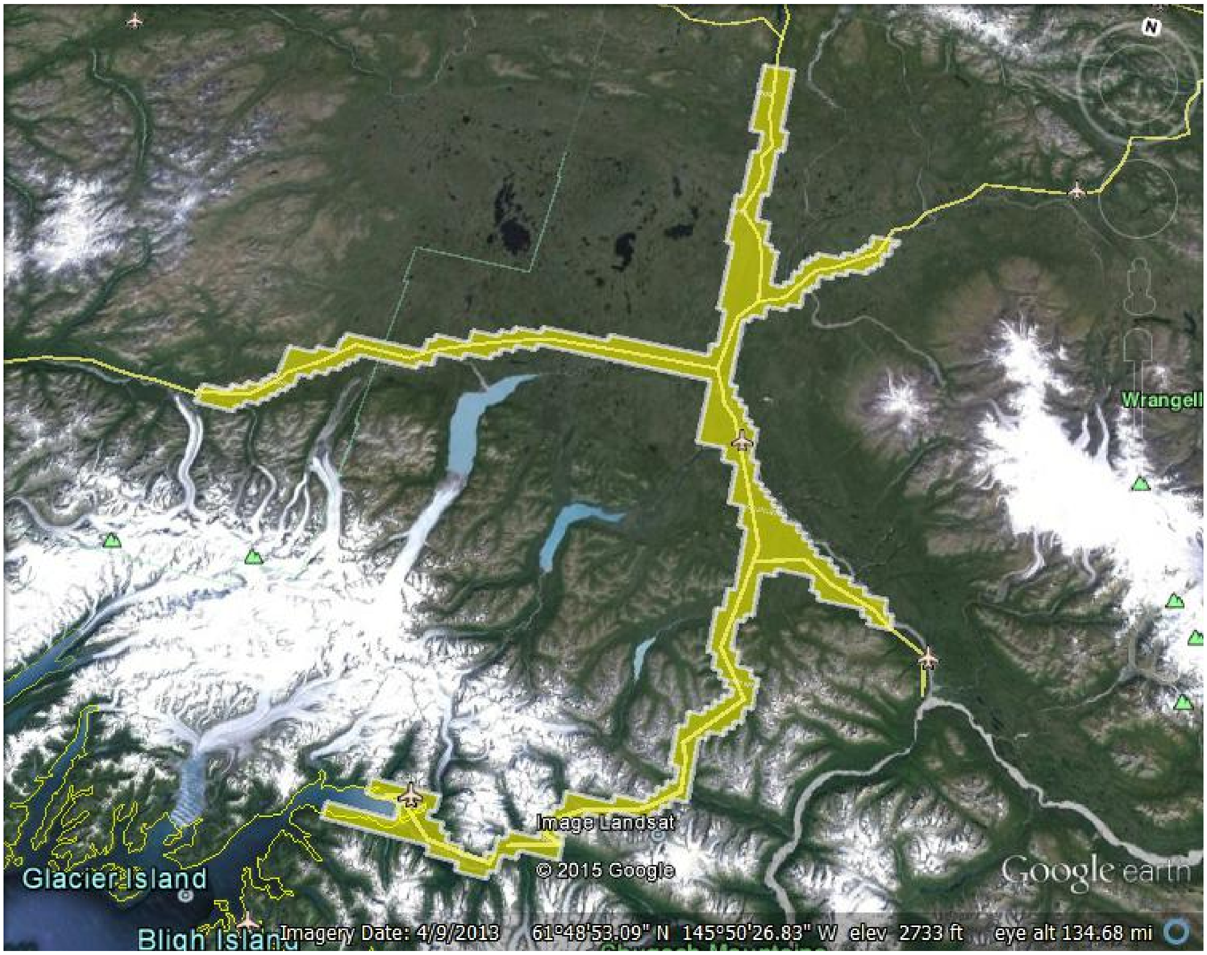
b. Conduct an analysis of existing LCOE estimates and render an opinion.

c. Forecast demand for CVEA's service area as well as the Railbelt and the APC service area at Tok, over a 50-year period, using low, medium and high growth estimates.

1.4 Project Geographic Scope

Figure 1 is a map that illustrates CVEA's service area, with major generating capacities in Valdez and Glennallen (Regulatory Commission of Alaska [RCA] 2015).

Figure 1. CVEA Service Area



Source: RCA, 2015.

1.4.1 Tiekel River

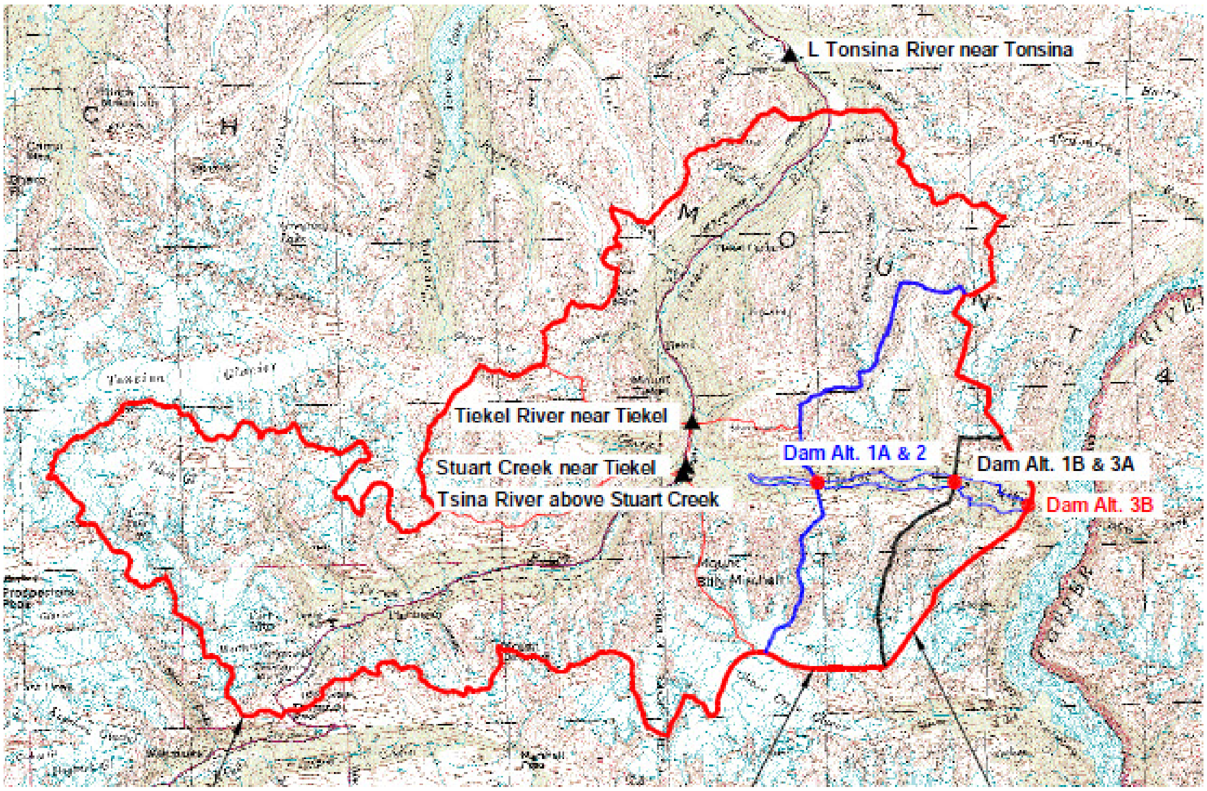
Figure 2 is a more detailed map that shows the Tiekel River, east and slightly north of Valdez (MWH, 2013).

Figure 2. General Location Map, Tiekel River

Source: Google Earth, 2015; MWH, 2013.

Figure 3 is an area map prepared by MWH, illustrating creeks and rivers near Tiekel and Stuart Creek, with several dam alternatives displayed.

Figure 3. Tiekel River Area, Tonsina

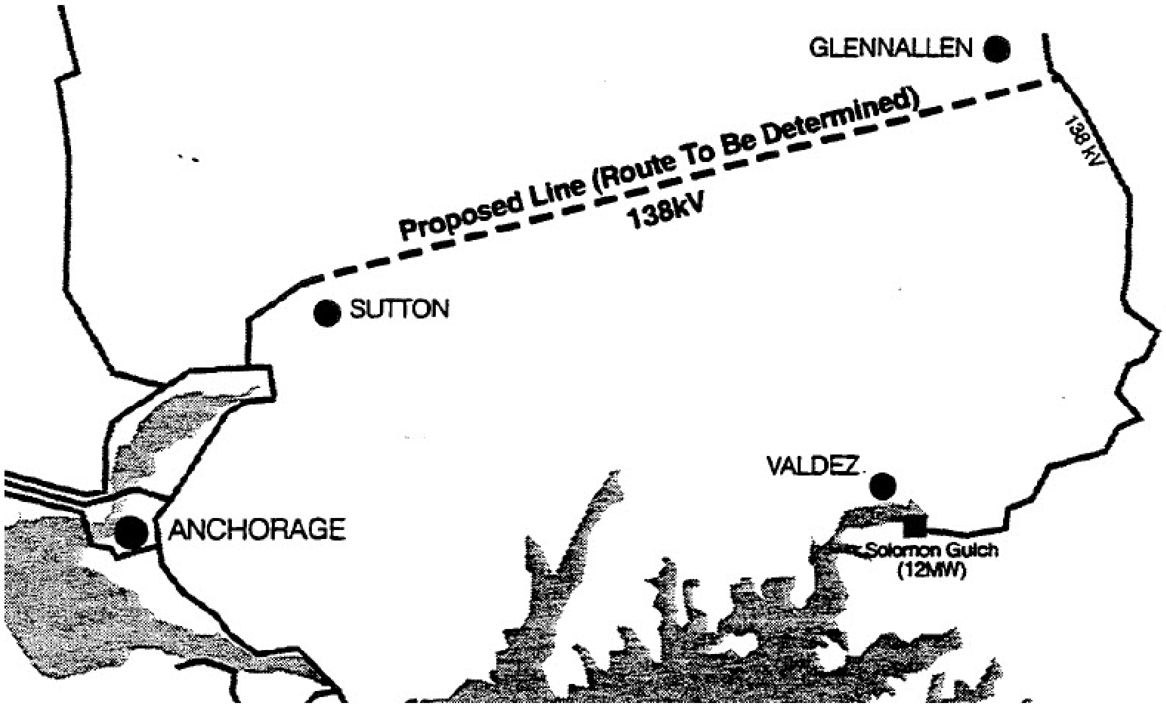


Source: MWH, 2013.

1.4.2 Intertie to Railbelt

The concept of an intertie from the Copper River area to the Railbelt has been analyzed several times in the past (Beck 1994). Public meetings were held in communities that would be affected by the proposed intertie and report authors noted "…considerable level of public resistance to construction of the Intertie on environmental grounds, concentrated among people living west of the Copper Valley Electric Association service territory" (Beck 1994). Figure 4 illustrates a conceptual intertie between Glennallen and the Railbelt, near Sutton, as part of an update to the earlier study (CH2M HILL 1995).

