File Copy

DOE/EIS-0186

FINAL
ENVIRONMENTAL IMPACT STATEMENT
FOR THE
PROPOSED HEALY CLEAN COAL PROJECT

Volume I of II
Text

December 1993

U.S. DEPARTMENT OF ENERGY

DOE/EIS-0186

FINAL
ENVIRONMENTAL IMPACT STATEMENT
FOR THE
PROPOSED HEALY CLEAN COAL PROJECT

Volume I of II
Text

December 1993

U.S. DEPARTMENT OF ENERGY

COVER SHEET

December 1993

LEAD AGENCY

U.S. Department of Energy (DOE)

COOPERATING AGENCIES

U.S. Department of Agriculture, Rural Electrification Administration
U.S. Department of the Army, U.S. Army Engineer District, Alaska (Corps of Engineers)
U.S. Department of the Interior, National Park Service, Alaska Regional Office
U.S. Environmental Protection Agency, Region 10

TITLE

Final Environmental Impact Statement for the Proposed Healy Clean Coal Project; Denali Borough, Alaska

CONTACT

Additional copies or information concerning this *final* environmental impact statement (EIS) can be obtained from Dr. Earl W. Evans, Environmental Coordinator, Office of Clean Coal Technology, U.S. Department of Energy, Pittsburgh Energy Technology Center, P.O. Box 10940, Pittsburgh, PA 15236. Telephone: (412) 892-5709.

ABSTRACT

DOE has prepared this EIS to assess environmental issues associated with the Healy Clean Coal Project (HCCP), a proposed demonstration project that would be cost-shared by DOE and the Alaska Industrial Development and Export Authority (a state agency) under the Clean Coal Technology Program. The ***proposed*** HCCP ***would*** demonstrate novel technologies using a new 50-MW coal-fired power generating facility to be built adjacent to the existing 25-MW Healy Unit No. 1 conventional pulverized-coal unit on a site about 4 miles north of the Denali National Park and Preserve (DNPP). The HCCP would use low-sulfur coal from the Usibelli Coal Mine, Inc., Poker Flats Mine, located about 4 miles north of the site. ***Golden Valley Electric Association, Inc. is the owner and operator of the existing Unit No. 1, and has entered into a power sales agreement for the purchase and distribution of the electricity that would be generated by the HCCP.*** After a 1-year demonstration and testing period, commercial operation of the HCCP is anticipated in ***1998***. The HCCP is intended to demonstrate the combined removal of sulfur dioxide (SO_2), nitrogen oxides (NO_x), and particulate matter (PM) using innovative combustion and flue gas cleanup technologies. The project is expected to generate data sufficient to allow private industry to assess the potential for commercial application of these technologies. Environmental impacts from construction and operation of the HCCP at the proposed site were evaluated and found to be minor for most resource areas. However, one concern is the potential impact to air quality and visibility expected from HCCP operation as predicted by computer-based models. Maximum concentrations resulting from the HCCP for the demonstration case were predicted to use up to 40% of the degradation allowed within DNPP and up to 56% of the degradation allowed outside of DNPP. ***Modeling*** of cumulative air quality impacts during simultaneous operation of the HCCP and Healy Unit No. 1 revealed that the maximum close-in concentrations ***could*** be as high as 96% of the National Ambient Air Quality Standards ***(NAAQS)*** because of downwash (downward movement) of the Unit No. 1 stack plume resulting from the presence of the new HCCP boiler building. ***However, mitigation of Unit No. 1 would reduce these concentrations; modeling predicts that the concentrations would decrease to 81% of the NAAQS. A visible plume from NO_2 emissions viewed from the valley containing*** the DNPP Visitor Access Center is predicted to occur during less than 1% of the ***daytime*** hours per year. ***However, a sensitivity analysis of the effect of using other assumptions indicated that a plume could be perceptible as much as 8% of the daytime hours per year for the combined operation of Unit No. 1 and the HCCP. Mitigation would reduce this latter prediction to 7% of the daytime hours per year. Further reductions would be implemented if visibility impacts occur.*** Ice bridge formation on the Nenana River near Ferry, Alaska, may be affected by HCCP thermal discharge. Although it is expected that the river would continue to freeze over at Ferry, remnants of the thermal plume reaching Ferry could cause a delay in the formation of the ice bridge at the beginning of winter and an earlier breakup of the ice sheet in the spring.

Socioeconomic impacts are expected during HCCP construction and operation, particularly in the areas of housing, education, police and fire protection, and medical services. In addition to the proposed action, the EIS considers the no-action alternative and an alternative site located about 4 miles from the proposed site. For the no-action alternative, if no new electrical generating facilities were built, impacts would remain unchanged from baseline conditions; if a conventional plant were built at Healy, the level of impacts would be almost identical to that of the HCCP for most resources, except air quality impacts would be greater. At the alternative site, environmental impacts are generally expected to be greater than at the proposed site because the proposed site has already been disturbed by the construction and operation of Healy Unit No. 1. However, air quality impacts would be less for the alternative site.

AVAILABILITY

This ***final*** EIS and the ***draft*** EIS ***are*** available for public inspection in the following public reading rooms.

- U.S. Department of Energy, Freedom of Information Reading Room, Room 1E-190, Forrestal Building, 1000 Independence Avenue SW, Washington, DC 20585
- Rocky Flats Area Office, c/o Front Range Community College, 3645 West 112th Avenue, Westminster, CO 80030
- Alaska Power Administration, ***2770 Sherwood Lane, Suite 2B***, Juneau, AK ***99801***
- Tri-Valley Community School Library, P.O. Box 400, Healy, AK 99743
- ***Alaska Resources Library, U.S. Bureau of Land Management, 222 W. Seventh Avenue No. 36, Anchorage, AK 99513***
- Fairbanks North Star Borough Library, 1215 Cowles Street, Fairbanks, AK 99701

PUBLIC COMMENTS

DOE encourages public participation in the National Environmental Policy Act process. Accordingly, ***public scoping meetings were held in Healy, Alaska, on October 22, 1990; in Fairbanks, Alaska, on October 23, 1990; and in Anchorage, Alaska, on October 24, 1990. Written comments were accepted for 30 days, from October 5, 1990 until November 5, 1990. In preparing the draft EIS, DOE considered both oral and written comments. Public hearings on the draft EIS were held in Healy, Alaska, on December 7, 1992; in Fairbanks, Alaska, on December 9, 1992; and in Anchorage, Alaska, on December 10, 1992. Written comments on the draft EIS were accepted for 60 days, from November 20, 1992 until January 20, 1993. In response to several requests, the original deadline of January 5, 1993 was extended for 15 days. DOE considered both oral and written comments in preparing the final EIS.***

CHANGES FROM THE DRAFT EIS

This final EIS is divided into two volumes: Volume I contains the text of the EIS and Volume II contains the public comments and responses pertaining to the draft EIS. Where responses to comments have initiated changes that appear in the text of the EIS, they have been so noted in the comment response. All changes, including correcting typographical errors, making grammatical improvements, and further clarifying information in the draft EIS, have been made to improve the usefulness of the document to the decision maker and to be responsive to the public. These changes are shown in a boldface italics font (as is this paragraph) in Volume I. Because Volume II contains comments and responses on the draft EIS, it is printed without a boldface italics font.

Changes from the draft EIS are shown in a boldface italics font.

Table of Contents

List of Figures

List of Tables

ABBREVIATIONS AND ACRONYMS

AADT	annual average daily traffic
ADCRA	Alaska Department of Community and Regional Affairs
ADEC	Alaska Department of Environmental Conservation
AFB	air force base
AIDEA	Alaska Industrial Development and Export Authority
APA	Alaska Power Authority
APUC	Alaska Public Utilities Commission
AQRV	***air-quality–related value***
BDL	below detection limits
BLM	Bureau of Land Management
BOD	biological oxygen demand
Btu	British thermal units
°C	degrees Celsius
CAA	Clean Air Act
CaO	***pebble lime***
CCT	clean coal technology
CEQ	Council on Environmental Quality
CERCLA	***Comprehensive Environmental Response, Compensation, and Liability Act of 1980***
CFR	Code of Federal Regulations
cfs	cubic feet per second
CO	carbon monoxide
CO_2	carbon dioxide
COD	chemical oxygen demand
COE	Corps of Engineers
CPC	***Certificate of Public Convenience***
CWA	Clean Water Act
d	***day***
DA	Department of the Army
dBA	decibels as recorded on the A-weighted scale of a standard sound level meter
DDD	a pesticide that is a metabolite of DDT
DDE	a pesticide that is a metabolite of DDT
DDT	dichlorodiphenyl-trichloroethane
DNPP	Denali National Park and Preserve
DO	dissolved oxygen
DOE	U.S. Department of Energy
EIS	environmental impact statement
EIV	environmental information volume
EO	Executive Order
EPA	U.S. Environmental Protection Agency
°F	degrees Fahrenheit
FCM	flash-calcined material
FGD	flue gas desulfurization
FLM	Federal Land Manager
FR	*Federal Register*
ft	foot
ft^3	cubic foot

FWPCA	Federal Water Pollution Control Act
FWS	U.S. Fish and Wildlife Service
FY	fiscal year
gal	gallon
GVEA	Golden Valley Electric Association, Inc.
H_2O_2	***hydrogen peroxide***
H_2SO_4	sulfuric acid
h	hour
ha	hectare
HCCP	Healy Clean Coal Project
HNO_3	***nitric acid***
HSWA	Hazardous and Solid Waste Amendments
in.	inch
IRP	***Integrated Resource Plan***
ISCST	Industrial Source Complex Short Term
Joy	Joy Technologies, Inc./Niro Atomizer
km	kilometer
kV	kilovolt
L	liter
lb	pound
LC_{50}	***Concentration which would result in fatalities to 50% of the population***
LSFO	***limestone scrubbing with forced oxidation***
µg	microgram
m	meter
MM	modified Mercalli
mm	millimeter
MBtu	million British thermal units
mg	milligram
mg/m^3	milligrams per cubic meter
min	minute
mL	milliliter
MOA	***Memorandum of Agreement***
MP	mile post
mph	miles per hour
MW	megawatt
MW1	monitor well 1
MW2	monitor well 2
NAAQS	National Ambient Air Quality Standards
NaOC1	sodium hypochlorite
NaOH	sodium hydroxide
NAPAP	National Acid Precipitation Assessment Program
NEPA	National Environmental Policy Act
NH_3	***ammonia***
NH_4HSO_4	***ammonium bisulfate***
$(NH_4)_2SO_4$	***ammonium sulfate***
NH_4NO_3	***ammonium nitrate***
NO	nitrogen oxide
No.	number
NO_2	nitrogen dioxide
NO_3	nitrate

NO_x	oxides of nitrogen
NOA	*Notice of Availability*
NOI	Notice of Intent
NPDES	National Pollutant Discharge Elimination System
NPS	National Park Service
NSPS	*New Source Performance Standards*
NWS	National Weather Service
O_3	*ozone*
ORNL	Oak Ridge National Laboratory
OSHA	Occupational Safety and Health Administration
PCB	polychlorinated biphenyl
PCN	pentachloronitrobenzene
PEIS	programmatic environmental impact statement
ppbv·km	parts per billion by volume times kilometers
ppm	parts per million
pH	pH (hydrogen ion concentration notation)
PLUVUE	a visibility air dispersion model
PM	particulate matter
PM_{10}	particulate matter less than 10 microns in diameter
PON	Program Opportunity Notice
PRS	*Power Requirements Study*
PSD	prevention of significant deterioration
psi	pounds per square inch
Pt(s)	Part(s)
R&D	*research and development*
RCRA	Resource Conservation and Recovery Act
REA	Rural Electrification Administration
REAA	Regional Educational Attendance Area
ROD	Record of Decision
RTDM	Rough Terrain Diffusion Model
s	second
SARA	*Superfund Amendments and Reauthorization Act*
SCR	selective catalytic reduction
SHPO	State Historic Preservation Office
SNCR	*selective non-catalytic reduction*
SO_2	sulfur dioxide
SO_4	sulfate
SPCCP	Spill Prevention, Control, and Countermeasures Plan
SWEC	Stone & Webster Engineering Corporation
TDS	total dissolved solids
TOC	total organic carbon
TRW	TRW Applied Technologies Division
TSP	*total suspended particulate matter*
UCM	Usibelli Coal Mine, Inc.
USGS	U.S. Geological Survey
V_2O_5	*vanadium pentoxide*
yd	yard
yd^3	*cubic yard*

EXECUTIVE SUMMARY

This environmental impact statement (EIS) has been prepared by the U.S. Department of Energy (DOE), in compliance with the National Environmental Policy Act of 1969 (NEPA), to assess environmental issues associated with the Healy Clean Coal Project (HCCP), a proposed demonstration project that would be cost-shared by DOE and the Alaska Industrial Development and Export Authority (AIDEA) (a state agency) under the Clean Coal Technology (CCT) Program. The goal of the CCT Program, a planned national commitment ***of nearly $7 billion***, is to demonstrate advanced coal utilization technologies that are more energy efficient and reliable, and achieve substantial reductions in emissions as compared with existing coal technologies.

The HCCP would demonstrate advanced combustion and scrubber technologies using a new 50-MW coal-fired power-generating facility to be built adjacent to the existing 25-MW Healy Unit No. 1 conventional pulverized coal unit owned and operated by Golden Valley Electric Association, Inc. (GVEA), in rural Healy, Alaska (located approximately 80 miles southwest of Fairbanks and 250 miles north of Anchorage). The site is situated approximately 4 miles north of the nearest border of Denali National Park and Preserve (DNPP) and 8 miles north of the entrance to DNPP. The HCCP would be fueled with a blend of low-sulfur coal and waste coal supplied by Usibelli Coal Mine, Inc. (UCM), from the Poker Flats Mine located about 4 miles north of the proposed site. ***GVEA has entered into a power sales agreement for the purchase and distribution of the electricity that would be generated by the HCCP.*** Construction of the HCCP is scheduled to begin in ***1994*** and be completed in late ***1996***. After a 1-year demonstration and testing period in ***1997***, commercial operation of the HCCP is anticipated in ***1998***.

The HCCP is intended to demonstrate the combined removal of sulfur dioxide (SO_2), nitrogen oxides (NO_x), both of which can contribute to acid rain, and particulate matter (PM) using advanced combustion and flue gas cleanup technologies. In doing so, the project would successfully demonstrate two promising technologies ready to be commercialized in the 1990s. The project is expected to generate sufficient data from design, construction, and operation to allow private industry to assess the potential for commercial application of these technologies to new or existing units. AIDEA, the project participant, has assembled a team comprised of GVEA; UCM; Stone & Webster Engineering Corporation; Foster Wheeler Energy Corporation; TRW, Inc.; and Joy Technologies, Inc., to design, build, and operate the power plant.

DOE determined that providing cost-shared funding support for this proposed project constitutes a major federal action that may significantly affect the human environment. Therefore, DOE has prepared this EIS to assess potential impacts on the human and the natural environment of the Healy area with special emphasis on DNPP. The EIS has been prepared in accordance with Section 102(2)(C) of NEPA, as implemented in regulations promulgated by the President's Council on Environmental Quality (CEQ) (40 CFR ***Parts*** 1500-1508), and as provided in DOE Regulations for compliance with NEPA ***(10 CFR Part 1021)***.

The EIS considers the proposed action (funding the demonstration); the no-action alternative (not funding the demonstration), including scenarios reasonably expected to result as a consequence of the no-action alternative; and an alternative site located about 4 miles north-northwest of the proposed site. Other alternatives to the proposed action have been examined and found not to be reasonable alternatives under NEPA.

Potential impacts to air quality, surface water, groundwater, and ecological and socioeconomic resources that could result from construction and operation of the proposed HCCP are analyzed. Key findings for areas of potential concern are summarized in this document.

Of primary concern are the impacts to air quality and visibility expected from HCCP operation, as predicted by analyses based on computer models. For the air quality analysis, generally accepted computer models, which are used for establishing compliance with Clean Air Act (CAA) regulatory requirements, were used for analyzing potential impacts within the Healy area (a Class II air quality area) and within DNPP (a Class I air quality area where stringent standards have been established by the U.S. Environmental Protection Agency). The CAA standards have been used as a gauge for assessing potential impacts associated with HCCP air emissions. For the purpose of air quality analysis, two emission rates (levels) based on a 100% plant capacity factor were analyzed using the computer models. The very low emission rates that are the target objectives of the HCCP demonstration were used to establish the "demonstration case" (see Sect. 4). For the demonstration case, the target emission rates are SO_2 emissions of 0.043 lb/MMBtu, NO_x emissions of 0.2 lb/MMBtu, and particulate emissions of 0.015 lb/MMBtu. These rates translate to 28 lb/h, 129 lb/h, and 10 lb/h, respectively. The results of the air quality computer analysis for the Healy area were compared with the National Ambient Air Quality Standards (NAAQS). Using the NAAQS annual average concentration limits for SO_2, NO_2, and particulates, maximum ambient (at or beyond the facility perimeter) concentrations resulting from the combined operation of Healy Unit No. 1 and the HCCP demonstration case are ***86%***, ***67%***, and ***50%*** of the limits, respectively. Almost all of the modeled concentrations are predicted to occur at the site perimeter resulting not from the new HCCP, but from downwash (downward movement) of the existing Unit No. 1 stack plume caused by the larger and taller HCCP boiler building. This localized effect could be greatly reduced by modifying (extending) the Unit No. 1 stack ***(an action which is beyond DOE's jurisdiction).*** However, to do so may increase concentrations within DNPP.

NAAQS are used to establish absolute limits for pollutant concentrations in the ambient air, whereas Prevention of Significant Deterioration (PSD) "increments" have been established to define permissible air quality degradation. For analyzing air quality impacts within DNPP, the stringent standards of the PSD limits for Class I areas were used to gauge potential impacts of the HCCP at the demonstration case emissions. Using the PSD Class I annual average concentration limits for SO_2, NO_2, and particulates, modeling results for the HCCP demonstration case are maximum concentrations of 9%, 32%, and 2% of the PSD Class I limits, respectively.

The issue of the HCCP's potential to cause visibility impacts within DNPP is of great concern to the National Park Service (NPS), a cooperating agency by virtue of its role as Federal Land Manager for the DNPP. Air quality and, when weather conditions permit, visibility within DNPP are considered among the best anywhere. Visibility impairment, if any, is expected to take the form of a yellowish-brown NO_2 plume that would reduce visibility or be noticeable when contrasted against relatively clean air either above or below the plume line. For visibility analysis, ***two*** computer ***models*** and a visibility monitoring (photographic) program were used to analyze potential visibility impacts within DNPP. The area of detailed study included the far eastern edge of DNPP within the Nenana River Valley. Views from the interior of DNPP, including views of Mt. McKinley, are not expected to be subject to visibility impairment. The results from the computer based modeling predict that for the HCCP demonstration case, a visible plume may be perceived by DNPP visitors ***a total of 2*** h/year. The computer ***modeling*** also ***predicts*** that when the HCCP and Unit No. 1 would operate simultaneously, a visible plume may be perceived by visitors ***15*** h/year. In addition, the computer ***modeling predicts*** that during operations of the existing Unit No. 1 alone, a visible plume should be perceived ***6*** h/year. ***A sensitivity analysis of the effect of using other assumptions indicated that a plume could be perceptible as much as 78 h/year for the HCCP demonstration case and 262 h/year for the simultaneous operation of the HCCP and Unit No. 1. However, there*** have been no ***published*** sightings from or within DNPP by observers or operating camera equipment of a visible plume from Unit. No. 1, suggesting that DNPP is not currently experiencing a visibility problem caused by Unit No. 1 and that the modeling ***using the original assumptions*** is conservative (forms an upper bound of expected impacts). ***An analysis of regional haze reveals that adding HCCP emissions to those from Unit No. 1 increases the estimated number of events per year by only one event. A sensitivity analysis of the effect of using other assumptions indicated little increase by adding HCCP emissions to those from Unit No. 1, regardless of the assumptions. Observations have not attributed regional haze to the existing Unit No. 1.***

In addition to air quality and visibility modeling and analysis for the HCCP demonstration case, a second, higher level of emissions is analyzed. This higher emission level equates to the "permitted case" and "*HCCP* retrofit case" (see Sect. 5). The emission levels are identical for both cases and present the upper bounds for emissions which could occur if the HCCP does not achieve its target emission objectives and either enters commercial operations at the "permit emission rate" or is retrofitted to more conventional combustion technology. For the permitted case, the emission rates used for modeling are SO_2 emissions of 0.086 lb/MMBtu, NO_x emissions of 0.35 lb/MMBtu, and particulate emissions of 0.02 lb/MMBtu. This translates to 55 lb/h, 226 lb/h, and 13 lb/h, respectively (see Sect. 5). Again the results of air quality computer analysis for the Healy area were compared with the NAAQS. Using the NAAQS annual average concentration limits for SO_2, NO_2, and particulates, maximum ambient concentrations resulting from the combined operation of Healy Unit No. 1 and the HCCP permitted case are ***86%, 67%, and 50%*** of the limits, respectively. These concentrations, which are ***identical*** to the results for the demonstration case, are predicted to occur at the site perimeter and result not from the new HCCP, but from the downwash of the existing Unit No. 1 stack plume caused by the larger and taller HCCP boiler building.

Potential air quality impacts within DNPP for the permitted case emission rates are also analyzed. Again, the PSD limits for Class I areas have been used to gauge potential air quality impacts. Using the PSD Class I annual average concentration limits for SO_2, NO_2, and particulates, the permitted case results are maximum concentrations of ***20%***, 56%, and ***2%*** of PSD Class I limits, respectively. These concentrations are higher than the corresponding concentrations for the demonstration case because the emission rates are up to a factor of two higher.