Figure 4. Proposed Intertie, Glennallen to Anchorage, 1995



Source: CH2M HILL, 1995.

1.4.3 Intertie to Tok

There is no formally designated route for an intertie from Glennallen to Tok; however, the shortest route would follow the Tok Cutoff north and east from Glennallen, tying into APC's system in the Chistochina, Slana, and Mentasta Area.

Figure 5 illustrates the various highway routes into and out of Glennallen, including the Glenn Highway north to Tok.

Figure 5. General Location Map, Glennallen to Tok

Source: Copper Valley Chamber of Commerce, 2015.

2 Existing Conditions

Forecasted future demand directly impacts the economic feasibility of proposed energy projects such as Susitna and Tiekel. A natural byproduct of population growth and increased economic activity is increased demand for electricity. Evaluating existing socioeconomic conditions and projected changes to population and commercial demand helps to predict future load growth and to assess how well proposed generation projects are likely to meet future demand.

Existing socioeconomic conditions are summarized in this section, with emphasis on population, employment, and income. This section introduces the three distinct study areas and then compares existing socioeconomic conditions across regions. This section concludes by comparing current cost of power in the different areas, as well as total generating capacity and distribution of generation by type of fuel.

Figure 6 shows boroughs and census areas, with the latter in plain black outline, from Alaska's Census 2010 (Alaska Department of Labor and Workforce Development [ADOLWD] 2011). Several areas are census designated places (CDP), used by federal and state economists to record (and project) socioeconomic factors.

Figure 6. Selected Alaska Boroughs, Census Areas, 2010

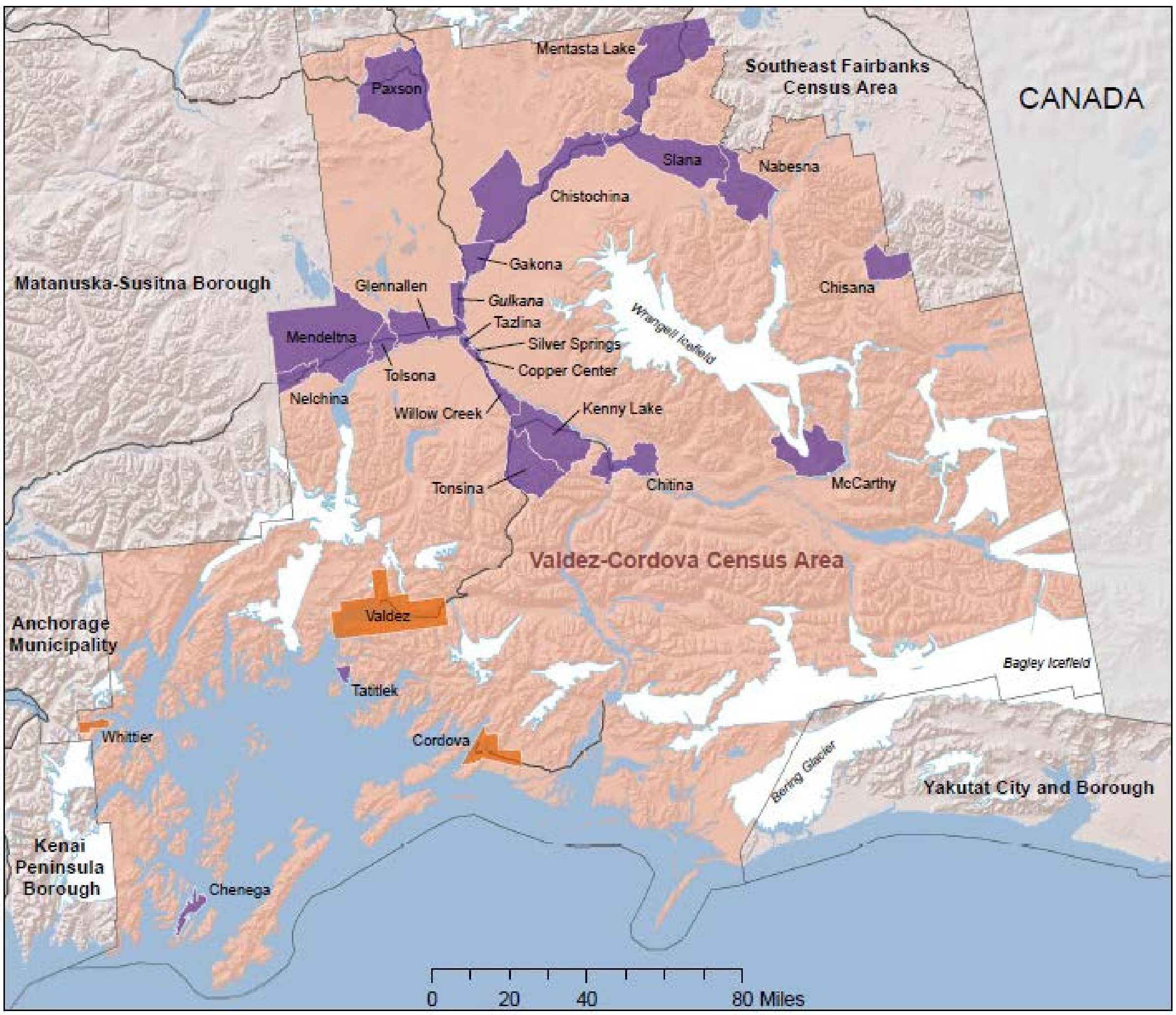
Source: ADOLWD, 2011; U.S. Census Bureau, 2010.

2.1 Introduction to Study Areas

2.1.1 CVEA Service Area

Unique in many ways, the Copper River Basin is the only region of Alaska without a borough or any municipal governments (Sandberg and Hunsinger 2014). The region is named for the copper located in the area, known to Alaska natives (Ahtna Athabascans) for many years, but commercially developed in 1900, with active mining near Cordova from 1911 to closure in 1935 (Sandberg and Hunsinger 2014). Figure 7 shows the Valdez-Cordova Census Area, along with city designations (Valdez, Cordova) and CDP (darker colored areas).

Figure 7. Valdez-Cordova Census Area, 2011

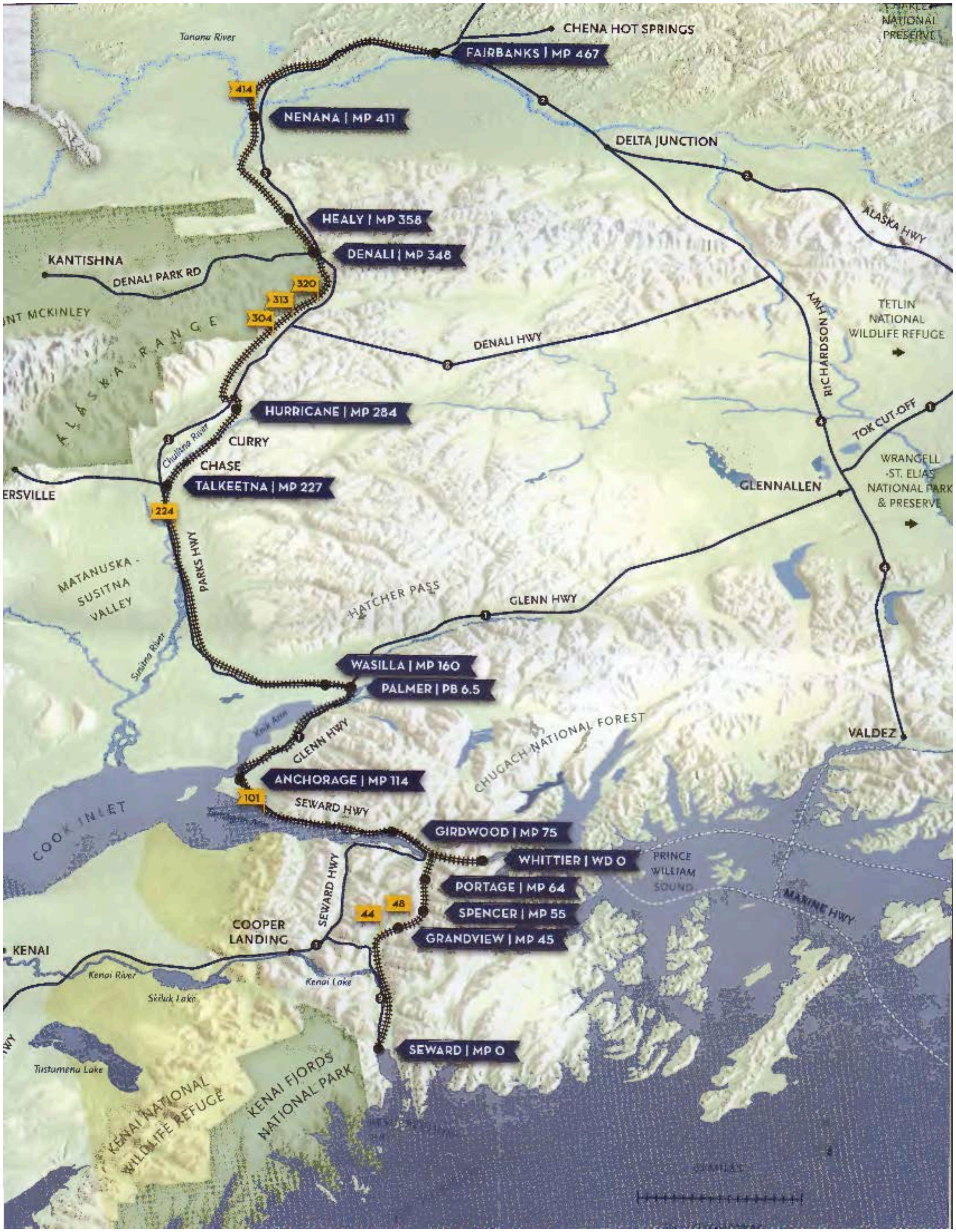


Source: ADOLWD, 2011; U.S. Census Bureau, 2010.

2.1.2 Railbelt Region

The boundaries of Alaska's Railbelt region are roughly defined by the Alaska Railroad's rail track, from Seward to Fairbanks. Figure 8 displays the Railbelt region and surrounding areas.

Figure 8. Alaska's Railbelt Area



Source: Alaska Railroad Corporation, 2015.

The six utilities that comprise the Alaska Railbelt region include Golden Valley Electric Association (GVEA) in Fairbanks, Homer Electric Association (HEA) and Seward Electric Service[2] on the Kenai Peninsula, Matanuska Electric Association (MEA) in the Matanuska-Susitna Valley area, and Municipal Light and Power (ML&P) and Chugach Electric Association (CEA) in the Anchorage area.

Four of the Railbelt utilities are member-owned cooperatives, while two are municipally owned. With a combined total population of more than 500,000, the Railbelt region is home to approximately 75 percent of the state of Alaska population. Current and forecasted sales of electricity to Railbelt customers are presented below by census-designated places, cities, and utilities.

2.1.3 Tok Area

The APC provides electric service to many small communities throughout the State of Alaska. The service area extending from the northern edge of CVEA's service area along the Tok Cut-off to Tok will be the focus of this report. The communities of Tok, Dot Lake, and Tetlin Junction (rate group 4), and Chistochina, Mentasta Lake, and Slana,[3] (rate group 5) are considered potential consumers for electrical output of the Tiekel River dam. APC currently provides power to these approximately 1,500 customers through diesel generation.

Many of the communities APC serves receive a subsidy through Alaska's Power Cost Equalization program to offset high electric rates. The cost of power projections in this study do not include this subsidy.

2.2 Population

The majority of CVEA's customer base lives within the borders of the Valdez-Cordova Census Area, while the remainder lives in the Matanuska-Susitna Borough. CVEA serves 65 percent of the Valdez-Cordova Census Area but only a small fraction of the Matanuska-Susitna Borough population, near the Eureka roadhouse. In total, CVEA's customer base includes 6,244 residents, which equates to 0.8 percent of the state population, and 2,535 households. As shown in Table 2, the population of the Railbelt region is vastly greater than that of both the Valdez-Cordova Census and the Southeast Fairbanks Census Area (ADOLWD 2014; U.S. Census Bureau 2010). Table 23 in the Appendix displays population and number of housing units for the study area at the community level.

Table 2. Population and Housing Units within Census Areas and Boroughs Comprising Utility Service Areas

Area	Population (2014)	Households (2010)
Valdez-Cordova Census Area	9,567	3,966
Anchorage Municipality	300,549	107,332
Kenai Peninsula Borough	57,212	22,161
Matanuska-Susitna Borough	98,063	31,824
Denali Borough	1,785	806
Fairbanks North Star Borough	97,972	36,441
Southeast Fairbanks Census Area	6,963	2,567

Source: ADOLWD, 2014; U.S. Census Bureau, 2010.

[2] Seward Electric Service receives all of its power needs from CEA.

[3] Chistochina, Mentasta Lake, and Slana are labeled as CMS.

ADOLWD has predicted annualized population growth for the Matanuska-Susitna Borough of 1.9 percent from 2012 to 2042, but negative growth of 0.3 percent over the same period for the Valdez-Cordova Census Area (see Table 3). With the majority of the CVEA service area within the latter, this analysis anticipates negative growth in the CVEA residential customer base through 2042 and beyond. Positive population growth from 2012 to 2042 is expected for all Railbelt areas except Denali Borough, while projected average annual population growth in the Southeast Fairbanks Census Area is 1.4 percent.

Table 3. ADOLWD Population Growth Projections for CVEA, Railbelt, and Tok Regions

Census Area/Borough	Estimate (1,000 residents)	Projections (1,000 residents)						Average Annual Growth (%)
	2012	2017	2022	2027	2032	2037	2042	
Valdez-Cordova Census Area	9.9	9.8	9.7	9.5	9.4	9.2	9.0	-0.3
Anchorage Municipality	298.8	313.3	326.6	338.1	347.9	356.6	364.9	0.7
Kenai Peninsula Borough	56.8	59.2	61.4	63.1	64.3	65.1	65.6	0.5
Matanuska-Susitna Borough	93.8	105.6	117.8	130.2	142.6	154.7	166.3	1.9
Denali Borough	1.9	1.8	1.8	1.8	1.7	1.7	1.6	-0.5
Fairbanks North Star Borough	100.3	106.8	112.8	118.2	123.0	127.6	132.0	0.9
Southeast Fairbanks Census Area	7.2	7.9	8.5	9.2	9.8	10.4	11.1	1.4

Source: ADOLWD, 2013.

2.3 Employment & Wages

Unemployment on a percentage basis was higher among Valdez-Cordova Census Area residents (9.8 percent) than Matanuska-Susitna Borough residents (8.2 percent) in 2013. As shown in Table 4, the unemployment rate was highest in the Southeast Fairbanks Census Area and Denali Borough (13 percent and 12 percent, respectively) among study areas and lowest in the Anchorage Municipality and Fairbanks North Star Borough (5 percent and 6 percent, respectively).

Average wages in 2013 among workers living within the CVEA service area exceed those of workers in both the Valdez-Cordova Census Area and Matanuska-Susitna Borough. This is likely attributable in large part to the oil industry jobs related to the Trans Alaska Pipeline System's Valdez Marine Terminal. Overall, average wages were highest in the Anchorage Municipality and lowest in the Southeast Fairbanks Census Area. Table 24 provides employment and wage data for the study area at the community level.

Table 4. Employment and Average Wages for CVEA, Railbelt, and Tok Areas (2013)

Area	Persons Employed	Percent Unemployed (%)	Average Wage ($)
Valdez-Cordova Census Area	4,452	10	41,560
Matanuska-Susitna Borough	40,328	8	42,673
Anchorage Municipality	150,448	5	45,044
Kenai Peninsula Borough	25,640	8	42,359
Fairbanks North Star Borough	44,596	6	40,738
Denali Borough	944	12	43,070
Southeast Fairbanks Census Area	2,624	13	32,760

Source: ADOLWD, 2013; ADOLWD, 2015.

Data showing employment by industry are not available at the community level but are at the census area/borough level. As shown in Table 5, the trade, transportation and utilities industry is the largest employer in five out of the seven study areas. Local government, leisure and hospitality, and education and health services also tend to be significant employers in the study areas. Manufacturing is important to the Valdez Cordova Census Area but nonexistent in all other areas except Kenai Peninsula Borough.

Table 5. Top Industries by Area as Share of Total Employment

	Share of Total Employment (%)						
Industry	VCCA	MSB	MOA	KPB	DB	FNSB	SFCA
Trade, Transportation and Utilities	23	22	21	19	10	20	15
Local Government	18	15	6	16	7	8	13
Leisure and Hospitality	11	12	11	12	60	11	6
Manufacturing	11			5			
Educational and Health Services	8	19	16	16	2	13	7
State Government	7	7	7	6	1	14	5
Professional and Business Services	6	6	13	4	8	6	9
Other Services	5	4	4	4			3
Construction	3	8	5	5		6	3
Federal Government	3		6		12	8	17
Financial Activities		3	5			4	
Information		2					
Natural Resources and Mining				8		4	18

Source: U.S. Department of Labor, 2013.

Notes: VCCA = Valdez Cordova Census Area; MOA = Anchorage Municipality; KPB = Kenai Peninsula Borough; MSB = Matanuska-Susitna Borough; DB = Denali Borough; FNSB = Fairbanks North Star Borough; SFCA = Southeast Fairbanks Census Area.

2.4 Existing Demand & Relative Cost of Power

The Railbelt utilities benefit from interconnection, economies of scale, and access to low cost natural gas as a generation fuel. Interior areas, with smaller, more isolated populations and diesel as the primary generating fuel, are more sensitive to fuel price changes.

Relative residential rates for the Railbelt, CVEA, and the Tok area are shown in Table 6. GVEA, in Fairbanks, lacks direct access to natural gas for generation, but purchases gas-generated electricity through interconnection with the southern Railbelt utilities. In its first quarter 2015 fuel adjustment filing, GVEA anticipated meeting more than one-half of total customer demand with purchased power from the southern Railbelt. All Railbelt utilities plan to have added new generating capacity during the 2012 to 2016 time period and will experience resulting rate increases over the next year or two.

CVEA provides power to its customers through a combination of hydro and diesel generation. APC provides power to customers in Tok and the communities along the Tok Cut-off road through diesel generation. These utilities (and the communities they serve) have benefited from the recent price reduction in the global oil markets.

Table 6 summarizes the relative cost of power among the Railbelt utilities, as well as CVEA and the APC service area, and provides total forecasted demand for the three areas in 2016. The cost of electricity (on a $/kWh basis) is lower among all Railbelt utilities than CVEA and APC areas under analysis, although monthly customer charges vary widely. Disparities in total forecasted demand across the three areas reflect vastly disparate population counts.

Table 6. Current Relative Cost of Power and Regional Total Demand in 2016, CVEA, Railbelt and Tok Areas

Area, Utility	Customer Charge ($/Month)	Base Rate ($/kWh)	Fuel and Purchased Power ($/kWh)	Total Rates ($/kWh)	Forecasted Demand, 2016 (MWh)
Railbelt					
CEA	8.00	0.09	0.07	0.16	5,250,070
GVEA	17.50	0.11	0.07	0.18	
HEA	15.00	0.14	0.07	0.21	
MEA	5.65	0.11	0.08	0.19	
ML&P	5.65	0.11	0.04	0.15	
Seward	20.11	0.13	0.07	0.19	
Copper Valley Electric					
CVEA-Copper Basin	12.00	0.07	0.18	0.25	80,784
CVEA-Valdez	12.00	0.056	0.18	0.23	
Alaska Power Company					
APC–Tok	13.85	0.18	0.19	0.37	9,053
APC–Chistochina, Mentasta, Slana	13.85	0.38	0.25	0.63	

Source: Utility websites; Northern Economics analysis.

2.4.1 Sales by Area and Sector, CVEA and APC

More than half of CVEA sales go to commercial customers, and 40 percent of all sales are to two customers. CVEA's allocation of sales by area and customer class is shown in Table 7.

Table 7. CVEA Average Allocation of Sales by Rate Area and Customer Type, 2010 to 2014

Residential		Commercial		Total Forecasted Sales, 2016 (MWh)
Copper Basin	Valdez	Copper Basin	Valdez	
7.7%	13.7%	19.0%	59.6%	80,784

Source: CVEA, 2015.

In its fuel cost regulatory filing dated March 6, 2015, APC predicts annual electricity sales and fuel rates by community, as summarized in Table 8.

Table 8. APC, Estimates Sale by Community (MWh), 2014

APC Community	Estimated Annual Sales (MWh)
Tok/Dot Lake/Tetlin (Tok)	8,125
Chistochina, Mentasta, Slana (CMS)	1,095
Total	**9,220**

Source: APC, 2015.

2.5 Capacity, Total & by Fuel Type

The primary source of Railbelt power generation is natural gas from the Cook Inlet fields. Hydro, diesel, coal, and wind are relied upon in smaller capacities. The Railbelt utilities are interconnected through transmission lines, including the AEA-owned 345 kV intertie from Willow to Healy (operated at 138 kV).

The utilities generate and purchase power from both one another and independent power producers. The AEA owns the Bradley Lake hydro project and maintains agreements with the Railbelt utilities that regularly purchase power from the project. Aurora Power (Chena) sells coal-generated power to GVEA, and CEA purchases wind power from Fire Island Wind LLC. CEA and ML&P share ownership of the Southcentral Power Plant (SPP), while the Eklutna Hydro Power Plant is owned by ML&P, CEA, and MEA.