Potential visibility impacts within DNPP at the permitted case emission rates are also analyzed. The results from the computer based modeling predict that, for the permitted case, a visible plume may be perceived by observers ***a total of 9*** h/year. The computer ***modeling*** also ***predicts*** that when the HCCP (permitted case) and Unit No. 1 would operate simultaneously, a visible plume may be perceived by observers ***26*** h/year. ***A sensitivity analysis of the effect of using other assumptions indicated that a plume could be perceptible as much as 240 h/year for the HCCP permitted case and 329 h/year for the simultaneous operation of Unit No. 1 and the HCCP permitted case.***

In response to NPS concerns that increased emissions from the combined operation of Unit No. 1 and the HCCP would adversely affect DNPP, DOE facilitated negotiations between the project participant team (AIDEA and GVEA) and the U.S. Department of the Interior (DOI) (the parent department of the NPS). These negotiations were successfully concluded and a Memorandum of Agreement (Appendix I) was signed by DOI, DOE, AIDEA, and GVEA on November 9, 1993.

The cornerstone of the Memorandum of Agreement is the planned retrofit of Unit No. 1 to reduce emissions of NO_x and SO_2. For NO_x control, the Agreement calls for Unit No. 1 to be retrofitted with low-NO_x burners after the start-up of the HCCP. GVEA has agreed to reduce Unit No. 1 NO_x emissions by approximately 50%, from 848 tons per year to 429 tons per year. The Agreement also requires that SO_2 emissions from Unit No. 1 be reduced by 25%, from 630 tons per year to 472 tons per year, using duct injection of sorbent (e.g., flash-calcined material or lime). In addition, GVEA has agreed to implement administrative controls (reduce Unit No. 1 output) if DNPP experiences any visibility impacts. If the HCCP demonstration technology operates as expected, combined NO_x and SO_2 emissions from the Healy site would increase by only about 8%, from 1478 tons per year to 1602 tons per year, even though electrical generation would increase from the existing 25 MW to 75 MW for the two units. If the HCCP demonstration fails to meet project objectives for air emissions, but attains levels allowed by the permit issued by ADEC in March 1993, then the combined emissions from the Healy site would be capped under the Agreement at 2160 tons per year (i.e., 1439 and 721 tons per year of NO_x and SO_2, respectively), about 46% over the emissions for the existing Healy site. These maximum emission levels would be incorporated as permit conditions. The Agreement also requires further reductions in combined emissions from the site, if necessary, to protect DNPP from observed plume impacts.

Mitigation of Unit No. 1 is expected to reduce cumulative air quality impacts resulting from simultaneous operation of the HCCP and Unit No. 1. Air dispersion modeling predicts that the annual SO_2 concentrations would decrease from 86% (without additional controls on Unit No. 1) to 74% of the NAAQS, and NO_2 concentrations would decrease from 67% (without additional controls on Unit No. 1) to 29% of the NAAQS.

The results of the visibility modeling indicate that, after the planned retrofit of Unit No. 1 and implementation of the Agreement, there would be very little change from the baseline results predicted for the existing Unit No. 1. For the simultaneous operation of the retrofitted Unit No. 1 and the HCCP demonstration case, a visible plume is predicted to be perceived 9 h/year (as compared to 15 h/year without additional controls on Unit No. 1). For the simultaneous operation of the retrofitted Unit No. 1 and the HCCP permitted case, a visible plume is predicted to be perceived 20 h/year (as compared to 26 h/year without additional controls on Unit No. 1). The total number of hours increases slightly from the 6 h predicted for the existing Unit No. 1 alone.

The EIS evaluates impacts of construction and operation of the HCCP on surface water, including the Nenana River. Primary impacts to the Nenana River would be caused by the rejection of waste heat to the river from the discharge of a once-through cooling system. During the production of electricity, power plants need to reject waste heat. During preliminary engineering design, the participant evaluated three different systems for waste heat rejection: (1) wet cooling tower, (2) dry (air) cooling tower, and (3) a once-through system that would use water directly from the Nenana River. The existing Unit No. 1 uses once-through cooling. A wet cooling tower was found to be not feasible because the subarctic climate of central Alaska would present operational problems and a wet cooling tower could adversely affect local weather conditions. A dry cooling tower was found to be very expensive because it would be much larger than a wet tower and dry towers consume large amounts of power to drive circulation fans. The large power requirement of a dry cooling tower would lower the overall plant efficiency. The option of a once-through system was selected because with the discharge of cooling water from Healy Unit No. 1 and the HCCP into the Nenana River, cumulative water temperatures during winter months would be below the Alaska Department of Environmental Conservation (ADEC) limit of 55.4°F at 30 ft downstream of the HCCP discharge and beyond. During summer months, cumulative water temperatures would be below the limit beyond 50 ft downstream of the HCCP discharge. The state has been asked by the project participant to allow a thermal mixing zone of *600* ft for the HCCP to meet the state limit. The Nenana River, at the proposed site, does not support a large population of sport fish; the fish found at the proposed site are primarily round whitefish and longnose suckers. However, during the winter, cold shock could kill fish acclimated to the warmer temperatures of the once-through cooling system discharge that become deprived of the warmed water if the HCCP would suddenly shut down. A cross connection would be installed between the Healy Unit No. 1 and HCCP discharges to provide the flexibility of discharging Unit No. 1 water downstream of the intake basin during summer, and to keep the water intakes free of ice during winter if Unit No. 1 is shut down. The cross connection may mitigate cold shock mortality by allowing discharge to both outfalls when Unit No. 1 is shut down during winter months.

During the winter, the waste heat rejected by Unit No. 1's once-through cooling system presently prevents the Nenana River from completely freezing over for an approximate distance of 4 miles downstream (to the north). It is estimated that during operation of both the proposed HCCP and Unit No. 1, the combined thermal discharge would extend the area to about 10 miles downstream. Residents of the village of Ferry, which is located about 13 miles downstream of the proposed site, use the frozen river as an ice bridge to transport supplies and materials across the Nenana River during the winter. Although it is expected that the river would continue to freeze at Ferry, remnants of the thermal plume reaching Ferry could cause a delay in the river's freezing at the beginning of winter and an earlier breakup of the ice sheet in the spring.

The EIS analyzes short-term and long-term socioeconomic impacts associated with construction and operation of the proposed HCCP, particularly in the areas of housing, education, traffic, police and fire protection, and medical services. During HCCP construction, a peak of approximately 300 workers is estimated. To help reduce the "boomtown" effect on the Healy area, it is proposed that a temporary construction camp would be built at a location about 0.5 miles from the proposed site to house most of the workers. Longer-term socioeconomic impacts would result from 32 new workers expected for HCCP operations and from 8 new jobs created at the UCM mine. It is estimated that these new workers and their families would increase the population of the Healy area by approximately 102 people by ***1996–1997***.

The no-action alternative would result if DOE does not provide cost-shared funding support for the HCCP; two reasonably foreseeable scenarios could result. First, GVEA could continue to operate Healy Unit No. 1 and continue to buy natural-gas–generated electricity from Anchorage utilities without building any new generating facilities. No construction activities or changes in operations would occur. Coal requirements for the existing plant and electricity generated would remain constant. The impacts would remain unchanged from the baseline conditions.

Second, a conventional coal-fired power plant equivalent in capacity to the proposed project with conventional flue gas desulfurization could be built at Healy by the project participants without DOE's financial assistance. Best available control technology would be used, including dry scrubbers utilizing lime to remove sulfur dioxide from the flue gas, low-NO_x burners, and a baghouse to remove PM. The dry scrubbers would generate a solid waste that, along with the PM from the baghouse, would be returned to the UCM mine for disposal.

The level of impacts for this scenario would be almost identical to that of the HCCP for most areas, because the resource requirements and discharges are nearly identical, except for air emissions. Surface water, groundwater, and ecological and socioeconomic impacts are not expected to change from those in the HCCP. The amount of coal required for the conventional plant would be about 90% of the coal required for the HCCP. However, total mining operations ***(including coal mined for other users)*** would increase at the UCM mine by about 10% for the conventional plant as compared with the HCCP, because about 50% of the coal used by the HCCP would be waste coal uncovered during mining for run-of-mine coal. Particulate emissions from fugitive dust during mining would be about 10% greater for the conventional plant. Operational air emissions are expected to be up to 100% greater for the conventional plant (compared with the HCCP demonstration case) because the conventional plant would only be required to meet emissions standards existing at the time of construction, while the HCCP is expected to generate emissions substantially less than the standards. The conventional plant would be expected to generate about 50% less ash following combustion. Fewer trips, involving less ash, would be required to return the ash to the UCM mine, although the mine can easily accommodate the greater amount of ash disposal from the HCCP. This no-action scenario is similar to ***the HCCP*** retrofit case which is analyzed in detail as part of the EIS analysis of impacts of commercial operations (see Sect. 5). A summary table (Table 2.2.1) that compares the proposed HCCP with the two scenarios of the no-action alternative is presented in Sect. 2.2.1.

In addition to the proposed site, the EIS considers, in detail, an alternative site for the HCCP located about 4 miles north-northwest of the proposed site. The alternative site is located at the UCM train loadout facility which is across the Nenana River from the mine area. The results of the EIS analysis indicate that except for air quality, other environmental and socioeconomic impacts would be greater if the HCCP were to be constructed and operated at the alternative site. The alternative site has been disturbed, in part, during the construction of the loadout facility and conveyor system that transfers coal across the Nenana River from the mine area. However, the alternative site is somewhat isolated and much less of an "industrial site" than the area adjacent to the existing Unit No. 1. For example, construction of the HCCP at the alternative site would require the site clearing of 37 acres of which 22 acres are ***identified as*** wetlands ***in the National Wetlands Inventory***. Only about 10 acres need to be prepared at the proposed site adjacent to Unit No. 1 and no loss of wetlands would occur. Also, during the winter the rejection of waste heat from the HCCP into the Nenana River at the alternative site may extend the area of ice-free water approximately 1 mile closer to the village of Ferry (2 vs 3 miles). However, cumulative thermal effects resulting from the discharge of the HCCP and Unit No. 1 cooling water into the Nenana River would not occur at the alternative site. The expected maximum elevation in river water temperature would be less than that expected at the proposed site because the ambient river temperature would not be elevated by Unit No. 1 thermal discharge. However, cumulative impacts at the proposed site would be mitigated by the installation of a cross connection to direct the discharge to either or both outfalls. If the HCCP were built at the alternative site about 13 additional workers would be required for plant operations over the 32 workers required at the proposed site because it would no longer be possible to integrate the operations of both Unit No. 1 and the HCCP. These additional operational workers would be needed for control room operations and maintenance.

Air quality analysis using computer models was performed to analyze the potential impact from air emissions if the HCCP was constructed and operated at the alternative site. Using the PSD Class I average annual concentration limits for SO_2, NO_2, and particulates, the predicted maximum concentrations ***for the demonstration case*** are 4%, 15%, and 1% of the PSD Class I limits, respectively. Because the alternative site is located about 6 miles east of the nearest border of DNPP (and about 8 miles north of the DNPP border that is downwind of frequent winds), while the proposed site is about 4 miles north of DNPP, air dispersion modeling has indicated that maximum concentrations of air pollutants within DNPP would be reduced for the alternative site as compared with the proposed site. The maximum 3-h SO_2 concentration within DNPP would be reduced from 38% of the PSD limit for the proposed site to 23% of the limit for the alternative site. Similarly, the maximum 24-h SO_2 concentration would decrease from 40% of the PSD limit for the proposed site to 25% of the limit for the alternative site. The annual NO_2 concentration would be reduced from 32% of the PSD limit for the proposed site to 15% of the limit for the alternative site.

Impacts outside of DNPP would also decrease, except for PM which would increase or remain about the same. Cumulative concentrations from the simultaneous operation of the HCCP at the alternative site and the existing Unit No. 1 would be reduced from those predicted for the HCCP at the proposed site because the new HCCP boiler building would not affect the Unit No. 1 stack plume. The magnitude of the reduction is large at the alternative site, although the area affected by downwash of the Unit No. 1 stack plume at the proposed site is localized (within about 0.5 miles of the site). For example, the maximum annual SO_2 concentration would decrease from ***86%*** of the NAAQS limit for the proposed site to only 8% of the limit for the alternative site. Visibility impacts to DNPP from operation of the HCCP at the alternative site are expected to be similar to the proposed site. A summary table (Table 2.2.2) that compares HCCP impacts expected for the proposed and alternative sites is presented in Sect. 2.2.2.

1. PURPOSE AND NEED FOR THE PROPOSED ACTION

1.1 INTRODUCTION

This environmental impact statement (EIS) has been prepared by the U.S. Department of Energy (DOE), in compliance with the National Environmental Policy Act (NEPA) of 1969, to evaluate environmental issues associated with a proposed clean coal technology demonstration project that would be cost-shared by DOE and the Alaska Industrial Development and Export Authority (AIDEA) (a state agency) under the Clean Coal Technology (CCT) Program.

Clean coal technology refers to a new generation of advanced coal utilization technologies that are environmentally cleaner and in many cases more efficient and less costly than conventional coal-using processes. These new energy and pollution control systems are the products of years of research and development (R&D) in hundreds of government and private laboratories throughout the world. The CCT Program's demonstration scale provides that essential step over the threshold between R&D and commercial application of these technologies. Clean coal technologies offer the potential for a cleaner environment and lower power costs by contributing to the resolution of issues relating to acid rain, global climate change, future energy needs, and energy security. The program takes the most promising advanced coal-based technologies and moves them into the commercial marketplace through demonstration.

One of the characteristic features of the CCT Program is its reliance on substantial funding from sources other than the federal government, in particular, funds provided by the project sponsor. Public Law 99-190, the Department of the Interior, and Related Agencies Appropriations Act of 1986, introduced and defined cost sharing as it was to be implemented in the program. In addition, Congress directed that projects in the CCT Program should be industry projects assisted by the government, and not government-directed demonstrations.

In the CCT Program, the project sponsor must finance at least 50% of the total cost of the project. The government assists the project sponsor by sharing in the project's cost, as detailed in a cooperative agreement negotiated between the project sponsor and DOE. The government also shares in the rewards of successful projects. The sponsor must agree to repay the government's cost contribution to ensure that the taxpayer shares in the returns from a successful project. The basis of the repayment is negotiated between the sponsor and the government.

The sponsor takes primary responsibility for the project. During project execution, the government oversees project activities, provides technical advice, assesses progress by periodically

reviewing project performance with the sponsor, and participates in decision making at major project junctures. In this manner, the government ensures that schedules are maintained, costs are controlled, project objectives are met, and the government's funds are repaid according to the terms in the cooperative agreements.

Congress has appropriated funding for the CCT Program that is being committed to demonstration projects through five competitive solicitations. The five solicitations have resulted in a combined commitment by the federal government and the private sector of about $6.9 billion. DOE's cost share for these projects is roughly $2.4 billion, or approximately 35% of the total. The project sponsors (i.e., the nonfederal-government participants) are providing the remainder—about $4.5 billion, or approximately 65% of the total estimated cost, which exceeds the 50% share of non-DOE funding mandated by Congress.

Technologies to be demonstrated must be capable of repowering or retrofitting existing facilities. Such existing facilities can be designed to use any conventional fuel (e.g., coal, oil, gas) or a new fuel form. A new fuel form is one in which coal has been chemically and/or physically altered with the objective of mitigating emissions of sulfur dioxide (SO_2) and/or oxides of nitrogen (NO_x).

Repowering technologies replace a major portion of an existing facility not only to achieve a substantial emissions reduction but also to increase facility capacity, extend facility life, improve system efficiency, and provide for the use of a new fuel form. Repowering can increase capacity from 10 to 150% and may be more cost-effective than retiring older units and replacing them with new plants. It also offers the opportunity to efficiently and reliably integrate emissions control and power generation technologies. Repowering technologies include circulating atmospheric fluidized-bed combustion, pressurized fluidized-bed combustion, integrated gasification combined cycle, and integrated gasifier-fuel cell.

Retrofit technologies reduce SO_2 and/or NO_x emissions by modifying existing facilities or their present feedstocks or by utilizing new fuel forms. Retrofit technologies include advanced coal cleaning, advanced combustors, advanced flue gas cleanup, alternative fuels, coal liquefaction, and coal gasification.

A Programmatic Environmental Impact Statement (PEIS) was published by DOE in November 1989 (DOE/EIS-0146) in compliance with NEPA to evaluate programmatic environmental issues associated with alternatives related to selecting, for cost-shared federal funding, one or more clean coal projects proposed by states or the private sector in response to the CCT Program solicitations.

In September 1988, Congress provided $575 million for the third solicitation (CCT-III) to DOE for cost-shared financial assistance to selected state and industrial participants (Pub. L. 100-446). The objectives of the third solicitation are to demonstrate innovative, energy-efficient technologies that would be ready to be commercialized in the 1990s and are capable of (1) achieving substantial reductions in the emissions of SO_2 and NO_x from existing facilities to minimize environmental impacts such as transboundary and interstate pollution, and (2) providing for future energy needs in an environmentally acceptable manner. A Program Opportunity Notice (PON) soliciting proposals was issued by DOE in May 1989. In response to the PON, 48 proposals were received in August 1989.

Of the 48 proposals received, 13 involved flue gas cleanup, 8 involved fluidized-bed combustion, and 6 involved advanced combustion technologies. Another 12 proposals would change coal to a new form of fuel, converting the coal into a cleaner, easier-to-handle fuel. Of the remaining proposals, 6 involved industrial processes, and 3 involved gasification combined cycle.

DOE's Source Evaluation Board evaluated the proposals submitted in response to the CCT-III PON. Additional support was provided by a team of more than 100 technical specialists. The majority of these specialists were from DOE, but they also included representatives from EPA. In December 1989, the Source Selection Official was presented with the Source Evaluation Board's findings. On December 19, 1989, the Source Selection Official chose 13 proposals as best furthering the goals and objectives of the PON. The projects are located in 10 different states and represent a variety of coal-based technologies. The Healy Clean Coal Project (HCCP) proposed by AIDEA is one of the 13 projects selected for funding under CCT-III.

1.2 PROPOSED ACTION

The proposed action is the provision of approximately ***$110*** million in cost-shared federal funding support (about 48% of the total cost of approximately ***$227*** million) for the construction and operation of two integrated clean coal technologies to be demonstrated in the HCCP, a new 50-MW coal-fired power generating facility at Healy, Alaska. The two technologies to be demonstrated are the TRW Applied Technologies Division (TRW) entrained combustion system and the Joy Technologies, Inc./Niro Atomizer (Joy) spray dryer absorber. These technologies have been designed to achieve reductions in emissions of SO_2, NO_x, and particulate matter (PM), while being energy efficient technologies capable of being used in new facilities or retrofitted to existing units. The technologies would be dependent on each other as part of an integrated system. AIDEA conceived, designed, and proposed the HCCP in response to the PON soliciting proposals that was issued by DOE in May 1989 (see Sect. 1.1); DOE's role is limited to providing the cost-shared funding for AIDEA's proposed project and, therefore, DOE's decision is whether or not to fund the project. ***DOE's*** limited involvement influences the alternatives discussed in the EIS (Sect. 2.2). Furthermore, AIDEA and DOE have different objectives to be attained through the HCCP. DOE's objective is to demonstrate the technologies, while AIDEA's objective is to promote economic development, in this case by increasing Alaska's coal-fired electrical generating capacity.

The facility is proposed to be built adjacent to the existing 25-MW Healy Unit No. 1 conventional pulverized coal unit owned and operated by Golden Valley Electric Association, Inc. (GVEA), in a rural setting along the Nenana River. Coal would be supplied by Usibelli Coal Mine, Inc. (UCM), from its open-pit Poker Flats Mine ***and other reserves***, located about 4 miles north of the proposed site. ***GVEA has entered into a power sales agreement for the purchase and distribution of the electricity that would be generated by the HCCP. The*** nearest border of Denali National Park and Preserve (DNPP) is approximately 4 miles south of the proposed site. AIDEA, the project participant, has assembled a team comprised of GVEA, UCM, Stone & Webster Engineering Corporation (SWEC), Foster Wheeler Energy Corporation, TRW, and Joy to design, build, and operate the power plant. AIDEA initially proposed a site about 4 miles north of the presently proposed site. The participant subsequently proposed, with DOE approval, to move the proposed HCCP 4 miles south to the presently proposed site after AIDEA limited the project to a power generation facility because the initially proposed collocated coal-upgrading operations were not expected to be economical due to their early stage of development (see Sect. 2.2.2).

In response to National Park Service (NPS) concerns that increased emissions from the combined operation of Healy Unit No. 1 and the HCCP would adversely affect DNPP (i.e., degradation of air quality and visibility, including regional haze), DOE facilitated negotiations between the project participant team (AIDEA and GVEA) and the U.S. Department of the Interior (DOI) (the parent department of the NPS). These negotiations were successfully concluded and a Memorandum of Agreement (Appendix I) was signed by DOI, DOE, AIDEA, and GVEA on November 9, 1993, whereby DOI has withdrawn its objections to the proposed project (see Sect. 2.1.3.2).

1.3 PURPOSE

The Clean Air Act (CAA), including the 1990 amendments, mandates that new, and now even ***existing***, coal-fired power plants meet stringent emission levels. Having foreseen this mandate, DOE established as one of the goals of the CCT Program to demonstrate novel coal utilization technologies that not only would help the power industry achieve mandated emission levels, but would result in even cleaner plants than ***presently*** are required by the CAA and, at the same time, reduce the cost of environmental control. As part of this goal, the HCCP was selected to demonstrate the combined removal of SO_2, NO_x, and PM from a new 50-MW coal-fired power plant using a combination of two advanced technologies that should emit even less pollution than CAA limits while at the same time producing power more efficiently and at less cost. The proposed HCCP is an integrated system for the combustion of coal and control of all emissions. The combustor, boiler, dry scrubber, and baghouse are all involved in reducing emissions for the proposed demonstration.