From 2012 through 2016, more than 500 MW of new gas generation capacity will have been built by CEA, ML&P, MEA, and HEA as a result of the need to replace aging plants with newer, more efficient units, as well as conversions by HEA and MEA from power purchasers to power producers. In the northern Railbelt, GVEA recently purchased the Healy 2 clean coal plant from the AEA as a lower-cost alternative to diesel generation and will bring the plant online during 2015. Table 9 displays characteristics of new Railbelt generation capacity.

Table 9. New Railbelt Generation by Plant Name, Capacity, Owner, Type, and Area of Service, 2012–2016

Plant Name	Capacity (MW)	Owner	Type	Area Served
Eklutna (EGS)	170	MEA	Gas	Valley
Healy 2	53	GVEA	Coal	Fairbanks
MLP 2A	125	MLP	Gas	Anchorage
Soldotna	46	HEA	Gas	Peninsula
SPP	188	CEA, MLP	Gas	Anchorage

Source: RCA, 2015.

CVEA provides electricity to its customers using a combination of diesel and hydro generation. CVEA's plants that use fuel oil are the Glennallen Diesel Plant, located in Glennallen, the Valdez Diesel Plant, and the Cogeneration Project (CoGen), located in Valdez. The CoGen plant, a solar-turbine heat recovery unit which uses a light straight-run fuel, is located at the Petro Star refinery and sells exhaust heat to Petro Star. Revenues from these heat sales are used to directly offset electricity rates to CVEA customers.

The Solomon Gulch Hydroelectric facility and the Allison Creek Hydroelectric facility, which is currently under construction, are located in Valdez. The Solomon Gulch facility houses CVEA's dispatch center, which contains remote controls for all of CVEA's plants.

In 2016, Allison Creek will begin operation, which will enable CVEA to supply 64 percent of its total generation demand using renewable energy. Table 10 identifies characteristics of CVEA's generating plants that are likely to be online in 2016.

Table 10. CVEA Generating Plants by Capacity and Type, 2016

Name	Type	Capacity in MW
Solomon Gulch	Hydro	12
Allison Creek	Hydro	6.5
Glennallen Diesel Plant	Diesel fuel	10.7
Valdez Diesel Plant	Diesel fuel	9.7
CoGen Plant	Solar Turbine, LSR fuel	5.3
Total Capacity		**44.2**

Source: CVEA, 2015.

Table 11 displays total projected Railbelt and CVEA capacity by fuel in 2016, while Table 22 in the Appendix details anticipated Railbelt expected in 2016 by plant, unit, capacity, utility, and geographic area served. Total CVEA generating capacity is only 2.4 percent of that of the Railbelt, although CVEA's proportional utilization of diesel is much higher. Notably, CVEA generates none of its electricity with natural gas. Also, CVEA's CoGen capacity is included as diesel capacity in Table 11.

Table 11. Railbelt and CVEA Capacity by Generation Type in MW, 2016

Region	Capacity/Share	Hydro	Wind	Coal	Natural Gas	Diesel	Total
Railbelt	Capacity (MW)	192	40	104	1,225	261	1,822
	Share of Total (%)	11	2	6	67	14	100
CVEA	Capacity (MW)	18.5	0	0	0	25.7	44.2
	Share of Total (%)	42	0	0	0	58	100

Source: AEA, 2015; CVEA, 2015.

3 Power Costs

This section explains the methodology used to develop cost of power estimates for the Railbelt region, CVEA service area, and Tok service area for the various generation infrastructure scenarios considered in the benefit-cost analyses in Section 5.

There are three potential components that are variably included in these scenarios and that profoundly influence both the future geographic extent of the Railbelt region and the price of electricity paid by Railbelt, CVEA, and Tok customers:

- The Tiekel River Hydroelectric Project
- An intertie from Glennallen to Sutton
- An intertie from Glennallen to Tok

The latter two projects would allow for the transmission of power from Tiekel to the existing Railbelt region and Tok, respectively, and anticipated capital and operating costs associated with each of the three components are presented below. Following the methodological documentation, this section presents cost of power estimates for the Railbelt region, CVEA service area, and Tok.

3.1 Costs of New Infrastructure Projects

3.1.1 Tiekel River Dam

This analysis anticipates that Tiekel will come online in 2021. An LCOE forecast was developed based on capital costs and capacity factors specified in Option 3B of the Tiekel River Reconnaissance Study (MWH 2013), with the capital costs escalated to year 2021.

An annual Operations and Maintenance (O&M) escalation rate of 3.4 percent, capital recovery rate of 2.82 percent, and capital carrying rate of 5.5 percent, all based on historical Bradley Lake financing data, also contributed to the calculation of the Tiekel LCOE.

As a sensitivity analysis, power costs and benefit-cost results were estimated applying an O&M cost in the first year of Tiekel operations of 0.5 percent of the project's capital cost, representing a reduction from the assumed baseline initial O&M cost of 1.0 percent of total capital cost. Other assumptions affecting the Tiekel LCOE calculation are presented below in the Railbelt LCOE summary.

Tiekel costs of power, whether presented individually or as a weighted average with other Railbelt hydro generation, assume that maximum generation output is sold to electric consumers. Sales of less than maximum output would result in an increase in the costs per kWh proportionate to the percent reduction in sales.

This analysis assumes that no additional transmission infrastructure is required for Tiekel power to be provided to CVEA customers and, therefore, that no additional transmission costs would be absorbed by this group. This analysis further assumes that additional costs of transmission associated with the Railbelt and Tok interties are added to the costs of power paid by Railbelt and Tok customers, respectively, as presented in Table 12.

Table 12. Cost per kWh, Tiekel River Dam and Transmission, 2021

Year	Tiekel River ($/kWh)	Transmission to Railbelt ($/kWh)	Transmission to Tok ($/kWh)
2021	0.20	0.03	1.29

Source: MWH, 2013, Northern Economics analysis.

3.1.2 Intertie from Glennallen to Sutton

CVEA will consume less than 10 percent of the Tiekel output, and a 138-kV transmission line (intertie) between Sutton and Glennallen will be required to sell the remaining 90 percent of power to the Railbelt. A 1994 feasibility study and finance plan for the intertie, authored by R.W. Beck and commissioned by the State of Alaska, Department of Community & Regional Affairs, Division of Energy, describes a 135-mile line and recommended route (R.W. Beck 1994).

This analysis calculated an estimated cost of the transmission line to the Railbelt of $172.8 million using the R.W. Beck study mileage and an updated estimated cost of $1.283 million per mile, with the transmission line cost estimate based on MWH's estimated cost of transmission lines between the Tiekel dam powerhouse and CVEA's existing transmission lines (MWH 2013).

Annual operating and maintenance costs of 2.5 percent of capital costs were estimated based on an average of CEA and GVEA transmission costs over the period 2011 through 2013, obtained from their RCA Annual Report (Federal Energy Regulatory Commission Form 1) filings.

An estimated levelized 50-year cost per kWh for the intertie was calculated by taking total costs and dividing by annual demand. This analysis anticipates that 90 percent of the output of Tiekel will be available annually for resale to the Railbelt and will constitute the entirety of load transmitted across the intertie. Total costs include capital costs, capital carrying cost, and annual operating and maintenance.

This analysis assumes that the transmission line, as well as Susitna-Watana and the Tiekel, would be owned by the state; thus, an identical capital carrying cost was applied for all three projects.

3.1.3 Tok Intertie

An intertie from Glennallen to Tok could make power from Tiekel available for sale to APC customers in Tok, Dot Lake, and Tetlin (Tok), as well as CMS. It is assumed that a 115 kV line will be adequate to carry load along the 139-mile highway route from Glennallen to Tok. This analysis developed an estimated cost of $184.6 million by scaling back the $1.28 million per mile cost used for the Glennallen to Sutton intertie to $1.07 million per mile, a reduction equivalent to the ratio of 115 kV to 138 kV. This analysis developed cost estimates for operations and maintenance and capital carrying costs similarly to those of the Glennallen to Sutton intertie.

3.2 Forecasted Cost of Power

This analysis developed a 50-year LCOE by fuel type for the existing Railbelt region, CVEA, and Tok based on capital and production costs per kW, a capital recovery factor, capacity factors, heat rates, and fuel costs. Costs were gathered from Railbelt utilities' public filings and websites, as well as through discussions with utility operators, and were estimated based on similar units where actual costs were unavailable.

The following assumptions hold across the different LCOE models:

- Capital costs will increase between the date of this study and the forecasted date of completion of construction at the Producer Price annualized growth rate for electric power. Following completion of construction, all capital costs are stated in dollars per kW and will remain constant throughout the study period.
- Operating and maintenance costs for all generation types will increase annually at the real rate of growth of the Bradley Lake Hydro project over the years 2001-2014.
- No diesel generation will occur after natural gas is available in Fairbanks in 2025, as diesel units will be retired or converted to natural gas generation.

LCOE estimates also relied on fuel price forecasts for refined oil products, coal, and natural gas (as measured as the cost per million British thermal units [MMBtu]) that extended through the study period. This analysis compared historical prices paid by utilities for coal and refined oil products to historical indexes (Energy Information Administration U.S. average minemouth price, Alaska North Slope [ANS] West Coast crude price) on a per-MMBtu basis.

It is anticipated that premiums paid by utilities (calculated as percentages above index prices) will remain constant through the forecast period. As the Alaska Department of Revenue ANS West Coast forecast extends only through 2024, this analysis applied the 2013–2040 rate of growth from the Energy Information Administration Brent Spot forecast to project the price of diesel through 2070. NERA Economic Consulting's estimated price of ANS gas through 2048 provided the estimated price of natural gas to Railbelt electric utilities, with the anticipated rate of growth in the price of gas over the final projection time period applied to the years 2049-2070.

The remainder of this section details the sources and methodologies used to develop LCOE estimates for the three regions and presents LCOE estimates under different scenarios.

3.2.1 Railbelt

The estimated Railbelt cost of power includes costs related to generation but excludes customer service, distribution, and transmission costs. For example, electricity utilities charge large commercial customers a demand charge, but demand charges are not considered or estimated in this cost of power model.

The LCOE estimates weighted capital and production costs per kW by capacity for individual generation types, with capacity factors for natural gas, diesel, and coal calculated based on 2013 annual generation from specific baseload units.[4]

Capacity factors for the various hydro plants under analysis provided the basis for the calculation of a weighted average capacity factor for hydro, with weights determined by capacity. The capacity factor for wind was calculated as a weighted average of 2015 CEA capacity for Fire Island and GVEA Eva Creek plant data.

This analysis calculated a 50-year capital recovery factor (CRR) of 5.22 percent based on the weighted average cost of capital (WACC) for each Railbelt utility, per utilities' 2013 financial statements, and further weighted by each utility's total assets. This CRR contributed to the estimation of LCOE rates for natural gas, diesel, coal, and wind.

Separately, this analysis calculated a 50-year CRR of 2.82 percent for the LCOE rate for hydro and the new transmission lines. This CRR is based on a financing scheme similar to that used for the Bradley

[4] Healy 1 (coal); NPCC (diesel), and SPP (natural gas).

Lake project,[5] which assumes significant State of Alaska participation in the development of both Tiekel and Susitna, as well as the transmission lines from Glennallen to Sutton and Tok. Table 13 shows the projected weighted average cost of power in the Railbelt region in 2016, by which time new natural gas and coal generation capacity is scheduled to be online. These cost estimates exclude both Tiekel and Susitna, which would come online later.

Table 13. Weighted Average Cost of Power, Railbelt, by Generation Type and Relative Capacity, 2016

Hydro		Wind		Coal		Natural Gas		Diesel	
% MW	$/kWh	% MW	$/kWh	% MW	$/kWh	% MW	$/kWh	% MW	$/kWh
11	0.02	2	0.09	6	0.16	67	0.12	14	0.26

Source: Northern Economics analysis.

This analysis developed a forecast for the Railbelt weighted average LCOE over the study period under four different scenarios, all of which assume the availability in 2025 of natural gas from the Alaska's North Slope to the Railbelt utilities. The scenarios assume (1) the Railbelt as-is; (2) Susitna coming online in 2034; (3) Tiekel coming online in 2021 and Susitna online in 2034; and (4) Tiekel coming online in 2021 but no Susitna.[6]

Table 14 compares the estimated weighted cost of power and distribution of Railbelt generation by fuel type for 2021 and 2070 under these four scenarios, with all costs presented in estimated 2021 dollars. From a generation standpoint, the primary effect of the addition of substantial hydro generation capacity is the dramatic reduction in utilization of natural gas-fired capacity. The inclusion of Susitna, specifically, to the mix of Railbelt generation resources appears to profoundly lower the average cost of power.

The cost of power estimates in Table 14 assume O&M costs in the first year of Tiekel operations of 1.0 percent of the project's capital cost. As noted previously, this analysis separately developed cost of power estimates with a lower initial O&M cost of 0.5 percent of total capital cost. This adjustment yielded estimated costs of power for Scenario 3 (with Susitna and Tiekel) and Scenario 4 (with Tiekel, without Susitna) of $0.31 per kWh and $0.42 per kWh, respectively, in 2070, each slightly lower than its respective cost estimate presented in Table 14.

[5] Plan 4 of AEA Presentation of Susitna-Watana financing options, made to the Alaska Legislature on 01/28/2015.

[6] The benefit-cost analyses presented in Section 5 do not include the "Railbelt as-is" scenario; instead, the Base assumes that Susitna comes online in 2034 but that Tiekel is not built, while major assumptions of the two alternative scenarios match those of LCOE scenarios (3) and (4).

Table 14. Railbelt Generation, by Scenario, Fuel, MW (%) and Cost ($/kWh), 2070

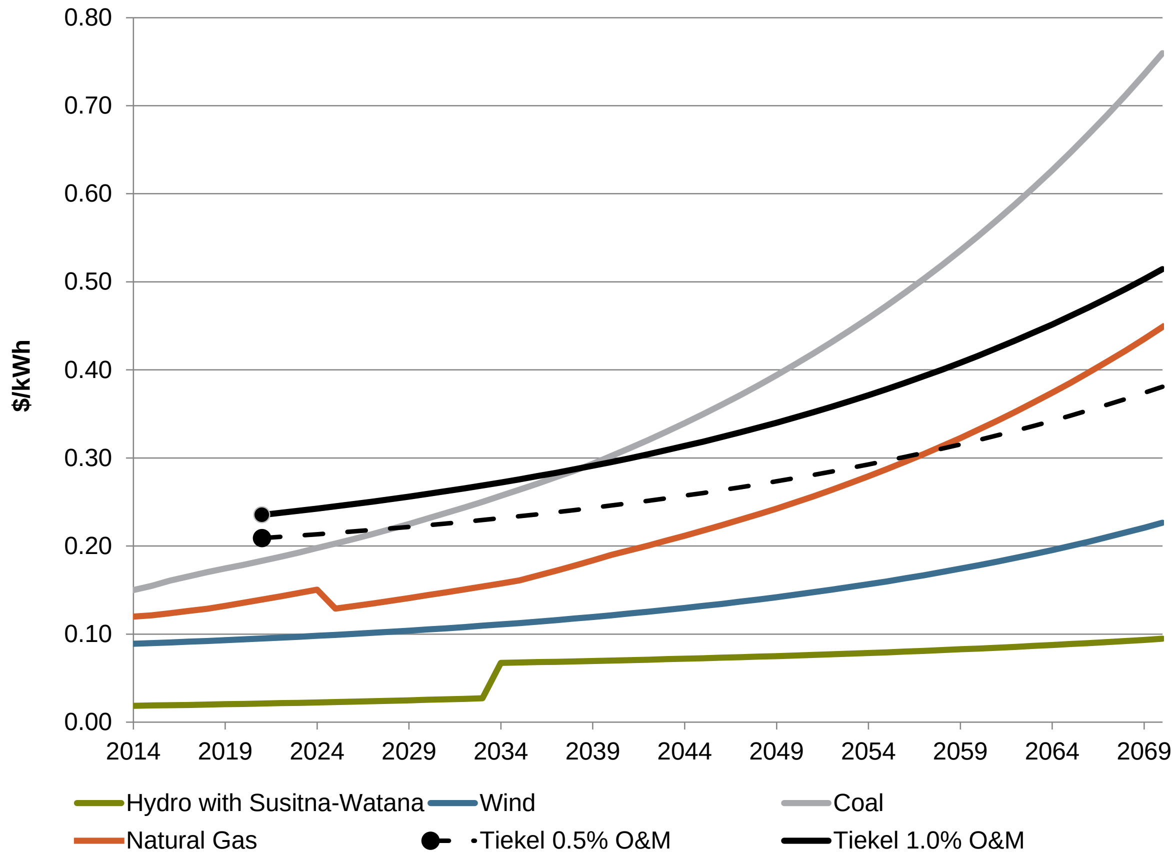
	Scenario	Year	Weighted Average Cost of Power ($/kWh)	Hydro (% MW)	Wind (% MW)	Coal (% MW)	Natural Gas (% MW)	Diesel (% MW)
1.	Railbelt, As-Is	2021	0.16	11	2	6	67	14
2.	Railbelt, w Watana		0.16	11	2	6	67	14
3.	Railbelt with Tiekel, Watana		0.16	15	2	5	64	14
4.	Railbelt, with Tiekel		0.16	15	2	5	64	14
1.	Railbelt, As-Is	2070	0.41	15	3	8	74	0
2.	Railbelt, w Watana		0.28	51	3	7	39	0
3.	Railbelt with Tiekel, Watana		0.33	54	2	6	37	0
4.	Railbelt, with Tiekel		0.42	21	3	7	69	0

Source: AEA, 2015; Northern Economics analysis.

Note: Susitna-Watana online in 2034 in Scenarios (2) and (3); Tiekel River online in 2021 in scenarios (3) and (4).

Figure 9 presents the forecasted Railbelt weighted cost of power by generation type. The weighted cost of hydro includes the addition of Susitna-Watana in 2034; however, the cost of power for Tiekel is presented independently of Railbelt hydro. The sudden decline in cost of natural gas-generated power reflects the anticipated completion of the North Slope natural gas pipeline in 2025. The cost of Railbelt hydro increases in 2034 but remains a lower-cost option than all other Railbelt generation types. Reducing the assumed O&M cost for the first year of operations from 1.0 percent to 0.5 percent of the project's total capital cost yields a lower estimated cost of power from Tiekel each year. Importantly, power from Tiekel also is anticipated eventually to become less expensive than gas-powered power with this adjustment, but only over the final quarter of the forecast period.

Figure 9. Forecasted Railbelt Cost of Energy, by Fuel Type, 2014-2070



Source: Northern Economics analysis.

3.2.2 Copper Valley

LCOE forecasts for CVEA were developed using capital and production costs, heat rates (efficiency factors) for the utility's various generation units, and projected fuel costs. In keeping with CVEA's method for calculating customer rates, this analysis developed separate generation and transmission (G&T) and fuel rate estimates over the study period. Those costs of generation not specifically related to fuel, such as cost of capital and production costs, provided the basis for the estimation of G&T rates.

This analysis developed two LCOE forecasts, one assuming no change to existing generation assets as of 2016 (As-Is) and the second assuming Tiekel coming online in 2021 (With-Tiekel). Both forecasts assume that CVEA will take power first from hydro, then from the CoGen plant, and that the CoGen plant will maximize revenues by selling as much heat as possible. Both forecasts also assume that there will be no change in the Trans Alaska Pipeline System facility demand during the study period and that overall commercial demand will remain constant. However, both forecasts do assume a decline in residential demand at the rate of 0.3 percent annually, equivalent to the rate of population decline estimated by ADOLWD in its 2012–2042 population forecast for the Valdez-Cordova Census Area.

According to the As-Is forecast, increases in fuel prices will yield higher CoGen revenues, largely offsetting high fuel costs in electric rates. The With-Tiekel forecast assumes that CVEA will source