The purpose of the HCCP is to demonstrate the enhanced capability of the TRW combustion system for simultaneous NO_x and SO_2 removal, when combined with Joy's back-end SO_2 absorption equipment, and boiler air staging to maintain emissions at 0.2 lb of NO_x and 0.015 lb of PM/million British thermal units (MBtu), and at least 90% removal of SO_2 resulting in emissions of no more than 0.043 lb/MBtu, while at the same time producing energy more efficiently and at lower operating cost than current coal-fired power plants. In ***so doing***, the project is expected to generate data from design, construction, and operation sufficient to allow private industry to assess its potential for commercial application.

Although the proposed HCCP is a new plant, the integrated system is also expected to be commercialized at existing facilities which are repowered. The TRW advanced combustion technology is capable of efficiently burning a low grade of fuel compared with that used in typical coal-fired power plants, while at the same time reducing NO_x emissions by more than 50% below standards. The TRW advanced combustion technology removes most of the mineral content (ash) of coal during combustion before the ash can enter the boiler. It is presently planned that the TRW combustion technology would burn a blend of at least 50% waste coal (low-grade coal or overburden-contaminated coal), which is high in moisture and ash content. Furthermore, 100% waste coal may also be tested and utilized by the HCCP. This ability of the TRW combustion technology to use low-grade fuel reduces the amount of new coal to be mined and at the same time greatly reduces the fuel cost over a conventional coal-fired power plant designed to burn the standard run-of-mine coal. In addition, the TRW combustion technology would be used to produce the reagent needed for the dry scrubber system.

Commercial dry scrubber units use highly reactive lime as the reagent for SO_2 removal. Lime, which is produced from limestone by heating in a kiln, is up to and sometimes more than five times the cost of raw limestone. For the HCCP, the required highly reactive reagent would be produced from limestone injected into the center of the TRW combustion system. The high heat of combustion would "flash calcine" the limestone and produce the required scrubber reagent. ***During*** the formation of this "flash calcined material" (FCM), some SO_2 would be captured in the boiler. The FCM would be carried through the boiler and collected in the HCCP baghouse filters. The FCM removed from the filters would be recycled back to the Joy Spray Dryer Absorber (dry scrubber unit) as the reagent for SO_2 removal. In addition, before the ***recycled*** FCM is used as the reagent, the HCCP would demonstrate heating and grinding processes that should increase the reactivity of the FCM even more, thereby reducing the amount of scrubber reagent required. The use of raw limestone and the activation processes would greatly reduce the operational cost of the HCCP dry scrubber unit.

The proposed HCCP demonstration is a scale-up of the TRW combustion technology to full utility size as the next step towards commercialization of this technology. The Joy dry scrubber technology is commercial technology when used with lime as the reagent for sulfur capture. The HCCP would demonstrate that the Joy scrubber technology can utilize a reagent created by the HCCP and further demonstrate technology to increase the reactivity of the reagent.

1.4 NEED

The need for the HCCP is twofold. First, it plays an important part in fulfilling the Congressional policy of demonstrating environmentally sound technologies for the utilization of coal. Second, it provides electricity for GVEA's service area, thereby encouraging economic development. The Alaska Public Utilities Commission (APUC) has approved the power sales agreement between AIDEA and GVEA, which in turn was based upon documentation of additional load forecasts for GVEA electrical power and replacement of aging generation. Although DOE feels that the need for the project may be justified on either basis, its reason for selecting the HCCP is not for power production or meeting local or regional demands for electricity; rather, its reason for selecting the project is to demonstrate innovative, coal-based technology.

1.4.1 DOE's Need

The goal of the Clean Coal Technology Program as established by Congress is to make available to the U.S. energy marketplace advanced and environmentally responsive technologies that will help alleviate pollution problems from coal utilization. DOE selected the HCCP to demonstrate advanced combustion and scrubber technologies using a new 50-MW coal-fired power-generating facility. The HCCP is the only project offered in response to the CCT Program solicitations that proposes to demonstrate this combination of technologies.

Solutions to a number of key energy issues are directly dependent upon the degree to which coal can be considered an available energy option. These issues include (1) long-range requirements for increased power demand, (2) need for energy security, and (3) increased competitiveness in the international marketplace.

Almost 50% of the current inventory of electrical generating capacity in the United States will be over 30 years old by 1997. The need to replace or refurbish this capacity, plus adding new capacity to keep pace with the rising demand for electricity, means that a major investment in electrical generation capacity should begin by the mid-1990s. Better technologies must be available for use on a commercial basis before the year 2000 to avoid the economic and environmental penalties associated with continued investments in only the currently available commercial technologies.

The abundance of coal makes it one of the nation's most important strategic resources in building a more secure energy future. Coal can be one of the country's most useful energy sources well into the twenty-first century and beyond. With current prices and technology, U.S. recoverable reserves of coal could supply the nation's coal consumption at current rates for nearly 300 years. However, if coal is to reach its full potential and be both environmentally acceptable and economically competitive, an expanded slate of advanced clean coal technologies must be developed to provide substantially improved options that are superior to today's choices.

New technology is a major factor in enhancing prospects of exporting coal utilization technologies to other nations. Such technologies may provide the single most important advantage that the United States could have in the global competition for new markets. The ability to show a prospective overseas customer an actual operating facility running on U.S. coal, rather than just a drawing-board concept or an engineering prototype, is expected to be a persuasive inducement. It easily could be the advantage that will sway overseas consumers to buy an American package of coal and the proven clean coal technologies to burn it cleanly and effectively. The opportunity is consistent with and recognizes the increasing demand for safe, effective technology that does not impose further burdens on environmental quality. The development of advanced clean coal technologies will also satisfy the demand for lower cost, more highly efficient energy concepts that will not reverse the recent gains in economic growth by imposing new costs on consumers.

While substantial deposits of coal exist as a resource suitable for and capable of resolving the critical near-term and long-range energy issues, a number of obstacles exist that not only limit its general availability but also act as a barrier to its increased use. These impediments include (1) concerns about environmental issues, such as acid deposition, global warming, and solid waste (see the PEIS for further discussion); (2) availability of the technology; and (3) performance of the technology. Since the early 1970s, DOE and its predecessor organizations have pursued a broadly based coal research and development program directed toward increasing the nation's opportunities to use its most abundant fossil energy resource while improving environmental quality. This research and development program contains long-term, high-risk activities that support the development of innovative concepts for a wide variety of coal technologies through the proof-of-concept stage.

However, the availability of a technology at the proof-of-concept stage is not sufficient to ensure its continued development and subsequent commercialization. Before any technology can be seriously considered for commercialization, it must be demonstrated. The risk associated with technology demonstration is, in general, too high for the private sector to assume in the absence of strong economic incentives or legal requirements. The implementation of a technology demonstration program has been endorsed by the President, Congress, and the private sector as a way to accelerate the development of technology to meet near-term energy and environmental goals, to reduce risk to an acceptable level, and to provide the incentives required for continued activity in innovative research and development directed at providing solutions to long-range energy supply problems.

A key element in enabling coal to realize its potential in the nation's energy future is to improve the technical performance of coal utilization and conversion technologies. Technical performance is measured in terms of efficiency, reliability, flexibility, and emissions reductions. The CCT Program presents the opportunity to demonstrate improved technical performance, which can lead to substantial reductions in the cost of using coal. The technical improvements demonstrated under the program will allow an effective response to the changing energy markets and a resolution of the conflict between the expanded use of coal and the environmental concerns of such use at the lowest possible cost.

The HCCP was selected in the third solicitation as one of the 13 projects that would best further the goals of the CCT Program *taking into consideration the evaluation criteria and relevant program policy factors. Program policy factors are factors which the Source Selection Official may use to select a range of projects that would best serve program objectives. The following program policy factors were among those considered: (1) the desirability of selecting projects that collectively represent a diversity of methods, technical approaches, and applications, and (2) the desirability of selecting projects that collectively utilize a broad range of U.S. coals and are in locations which represent diversity of environment, health, safety, and socioeconomics; regulatory, and climatic conditions. The word "collectively" is meant to include projects selected in the the third solicitation and prior Clean Coal solicitations, as well as other ongoing demonstrations in the United States.*

Ultimately, this clean coal technology is expected to be used commercially in a wide range of applications. The potential market includes any size utility or industrial boiler in new and retrofit uses. The resulting nationwide emissions reductions (if the combustor penetrates its potential market) are discussed in the PEIS for the CCT Program.

1.4.2 AIDEA's and GVEA's Need

AIDEA was formed in 1967 by the Alaska state legislature through the governing statute AS 44.88 with the purpose of creating jobs and promoting economic prosperity in Alaska. AIDEA is a public corporation that provides various means of financing for industrial, manufacturing, and other business enterprises to further the overall goal of developing and diversifying the state's economic base and providing employment for Alaskans. AIDEA encourages economic development by providing capital at a reasonable cost for Alaskan businesses. AIDEA has historically accomplished its purpose by acting as a secondary market for financial institutions and by providing loan guarantees for small business loans secured through financial institutions. AIDEA makes no direct loans, but rather purchases from financial institutions a portion of a loan financed through the sale of bonds or from internal assets. With the establishment of the Development Finance Program in 1987, AIDEA can also promote private sector employment through infrastructure and resource development projects owned by AIDEA. Typically, AIDEA will lease these projects to a private sector user for operation. Activity under the Development Finance Program has rapidly expanded, and today AIDEA has projects that have been developed or are being developed across Alaska that include port developments and fueling *facilities to support the fishing industry and resource export operations, maintenance facilities for large aircraft, and power generation facilities. AIDEA is governed by a board consisting of the state commissioners of the Departments of Revenue and Commerce, one other commissioner, and two public sector members.*

The need for and economics of electrical generation were considered by the APUC. In determining whether service from HCCP is required, the APUC relied on two planning documents prepared by the consulting firm of CH2M Hill for GVEA—a Power Requirements Study (PRS) (GVEA 1991a) and an Integrated Resource Plan (IRP) (GVEA 1991b). Utilizing high, medium, and low scenarios, the PRS forecast GVEA's load growth under a variety of assumptions regarding the economy in Alaska and the Fairbanks area. The IRP analyzed a number of alternative means under which GVEA could meet that predicted load growth.

The IRP considered the HCCP, as well as supply- and demand-side resource alternatives. Among the supply-side alternatives considered in the IRP were continued GVEA energy purchases from Anchorage-area utilities, a conventional coal facility, gas turbines, and transmission line upgrades. Various alternative technologies, such as wind, solar, and waste-to-energy, were considered in the IRP and dismissed because of serious questions about their viability in the Fairbanks area. On demand-side programs, the IRP considered both residential and commercial energy efficiency programs (conservation).

AIDEA's application for a Certificate of Public Convenience (CPC) was considered by the APUC under Alaska law, which precludes a utility from providing service without first obtaining a certificate from the APUC. To obtain a certificate, the applicant must show that it is fit, willing, and able to provide the utility service for which the certificate is applied for and that the service is required for public convenience and necessity. The APUC concluded that AIDEA had made the required showings. AIDEA proposed the project next to the existing plant to make use of some of the common facilities.

The APUC concluded, consistent with the IRP, that HCCP represents the lowest-cost alternative for GVEA to meet its load growth. On September 3, 1992, the APUC issued a CPC to AIDEA for the HCCP. The APUC also approved a power sales agreement under which GVEA will purchase the output of HCCP from AIDEA. This decision was issued after a public process that included 3 days of hearings at which the testimony of 20 witnesses was presented for APUC consideration. The Commission noted that GVEA's load forecasts justify the need for the contract, and that the contract represents the most feasible way for GVEA to meet its forecasted loads. The Commission also concluded that the terms of the power sales agreement are just and reasonable, providing an adequate return to AIDEA and offering the least-cost option to GVEA. DOE has independently reviewed the APUC conclusions and finds them reasonable.

1.5 NATIONAL ENVIRONMENTAL POLICY ACT STRATEGY

An overall strategy for compliance with NEPA was developed for the CCT Program, consistent with the Council on Environmental Quality (CEQ) NEPA regulations and DOE regulations for compliance with NEPA, that includes consideration of both programmatic and project-specific environmental impacts during and after the process of selecting a project. This strategy is called tiering (40 CFR *Part* 1508.28), which refers to the coverage of general matters in a broader EIS (e.g., for the CCT Program) with subsequent narrower statements or environmental analyses incorporating by reference the general discussions and concentrating solely on the issues specific to the statement prepared subsequently. Tiering eliminates repetitive discussions of the same issues and focuses on the actual issues ripe for decision at each level of environmental review.

The DOE strategy has three principal elements. The first element involved preparation of a comprehensive PEIS for the CCT Program, published in November 1989 (DOE/EIS-0146), to address the potential environmental consequences of widespread commercialization of each of 22 successfully demonstrated clean coal technologies in the year 2010. The PEIS evaluated (1) a no-action alternative, which assumed that the CCT Program was not continued and that conventional coal-fired technologies with flue gas desulfurization controls would continue to be used for new plants or as replacements for existing plants that are retired or refurbished, and (2) a proposed action, which assumed that CCT Program projects were selected for funding and that successfully demonstrated technologies undergo widespread commercialization by 2010.

The second element involved preparation of a preselection, project-specific environmental review of the HCCP based on project-specific environmental data and analyses that the offeror supplied to DOE as part of the proposal. The review contained discussions of the site-specific environmental, health, safety, and socioeconomic issues associated with the project for the use of DOE selection officials. The review analyzed the advantages and disadvantages of the proposed and alternative sites and/or processes reasonably available to the offeror. Because this review contains proprietary data supplied by the offeror, it is not made publicly available.

The third element consists of preparing site-specific NEPA documents for each selected project. For the HCCP, DOE determined that an EIS should be prepared to address project-specific concerns. As part of the overall NEPA strategy for the CCT Program, this EIS draws upon the PEIS and preselection environmental reviews that have already analyzed many alternatives and scenarios (e.g., alternative technologies and sites).

DOE determined that providing cost-shared funding support for the proposed HCCP constitutes a major federal action that may significantly affect the quality of the human environment. Therefore, DOE has prepared this EIS to assess the potential impacts on the human and natural environment of the proposed action and reasonable alternatives. Oak Ridge National Laboratory (ORNL) was selected to assist DOE in the preparation of the EIS and supporting documents for the HCCP. ORNL has utilized information provided by DOE, other federal agencies, the project participants and contractors, and others. In particular, Stone & Webster Engineering Corporation prepared an Environmental Information Volume (EIV) for the project participants that ORNL has used as a basis to independently assess the issues and prepare the EIS. DOE is responsible for the scope and content of the EIS and supporting documents and has provided direction to ORNL and all participants, as appropriate, in the preparation of these documents. The EIS has been prepared in accordance with Sect. 102(2)(C) of NEPA, as implemented under regulations promulgated by the CEQ (40 CFR *Parts* 1500–1508) and as provided in DOE regulations for compliance with NEPA *(10 CFR Part 1021)*.

A Notice of Intent (NOI) to prepare the EIS and hold public scoping meetings was published by DOE in the *Federal Register* on October 5, 1990 (55 *FR* 40912–40914). The NOI invited comments and suggestions on the proposed scope of the EIS, including environmental issues and alternatives, and invited participation in the NEPA process. The NOI also was printed in the "Legal Notices" section of Anchorage and Fairbanks newspapers, and the NOI and a DOE press release to announce the scoping meetings were sent to 35 publications, radio stations, and television stations in Alaska. The NOI was sent to federal and state agencies, Native American corporations, and environmental groups for their information and comments on the proposed project.

Publication of the NOI initiated the EIS process with a public scoping period. The scoping process involves soliciting public input to ensure that significant issues are identified early and properly studied, issues of little significance do not consume time and effort, the EIS is thorough and balanced, and delays occasioned by an inadequate EIS are avoided (40 CFR *Part* 1501.7). DOE held scoping meetings in Healy, Alaska, on October 22, 1990; in Fairbanks, Alaska, on October 23, 1990; and in Anchorage, Alaska, on October 24, 1990. The public was invited to provide oral comments at the scoping meetings and to submit additional comments in writing to DOE by the close of the EIS scoping period on November 5, 1990. DOE received responses from 31 members of the public, interested groups, and federal, state, and local officials: 23 presented testimony and 8 submitted correspondence. The responses contained 111 scoping comments that assisted in identifying significant issues to be analyzed in depth in the EIS as well as those issues that are not significant or have been evaluated and dismissed from further consideration in the EIS. Following the scoping process, an EIS Implementation Plan (DOE 1991) was developed to define the scope and provide further guidance for preparing the EIS, and is available for public inspection in the public reading rooms listed on the cover sheet.

In response to the NOI, four federal agencies came forward to request cooperating agency status. The U.S. Department of Agriculture, Rural Electrification Administration (REA) requested cooperating agency status in December 1990. DOE granted this status in February 1991 because of REA's jurisdiction over transmission and power purchases. The U.S. Department of the Army, U.S. Army

Engineer District, Alaska [Corps of Engineers (COE)] requested cooperating agency status in June 1991. DOE granted this status in August 1991 because of the agency's permitting responsibilities for waters of the United States, including wetlands, under the Clean Water Act (CWA). The U.S. Department of Interior, National Park Service (NPS), Alaska Regional Office requested cooperating agency status in November 1990. DOE granted this status in December 1990 because of its expertise in air quality and visibility issues and because NPS is the Federal Land Manager (FLM) of DNPP. The U.S. Environmental Protection Agency (EPA), Region 10, requested cooperating agency status in November 1990. DOE granted *this* status in January 1991 because of EPA's jurisdiction over the National Pollution Discharge Elimination System (NPDES) permit program under the CWA; oil spill prevention, control and countermeasure plans for oil storage facilities; and over the generation, transportation, storage, treatment, or disposal of hazardous waste. The responsibilities of these agencies are discussed further in Sects. 1.8 and 7.2.

A Notice of Availability (NOA) of the draft EIS was published by DOE in the Federal Register on November 20, 1992 (57 FR 54775-54777). The NOA announced public hearings on the draft EIS and invited oral and written comments and suggestions regarding the adequacy, accuracy, and completeness of the EIS. The NOA also was printed in the "Legal Notices" section of Anchorage and Fairbanks newspapers and was sent to 35 publications, radio stations, and television stations in Alaska to assist in announcing the public hearings and comment period. The NOA was sent to federal and state agencies, Native American corporations, and environmental groups for their information and comments on the EIS.

Publication of the NOA initiated the public comment period that was originally scheduled for 45 days ending on January 5, 1993, but in response to several requests was extended for another 15 days until January 20, 1993. DOE held public hearings on the draft EIS in Healy, Alaska, on December 7, 1992; in Fairbanks, Alaska, on December 9, 1992; and in Anchorage, Alaska, on December 10, 1992. The public was invited to provide oral comments at the public hearings and to submit additional comments in writing to DOE by the close of the public comment period. Testimony was presented by 83 people during the 3 public hearings, and DOE received correspondence from 82 members of the public, interested groups, and federal, state, and local officials. Altogether, 441 comments were received that assisted in improving the quality and usefulness of the EIS. All comments and corresponding responses by DOE are contained in Volume II of this final EIS. Where responses to comments have initiated changes that appear in the final EIS, they have been so noted in the comment response.

1.6 SCOPE OF THE ENVIRONMENTAL IMPACT STATEMENT

This section summarizes the issues considered during the preparation of this EIS. The issues listed in the first section of Table 1.6.1 are those initially proposed in the NOI for analysis and assessment in the EIS. All of these issues were also identified during public scoping. The issues listed in the second section of Table 1.6.1 are those identified as a result of testimony received during public scoping. Subsequently, further issues were identified by DOE and are listed in part three of Table 1.6.1.

Table 1.6.2 indicates the disposition of alternatives that have been identified for consideration in the EIS. The alternatives developed to address the issues presented in Table 1.6.1 can be seen in Table 1.6.3, wherein an alternative or mitigation measure has been developed to address a corresponding issue. All of the mitigation measures presented in Table 1.6.3 are discussed throughout Sect. 4 of the EIS and in Table 4.4.1 ***or discussed in Sect. 5.4.***

The most detailed analyses focus on the level of impacts expected to air quality and visibility as a result of HCCP operation. Of primary concern is the potential for visibility impairment at DNPP. The potential for ice fog is also addressed. The EIS also fully examines potential impacts to the quality and

Table 1.6.1. Issues identified for consideration in the environmental impact statement

Issues identified in the Notice of Intent
Air quality (including meteorology, ice fog, and potential visibility impairment at Denali National Park and Preserve)
Surface water quality
Groundwater quality
Waste management
Ecological resources
Noise
Socioeconomic impacts
Issues identified during public scoping
Need for the project
Floodplains and wetlands
Threatened and endangered species
Archeological and cultural resources
Aesthetics
Health and safety
Further issues identified by U.S. Department of Energy
Electromagnetic fields
Regulatory compliance
Fuel/resource availability
Cumulative or long-term effects (following demonstration)

Table 1.6.2. Alternatives considered to address issues anticipated to arise during construction and operation

a) Alternatives considered
  - Proposed project
  - No-action alternative (including two reasonable foreseeable scenarios)
  - Alternative site

b) Alternatives beyond the scope of the environmental impact statement
  - ***Delaying the project***
  - ***Reducing the size of the project***
  - Alternative technologies, such as natural gas, oil, solar and wind power, and other coal-fired technologies

temperature of water resources. Of special concern are the potential effects resulting from increased discharge of cooling water (water that is heated as a result of being used to cool the boiler) into the Nenana River. Potential impacts to residents that cross the frozen surface in vehicles downriver from the HCCP during winter are evaluated. Other areas with detailed analyses include groundwater, ecological resources, waste management (including hazardous materials), and socioeconomic impacts. In the socioeconomics section, the EIS assesses the impacts of the project on local and regional economies, including population growth, employment and income, taxes, land use, industry, housing, public and community services, education, transportation, health care and human services, police and fire protection, parks and recreation, and utilities.

The EIS also examines noise; regulatory compliance; wetlands and floodplains; threatened and endangered species; historical, archeological, and cultural resources; aesthetics; electromagnetic fields; health and safety; and fuel/resource availability.

With regard to alternatives, ***one*** alternative site, located about 4 miles north-northwest of the proposed site, is evaluated in detail (see Sect. 2.2.2). ***No other alternative sites are capable of meeting the goals of the project participant.*** The no-action alternative is discussed in the EIS, including two reasonably foreseeable scenarios that could result (see Sect. 2.2.1). Alternative technologies that are not coal based have been dismissed from further consideration (see Sect. 2.2.3.1), and alternative coal technologies have already been evaluated as part of the first and second elements of the CCT Program's overall strategy for compliance with NEPA (see Sect. 1.5).

The EIS discusses potential impacts following the completion of the demonstration (see Sect. 5). Three scenarios are considered: (1) a successful demonstration followed by continuation of the project at

Table 1.6.3. Alternatives and mitigation measures developed *(if necessary)* to address the issues identified for consideration in the environmental impact statement (EIS)

Issues considered in the EIS	Alternatives and mitigation measures provided in EIS that address the issue
Air quality, meteorology, visibility	Alternative site Sprinkler truck to spray roads/construction areas ***Retrofit of Healy Unit No. 1***
Surface water resources	Erosion control measures No biocides in the once-through cooling water (Sect. 4.1.5.2) Catchment basin for coal pile run-off (Sect. 4.1.3.2)
Groundwater	***Replace*** water supply (and thus quality) by ***pipeline or well modification if other users are adversely affected*** Catchment basin for coal pile run-off Silos for ash before removal for mine disposal (Sect. 4.1.10)
Ecological resources	Cross connection to minimize cold shock to fish No biocides will be used in the once-through cooling water (Sect. 4.1.5.2)
Waste management	Conventional coal-fired power plant (there will be 50% less ash to dispose of)
Socioeconomic	Construction camp
Noise	Silencers for intake of forced-draft fans
Floodplains and wetlands	Return laydown area to original state (the laydown area may not be used at all) The proposed site will require that less land will be disturbed The site is located above the 100-year floodplain (Sect. 4.1.6)
Threatened and endangered species	Proposed site: no transmission lines need to be built as they would at the alternative site Impact considered to be negligible (Sect. 4.1.5.3)
Historical/archeological/ cultural resources	Impact considered to be negligible (Sect. 4.1.7)
Aesthetics	Impact considered to be minor (Sect. 4.1.1)
Electromagnetic fields	No change from baseline conditions (Sect. 4.1.11)
Health and safety	Provide enough equipment for firefighters Provide medical/helicopter medivac services Safety training, audits, and enforcements of safety rules (Sect. 4.1.12)

Table 1.6.3 (continued)

Issues considered in the EIS	Alternatives and mitigation measures provided in EIS that address the issue
Regulatory compliance	Tables listing the state ***and*** federal ***permits*** and National Environmental Policy Act (NEPA) documents (Sect. 7) Department of Energy NEPA mechanisms are in place to meet several regulatory requirements Other regulations will be complied with
Fuel/resource availability	Sufficient resources are available (Sects. 2.1.6.1–2.1.6.4)
Cumulative/long-term effects following demonstration	All future projects are not sufficiently planned to assess impacts except one which was determined not to create significant cumulative impacts (Sect. 6)

approximately the same power level using the same technologies; (2) a demonstration that fails to meet project objectives for air emissions (the demonstration case discussed in Sect. 4), but attains permitted levels for air emissions, is otherwise successful, and continues to operate at permitted levels; and (3) an unsuccessful demonstration followed by conversion of the facility to a coal-fired power plant using conventional best available control technology, including low-NO_x burners to burn pulverized coal, dry scrubbers utilizing lime for flue gas desulfurization, and a baghouse for particulate control.

The need for electrical generation ***has*** been considered by the Alaska Public Utilities Commission as part of GVEA's request for approval of a power sales agreement for the purchase of power from the proposed HCCP ***(see Sect. 1.4.2)***.

1.7 ASSUMPTIONS AND APPROACHES

Several basic assumptions and approaches are made for this EIS and are summarized as follows:

- The operating characteristics, including resource requirements and discharges, for the proposed HCCP are presented in Sect. 2 for the demonstration case, conservatively based on an 85% capacity factor (the capacity factor is expected to be approximately 65% during the demonstration).

- The corresponding operating characteristics for the existing Healy Unit No. 1 are presented in Sect. 2 based on a 90% capacity factor, which approximates historical operating conditions for Unit No. 1.
- Except as otherwise noted, potential environmental effects of the proposed project are based on the operating characteristics presented in Sect. 2.
- One major exception is that the air dispersion modeling assumes the demonstration case, but long-term effects are conservatively based on a 100% capacity factor for the HCCP and Unit No. 1.
- Potential environmental impacts are assessed for the surrounding environment (beyond the facility boundary), with particular emphasis placed on potential impacts at DNPP.
- Potential environmental impacts of the proposed project during construction and operation (during the demonstration) are assessed. A separate section addresses potential impacts of commercial operation following completion of the demonstration.

1.8 ROLE OF COOPERATING AGENCIES

CEQ NEPA regulations state that upon request of the lead agency (i.e., DOE), any other federal agency that has jurisdiction by law shall be a cooperating agency in the preparation of an EIS (40 CFR *Part* 1501.6). The regulations add that any other federal agency that has special expertise with respect to any environmental issue which should be addressed in the EIS may be a cooperating agency upon request of the lead agency. Also, an agency may request the lead agency to designate it a cooperating agency. Agency cooperation early in the NEPA process is emphasized. The role of a cooperating agency can vary from one of minimal review of an EIS to active participation in the scoping process and preparation of environmental analyses, including portions of the EIS germane to the agency's area of expertise.

The role of a cooperating agency differs from that of a permitting agency: the role of the latter is to perform assessments and make decisions regarding whether a proposed activity complies with regulatory requirements. ***However, in some cases a federal agency may play the roles of both a cooperating agency and a permitting agency.*** AIDEA, not DOE, is responsible for obtaining all required permits for the proposed HCCP (see Sect. 7). The agencies in the following sections have been designated as cooperating agencies for the HCCP EIS. Text in the following sections has been contributed by the cooperating agencies.

1.8.1 U.S. Department of Agriculture, Rural Electrification Administration (REA)

REA was granted cooperating agency status by DOE because GVEA, an REA borrower, would be participating in the HCCP for activities such as transmission, and power purchases.

REA has reviewed and commented on the preliminary draft EIS. After DOE has completed its environmental review process, REA will consider the adoption of this document and then issue an independent determination as per REA Environmental Policies and Procedures given in 7 CFR *Part* 1794.81.

1.8.2 U.S. Department of the Army, U.S. Army Engineer District, Alaska (Corps of Engineers)

The COE, which is both a permitting and a cooperating agency for the HCCP, exerts regulatory jurisdiction over waters of the United States, including wetlands, pursuant to Sect. 404 of the CWA of 1972. For regulatory purposes, COE defines wetlands as those areas that are inundated or saturated by surface or groundwater at a frequency and duration sufficient to support, and under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. The law requires that any individual proposing to discharge or place dredged or fill material into waters of the United States, including wetlands, must obtain a ***COE*** permit before conducting the work. As a part of the project evaluation, the ***COE*** is responsible for determining compliance with the EPA's Sect. 404(b)(1) guidelines (as stated in 40 CFR ***Part*** 230). The ***COE*** is authorized to issue permits at the district level in those cases in which all substantive objections have been resolved to the satisfaction of the district engineer provided other portions of the evaluation are favorable.

An evaluation and determination of compliance for the Sect. 404(b)(1) guidelines restrictions on discharges into wetlands "a special aquatic site" for permit application decisions is the sole responsibility of the ***COE***. The guidelines provide that no discharge of dredged or fill material shall be permitted that will cause or contribute to the significant degradation of the waters of the United States. Findings of significant degradation related to the proposed discharge shall be based upon appropriate factual determinations. Effects contributing to significant degradation are those significant adverse effects on:

- human health and welfare including municipal water supplies, plankton, fish, shellfish, wildlife, and special aquatic sites;
- life stages of aquatic life and wildlife;
- aquatic ecosystem diversity, productivity, and stability, and;
- recreational, aesthetic, and economic values.

In addition to the prohibition of permitting any discharge of fill material that would lead to significant degradation, a "water dependency test" must also be passed. The water dependency test is more accurately an alternatives analysis that contains the double presumption against certain discharges. No discharge will be permitted if there is a practicable alternative to the discharge that would have less adverse impact on the aquatic ecosystem provided the alternative does not have other significant adverse environmental consequences. The first rebuttable presumption is stated at 40 CFR ***Part*** 230.10(a)(3): "Where the proposed activity associated with a discharge does not require siting within a special aquatic site to achieve its basic purpose (i.e., 'water dependent') practicable alternatives not involving special aquatic sites are presumed to be available unless clearly demonstrated otherwise." The second rebuttable presumption is also stated at 40 CFR *Part* 230.10(a)(3): "Alternatives involving discharges into non-special aquatic sites are presumed to have less adverse impact on the aquatic ecosystem than discharges into special aquatic sites unless clearly demonstrated otherwise." The preamble to the guidelines states that it is the applicant's responsibility to rebut the presumption that there is a less damaging nonwetland alternative. It is the ***COE's*** responsibility to objectively evaluate the applicant's rebuttal to ensure that it is reasonable and prudent. The ***COE's*** review includes the applicant's selection criteria, alternatives rejected and reasons therefore, and sufficient project information for comparison with other apparent alternatives.

All appropriate and practicable steps to minimize potential impacts of the discharge on the aquatic ecosystem should be evaluated by the applicant. Also, there may be other practicable alternatives (other sites) to the discharge as proposed, which would have less adverse impacts on the aquatic ecosystem. Therefore, the ***COE requires*** as a major part of the alternatives analysis that the applicant address why such alternatives as other sites, particularly upland sites, have not been deemed practicable for portions of this project.

Practicable alternatives include, but are not limited to the following:

- Activities that do not involve a discharge of dredged or fill material into waters (including wetlands) of the United States, and;
- Discharges of dredged or fill material at other locations in waters of the United States.

An alternative is practicable if it is available and capable of being done after taking into consideration cost, existing technology, and logistics in light of the overall project purposes. If it is otherwise a practicable alternative, an area not presently owned by the applicant that could reasonably be obtained, utilized, expanded, or managed to fulfill the basic purpose of the proposed activity may be considered.

1.8.3 U.S. Department of the Interior, National Park Service, Alaska Regional Office

NPS was granted cooperating agency status by DOE because it exhibits special expertise with respect to air quality and visibility, and is charged under the CAA with a consulting role during the permitting process. As a cooperating agency, NPS has reviewed and commented on the draft EIS.

Additionally, NPS is the FLM of the nearby DNPP. DNPP is designated a CAA Class I area for Prevention of Significant Deterioration (PSD). The FLM has an affirmative responsibility with the permitting agency to protect the air quality related values of lands within a Class I area. NPS ***has consulted*** with ***the Alaska Department of Environmental Conservation (ADEC),*** the permitting agency, on the PSD permit.

1.8.4 U.S. Environmental Protection Agency, Region 10

The EPA, which is both a permitting and a cooperating agency for the HCCP, administers the NPDES permit program under Sect. 402 of the CWA. NPDES permit ***applications*** for the proposed HCCP ***have*** been received by EPA. The proposed HCCP is classified as an NPDES "new source" to which new source performance standards for Steam Electric Power Generating Facilities (40 CFR ***Part*** 423.12) apply.

Under Sect. 511(c)(1) of the CWA, NPDES permit actions for new sources are subject to NEPA. EPA's NEPA review procedures for the new source NPDES program are included in 40 ***Part*** CFR 6, Subpart F. EPA is a cooperating agency on the HCCP EIS to facilitate EPA compliance with NEPA and avoid duplication of effort in preparation of the EIS. As a cooperating agency EPA has reviewed and provided comments on overall EIS-related issues pertaining to the proposed HCCP. An EPA Record of Decision (ROD) will be prepared in conjunction with the final NPDES permit action.

Other regulatory responsibilities of EPA with respect to the HCCP are indicated in Sect. 7.2 of this EIS.

2. THE PROPOSED ACTION AND ALTERNATIVES

This section discusses the proposed action, the no-action alternative (including scenarios that are reasonably expected to result as a consequence of the no-action alternative), alternative sites, and alternatives dismissed from further consideration.

2.1 PROPOSED ACTION

The proposed action is to provide cost-shared federal funding support for the construction and operation of an integrated system of two clean coal technologies to be demonstrated in the HCCP, a new 50-MW (nominal electrical output), coal-fired power generating facility proposed by AIDEA for Healy, Alaska. The purpose of the proposed action is to demonstrate the combined removal of SO_2, NO_x, and PM using innovative combustion and flue gas cleanup technologies. ***The proposed action as described in the following sections is DOE's preferred alternative.***

2.1.1 Project Location

The HCCP would be located on the southern edge of the Interior Basin of Alaska, approximately 80 miles southwest of Fairbanks and 250 miles north of Anchorage (Fig. 2.1.1). The facility is proposed to be built adjacent to the existing 25-MW Healy Unit No. 1 conventional pulverized-coal unit owned and operated by GVEA in a rural setting along the east bank of the Nenana River, about 2.5 miles east-southeast of Healy (Fig. 2.1.2). Figure 2.1.3 is a topographic map that displays the mountainous characteristics of the area, and Fig. 2.1.4 presents an artist's conception of the HCCP superimposed on a photograph of Healy Unit No. 1 and its environs. Healy Unit No. 1 has been operating as a baseload power plant since November 1967 and has an expected operating life until at least 2007. The facility presently employs 29 people. The 65-acre site is located approximately 4 miles north of the nearest border of DNPP and 8 miles north of the entrance to DNPP.

Healy can be reached throughout the year via the George Parks Highway (State Highway 3). It can also be reached by railroad and small plane. The Suntrana spur of the Alaska Railroad passes at the south border of the HCCP site. Access to the site is provided by the Suntrana spur and the Healy Spur Highway, which leads between Healy and Suntrana. Coal would be supplied from the UCM Poker Flats Mine ***and other reserves***, located about 4 miles north of the proposed site, using the existing haulroad between the mine and the site.

The HCCP site would be classified for land use as an industrial site. The majority of the site has sustained surface alteration from the construction and operation of the existing Healy Unit No. 1 coal-fired generating plant, support buildings, coal storage areas, ash ponds, roads, electric substation, and transmission lines.

ORNL-DWG 91M-13334R2

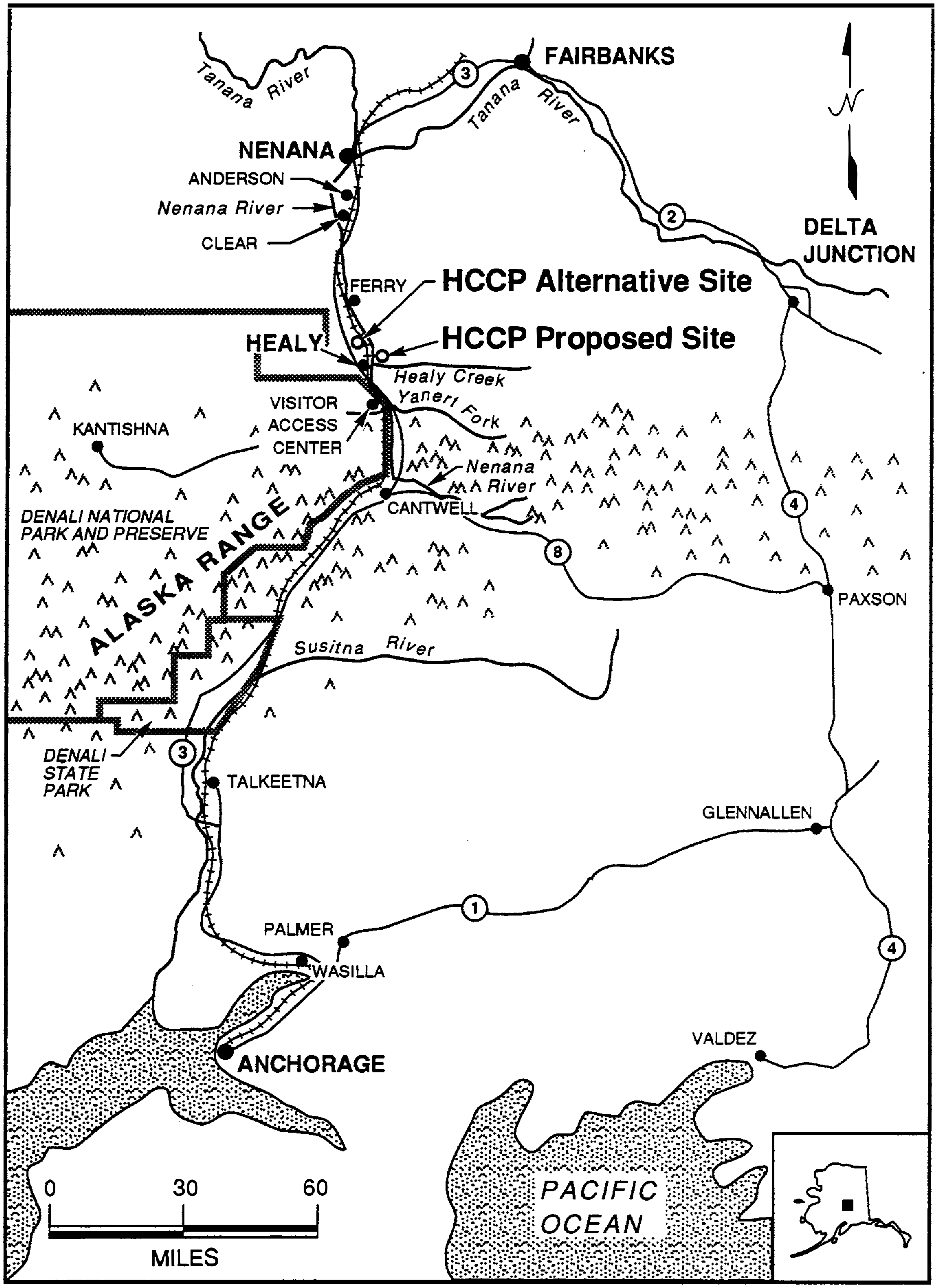


Fig. 2.1.1. Regional location map.

ORNL-DWG 91M-13333R

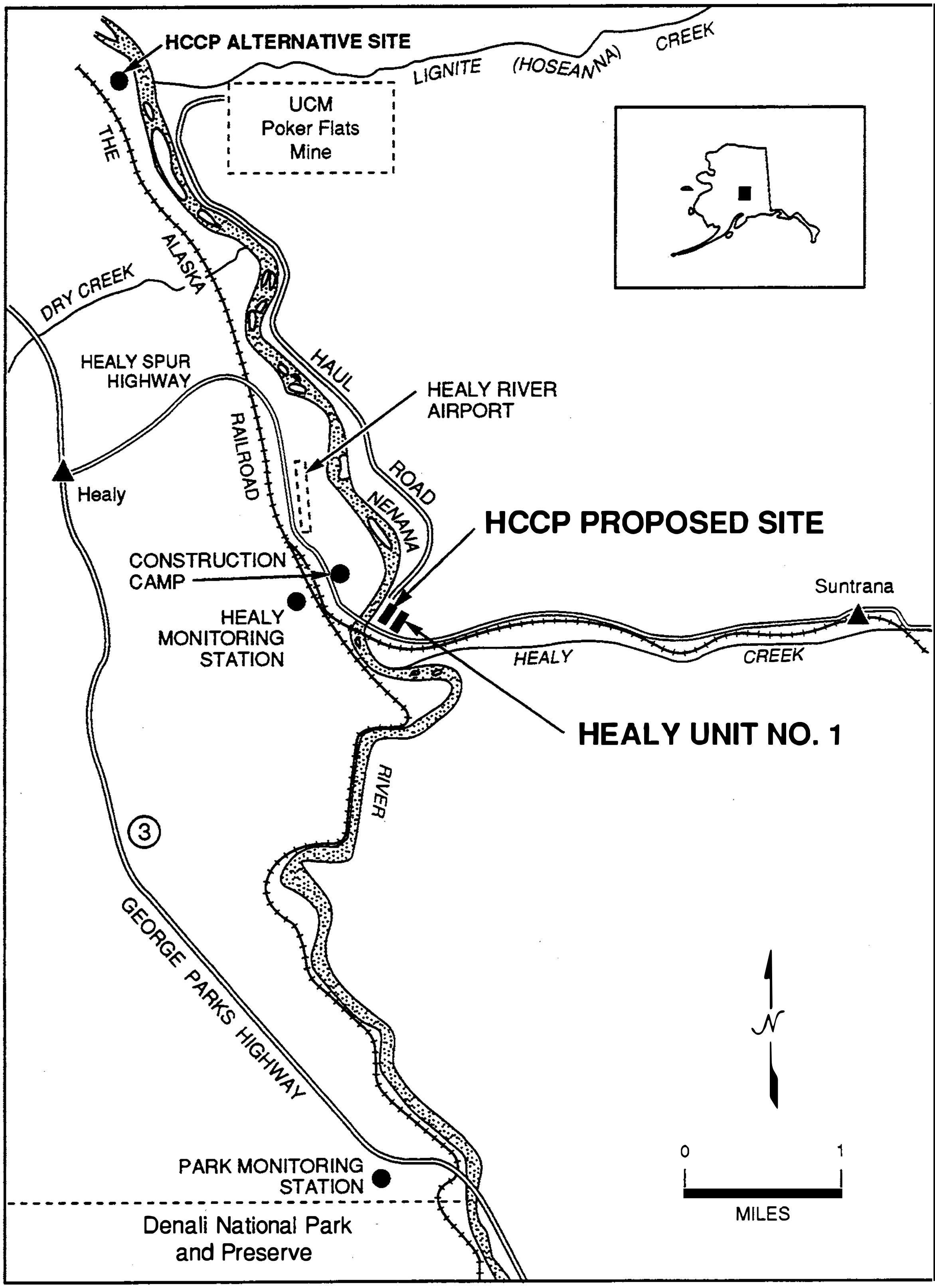


Fig. 2.1.2. Proposed site of the Healy Clean Coal Project.