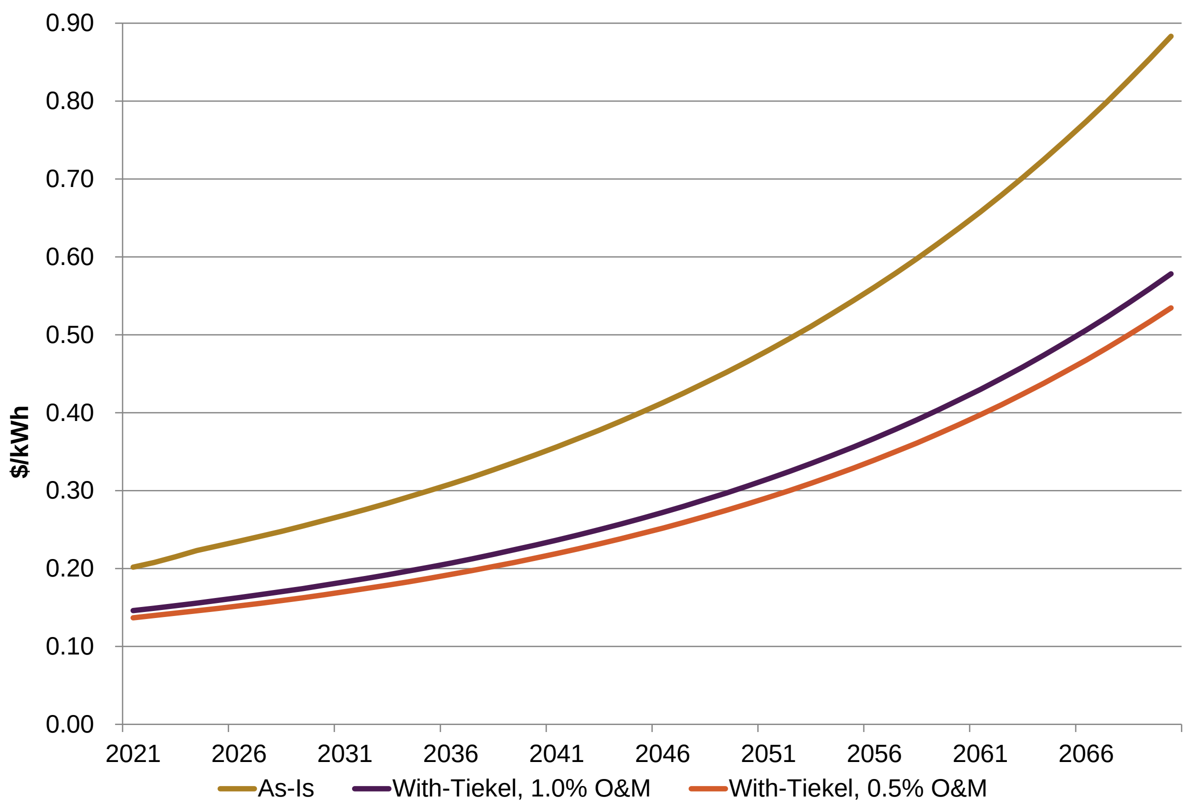
98 percent of its energy from hydro and 2 percent from diesel once the dam comes online in 2021. CoGen revenues will cease, and all diesel generating assets will be maintained as stand-by units.

Figure 10 compares the estimated $/kWh over the study period for the As-Is and With-Tiekel scenarios, with the cost under the latter estimated applying both a 1.0 percent and 0.5 percent initial (Year 2021) O&M cost as a percentage of total capital cost. The With-Tiekel scenario assumes all output for Tiekel River is sold, minimizing costs per kWh, and uses the same G&T rate as the As-Is scenario, reflecting the costs of maintaining standby generation. The 35 percent of power generated with diesel in the As-Is scenario is replaced by Tiekel power in the With-Tiekel scenario.

Further, the With-Tiekel estimates reflect a lower anticipated overall annual escalation of the O&M rate than the As-Is estimates, as indicated by the less pronounced rate of rise of the With-Tiekel curves. Based on publicly available Alaska Power Company annual reports for 2006–2014, the analysis team estimated the annual O&M growth rate for diesel generating capacity to be 5.2 percent, compared to 3.4 percent for hydro generating capacity. The overall estimated annual O&M escalation rate was calculated as the average of the hydro and diesel O&M rates, with each source's rate weighted according to its anticipated respective share of total generation.

It is important to note that accurate forecasting of CVEA's rates under both the With-Tiekel and As-Is scenarios would require the provision of historical generation data, including O&M and standby generation cost data. Without such data, Figure 10 serves primarily to suggest the likely nature of the divergence over time of With-Tiekel and As-Is electricity costs to CVEA customers.

Figure 10. CVEA Estimated Power Cost Comparison, With and Without Tiekel ($/kWh), 2021–2070



Source: Northern Economics analysis.

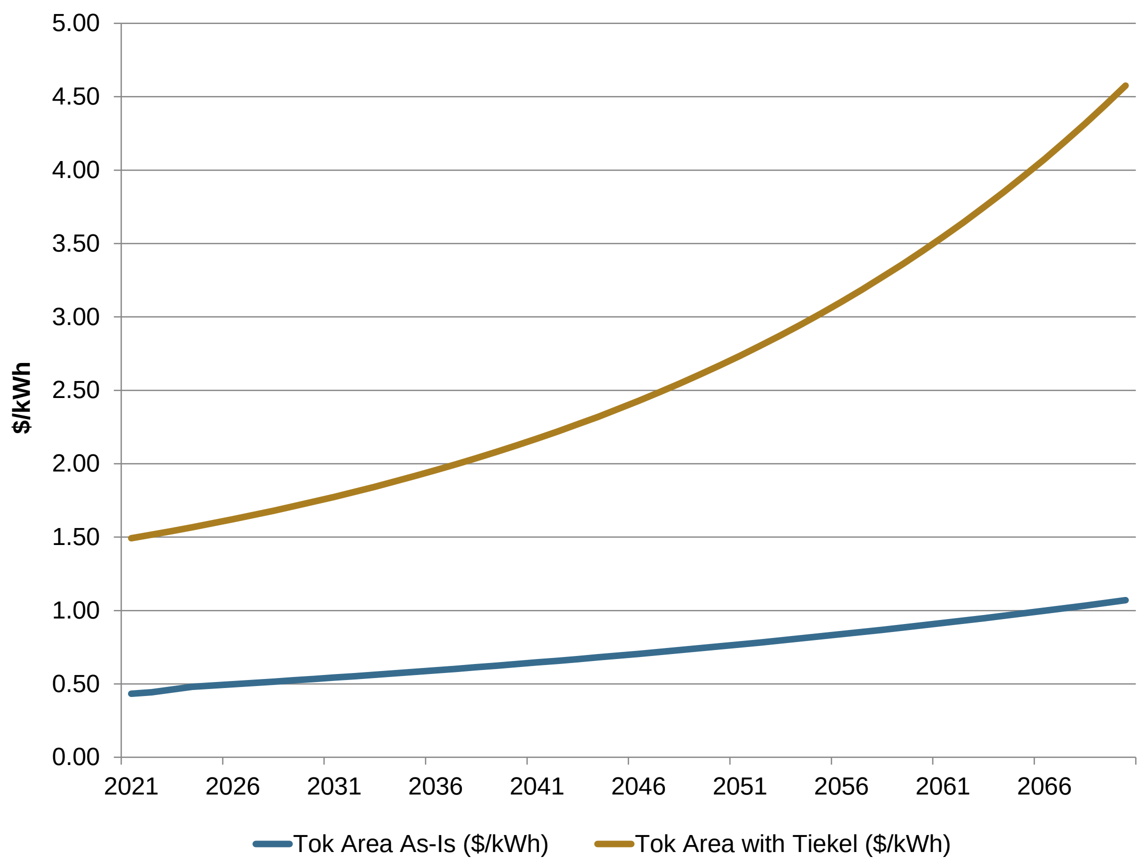
3.2.3 Tok Area

This analysis developed an LCOE forecast for Tok based on heat rates obtained from APC regulatory filings, a fuel price forecast, and the estimated cost of building and operating a 115 kV transmission line between Glennallen and Tok. This analysis does not address the costs of power included in base rates, as the fuel rates and transmission costs proved adequate to conduct an analysis of the cost of Tiekel power to the Tok area.

Average weighted costs of fuel for Rate groups 4 (Tok area) and 5 (CMS area) were calculated based on relative load ratios from APC's most recent regulatory filing, held constant through the study period. The projected cost of transmission was based on an annual capital carrying cost and operating costs spread over forecasted kilowatt-hour demand of the Tok and CMS areas.

This analysis anticipates an annual decline in kWh load of 0.5 percent for the combined Tok and CMS areas through the study period. This decline is equivalent to the rate of population contraction exhibited by the Tok and Dot Lake areas from 2010 to 2014 (ADOLWD 2015). Figure 11 illustrates the estimated cost of power in Tok with and without Tiekel. The cost of transmission alone, spread across relatively low demand from the Tok area, results in costs to obtain power from Tiekel greater than $1 per kWh.

Figure 11. Power Cost Comparison, Tok, With and Without Tiekel ($/kWh), 2024–2070



Source: Northern Economics analysis.

4 Forecasted Demand and Load

This section presents forecasted capacity and energy (load) forecasts for the Railbelt region and CVEA service areas, as well as an energy forecast for the Tok area. Both energy demand and availability (and type) of capacity contribute to the assessment of the economic feasibility of proposed energy projects, as is discussed in greater detail in Section 5.

Total Railbelt capacity projections vary according to which new projects are assumed to be constructed over the forecast timeframe. This analysis predicts that total Railbelt demand will increase through 2070, while energy demand in the CVEA and Tok areas will decline as a result of population declines. The remainder of this section describes the sources and methodologies used to derive capacity and load forecasts for the Railbelt, CVEA, and Tok regions. Regional capacity and load forecast estimates also are presented in 10-year increments through 2070.

4.1 Railbelt Demand

A Railbelt demand and energy forecast was developed by Slater Consulting, under subcontract to MWH, for the Susitna-Watana Engineering Feasibility study. Slater worked with the Railbelt utilities to evaluate the impact of Susitna on the Railbelt transmission grid. The capacity and energy demand forecasts from that effort for the period 2014 through 2054, and the associated growth rates, serve as the basis for the Railbelt load forecast in this study.[7] Table 15 summarizes Slater Consulting's estimated capacity and energy demand by decade for the period 2014 to 2070.

Table 15. Forecasted Railbelt Demand and Energy Forecast by Decade, 2014 to 2070

Year	Energy Demand (GWh)	Capacity Demand (MW)
2014	5,149	804
2020	5,458	845
2030	5,737	889
2040	5,855	909
2050	5,947	924
2060	6,018	939
2070	6,098	953

Source: AEA, 2015.

This analysis relied on the Slater report to develop four Railbelt capacity forecasts, each adopting Slater's predicted increase in capacity for 2014 through 2054 and then holding capacity constant through 2070.

These forecasts align with those discussed in Section 3 and are distinguished as follows: (1) Neither Susitna nor Tiekel is constructed (As-Is); (2) Susitna comes online in 2034; (3) Tiekel and Susitna are built and come online in 2021 and 2034, respectively; and (4) Tiekel comes online in 2021, while Susitna is not built. All forecasts assume natural gas from Alaska's North Slope will first be available to the Railbelt in 2025, at which time diesel generation is retired or converted to natural gas.

[7] Table 5.7-4, *Railbelt Demand and Energy Forecasts – 2013*, Alaska Energy Authority, AEA11-022, Engineering Feasibility Report, Section 05, *Integration into the Railbelt System*, released January 2015 and retrieved from: akenergyauthority.org, 02/15/2015

The inclusion of Susitna in 2034 adds 600 MW of hydro power capacity. The AEA predicts that, without Susitna, some existing natural gas generation will need to replaced, but total Railbelt generating capacity will be lower in 2054 than 2016 (AEA 2015). An additional 100 MW of hydro power capacity from Tiekel is added to the forecast in 2021 in the two scenarios that include it. Table 16 and Table 17 present predicted total capacity and distribution by fuel for the As-Is scenario and the scenario in which both Tiekel and Susitna are assumed built.[8] Projected natural gas capacity in the As-Is scenario exceeds that of the latter scenario, but total capacity is far lower in the later years of the forecast period.

Table 16. Forecasted Railbelt Capacity without Susitna or Tiekel, by Fuel and Year (MW)

Year	Hydro	Wind	Coal	Natural Gas	Diesel	Total
2014	192	40	51	950	261	1,494
2020	192	40	104	1,225	261	1,822
2030	192	40	104	1,302		1,638
2040	192	40	104	1,072		1,408
2050	192	40	104	984		1,320
2060	192	40	104	974		1,310
2070	192	40	104	974		1,310

Source: AEA, 2015; Northern Economics analysis.

Table 17. Forecasted Railbelt Capacity with Tiekel and Susitna, by Fuel and Year (MW)

Year	Hydro	Wind	Coal	Natural Gas	Diesel	Total
2014	192	40	51	950	261	1,494
2020	292	40	104	1,225	261	1,822
2030	292	40	104	1,302		1,738
2040	892	40	104	836		1,872
2050	892	40	104	618		1,654
2060	892	40	104	608		1,644
2070	892	40	104	608		1,644

Source: AEA, 2015; Northern Economics analysis.

4.2 CVEA Service Area

CVEA sells power to customers in the Copper River Basin and Valdez, with commercial demand constituting approximately 80 percent of total sales. As noted in Section 3, this analysis developed an energy demand forecast that holds commercial demand constant throughout the study period and incorporates a slight annual decline in residential demand.

[8] The scenario that includes the construction of both Tiekel and Susitna equates to Alternative 1 of the benefit-cost analysis (Section 5).

Table 18. CVEA Load Forecast, 2014 through 2070

Year	Total Load (MWh)	Residential Load (MWh)	Commercial Load (MWh)
2014	80,768	15,795	64,973
2020	80,717	15,744	64,973
2030	80,666	15,693	64,973
2040	80,615	15,642	64,973
2050	80,564	15,591	64,973
2060	80,514	15,541	64,973
2070	80,463	15,490	64,973

Source: CVEA, 2015; Northern Economics analysis.

4.3 Alaska Power Company (Tok Area)

An estimated decline in kWh load for the combined Tok and Tok Cut-Off areas is projected through the study period, as discussed in Section 3. Table 19 displays forecasted energy demand among Tok area electricity customers for the years 2014 to 2070.

Table 19. Tok Area Load Forecast, 2014 to 2070 (MWh)

Year	Load Forecast
2014	9,220
2020	8,930
2030	8,467
2040	8,029
2050	7,612
2060	7,218
2070	6,844

Source: APC, 2015; Northern Economics analysis.

5 Benefit Cost Analysis

Benefit-cost analyses (BCAs) typically attempt to capture all benefits and costs accruing to members of society for the various project alternatives. For purposes of this analysis, society is defined as the existing Alaska Railbelt region, plus the CVEA service area.

Estimated benefits and costs associated with two alternative scenarios were considered in relation to costs of the base scenario. The base, Alternative 1, and Alternative 2 are distinguished by assumptions regarding the variable inclusion of major projects, as denoted by the check marks in Table 20.

All three scenarios assume that ANS gas initially will be available to Railbelt electrical utilities in 2025 by means of a pipeline that transports liquefied natural gas from the North Slope to Fairbanks and southcentral Alaska. In addition, this analysis considers the Sutton-Glennallen intertie a component of Tiekel. Tiekel is assumed to come online in 2021 in Alternative 1 and Alternative 2, and Susitna first supplies power to the Railbelt in 2034 in the base and Alternative 1.

While previous sections of this report that discuss forecasted cost of power and demand include an “As-Is” scenario, which assumes that neither Tiekel nor Susitna is built, this section does not explicitly consider that scenario.

Table 20. Major Assumptions of BCA Scenarios

Scenario	Tiekel	Susitna-Watana
Base		✓
Alternative 1	✓	✓
Alternative 2	✓	

Source: Northern Economics analysis.

Benefits under the alternatives consist of avoided costs that would be incurred without implementation of the alternatives. In this case, benefits consist entirely of savings accrued to CVEA customers. Conversely, since electricity costs are projected to increase for non-CVEA Railbelt customers under both alternatives, costs are defined as the marginal change in electricity costs for purposes of the BCA.

This analysis combined load and LCOE forecasts to calculate the total estimated electricity costs to the Railbelt and CVEA service areas for each year of the 50-year projection period.

This analysis also applied a base discount rate of 4 percent, representing an approximate midpoint of the WACCs of state-owned and utility-owned electrical generation infrastructure. The net present values (NPV) of benefits and costs for the two alternative scenarios first were calculated for expected capital costs (for Tiekel and Susitna) and using the 4 percent discount rate, with the ratio of NPV of benefits to costs providing the benefit-cost ratio (BCR). The discount rate, Tiekel capital cost, and Susitna capital cost were then increased or decreased, either in isolation or combination, to assess the sensitivity of the BCR to changes in one or more of these key inputs.

Table 21 summarizes NPV costs and benefits, as well as BCR results for the two alternative scenarios under expected conditions and with adjustments made to the discount rate and project capital costs.

BCRs for Alternative 1 and Alternative 2 under expected conditions (highlighted rows) were 0.02 and 0.01, respectively.

As noted above, these ratios signal that anticipated benefits enjoyed by CVEA ratepayers are outweighed by the costs to existing Railbelt customers. As the Tiekel and Susitna capital costs estimates used in this analysis are Class 5 and Class 4 estimates, respectively, according to the AACE International Cost Estimate Classification System, the sensitivity of the BCR was tested for a 50 percent decrease in the Tiekel capital cost and a 50 percent increase in the Susitna capital cost.

Neither of these adjustments nor an increase in the assumed discount rate yields a BCR greater than 0.1 for Alternative 2, underscoring Susitna's superior economic viability relative to other generation sources under consideration. The BCR does jump up considerably, however, when the Tiekel capital cost is reduced by half, reaching 0.35 when the change in cost is considered in isolation and 0.78 when considered in combination with an increase in the discount rate from 4.0 percent to 7.0 percent. This likely signals that, as its capital cost decreases, Tiekel becomes increasingly cost-competitive with natural gas-fired generation.

Observing the effects on the Alternative 1 BCR of altering the Tiekel capital cost and discount rate also provides an indirect assessment of the economic merits of a scenario in which Tiekel is built relative to the "As-Is" scenario, in which neither Tiekel nor Susitna is built. Keeping the Susitna capital cost constant while varying the Tiekel capital cost essentially illustrates how the cost of power from Tiekel compares to power from gas-fired generation over time. It is important to note that the addition of hydro capacity, whether from Susitna or Tiekel, incurs not only direct capital and operating costs, but also costs associated with maintaining higher levels of natural gas reserve capacity.[9,10] This analysis concludes that Railbelt system power costs with Susitna—including increased costs associated with higher volumes of gas-fired capacity—would be lower than costs without the 600 MW project, but total system costs would be higher in a scenario that includes Tiekel.

Table 21. Benefit-Cost Ratios for Alternative Scenarios and Sensitivity Analyses

Scenario	Discount Rate (%)	Tiekel CapEx Adjustment	Susitna CapEx Adjustment	NPV Costs ($millions)	NPV Benefits ($millions)	BCR
Alternative 1	4.0	None	None	2,221.7	39.4	0.02
	4.0	- 50%	None	315.7	111.9	0.35
	4.0	None	+ 50%	1,903.1	39.4	0.02
	4.0	- 50%	+ 50%	1,344.0	111.9	0.08
	7.0	- 50%	None	85.9	66.7	0.78
Alternative 2	4.0	None	N/A	5,179.3	39.4	0.01
	4.0	- 50%		3,988.5	111.9	0.03
	4.0	None		1,903.1	39.4	0.01
	4.0	- 50%		2,841.7	111.9	0.04
	7.0	- 50%		1,117.7	66.7	0.06

Source: MWH, 2013; AEA, 2015; Northern Economics analysis.

Tok Intertie

This analysis assessed the economic feasibility of constructing an intertie from Glennallen to Tok and supplying power from Tiekel to the Tok service area. The estimated capital cost of the transmission line was $184.6 million ($2021), which yielded an estimated cost of transmission of $1.29 per kWh in 2021.

9 Section 3 discusses how the cost of power from natural gas-fired generation is composed dually of a fuel cost and base cost. Greater volumes of reserve gas capacity increase the base cost.

10 As hydro capacity is added, the amount of natural gas capacity required for generation decreases. This extra gas generation capacity becomes reserve capacity, which incurs additions to total system costs.

Thus, the cost of transmission alone from the proposed Glennallen-Tok intertie vastly exceeds the estimated cost of electricity to Tok ratepayers without the intertie, rendering the intertie economically nonviable. A BCA incorporating the Tok intertie was not conducted, as its inclusion invariably would have driven down the BCR.

High Load Growth Scenario

The benefits and costs of the alternatives were estimated under a high load growth scenario, in which the annual load growth rate for each of the three areas was adjusted upward 0.3 percent from expected growth rates. Holding Tiekel and Susitna capital costs at expected levels and the discount rate at 4 percent, this adjustment yielded BCRs of 0.03 and 0.01 for Alternative 1 and Alternative 2, respectively. Considering the relatively low sensitivity of the BCR to the increase in electricity demand, this analysis did not estimate the effects of the addition of the Tok intertie (with higher assumed demand within the Tok area) on the BCR.

Low Initial O&M Cost for Tiekel

This analysis estimated the benefits and costs of the alternatives under a scenario in which the O&M cost for Tiekel in its first year of operations was lowered from 1.0 percent to 0.5 percent of total project capital costs. This adjustment was performed holding the discount rate at 4.0 percent and the Tiekel and Susitna capital costs at baseline levels. Lowering the assumed initial O&M cost for Tiekel yielded negligible increases in the BCRs for both alternatives.