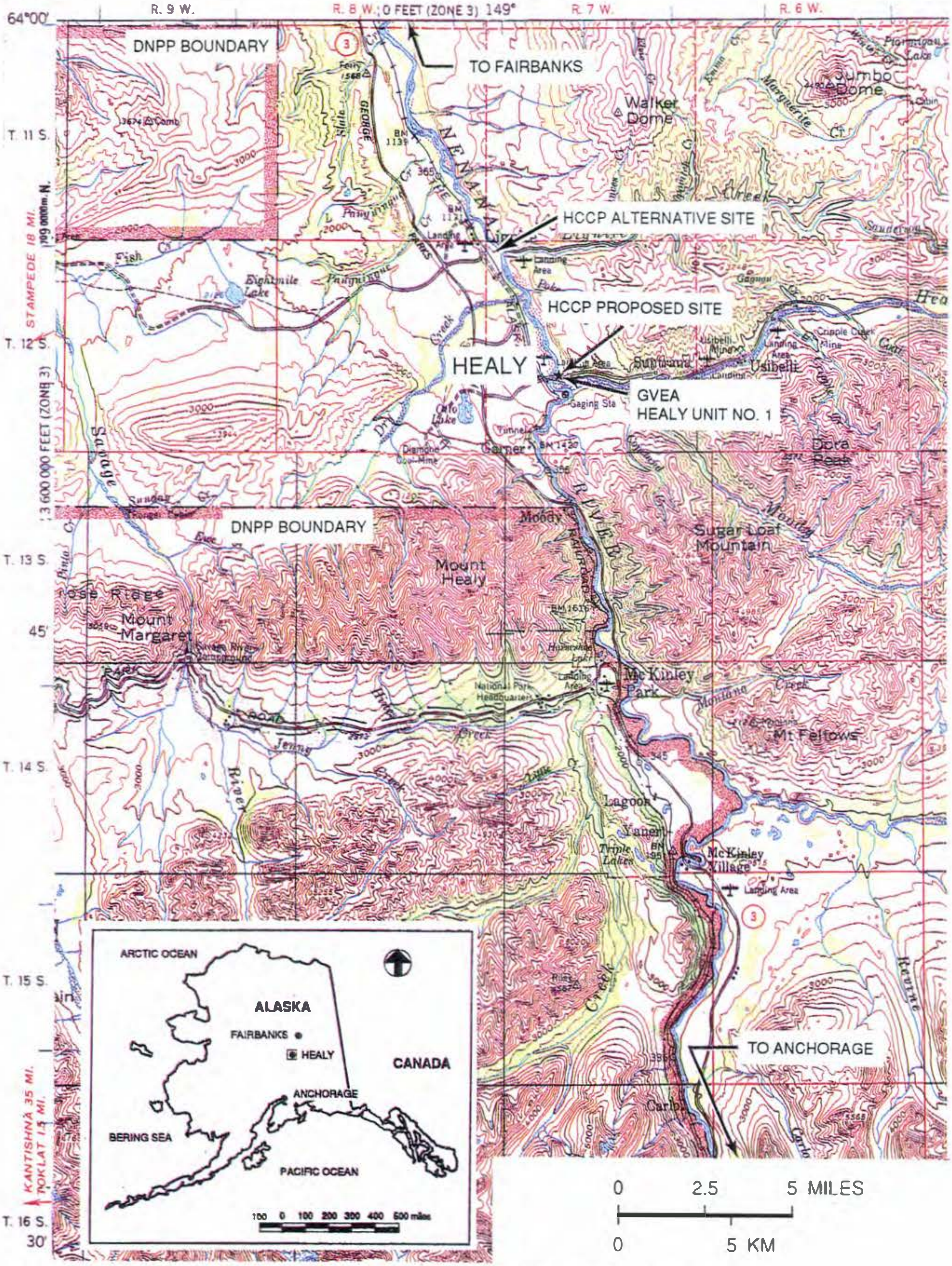


Fig. 2.1.3. Topographic map of the Healy, Alaska, area.

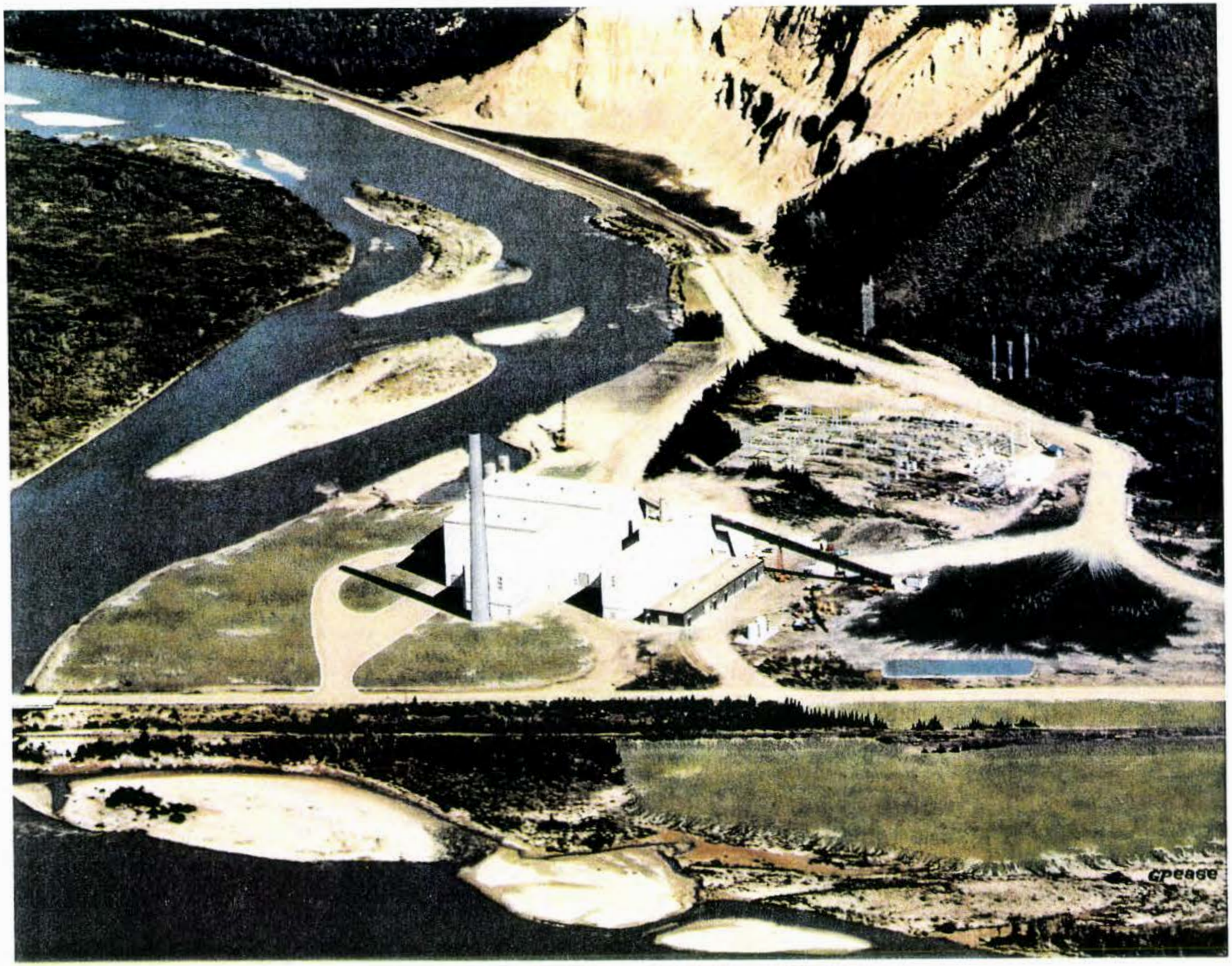


Fig. 2.1.4. Artist's conception of the Healy Clean Coal Project superimposed on a photograph of Healy Unit No. 1 and environs.

2.1.2 Technology Description

The HCCP proposed by AIDEA would incorporate an innovative power plant design that features integration of advanced combustors and a heat recovery system coupled with both high- and low-temperature emission control processes. The technologies would be dependent on each other as part of the integrated system. Figure 2.1.5 depicts an artist's conception of key components in the integrated HCCP system. Figure 2.1.6 is a mass balance flow diagram that depicts the major components of the HCCP.

The combustion technology to be demonstrated is TRW's entrained combustion system with limestone injection to capture SO_2 in the flue gas. The heart of the system consists of twin all-metal combustors connected by short ducts to the boiler. First-stage precombustors burn about 25% of the coal, and exhaust gas from the precombustors is mixed with intake air to preheat the main (or slagging-stage) combustors that burn the remaining 75% of the coal. As the coal burns, molten slag collects on the walls of the combustors and flows toward openings in the bottom of the main combustors where it falls into water-filled slag tanks. The slagging combustors decline slightly from horizontal to aid in the flow of the molten slag. Some slag solidifies on the water-cooled surfaces and serves to insulate and protect the metal walls from erosion and excessive temperatures. The main combustion sections operate at a slight air deficiency to reduce the amount of NO_x produced. In the boiler, combustion products mix with additional air to complete the combustion reactions. The combustors are coupled with a specially designed boiler that, in addition to its heat recovery function, produces low NO_x levels, functions as a limestone calciner, and accomplishes first-stage SO_2 removal. Therefore, flue gas from combustion is expected to contain lower concentrations of SO_2 and NO_x than flue gas from conventional combustion.

The postcombustion technology to be integrated with the advanced combustion system is the Joy spray dryer absorber for a second stage of SO_2 removal and particulate removal. The flue gas would mix with an atomized spray that includes activated lime from the limestone injection during combustion, resulting in additional chemical reactions to remove SO_2 and PM. A baghouse provides further capture of PM and SO_2 before the flue gas exits through the stack. A portion of the lime collected by the spray dryer and the baghouse would be recycled to the spray dryer and used for SO_2 removal, thereby increasing SO_2 removal efficiency while reducing solid waste.

The integrated process is expected to demonstrate at least 90% SO_2 removal resulting in emissions of no more than 0.043 lb/MBtu of heat input to the combustion process, NO_x emissions of no more than 0.2 lb/MBtu, PM_{10} (particulate matter $\leq 10\ \mu m$, inhalable particulate matter) emissions of no more than 0.015 lb/MBtu, and at least 99.5% combustion efficiency. It is anticipated that at least 20% of the total available sulfur in the flue gas would be captured in the combustion process and at least 70% in the flue gas desulfurization system. Of the total ash generated, 60–90% would be removed from the combustors as slag and from the boiler hoppers as bottom ash. Most of the remaining ash would be removed in the

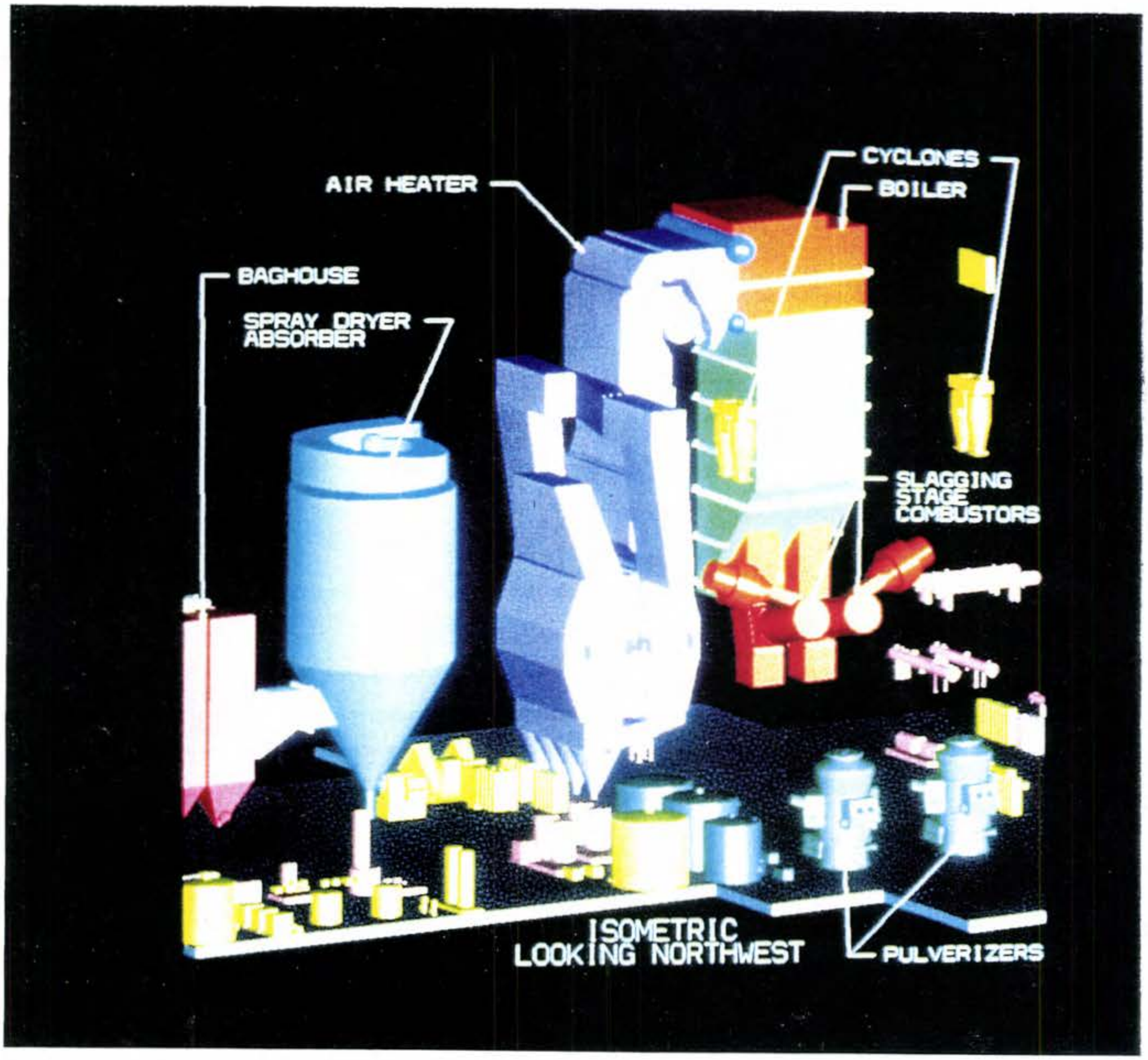


Fig. 2.1.5. Artist's conception of key components in the integrated Healy Clean Coal Project system.

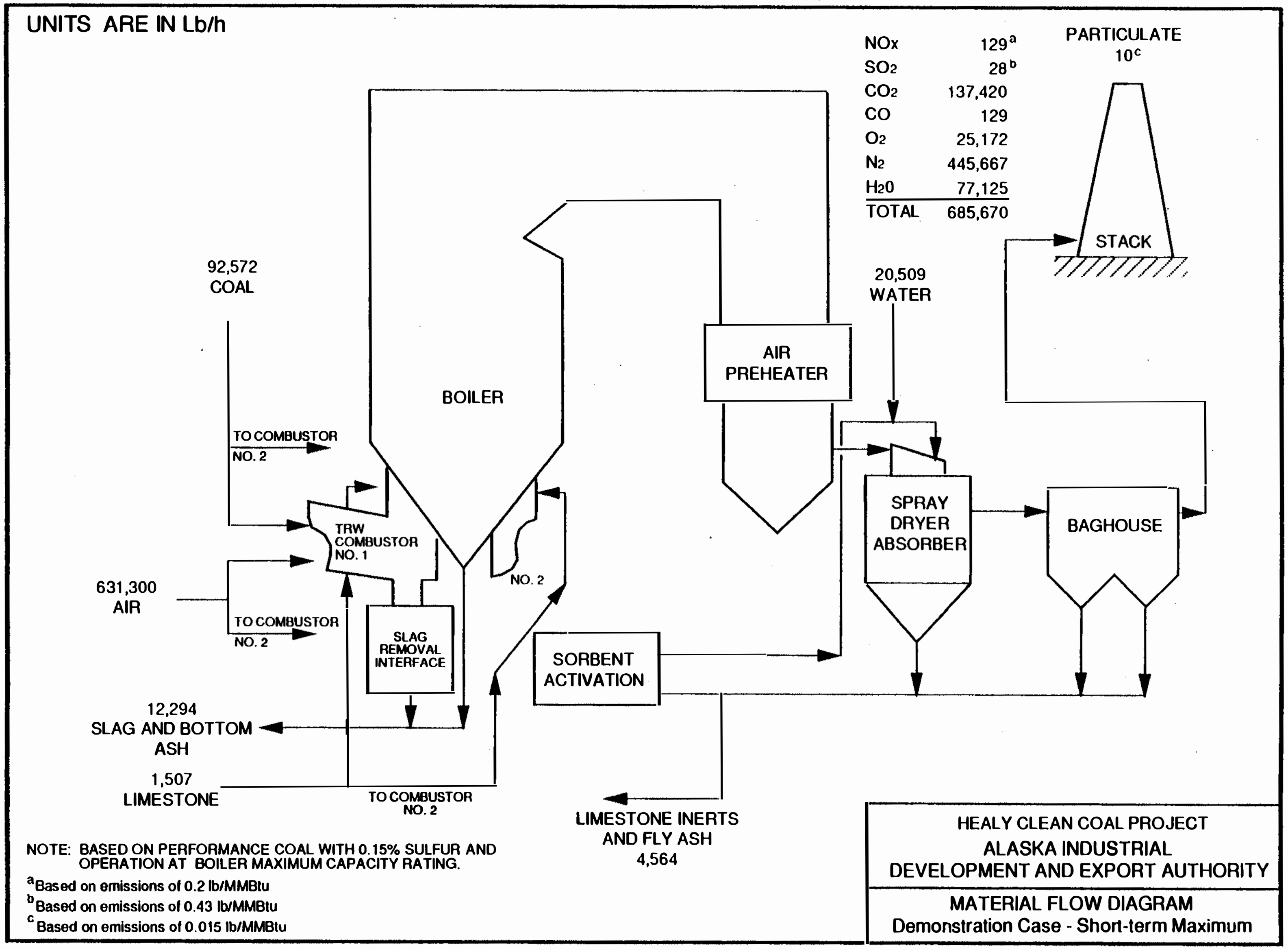


Fig. 2.1.6. Material flow diagram for the short-term maximum rate during the demonstration.

baghouse. The integrated process is suitable for repowering existing facilities or for new facilities. If successfully demonstrated, it would provide an alternative technology to conventional pulverized-coal boilers with conventional flue gas desulfurization controls, while lowering overall operating costs and reducing the volume of solid waste generated by conventional technology in current use. Further details regarding the technologies, including preliminary testing results, can be found in Appendix F.

2.1.3 Project Description

The following section describes the proposed HCCP and discusses the mitigation agreement for the retrofit of Healy Unit No. 1.

2.1.3.1 HCCP Description

The HCCP would incorporate the technologies described in Sect. 2.1.2 into the new 50-MW (nominal electrical output), coal-fired power generating facility. The HCCP would be fueled with low-sulfur coal from the UCM Poker Flats open-pit mine, located about 4 miles north of the proposed site. Run-of-mine UCM coal (coal that is currently used at Healy Unit No. 1) and waste coal would be the primary fuels. Waste coal is either low-grade coal or overburden- or underburden-contaminated coal (uncovered during mining for run-of-mine coal) that normally remains at the mine. These coals would be transported from the mine to the HCCP by mine trucks using the existing haulroad and dumped into separate storage piles. Approximately equal amounts of run-of-mine coal and waste coal would be blended using mobile equipment. An analysis of the composition of ***typical*** run-of-mine coal, waste coal, and blended coal for the HCCP (as is expected to be received at the HCCP site) is shown in Table 2.1.1. The carbon content and, consequently, the heating value are greater for the run-of-mine coal, while the waste coal contains much more ash. During the 1-year demonstration, short duration tests with other Alaskan coals are expected as these coals are identified and made available to the HCCP. UCM is responsible for delivering all coal sources to their appropriate coal pile(s). UCM's title for the coal transfers to the HCCP operator upon delivery to the coal pile. The HCCP operator is responsible for crushing and blending. Coal pile runoff, if any, will be monitored by the HCCP operator. The HCCP operator is responsible for the quality of the wastewater discharge from the coal pile.

The blended coal would first be crushed to pieces having a maximum diameter of 0.75 in. The existing Healy Unit No. 1 coal handling system includes two coal crushers with a capacity of 100 tons/h, each ***providing*** sufficient capacity to support the additional requirements of approximately 45 tons/h resulting from HCCP operation. From the crushers, the coal would be fed onto a feed conveyor and then to a diverter chute that would transfer the coal to a series of new belt conveyors to transport the coal to the HCCP coal silos. Coal would be removed from the bottom of the silos and taken to the pulverizers and combustors via the coal feed system.

Table 2.1.1. Analysis of the composition of *typical* run-of-mine coal, waste coal, and blended coal for the Healy Clean Coal Project (HCCP) (as is expected to be received at the HCCP site)

	Typical run-of-mine coal	*Typical blended* performance coal	*Typical waste* coal
Heating value (Btu/lb)	*7815*	*6960*	*6105*
Analysis (percent by weight)			
Moisture	*26*	*25*	*24*
Carbon	*46*	*41*	*36*
Hydrogen	*3.5*	*3.1*	*2.7*
Nitrogen	*0.6*	*0.5*	*0.5*
Sulfur	*0.17*	*0.15*	*0.13*
Ash	*8*	*17*	*25*
Oxygen	*16*	*14*	*12*
Chlorine	0.03	0.03	0.02
Total	*100*	*100*	*100*

Source: Usibelli Coal Mine, Inc.