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7 Appendix

Table 22. Anticipated Railbelt Generation by Plant, Unit, Capacity, Owner, Type and Service Area, 2016

Plant Name	Unit	Capacity (MW)	Owner	Type	Area Served
Chena	1	24	Aurora	Coal	Fairbanks
Beluga	1	18	CEA	Gas	Anchorage
Beluga	2	18	CEA	Gas	Anchorage
Beluga	3	67	CEA	Gas	Anchorage
Beluga	5	65	CEA	Gas	Anchorage
Beluga	6	82	CEA	Gas	Anchorage
Beluga	7	82	CEA	Gas	Anchorage
Bernice	2	19	HEA	Gas	Peninsula
Bernice	3	26	HEA	Gas	Peninsula
Bernice	4	26	HEA	Gas	Peninsula
Bradley	1	63	AEA	Hydro	Railbelt
Bradley	2	63	AEA	Hydro	Railbelt
Fire Island		15	CIRI	Wind	Anchorage
Cooper	1	10	CEA	Hydro	Anchorage
Cooper	2	10	CEA	Hydro	Anchorage
Delta Power Plant	6	26	GVEA	Diesel	Delta
Eklutna	1	17	MEA	Gas	Valley
Eklutna	2	17	MEA	Gas	Valley
Eklutna	3	17	MEA	Gas	Valley
Eklutna	4	17	MEA	Gas	Valley
Eklutna	5	17	MEA	Gas	Valley
Eklutna	6	17	MEA	Gas	Valley
Eklutna	7	17	MEA	Gas	Valley
Eklutna	8	17	MEA	Gas	Valley
Eklutna	9	17	MEA	Gas	Valley
Eklutna	10	17	MEA	Gas	Valley
Eklutna Lake	1	23	CEA, MLP, MEA	Hydro	Anchorage/Valley
Eklutna Lake	2	23	CEA, MLP, MEA	Hydro	Anchorage/Valley
Eva Creek		25	GVEA	Wind	Fairbanks
Healy	1	27	GVEA	Coal	Fairbanks
Healy	2	53	GVEA	Coal	Fairbanks
Healy D	1	3	GVEA	Diesel	Fairbanks
MLP1	3	29	MLP	Gas	Anchorage
MLP2	5	37	MLP	Gas	Anchorage
MLP2	7	82	MLP	Gas	Anchorage
MLP2	8	88	MLP	Gas	Anchorage
MLP2A		125	MLP	Gas	Anchorage
Nikiski	2	59	HEA	Gas	Peninsula

Plant Name	Unit	Capacity (MW)	Owner	Type	Area Served
NP	1	63	GVEA	Diesel	Fairbanks
NP	2	61	GVEA	Diesel	Fairbanks
NPCC	3	63	GVEA	Naphtha	Fairbanks
Seward	1	3	Seward	Diesel	Seward
Seward	2	3	Seward	Diesel	Seward
Soldotna	1	46	HEA	Gas	Peninsula
SPP		188	CEA, MLP	Gas	Anchorage
Zehn IC	5	3	GVEA	Diesel	Fairbanks
Zehn IC	6	3	GVEA	Diesel	Fairbanks
Zehnder	1	19	GVEA	Diesel	Fairbanks
Zehnder	2	20	GVEA	Diesel	Fairbanks

Source: AEA, 2015.

Table 23. Study Area Population and Housing Units

Borough, Census Area, or Community	Population (2014)	Housing Units (2010)
Valdez-Cordova Census Area	**9,567**	**3,966**
Copper Center	283	123
Gakona	205	86
Glennallen	473	203
Gulkana	114	36
Kenny Lake	307	145
Mendeltna	38	19
Nelchina	64	30
Silver Springs	117	44
Tazlina	270	111
Tolsona	32	18
Tonsina	85	39
Valdez	4,032	1,573
Willow Creek	186	92
Chenega	57	31
Chisana	-	0
Chistochina	94	36
Chitina	116	52
Cordova	2,286	922
McCarthy	34	20
Mentasta Lake	125	46
Nabesna	2	3
Paxson	29	22
Slana	149	77
Tatitlek	98	36
Whittier	234	114

Borough, Census Area, or Community	Population (2014)	Housing Units (2010)
Anchorage Municipality	**300,549**	**107,332**
Kenai Peninsula Borough	**57,212**	**22,161**
Anchor Point	2,059	840
Bear Creek	1,985	835
Clam Gulch	183	91
Cohoe	1,394	600
Cooper Landing	295	161
Crown Point	71	26
Diamond Ridge	1,174	493
Fox River	644	146
Fritz Creek	2,024	848
Funny River	877	390
Halibut Cove	65	34
Happy Valley	566	270
Homer	5,099	2,235
Hope	196	97
Kachemak	460	235
Kalifornsky	8,441	2,978
Kasilof	574	232
Kenai	7,167	2,809
Lowell Point	68	36
Moose Pass	234	93
Nanwalek	275	55
Nikiski	4,652	1,689
Nikolaevsk	270	107
Ninilchik	847	412
Port Graham	168	79
Primrose	73	38
Ridgeway	2,187	780
Salamatof	1,120	246
Seldovia	233	121
Seldovia Village	170	74
Seward	2,768	928
Soldotna	4,311	1,720
Sterling	5,869	2,254
Tyonek	174	70
Matanuska-Susitna Borough	**98,063**	**31,824**
Big Lake	3,575	1,372
Buffalo Soapstone	876	314
Butte	3,418	1,205
Chase	41	18
Chickaloon	232	123

Borough, Census Area, or Community	Population (2014)	Housing Units (2010)
Eureka Roadhouse	38	16
Farm Loop	1,079	361
Fishhook	5,331	1,591
Gateway	6,472	1,851
Glacier View	247	99
Houston	1,965	731
Knik-Fairview	17,097	5,040
Knik River	756	296
Lakes	8,986	2,883
Lazy Mountain	1,568	512
Meadow Lakes	8,336	2,717
Palmer	6,053	2,113
Petersville	3	4
Point MacKenzie	2,026	112
Susitna North	1,379	570
Sutton-Alpine	1,403	393
Talkeetna	850	449
Tanaina	8,869	2,713
Trapper Creek	472	225
Wasilla	8,275	2,962
Willow	2,043	893
Denali Borough	**1,785**	**806**
Anderson	209	90
Cantwell	182	104
Healy	1,104	434
McKinley Park	179	109
Fairbanks North Star Borough	**97,972**	**36,441**
Badger	19,100	6,858
Chena Ridge	6,160	2,323
College	13,092	4,820
Eielson AFB	2,205	639
Ester	2,546	1,069
Fairbanks	31,721	11,534
Farmers Loop	4,953	1,920
Fox	440	199
Goldstream	3,689	1,579
Harding-Birch Lakes	319	129
Moose Creek	631	305
North Pole	2,198	828
Pleasant Valley	745	312
Salcha	1,053	429
South Van Horn	565	223

Borough, Census Area, or Community	Population (2014)	Housing Units (2010)
Steele Creek	6,819	2,525
Southeast Fairbanks Census Area	**6,963**	**2,567**
Tok	1,246	532

Source: ADOLWD, 2014; U.S. Census Bureau, 2010.

Table 24. Employment and Average Wages for Selected Project Area Communities, 2013

Borough, Census Area, or Community	Persons Employed	Unemployment Rate (%)	Average Wage ($)
Valdez-Cordova Census Area	**4,452**	**9.8**	**41,560**
Copper Center	97	--	38,250
Gakona	82	--	35,983
Glennallen	244	--	31,973
Gulkana	48	--	26,268
Kenny Lake	118	--	37,447
Mendeltna	21	--	48,349
Nelchina	23	--	48,913
Silver Springs	121	--	36,296
Tazlina	155	--	39,050
Tolsona	15	--	47,814
Tonsina	29	--	24,197
Valdez	1,950	--	53,443
Willow Creek	53	--	29,835
Chenega	28	--	21,192
Chisana	--	--	--
Chistochina	46	--	37,641
Chitina	47	--	15,068
Cordova	1,024	--	31,310
McCarthy	38	--	23,267
Mentasta Lake	52	--	21,910
Nabesna	--	--	--
Paxson	6	--	63,534
Slana	36	--	26,097
Tatitlek	35	--	24,103
Whittier	115	--	26,338
Anchorage Municipality	**150,448**	**5.2**	**45,044**
Kenai Peninsula Borough	**25,640**	**7.9**	**42,359**
Anchor Point	827	--	35,744
Bear Creek	976	--	36,760
Clam Gulch	94	--	38,416
Cohoe	508	--	38,789
Cooper Landing	134	--	35,909
Crown Point	25	--	31,106

Borough, Census Area, or Community	Persons Employed	Unemployment Rate (%)	Average Wage ($)
Diamond Ridge	429	--	39,995
Fox River	97	--	17,801
Fritz Creek	782	--	36,929
Funny River	310	--	44,034
Halibut Cove	7	--	53,709
Happy Valley	200	--	30,740
Homer	2,055	--	35,404
Hope	65	--	34,820
Kachemak	169	--	42,220
Kalifornsky	3,841	--	48,712
Kasilof	256	--	39,987
Kenai	3,467	--	42,171
Lowell Point	29	--	35,439
Moose Pass	101	--	32,843
Nanwalek	98	--	17,197
Nikiski	1,981	--	45,177
Nikolaevsk	89	--	28,063
Ninilchik	329	--	37,074
Port Graham	66	--	19,936
Primrose	38	--	33,641
Ridgeway	958	--	48,326
Salamatof	256	--	47,625
Seldovia	102	--	30,821
Seldovia Village	59	--	31,541
Seward	959	--	35,477
Soldotna	1,964	--	44,420
Sterling	2,463	--	49,202
Tyonek	100	--	28,759
Matanuska-Susitna Borough	**40,328**	**8.2**	**42,673**
Big Lake	1,377	--	41,221
Buffalo Soapstone	359	--	39,514
Butte	1,405	--	41,681
Chase	16	--	48,719
Chickaloon	96	--	40,045
Eureka Roadhouse	7	--	59,615
Farm Loop	519	--	41,419
Fishhook	2,109	--	47,424
Gateway	2,695	--	48,801
Glacier View	88	--	35,070
Houston	762	--	34,758
Knik-Fairview	6,372	--	45,530

Borough, Census Area, or Community	Persons Employed	Unemployment Rate (%)	Average Wage ($)
Knik River	319	--	41,458
Lakes	3,866	--	45,819
Lazy Mountain	596	--	40,873
Meadow Lakes	3,223	--	41,124
Palmer	2,490	--	34,960
Petersville	5	--	43,162
Point MacKenzie	73	--	48,720
Susitna North	473	--	29,820
Sutton-Alpine	428	--	35,440
Talkeetna	428	--	33,978
Tanaina	3,814	--	42,945
Trapper Creek	175	--	27,408
Wasilla	3,392	--	40,261
Willow	766	--	39,593
Denali Borough	**944**	**12.3**	**43,070**
Anderson	91	--	43,336
Cantwell	90	--	39,042
Healy	476	--	45,819
McKinley Park	100	--	34,571
Fairbanks North Star Borough	**44,596**	**5.8**	**40,738**
Badger	7,730	--	40,756
Chena Ridge	2,789	--	49,383
College	5,670	--	41,205
Eielson AFB	141	--	15,929
Ester	1,098	--	37,843
Fairbanks	10,236	--	35,817
Farmers Loop	2,256	--	46,950
Fox	211	--	41,364
Goldstream	1,632	--	42,313
Harding-Birch Lakes	71	--	40,787
Moose Creek	216	--	30,126
North Pole	807	--	36,716
Pleasant Valley	264	--	40,661
Salcha	333	--	36,494
South Van Horn	287	--	34,350
Steele Creek	2,992	--	48,292
Southeast Fairbanks Census Area	**2,624**	**12.9**	**32,760**
Tok	591	--	30,863

Source: ADOLWD, 2015.

Note: The Borough or Census Area-level employment numbers are from ADOLWD while the community-level estimates are from ADOLWD, Alaska Local and Regional Information.