The coal would be injected into the HCCP combustors, and the heated air from the coal's combustion would heat the water in the boiler. The boiler would generate steam to drive the turbine-generator. The turbine-generator, in turn, would convert the energy in the high-temperature (950°F), high-pressure [1250 pounds per square inch (psi)] steam to electrical energy. The HCCP generator would be connected to the 138-kilovolt (kV) electrical transmission line (the Anchorage-Healy portion of the Anchorage-Fairbanks Transmission Intertie) through an extension of the existing substation located on the Healy Unit No. 1 site.

As with any process involving the conversion of thermal energy to electrical energy, waste heat must be rejected. In the HCCP, water is proposed to be drawn from the Nenana River into the condenser (located in the turbine building) through an underground cooling water intake pipe. As the cool river water passes through the condenser, it would absorb heat from the turbine exhaust steam and condense the steam into water, which then would be recycled to the boiler. The warmed river water would be returned from the condenser back to the Nenana River through a second underground cooling water discharge pipe.

A diagram of the HCCP along with the existing Healy Unit No. 1 is shown in Fig. 2.1.7, and a layout of the plant is shown in Fig. 2.1.8. The major HCCP equipment and buildings, as identified in Fig. 2.1.7, and their functions follow. The number preceding each listed item corresponds to its location in Fig. 2.1.7.

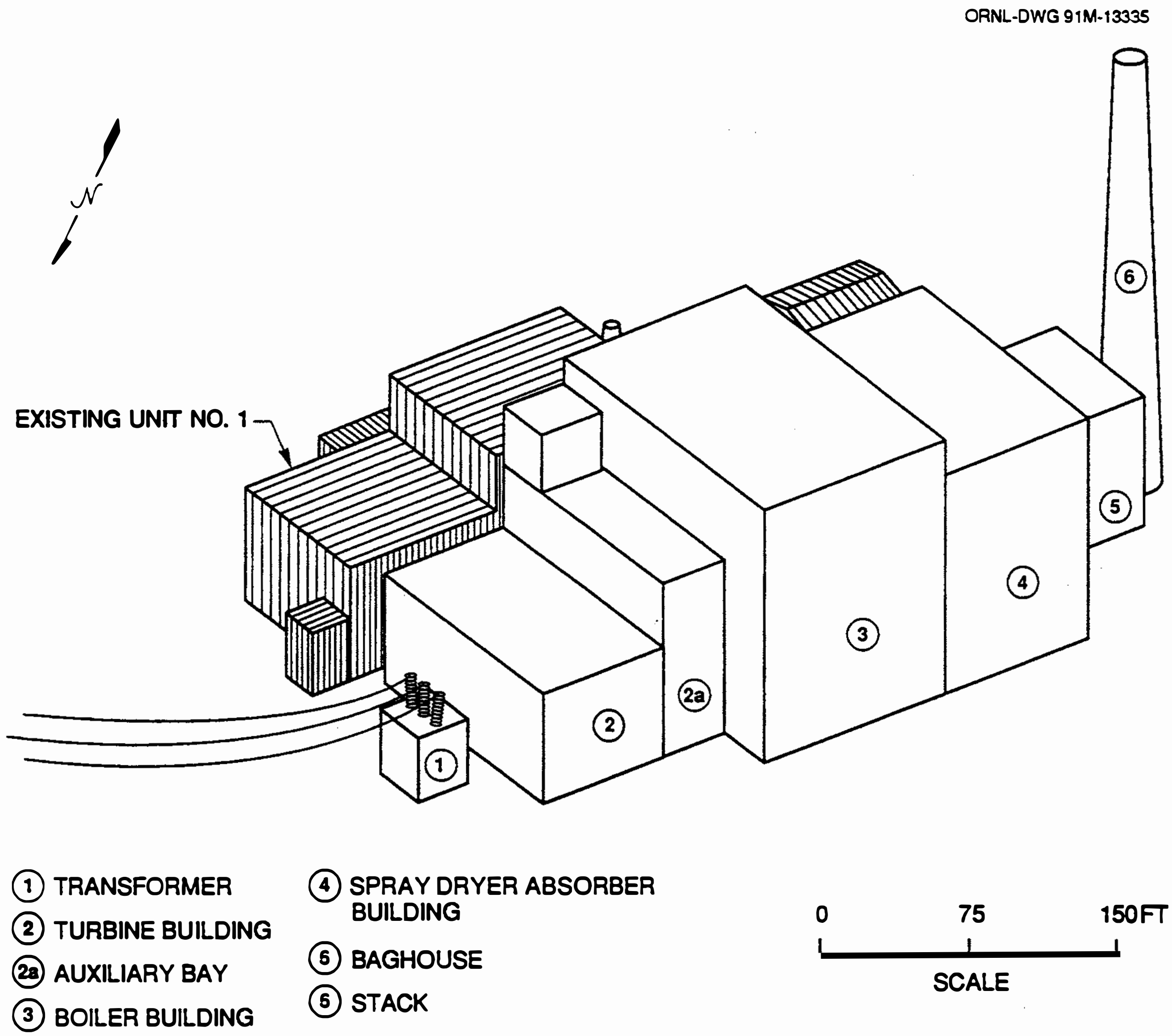


Fig. 2.1.7. Diagram of the Healy Clean Coal Project and the existing Healy Unit No. 1.

ORNL-DWG 91M-13336R3

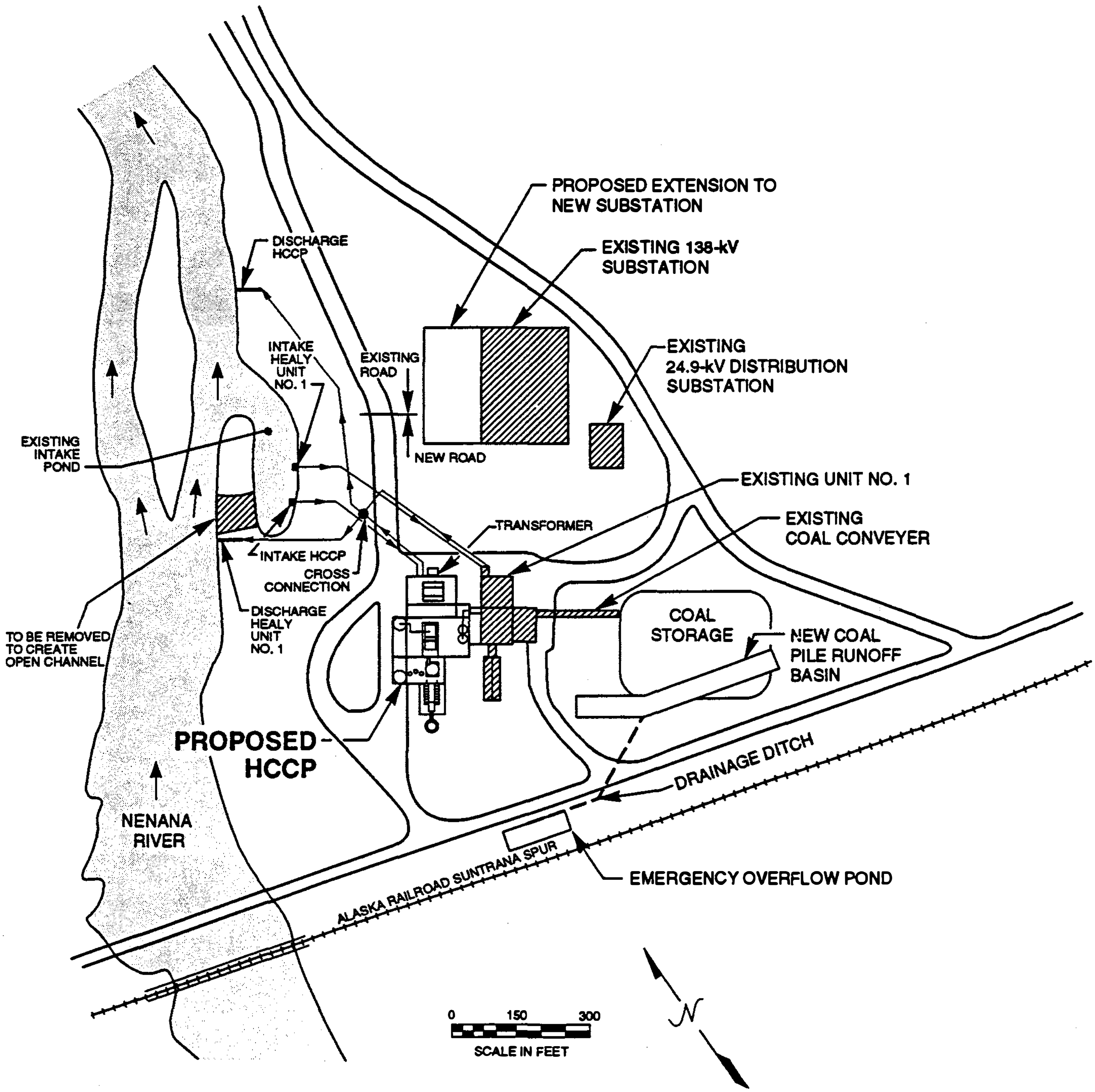


Fig. 2.1.8. Layout of the Healy Clean Coal Project and the existing Healy Unit No. 1.

1. *Transformer*. The HCCP main power transformer would transform electrical energy from the generator to a higher voltage for transmission via a new 300-ft long overhead line to a proposed extension of the existing substation and subsequent distribution to Fairbanks or Anchorage.
2. *Turbine building*. The turbine building would contain the turbine-generator, condenser, boiler feed pumps, and other equipment required to convert the high-pressure, high-temperature steam energy into electrical energy. The taller building (2a) next to the turbine building would be the auxiliary bay that houses the boiler feedwater heaters and other plant auxiliary equipment. The boiler feedwater heaters use steam extracted from different stages of the turbine to preheat the feedwater to the boiler.
3. *Boiler building*. The tallest building, located next to the turbine building auxiliary bay, would be the boiler building that contains the boiler and associated advanced coal combustion equipment. The high-pressure, high-temperature steam generated in the boiler would flow to the turbine and then, after releasing its energy to generate electricity, would be condensed and returned to the boiler as feedwater to be reboiled and superheated in the boiler, thus completing the steam cycle.
4. *Spray dryer absorber building*. The combustion gases (flue gas) would flow from the boiler building to the next building, which houses the spray dryer absorber. The spray dryer absorber would remove SO_2 from the flue gas.
5. *Baghouse*. The flue gas would flow from the spray dryer absorber to the baghouse. The baghouse would remove PM from the flue gas before exhausting to the 315-ft stack (6).

2.1.3.2 Mitigation Agreement for the Retrofit of Healy Unit No. 1

In response to NPS concerns that increased emissions from the combined operation of Unit No. 1 and the HCCP would adversely affect DNPP (i.e., degradation of air quality and visibility, including regional haze), DOE facilitated negotiations between the project participant team (AIDEA and GVEA) and DOI. These negotiations were successfully concluded and a Memorandum of Agreement (Appendix I) was signed by DOI, DOE, AIDEA, and GVEA on November 9, 1993, to ensure the protection of DNPP's resources from potential adverse air pollution impacts attributable to the HCCP and Unit No. 1.

The cornerstone of the Memorandum of Agreement is the planned retrofit of Unit No. 1 to reduce emissions of NO_x and SO_2. For NO_x control, the Agreement calls for Unit No. 1 to be retrofitted with low-NO_x burners with overfire air (if technologically feasible) after the start-up of the HCCP. GVEA has agreed to reduce Unit No. 1 NO_x emissions by approximately 50%, from 848 tons per year to 429 tons per year. The Agreement also requires that SO_2 emissions from Unit No. 1 be reduced by 25%, from 630 tons per year to 472 tons per year, using duct injection of sorbent (e.g., flash-calcined material or lime). In addition, GVEA has agreed to implement administrative controls (reduce Unit No. 1

output) to protect DNPP from observed plume or haze impacts. Furthermore, Section IV of the procedures for implementing the Agreement provides for the renegotiation of the Agreement if visibility impacts occur more than 10 times during any six-month period. In addition, two years after start-up of the HCCP and as otherwise agreed, GVEA and the DNPP superintendent would meet to evaluate these procedures and discuss additional reasonable measures, if necessary, to protect air quality related values of DNPP, including measures applicable to ice and/or steam plumes.

If the HCCP demonstration technology operates as expected, combined NO_x and SO_2 emissions from the Healy site would increase by only about 8%, from 1478 tons per year to 1602 tons per year, even though electrical generation would increase from the existing 25 MW to 75 MW for the two units. If the HCCP demonstration fails to meet project objectives for air emissions, but attains levels allowed by the permit issued by ADEC but challenged by DOI, then the combined emissions from the Healy site would be capped under the Agreement at 2160 tons per year (i.e., 1439 and 721 tons per year of NO_x and SO_2, respectively), about 46% over the emissions for the existing Healy site. This is 576 tons per year less than the combined maximum allowable emissions for the site under the permit DOI had challenged without mitigation of Unit No. 1.

The Agreement requires that the permit to operate issued by the ADEC reflect the new reductions in emissions from Unit No. 1. Furthermore, the Agreement establishes that if the HCCP successfully attains the low level of emissions expected for the demonstration case, then GVEA would request that ADEC reduce SO_2 and NO_x emission limits in the HCCP's permit to operate to match achieved emission levels. The Agreement also requires GVEA to reduce combined emissions from the site to the existing Unit No. 1 emissions, immediately upon notification by either NPS or ADEC that a NO_x or other pollutant plume, or a sulfate or other pollutant haze, is visible inside DNPP. The Agreement states that DOI shall withdraw its request to the ADEC to reconsider the issuance of the permit to operate, and that the mitigation terms and conditions of the Agreement shall be incorporated into and become enforceable requirements in the permit which allows the HCCP and Unit No. 1 to operate. An analysis of changes in potential impacts resulting from retrofitting Unit No. 1 is presented in Sect. 5.4.6.

2.1.4 Healy Clean Coal Project Construction

Construction of the HCCP would involve the following overlapping phases (with approximate durations in parentheses):

- site preparation (2 months);
- preparation of construction storage, laydown, and fabrication areas (2 months);
- construction of temporary facilities (2 months);
- concrete foundation installation (3 months);
- underground piping and electrical installation (3 months);

- structural steel erection (4 months);
- major equipment and main building erection (10 months);
- piping, electrical, and instrumentation installation (5 months);
- start-up and testing (5 months); and
- removal of temporary facilities (1 month).

As part of its annual plant maintenance and infrastructure improvement program, GVEA ***removed*** ash during ***1993*** from the area where HCCP construction activities involving storage, laydown, and fabrication would take place. This activity ***was*** advantageous to the proposed HCCP, but ***was*** not a part of the HCCP construction program. DOE will not provide construction funding for HCCP facilities before a ROD is issued for the EIS that supports the proposed action.

Following a ROD supporting the proposed action, construction of permanent facilities is scheduled to begin in ***April 1994*** and continue through about mid-November ***1994***, depending upon weather conditions. Severe weather conditions in Alaska would prevent continuing construction activities during winter ***1994–1995***. Construction of the HCCP would resume in the spring of ***1995*** and continue without interruption until completion of the HCCP in late ***1996***.

After a 1-year demonstration and testing period during ***1997***, commercial operation of the HCCP is anticipated to begin in ***1998***.

The peak labor force of construction personnel is anticipated to be 300 workers during ***1995*** and early ***1996***. The average work force during the construction effort is expected to be approximately 200 workers. A construction camp would be erected to house up to 90% of the peak work force (270 workers).

Site clearing, grading, and surfacing would be confined to those areas to be built upon or used during construction. Site clearing would be conducted on an "as-needed basis," and individual construction areas would be cleared only as required to support construction start-up.

2.1.5 Level of Healy Clean Coal Project Operation

The HCCP is planned as a baseload power plant operating 24 hours a day and would be operated by some of the same staff that operates the existing Healy Unit No. 1. The HCCP would operate using two 12-h workshifts; maintenance personnel would work four 10-h days.

HCCP operation at the 50-MW level would progressively increase from 65% of the time during the first year (because of extended periods of downtime for adjustments and maintenance) to 80% during the second year to 85% for years 3 through at least 25. The expected operating life of the HCCP is in excess of 40 years.

2.1.6 Resource Requirements

This section discusses the resource requirements for the proposed HCCP. Operating characteristics, including resource requirements, during the demonstration are presented in Table 2.1.2. Material flow diagrams that depict the resource requirements and discharges are displayed in Fig. 2.1.6 for the short-term maximum rate during the demonstration, and in Fig. 2.1.9 for the long-term rate based on an 85% capacity factor.

2.1.6.1 Land Area Requirements

Construction

Land requirements for construction include equipment/material laydown and temporary storage areas, areas for assembly of site-fabricated components, construction equipment access areas, and an area for temporary facilities to be used by the construction work force (i.e., offices and sanitary facilities). It is anticipated that most of these land areas would be restricted to the existing Healy 65-acre site. One possible exception is a 2-acre site between the Healy Spur Highway and the Suntrana Spur of the Alaska Railroad that may be used for laydown and storage during construction.

A temporary construction camp would be established to house the peak work force. The proposed location for the construction camp is immediately east of the Healy Spur Highway on property owned by the Alaska Railroad, about 0.5 mile northwest of the HCCP proposed site (Fig. 2.1.2). The camp would require approximately 6 acres at the site, which is disturbed from past use as a gravel quarry.

Operation

The land required for HCCP operation would be restricted to the existing Healy 65-acre site.

2.1.6.2 Water Requirements

Construction

Water would be used during HCCP construction for various purposes including personal consumption and sanitation, concrete formulation, equipment washdown, general cleaning, and dust suppression. It is anticipated that all water used during construction would be supplied from a new well located adjacent to Healy Unit No. 1. If the well supply is not adequate for all uses, water for equipment washdown, general cleaning, and dust suppression would be supplied from the Nenana River.

Operation

Water for plant operation would be supplied both from the Nenana River and from a new well. Cooling water would be obtained directly from the Nenana River. The estimated amount of water required for once-through condenser cooling would be approximately 28,000 gallons per minute (gal/min) ($12,500 \times 10^6$ gal/year), about 10% of the Nenana River flow during the winter and less than 1% of the flow during the summer. Service water, potable water, process water for generating steam, and other HCCP high-quality water needs would be obtained from the well. Water for bottom ash quenching and

Table 2.1.2. Operating characteristics for the existing Healy Unit No. 1 and the proposed Healy Clean Coal Project (HCCP)[a]

Operating characteristics	Existing Healy Unit No. 1[b]	Proposed HCCP[c]	Both units
Capacity, MW	25	50	75
Capacity factor, %[d]	90	85	-
Power production, MWh/year	196,300	385,800	582,100
Size of site, acres	65	65	65
Coal consumption, tons/year	174,300	344,600	518,900
Limestone consumption, tons/year	0	5,600	5,600
Water consumption			
Cooling water, 10^6 gal/year	6,150	12,500	18,650
Wastewater, 10^6 gal/year	0	40	40
Process water, 10^6 gal/year[e]	154	127	281
Air emissions			
Sulfur dioxide, tons/year	567[f]	103	670
Nitrogen oxides, tons/year	763[g]	480	1,243
Particulate matter, tons/year	22[h]	36	58
Carbon monoxide, tons/year	51[i]	480	531
Carbon dioxide, tons/year	288,300[i]	511,600	799,900
Effluents			
Wastewater discharges, 10^6 gal/year	0	87	87
Cooling water, 10^6 gal/year	6,150	12,500	18,650
Winter temperature rise above ambient (30 ft downstream from HCCP outfall), °F	5	9.3	14.3
Solid waste			
Slag/Bottom ash, tons/year	1,550	45,750	47,300
Fly ash, tons/year	13,950	11,450	25,400
Scrubber waste, tons/year	0	5,550	5,550

[a]Values presented do not reflect the Mitigation Agreement discussed in Sect 2.1.3.2. See Table 5.4.1.
[b]Based on a 90% capacity factor, which approximates historical operating conditions for Unit No. 1.
[c]Based on the demonstration case with an 85% capacity factor.
[d]Capacity factor is the ratio of the energy output during a period of time to the energy that would have been produced if the equipment had operated at its maximum power during that period.
[e]Process water consumption includes water consumed by the HCCP process and water discharged as vapor.
[f]Based on 90% of proposed permitted emissions of 630 tons/year. Present permitted emissions are 870 tons/year. Actual emissions are uncertain, but are expected to be less than proposed permitted emissions.
[g]Based on actual emissions. Permitted emissions are 2,500 tons/year.
[h]Based on actual emissions. Permitted emissions are 161 tons/year.
[i]Based on actual emissions. Emissions are not subject to permit limitations.

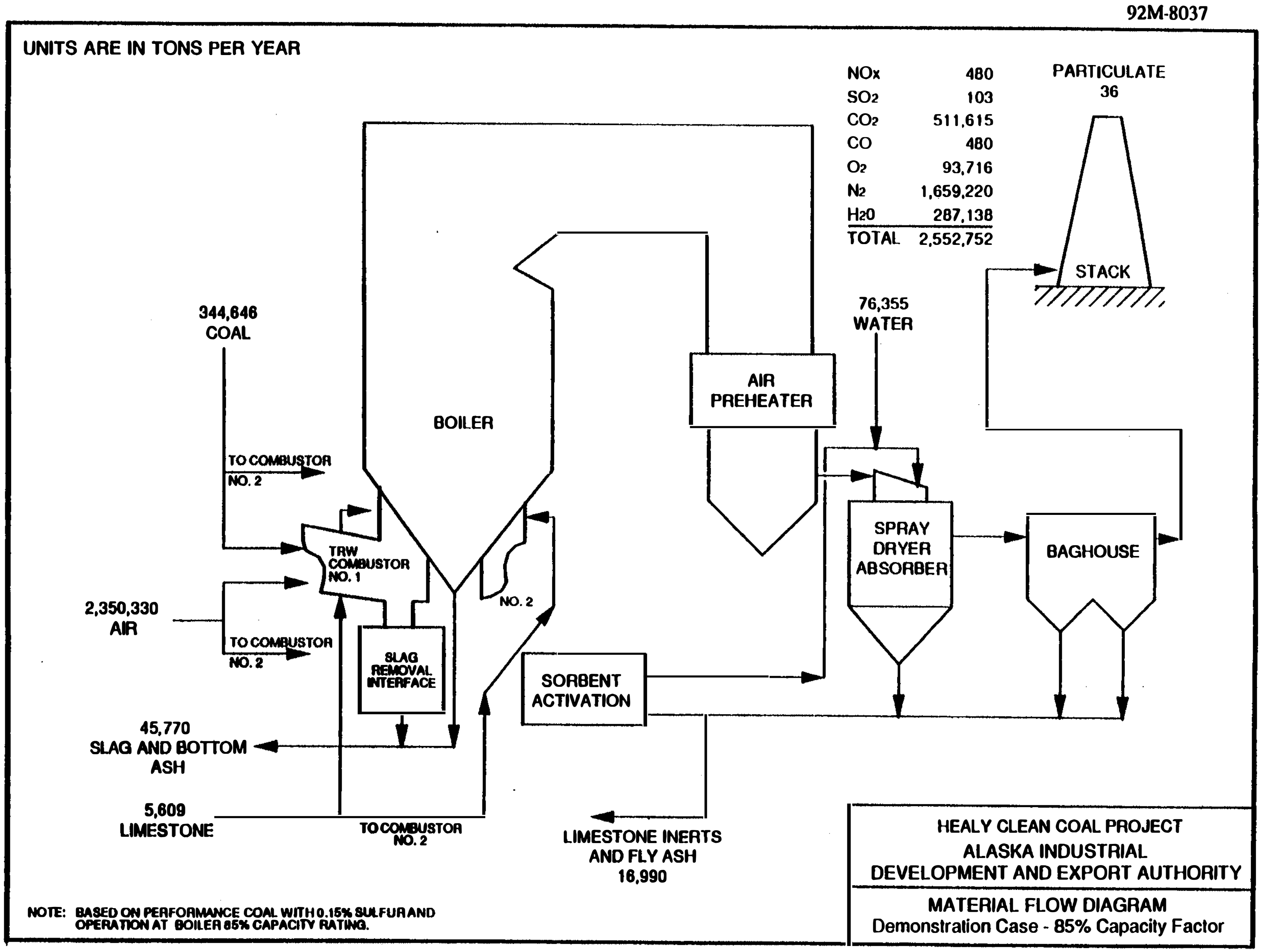


Fig. 2.1.9. Material flow diagram for the demonstation case with an 85% capacity factor.

conveying would also be obtained from the well unless the well would not produce an adequate volume, at which time Nenana River water would be used. The estimated total plant water usage (other than for condenser cooling) would vary from flow rates of 85 gal/min for steady-state operation upward to 200 gal/min at other times such as during restarts, periodic plant washdowns, and fire system drills. The estimated total annual HCCP water requirement based upon a mean usage of 100 gal/min would be 161 acre-ft.

2.1.6.3 Fuel Requirements

The HCCP would be fueled with coal from the UCM Poker Flats Mine. Run-of-mine UCM coal (coal that is currently used at Healy Unit No. 1) blended with waste coal would be the primary fuel. Short duration tests during the 1-year demonstration with other Alaskan coals are expected as these coals are identified and made available to the HCCP. At full load conditions using the blended coal, the HCCP would require about 15 truckloads of coal per day from the UCM mine (1100 tons/d). Based on the 85% capacity factor, average annual coal consumption would be approximately 345,000 tons.

2.1.6.4 Construction and Other Materials

Locally obtained construction materials would include crushed stone, sand, and lumber for the HCCP and temporary structures such as enclosures, forming, and scaffolding. It is estimated that about 8000 yd^3 of concrete would be required to construct the HCCP.

Annual consumption of limestone, injected to capture SO_2 in the HCCP's flue gas, would be approximately 5600 tons. ***The HCCP would require pulverized limestone. Because no mining operations that produce pulverized limestone are presently operating in Alaska, pulverized limestone would be received by the HCCP from the contiguous 48 states during the demonstration. The incremental disturbance of land in the contiguous 48 states resulting from limestone mining for the HCCP is expected to be slight. Similarly, incremental amounts of windblown dust and emissions from limestone removal equipment are expected to be minor.***

The limestone pulverizing facilities in the contiguous 48 states would have extensive dust control and containment equipment such as cyclones or baghouse systems with monitors to ensure that emissions of particulate matter are minimized. The pulverized limestone would be conveyed via a pneumatic system (using a vacuum of air) to large enclosed storage silos until ready for shipment. At the time of shipment, limestone would be transferred using a pneumatic loading system into completely enclosed containers (sized to be transported by tractor-trailer trucks or railroad flatbed cars). Dust collectors and negative-pressure air ducts to minimize particulate emissions would be important components of the transfer system.

The HCCP would require about four containers per week. The sealed containers would be transported to barge-loading facilities by truck or rail, shipped to Anchorage by barge, and transported to Healy by truck or rail. The incremental emissions associated with the vehicles used to transport the limestone are expected to be minor. In the event of a transportation accident involving limestone, consequences to the environment also would be minor.

Upon arrival in Healy, the limestone would be transferred from each container to the HCCP storage silo using a pneumatic system that would be hooked directly from the silo to the container. The HCCP storage silo would be equipped with a dust collector to allow for venting.

A decision on a source of limestone during commercial operation would be made following the demonstration; limestone is expected to be obtained from a source within Alaska because limestone formations are available, and needed equipment would be installed at the source to accommodate commercial operation of the HCCP. One potential source is an existing mine located in Cantwell, about 30 miles south of the HCCP proposed site. Another potential source is an inactive mine located about 150 miles north of Healy, between Fairbanks and Livengood. Other sources within Alaska also are possible. If the demonstration is successful, a pulverizer is expected to be installed at the selected Alaska mining location to meet the HCCP's requirement. If the demonstration is unsuccessful, the HCCP would be converted to a facility with dry scrubbers using lime rather than pulverized limestone. The same sources could be used to obtain the lime if a kiln were installed to convert the limestone to lime.

Salient characteristics of limestone mining, pulverization, transport, and transfer during commercial operation are expected to be almost identical to those described above for the demonstration with the exception that an Alaskan source would be used, pulverization equipment would be purchased, and the limestone would be shipped a shorter distance and require transport by truck alone. About 10 to 20 truck loads per week (using smaller trucks) would be required. The same type of emission control systems would be used during pulverization, transport, and transfer. Because impacts associated with the HCCP's use of limestone are expected to be nearly negligible, they are not considered further.

2.1.7 Discharges and Wastes

This section discusses discharges and wastes for the proposed HCCP. Table 2.1.2 includes a summary of discharges and wastes.

2.1.7.1 Air Emissions

During the demonstration, air emissions from the HCCP would include approximately 103 tons/year of SO_2, 480 tons/year of NO_x, 36 tons/year of PM_{10}, and 480 tons/year of carbon monoxide (CO) (based on an 85% capacity factor). The 85% capacity factor, expected for HCCP operation during years 3 through 25, is used as an upper bound for the demonstration (in which the capacity factor is expected to be 65% due to extended periods of downtime for adjustments and maintenance). Estimates *of air* emissions are based on the following assumptions. Sulfur dioxide emissions are based on a 90% SO_2 removal rate by the HCCP (resulting in emissions of 0.043 lb/MBtu of heat input to the combustion process), from a blended coal (using equal amounts of run-of-mine coal and waste coal) containing 0.15% sulfur and 6960 Btu/lb. NO_x and PM_{10} emissions are based on 0.2 and 0.015 lb, respectively, per million Btu of heat input to the combustion process. Section 5 includes a discussion of emissions associated with the scenario in which the HCCP fails to meet these project objectives for air emissions, but attains permitted levels. Trace emissions of other pollutants include beryllium, sulfuric acid mist, mercury, hydrochloric acid, hydrofluoric acid, benzene, arsenic, ***and various heavy metals***.

The HCCP would emit about 512,000 tons/year of carbon dioxide (CO_2). While CO_2 is not considered an air pollutant, it is a contributor to the "greenhouse effect" that is suspected to cause global warming and climate change (Mitchell 1989).

2.1.7.2 Liquid Discharges

Condenser Cooling Water

The estimated amount of water required for once-through condenser cooling would be approximately 28,000 gal/min ($12,500 \times 10^6$ gal/year). The water would be pumped from the Nenana River, through the turbine condenser, and returned untreated to the Nenana River.

Chlorine or other biocides ***would*** not ***be used*** for the once-through condenser cooling water system. Unit No. 1 has never experienced biofouling of the once-through cooling system. The Nenana River is a glacial-fed river, low in biological activity and high in glacial silt. The large volumes of water ***and glacial silt*** passing through the system continuously scour the entire system of potential biological growth. Consequently, no growth has ever occurred in the once-through cooling system of Unit No. 1.

Wastewater Streams

The wastewater treatment system would process waste streams to remove suspended solids, oil, and grease and to adjust pH. All wastewater not used for flue gas desulfurization, fly ash wetdown, or slag ash quenching and conveying would be sent to the wastewater treatment system. Wastewater associated with the residual slag moisture and fly ash dust control would be transported by truck with the slag and fly ash to the UCM Poker Flats Mine. The plan of treatment for each of the wastewater streams is described in the following paragraphs.

Boiler blowdown. All or most of the boiler blowdown stream (which removes impurities that have settled to the bottom of the boiler) would be used in the flue gas desulfurization system and thus would be evaporated and discharged to the atmosphere through the flue gas stack. ***Maximum boiler blowdown has been estimated at about 40 gal/min.*** Any surplus blowdown that may result during peak flow conditions, such as during start-ups, would be pumped to the wastewater treatment system and mixed with other wastewater streams for adjustment to a pH between 6.5 and 8.5. The resulting combined wastewater stream would be treated for suspended solids removal and discharged into the Nenana River. No chemicals ***would be*** used for boiler blowdown. However, the chemicals added to the boiler water to fluidize solids ***would*** typically be sodium phosphate, sodium sulfite, and morpholine.

Demineralizer regenerant wastewater. Demineralizer regenerant wastewater would be neutralized to adjust pH to between 6.5 and 8.5. Most or all of the estimated 21 gal/min of the neutralized stream would be used in the flue gas desulfurization process. Any surplus neutralized regenerant wastewater that may result during peak flow conditions would be pumped to the wastewater treatment system and mixed with the other wastewater streams for adjustment to a pH between 6.5 and 8.5. The combined wastewater stream would be treated for suspended solids removal and discharged into the Nenana River.

Floor and equipment drain wastewaters. Plant floor drain and equipment drain water would be collected in the plant floor sumps and pumped to an oil/water separator. The resulting oil- and grease-free water would be mixed with other wastewater streams in the wastewater treatment system for adjustment to a pH between 6.5 and 8.5. The combined wastewater stream would be treated for suspended solids removal and discharged into the Nenana River.

Coal pile runoff. The ground surface of the coal pile storage area would be graded to direct coal pile runoff waters to a new unlined catchment pond sized to store quantities of runoff water equal to the historical recorded amount experienced for a 10-year, 24-h precipitation event (approximately 2 in.). ***In addition, Healy Unit No. 1 bottom ash would be sluiced to the pond when the HCCP is not operating.*** Overflow from this pond is not expected. However, if overflow should occur, such water would be caught in ***an*** unlined ***emergency overflow*** pond between the Healy Spur Highway and the Alaska Railroad Suntrana Spur. ***No discharge of coal pile runoff to the Nenana River would occur.***

Metal cleaning wastes. Metal cleaning wastes such as those resulting from cleaning the boiler and associated equipment would be generated infrequently and in relatively small quantities during planned shutdown periods. Because of the chemical nature of the cleaning fluids and resulting wastes, the metal cleaning wastes would be collected in appropriate containers and transported off-site by a contractor for disposal at an approved landfill in accordance with federal, state, and local regulations (location has not yet been identified).

Discharge rates. The effluent that would be discharged into the Nenana River is made up of a combination of previously described wastewater streams. The total effluent to be discharged into the river is estimated to be approximately 75 gal/min under normal operating conditions and about 102 gal/min under peak conditions.

In addition to the discharge of wastewater effluent into the Nenana River, various wastewater streams would be disposed of to the plant septic system, to the atmosphere, and with wet solid residues. It is estimated that the potable water system would generate about 1 gal/min of sanitary wastewater during normal operations. The sanitary wastewater would be discharged into the existing septic and leach field system. Wastewater that would be discharged to the atmosphere by evaporation consists of water from the boiler blowdown flash tank; the flue gas desulfurization system; the slag ash quenching and conveying system; the coal pile runoff catchment pond; and to a very minor extent, from open sumps, tanks, and washdown surfaces. The estimated average total evaporation rate from all of the described sources would be approximately 13 gal/min. Wastewater that would be disposed of with wet solid residues includes the residual moisture in the waste bottom slag ash and the flue gas desulfurization (FGD) slurry, and the water sprayed on the dry fly ash for dust control. The average total disposal of water to these solid wastes is estimated to be about 85 to 90 gal/min. Approximately 80 gal/min of ***this disposal*** to solid wastes would be from water of hydration (water lost via chemical reaction) and absorbed water in the FGD slurry. ***None of the wastewaters from fly ash, bottom ash, and FGD slurry are expected to enter the Nenana River.***

2.1.7.3 Solid Wastes

The HCCP would be expected to produce about 80% of the total ash as slag and bottom ash (45,770 tons/year), which would be transported to a storage silo. The remaining ash (11,445 tons/year) would be collected as fly ash in the flue gas desulfurization system and conveyed to another storage silo. The ash would be removed periodically from the silos and hauled by truck for disposal in the UCM open-pit mine. The annual rate of ash disposal is discussed in Sect. 4.1.10.

2.1.7.4 Toxic and Hazardous Materials

Several materials considered toxic or hazardous would be required for the HCCP. Contractors would transport the chemicals by truck to the HCCP. All chemicals would be properly labeled and stored according to local fire codes and Occupational Safety and Health Administration (OSHA) requirements. An approved spill plan would be prepared which would specify storage location, clean-up methods, training, and inspection procedures.

Concentrated sulfuric acid (H_2SO_4) would be used for regeneration of the ion exchange demineralizers. The estimated annual use would be approximately 6 tons (840 gal). A new 1000-gal bulk storage tank would be provided to store the concentrated sulfuric acid. This tank would be filled approximately once per year. The bulk tank would be installed over a sump area large enough to enclose the contents of the bulk tank plus 10%. Any large spills, including a spill resulting from tank rupture, would be neutralized immediately and subsequently cleaned up. Once neutralized, the by-products of neutralization would not be toxic or hazardous. The wastes produced from any process using sulfuric acid would be neutralized with an equivalent amount of sodium hydroxide ***(NaOH, or caustic soda) in the*** wastewater treatment system before discharge to the Nenana River. No sulfuric acid would be discharged before neutralization and dilution was complete.

Sodium hydroxide would also be used for regeneration of the ion exchange demineralizers. The estimated annual use would be approximately 3 tons (942 gal). A new 1000-gal bulk storage tank would be provided to store the NaOH. This tank would be filled about once per year. The bulk tank would be installed over a sump area large enough to hold the contents of the bulk tank plus 10%. Any large spills, including a spill resulting from tank rupture, would be neutralized immediately with an equivalent amount of sulfuric acid and cleaned up. Once neutralized, the by-products of neutralization would not be toxic or hazardous. The wastes produced from any process using NaOH would be neutralized with sulfuric acid in the wastewater treatment system before discharge to the Nenana River.

A combination of amines, such as morpholine or cyclohexylamine, would be used to control corrosion in the preboiler system. Amines would be stored and used in curbed areas; minor spills would be routed to the wastewater treatment system for treatment before discharge to the Nenana River, and major spills would be cleaned up and disposed of off-site in accordance with appropriate regulations. The annual use of amines would be less than one drum, with no more than two drums on-site at any time.

A sodium hypochlorite (NaOCl) solution, similar to household bleach, would be used to treat the potable water supply. The estimated annual use would be 48 to 60 gal, with no more than three to five 1-gal containers on-site at any time. The ***sodium hypochlorite*** solution would be stored and used in curbed areas. This chemical would not be toxic or hazardous as used for water treatment.

2.2 ALTERNATIVES

Section 102(2)(C) of NEPA requires that agencies discuss the reasonable alternatives to the proposed action in an impact statement. The term "reasonable alternatives" is not self-defining, but rather must be determined in the context of the statutory purpose expressed by the underlying legislation. The goals of the federal action establish the limits of its reasonable alternatives. Congress established a very specific goal for this phase of the CCT Program—to demonstrate innovative, energy-efficient coal technologies capable of achieving substantial reductions in SO_2 and NO_x from existing facilities. DOE's purpose in selecting the HCCP is to demonstrate the viability of the TRW entrained combustion system and the Joy spray dryer absorber to work in conjunction in effectively controlling these pollutants. Reasonable alternatives to this proposed action must be capable of meeting this purpose.

Congress also directed DOE to pursue the goals of the legislation by means of partial funding of projects owned and controlled by nonfederal-government sponsors. This statutory requirement places DOE in a much more limited role than if the federal government were the owner and operator of the project. In the latter situation, DOE would be responsible for a comprehensive review of reasonable alternatives for siting the project. However, in dealing with an applicant, the scope of alternatives is

necessarily more restricted, because the agency must focus on alternative ways to accomplish its purpose which reflect both the application before it and the functions it plays in the decisional process. It is appropriate in such cases for DOE to give substantial weight to the applicant's needs in establishing a project's reasonable alternatives.

Based on the foregoing principles, the reasonable alternatives to the proposed action are the no-action alternative (including scenarios reasonably expected as a consequence of the no-action alternative) and an alternative site nearer the UCM Poker Flats coal mine.

2.2.1 No-Action Alternative

The no-action alternative would result if DOE does not provide cost-shared funding support for the HCCP. The PEIS for the CCT Program (DOE/EIS-0146) evaluated the consequences of no action on a programmatic basis (see Sect. 1.5). Under the no-action alternative for the HCCP, the commercial readiness of the proposed technologies for the combined removal of SO_2, NO_x, and PM would not be demonstrated. The innovative technologies would not be demonstrated at Healy, Alaska, and probably would not be demonstrated elsewhere because there are currently no other similar proposals in the CCT Program. The opportunity to demonstrate these technologies would likely be lost. Consequently, commercialization of the technologies could be delayed or might not occur because the utility and industrial sectors tend to utilize known and demonstrated technologies over new, unproven technologies.

Under the no-action alternative, two reasonably foreseeable scenarios could result. Neither scenario would contribute to the CCT Program objective of demonstrating the economic feasibility and environmental acceptability of new coal utilization and pollution control technologies.

First, GVEA could continue to operate the present power plant (Healy Unit No. 1) and continue to buy natural gas–generated power from Anchorage utilities without building any new generating facilities. No construction activities or changes in operations would occur. Coal requirements for the existing plant and the electricity generated would remain constant. There would be no change in present environmental conditions at the proposed project site, and the impacts would remain unchanged from the baseline conditions. Because the level of impacts would not change, no further discussion is provided for this scenario.

Second, a conventional coal-fired power plant equivalent in capacity to the proposed project with conventional flue gas desulfurization could be built at Healy by the project participants without DOE's financial assistance. The best available control technologies would be used, including dry scrubbers that use lime to remove SO_2 from the flue gas, low-NO_x burners, and a baghouse to remove PM. The dry scrubbers would generate a solid waste that, along with the PM from the baghouse, would be returned to the UCM Poker Flats Mine for disposal. The new plant would lessen or eliminate the need to buy power from Anchorage utilities to the same extent as the HCCP. This scenario is almost identical to the scenario expected for commercial operation of the facility if the HCCP demonstration proves unsuccessful and is converted to a coal-fired power plant that uses best available control technology. Therefore, an analysis of this scenario is included in Sect. 5 (the retrofit case). The analysis indicates that the level of impacts would be similar to those for the HCCP demonstration, except that the facility would generate about 50% less ash and up to 100% greater air emissions.

Table 2.2.1 presents a comparison of the proposed HCCP with the two reasonably foreseeable consequences of no action.

2.2.2 Alternative Sites

The goals of the proposed action define the scope of reasonable alternatives to the action. DOE's goal for the CCT Program is demonstration of technologies. This goal is achieved by the partial funding of specific projects proposed by project participants. ***Since AIDEA was the only participant to offer to demonstrate the limestone-injection entrained combustion system/spray dryer absorber combination of technologies, DOE's goal can be met only by funding this project.*** The goal of AIDEA and GVEA is to create additional electrical generating capacity for the ***region*** served by GVEA, ***including Fairbanks and outlying communities such as Delta, Nenana, Healy, and DNPP. This*** goal ***cannot*** be met by alternative sites that do not have economical access to a suitable coal source or that do not have economically viable interties with GVEA's power distribution system.

The feasibility of siting coal-fired power plants in various locations in the Alaska Railbelt has been studied on several occasions by several organizations. GVEA and the City of Fairbanks proposed to build a 130-MW coal-fired plant adjacent to Healy Unit No. 1 in 1978 (GVEA 1978) because their electric system was experiencing unprecedented load growth during the construction of the Trans Alaska Pipeline. In coordination with the proposal, meteorological data were collected simultaneously for one year at Garner, Alaska (located about 1.5 miles southwest of Unit No. 1) for the proposed Healy site and at an alternative site near Nenana, Alaska (located approximately 50 miles north of Healy).

Healy was the most economical site for the proposed facility because of the low cost of transporting coal from the nearby UCM Poker Flats mine, existing work force at Unit No. 1 that would minimize the number of additional workers needed, and existing facilities that could be shared by both units (e.g., coal handling facilities, fuel oil tanks, and electrical substation). However, there was concern that emissions from the 130-MW plant might exceed air quality standards within DNPP or that the volume of cooling water required might exceed the capability of the Nenana River at Healy. If either concern materialized, the Nenana site would be selected as the best alternative site because it has an established community with an infrastructure to support a work force, a plentiful supply of cooling water from the confluence of the Tanana and Nenana Rivers, ready access to transport by rail and

Table 2.2.1. Comparison of the proposed Healy Clean Coal Project (HCCP) with the no-action alternative

	No-action alternative	
Proposed project	No project	Project with conventional technology
The objective of the HCCP is to demonstrate the commercial readiness, economic feasibility, and environmental acceptability of the proposed technologies for the combined removal of SO_2, NO_x, and PM. A successful proposed project would enhance commercialization of those technologies in the industrial sector.	Commercial viability and environmental acceptability of the proposed technologies would not be demonstrated, and commercialization of those technologies would be delayed or would not occur.	Commercial viability and environmental acceptability of the proposed technologies would not be demonstrated, and commercialization of those technologies would be delayed or would not occur.
Operation of the HCCP would generate electricity that would replace natural-gas–generated electricity presently bought from Anchorage utilities.	Golden Valley Electric Association, Inc., would continue to operate Healy Unit No. 1 and to buy natural-gas–generated electricity from Anchorage utilities.	Operation of the conventional plant would generate electricity that would replace natural-gas–generated electricity presently bought from Anchorage utilities.
Substantial construction activities would be required.	No construction activities would occur.	Substantial construction activities would be required.
The HCCP would consume approximately 345,000 tons of coal per year to generate 50 MW of electricity.	No additional coal required or electricity generated.	Conventional plant would use about 10% less coal than the HCCP but would ***result in*** about 10% more ***total*** mining activity ***at the UCM mine*** (because of differences in type of coal used), resulting in a small increase in fugitive dust emissions. The conventional plant would be a 50-MW generating facility.
Impacts are not expected to be major for most resource areas. Visibility/air quality impacts are a concern. Remnants of the thermal plume reaching Ferry could shorten the duration of ice bridge use. Impacts are expected on socioeconomic resources (e.g., education, medical services).	Environmental impacts would not change from baseline conditions.	Level of impacts would be similar to that for HCCP construction and operation. Differences include the fact that a conventional coal-fired plant would generate about 50% less ash than HCCP operations. Air emissions are expected to be up to 100% greater for the conventional plant because it would only be required to meet existing emissions standards, while the HCCP is expected to generate emissions less than the standards.

highway, and less electrical loss from transmission lines because it is located 50 miles closer to Fairbanks than the Healy site. In addition, it is located more than 30 miles from the nearest boundary of DNPP. However, Nenana usually has lighter winds than Healy, and strong inversions that trap emissions can form in Nenana during winter months (as occurs in Fairbanks).

A PSD air permit application was filed with the Alaska Department of Environmental Conservation (ADEC) indicating that the 1978 proposed project could be built at the Healy site without exceeding air quality standards within DNPP. However, as discussed below, unexpected circumstances quickly halted GVEA's electric load growth and the need for the project. GVEA installed two 60-MW oil-fired units at North Pole, Alaska, in 1976 and 1977 to meet the growing demand for electricity. The cost of fuel oil was expected to be about $0.25/gal, but oil prices skyrocketed worldwide until the cost of fuel oil was more than $0.70/gal. Consequently, GVEA was forced to increase electric rates. Many GVEA customers stopped using electricity to heat their homes and businesses. This situation suddenly changed GVEA's electric load projections, and a decision was made to halt the proposed project (shortly after the PSD permit application was filed with the ADEC).

In 1985 and 1988, the Alaska Power Authority (APA) studied the feasibility of siting coal-fired power plants in the Alaska Railbelt. The 1985 study evaluated building coal-fired plants as alternatives to building a 1200-MW hydroelectric project on the Susitna River (APA 1985). The study considered the comparative costs of locating a 200-MW coal-fired power plant at Nenana and Beluga (located approximately 200 miles south of Healy) and considered the environmental impacts that might be associated with such development.

In 1987, the City of Nenana performed a preliminary feasibility study for a coal-fired electric generation facility to be located near the city (Nenana 1987a, 1987b). The study assumed that the plant would have a capacity of approximately 150 MW. The study described the environmental problems associated with the development of such a project, including the project's thermal impact upon the Nenana River, the need for available land for the disposal of fly ash, and issues related to transporting coal approximately 50 miles to the plant site from the UCM Poker Flats mine. A complete feasibility study was not conducted because of a lack of funds. The project was abandoned because the cost of the plant was not competitive, the utilities did not need the additional 150 MW of electricity, and the existing transmission facilities could not transport all of the additional electricity to Fairbanks and Anchorage.

In 1988, APA undertook a study to assess the feasibility of electrical transmission projects in the Alaska Railbelt (APA 1988). This study included estimates of the capital costs; operations and maintenance costs; and environmental impacts of coal-fired power plants at Healy, Nenana, Beluga, and Matanuska Valley. Both circulating fluidized bed and pulverized coal technologies ranging in size from 50 to 150 MW were considered. All four of these sites would experience environmental impacts,

but the impacts were capable of being mitigated. The lowest cost options were found to be the circulating fluidized bed technology, the Matanuska site, and the largest plant size (150 MW). However, the report noted that smaller plant sizes may have other advantages such as reliability for system planning, fewer environmental impacts, and lower capital requirements. In both APA studies (1985 and 1988) the estimated costs were sensitive to the assumptions; site-specific studies were recommended to determine actual impacts and costs of the proposed projects.

These studies all showed that siting a coal-fired power plant at any of the studied locations, including Healy, would have environmental impacts. Although an alternative site location such as Nenana might have been a feasible site for the projects referenced above, such a location renders a proposed CCT project economically infeasible from GVEA's standpoint, because of increased capital requirements, labor costs, and fuel costs. In addition, siting the plant near Nenana to utilize the river water source could impact anadromous* fisheries. Locating the plant between Nenana and Fairbanks would probably not be permitted due to nonattainment of air quality standards in the Fairbanks area. Location away from the existing electrical intertie system, which roughly parallels the Parks Highway and Alaska Railroad corridor, would require construction of a new powerline transmission link at a cost of approximately $500,000 per mile and with associated environmental impacts. ***Siting a plant near existing communities between Healy and Fairbanks could also require developing new infrastructure.***

In summary, the project participant has determined that the only alternative sites that appear feasible for economic or environmental reasons are those along the Nenana River close to the UCM mine and adjacent to the existing power intertie. Within that area, sites closer to the mine mouth, sites near an existing community infrastructure, and sites that do not require additional disturbance or access routes appear to have advantages. The project participants have previously considered a site across the Nenana River from the UCM mine (see Fig. 2.1.2). This site, ***which is the site initially proposed by AIDEA (see Sect. 1.2),*** is typical of feasible alternative sites from the standpoint of environmental and socioeconomic impacts and was therefore adopted as the reasonable alternative site to be analyzed for purposes of this document. Table 2.2.2 presents a summary of HCCP impacts expected for the proposed site and alternative site.

2.2.3 Alternatives and Issues Dismissed from Further Consideration

The following sections discuss alternatives and issues that were raised via testimony, via written correspondence during the scoping process (Sect. 1.5), and during further planning for the project.

* "Anadromous" fish migrate up rivers from the sea and breed in fresh water.

Table 2.2.2. Comparison of the Healy Clean Coal Project (HCCP) for the proposed site versus the alternative site

	Environmental impact	
Resource	Proposed site	Alternative site
Atmospheric resources	*Construction* Minimal air quality impacts are expected from disturbance to about 10 acres; effects would occur intermittently and be limited primarily to emissions of fugitive dust and exhaust emissions (localized emissions of NO_x, CO, PM, and hydrocarbons).	Minor air quality impacts are expected from disturbance to about 37 acres; effects would occur intermittently and be limited primarily to emissions of fugitive dust and exhaust emissions (localized emissions of NO_x, CO, PM, and hydrocarbons).
	Operation[a] Air pollutants of potential concern are SO_2, NO_x, and PM_{10}. Air dispersion modeling for the demonstration case shows maximum concentrations would be up to 40% and 56% of the respective PSD[b] Class I (within DNPP[c]) and II (outside DNPP) increments.	Maximum concentrations of air pollutants within DNPP would be reduced from those predicted for the proposed site. Impacts outside DNPP would also decrease, except for PM which would increase or remain about the same.
	Air dispersion modeling shows maximum cumulative concentrations from the simultaneous operation of the HCCP and the existing Healy Unit No. 1 would be up to 96% of the NAAQS[d]. ***The planned retrofit of Unit No. 1 reduces these predictions to 81% of the NAAQS.***	Cumulative concentrations from the simultaneous operation of the HCCP at the alternative site and the existing Healy Unit No. 1 would be reduced from those predicted at the proposed site because the HCCP boiler building at the alternative site would not affect the Unit No. 1 stack plume.
	Ice fog downstream distance would increase from the current 3 or 4 miles to about 9 or 10 miles; this may affect the use of the private Usibelli Coal Mine, Inc. (UCM), airstrip.	Ice fog downstream distance would increase from the current 3 or 4 miles to about 10 or 11 miles; this may affect the use of the private UCM airstrip.
	Emission plume is predicted to be visible from the DNPP Visitor Access Center during less than 1% of the ***daytime*** hours per year. ***Using other assumptions preferred by the NPS, a plume is predicted as much as 8% of the daytime hours per year for the combined operation of Unit No. 1 and the HCCP (permitted case). Mitigation of Unit No. 1 would reduce this latter prediction to 7%.***	Visibility impacts are expected to be similar to impacts predicted for the proposed site.
Surface water resources	*Construction* Erosion and sedimentation not likely to substantially degrade water quality for recreation or other downstream uses of the Nenana River.	Impacts would be similar to those at the proposed site.
	No alteration of watershed drainage patterns.	Impacts would be similar to those at the proposed site.

Table 2.2.2 (continued)		
	Environmental impact	
Resource	Proposed site	Alternative site
Surface water resources (continued)	***Minor*** consumptive use of surface water ***if well groundwater source is inadequate.***	***Minor*** consumptive use of surface water ***if well groundwater source is inadequate.***
	Operation Occasional surface water withdrawals would not substantially affect Nenana River flow.	Effects on water quality and flow rate of the Nenana River would be similar to those at the proposed site. It is unlikely that HCCP effluents or runoff would affect Lignite (Hoseanna) Creek.
	During winter months, the cumulative water temperatures from the discharge of heated water during operation of Healy Unit No. 1 and the HCCP are predicted to be below the Alaska Department of Environmental Conservation limit of 55.4°F at 30 ft downstream of the HCCP discharge and beyond. During summer months, the cumulative water temperatures are predicted to be below the limit beyond 50 ft downstream of the HCCP discharge. Fishery impacts are expected to be minor due to small fish populations in the Nenana River and the species involved.	Cumulative thermal effects that would occur as a result of the HCCP and Unit No. 1 simultaneous operation at the proposed site would not occur at the alternative site because of the physical separation. Maximum elevation in river water temperature from discharge of HCCP once-through cooling would be less than that of both units at the proposed site.
	Thermal discharges may affect ice bridge formation at Ferry (about 13 miles downstream).	Thermal discharges would probably affect ice bridge formation at Ferry.
	Wastewater effluent would not have a major adverse effect on the water quality of the Nenana River.	Impacts would be the same as at the proposed site.
	Solid waste disposal practices are not expected to impact surface waters.	Impacts would be the same as at the proposed site.
Groundwater resources	Existing unlined fly ash ponds would be eliminated; ***dry fly*** ash would be stored in a silo. An unlined ash pond would be developed near the coal pile for coal pile runoff and for temporary ash disposal from Unit No. 1 when the HCCP is down for an outage. Seepage of coal pile runoff to groundwater is expected, but groundwater quality impacts are expected to improve slightly from existing conditions.	Impacts associated with runoff from the HCCP coal pile would be similar to the proposed site. Temporary ash disposal from Unit No. 1 would not occur at the alternative site. However, impacts associated with the existing unlined fly ash ponds at Unit No. 1 would not change from existing conditions.
	Groundwater withdrawal impacts are expected to be minor.	Impacts would be the same as at the proposed site.
	Off-site disposal of construction rubble and HCCP fly ash would have minimal impacts on groundwater.	Impacts would be the same as at the proposed site.

Table 2.2.2 (continued)		
	Environmental impact	
Resource	Proposed site	Alternative site
Ecological resources, terrestrial	*Construction* No major loss of wildlife habitat is expected from site preparation, increased numbers of people, and increased frequency of loud noises.	Site preparation would disturb more area (37 vs 10 acres). Increased removal of terrestrial ecosystems would result.
	Operation Surface mining of coal for the HCCP would require disturbing and revegetating an additional 4 acres per year (currently, about 29–33 acres are disturbed in surface mining).	Impacts would be the same as at the proposed site.
	Leachate from wastes disposed of in the coal mine is not expected to affect near-surface groundwater (which would affect terrestrial resources).	Impacts would be the same as at the proposed site.
	No effects on wildlife populations would occur as a result of respiring HCCP SO_2 and NO_2 emissions. Effects of pollutant gases on vegetation are not expected to be major and are expected to be limited to maximally exposed locations. Deposition of coal ash particles may measurably increase metal concentrations in some local ecosystem components but would not have major effects on those ecosystems. A substantial HCCP contribution to ecological effects of acidic deposition is unlikely.	Any potential impacts from operation at the proposed site would be about the same or slightly less at the alternative site.
Ecological resources, aquatic	*Construction* Effects of construction excavation (at the water intake and discharge structures) may disturb riverine benthic communities, which should recover within 2 years. Suspended sediments are not expected to have major effects on the aquatic community.	Effects at the alternative site would be similar.
	Operation The HCCP may cause a small amount of entrainment, impingement, and cold-shock mortality; but the effects are not expected to be major. A cross connection would be installed between the Healy Unit No. 1 and HCCP discharges that may mitigate cold-shock mortality by allowing discharge to both outfalls when one of the units is shut down.	Effects at the alternative site would be similar. Cumulative effects would be less, but no cross connection would be installed to mitigate impacts.

Table 2.2.2 (continued)		
	Environmental impact	
Resource	Proposed site	Alternative site
Ecological resources, threatened and endangered species	No anticipated effects on threatened or endangered species.	No anticipated effects on threatened or endangered species.
Floodplains and wetlands	Construction would occur on land that already has been disturbed. No intrusion on a floodplain nor loss of wetlands is expected.	22 acres of wetland could be disturbed and lost because of construction, of which 2 acres currently support wetland communities.
Prehistoric and historic resources	No impacts to prehistoric or historic resources are likely to occur.	Impacts would be the same as at the proposed site.
Socioeconomics, population	Construction-related population growth would add 382 residents to the Denali Borough; operations would add 102 residents. This HCCP-related growth would represent 25% of the Denali Borough's ***1996*** population.	Impacts of construction would be similiar to those for the proposed site; operations would add 134 residents. This HCCP-related growth would represent ***26%*** of the Denali Borough's ***1996*** population.
Socioeconomics, employment	*Construction* The major employment impact for borough residents would be the indirect jobs created by the construction workers' expenditures in the local economy. The creation of 75 indirect jobs would have economic impacts in the Denali Borough.	Impacts would be similiar to those for the proposed site.
	Operation A minor impact for the borough would be the likelihood that some (13) of the temporary indirect jobs created during construction would become permanent jobs.	Impacts would be greater because of the presence of 45 workers (as opposed to 32 workers at the proposed site).
Socioeconomics, housing	Both construction- and operations-related impacts are expected because of the demand for 49 housing units during construction, 40 housing units during the demonstration, and up to 89 units in ***1996–1997*** during an overlapping period of construction and demonstration.	Construction impacts would be similar to those for the proposed site; impacts of operation would be slightly greater because of the 13 additional operations workers.
Socioeconomics, public services, education	*Construction* The addition of 22 students to the projected 1995–96 enrollment of ***285*** would exceed the school capacity of ***165*** by ***142*** students ***but should not create major impacts if current plans for school expansion are implemented.***	Impacts would be similiar to those for the proposed site.

Table 2.2.2 (continued)

Resource	Environmental impact: Proposed site	Environmental impact: Alternative site
Socioeconomics, public services, education (continued)	*Operation* The addition of 22 students to the projected ***1996–97*** enrollment of ***290*** would exceed the school capacity of ***165*** by ***147*** students ***but should not create major impacts if current plans for school expansion are implemented.***	The addition of 35 students to the projected ***1996–97*** enrollment of ***290*** would exceed the school capacity of ***165*** by ***160*** students ***but should not create major impacts if current plans for school expansion are implemented.***
Socioeconomics, public services, police and fire protection	*Construction* Population growth of 382 residents would stretch the resources of the local police and fire departments.	Impacts would be the same as at the proposed site.
	Operation The addition of 102 new residents would slightly increase the work load for the local police and fire departments, but impacts are expected to be minor.	With projected population growth of 134, impacts would be larger than those for the proposed site.
Socioeconomics, public services, medical services	*Construction* The addition of 382 residents during HCCP construction would ***not*** have major impacts on medical services in the Healy vicinity.	Impacts would be the same as at the proposed site.
	Operation With projected population growth of 102, operations ***would not*** substantially reduce the ability of local medical services to serve the local population.	With projected population growth of 134, impacts would be larger than those for the proposed site ***but should not be substantial.***
Aesthetics	Major impacts are not expected.	Major impacts are not expected.
Noise	Major impacts are not expected.	Major impacts are not expected.
Waste management	No substantial on-site impacts. Additional waste generated during construction may hasten the borough's need for additional landfill space before the year 2000.	Level of impacts would not change. Distance for transporting ash to the mine would double.
Electromagnetic fields	The HCCP would not change the level of effects, if any.	A new electrical transmission line would be required, but no adverse impacts are expected.
Worker health and safety	Health and safety impacts are not expected to be substantial.	Level of impacts would be the same as at the proposed site.

[a] *Values presented do not reflect the Mitigation Agreement discussed in Sect. 2.1.3.2, except for visibility impacts.*
[b] *Prevention of Significant Deterioration*
[c] *Denali National Park and Preserve*
[d] *National Ambient Air Quality Standards*

AIDEA conceived, designed, and proposed the HCCP in response to the PON soliciting proposals that was issued by DOE in May 1989 (Sect. 1.1). DOE's role is limited to providing the cost-shared federal funding for AIDEA's proposed project. As such, the alternatives that meet the goals of demonstrating this technology are narrowed due to the proposal selection process that DOE must follow by law.

2.2.3.1 Alternative Technologies

The HCCP was selected to demonstrate a particular type of technology. Other CCT projects would not achieve this goal. Furthermore, in the context of the no-action alternative, a coal-fired plant is the only reasonable technology to site in the study area because of fuel availability. In addition, the use of other technologies to meet ***GVEA's*** need for power (e.g., natural gas***, wind power, solar energy, and conservation***) not only would not achieve the goals of the CCT Program, but also would result in impacts remote from the study area and thus would be subsumed in the no-action alternative.

2.2.3.2 Other Projects

Environmental comparisons between the offerors for the CCT Program were made as a part of the preselection review (Sect. 1.5). DOE is in the process of negotiating cooperative agreements with the sponsors of all selected projects. Therefore, they are not alternatives to each other. In addition, the HCCP is the only selected project that would accomplish the goal of demonstrating this technology.

2.2.3.3 Alternative Component Options

Alternative options for removing waste heat from the steam condenser were considered during the planning process of the project (AIDEA 1991b). These include (1) wet cooling tower, (2) air cooled condenser, and (3) wet/dry cooling tower. An analysis was performed to compare these options. They were ranked from most to least desirable as follows:

1. air-cooled condenser,
2. once-through system,
3. wet/dry cooling system, and
4. wet cooling tower.

The air-cooled condenser had the least environmental impact because it would neither warm the river nor create a vapor plume. However, it is more costly and less energy efficient than other alternatives. The once-through cooling system was the alternative that was chosen and discussed as part of the proposed project and is therefore discussed in this EIS.

The wet/dry cooling system alleviates the ice fog problem associated with river water warmed by the once-through cooling system. However, a vapor plume would be visible from some areas in DNPP, local roads, and the Alaska Railroad. This system is considered to be only marginally better than the wet cooling system in terms of environmental impacts. It is also the most costly of the available options.

The wet cooling tower would have no impact on the Nenana River; however, there would be a year-round vapor plume visible from northern portions of DNPP, the George Parks Highway, the Healy Spur Highway, the Alaska Railroad, and charter aircraft visiting the Denali area. This system is also prone to freezing problems in the severe climate of the Healy area. These problems make this option less desirable than the other alternatives.

Stack height options were also examined. Two assumed stack heights for the combined HCCP and Unit No. 1 emissions (150 ft and 212.5 ft) were analyzed for their impact on visibility. The study found that the value assumed for the stack height for the combined emissions had only a minor effect on the number of hours the emissions exceeded the theoretical threshold for plume visibility.

2.2.3.4 Other Alternatives and Issues

Other alternatives, such as delaying or reducing the size of the proposed project, have been dismissed as not reasonable. ***Delaying the project would not result in any reduction of impacts once it is implemented, but would adversely affect DOE's schedule for demonstrating the technology and GVEA's ability to meet the needs of its customers.*** The 50-MW design size of the HCCP was chosen ***by the participant*** in order to be able to demonstrate the slagging combustor technology at the smallest scale that could make use of commercial-size components ***and offer reliable and flexible plant operations. In addition, the 50-MW unit was selected as a minimum size because it is large enough to convince utility companies that the technology, once demonstrated at this scale, can be applied directly, without further scale up, to a host of similar sized boilers and, more importantly, the same size combustion system can be applied to larger sized utility boilers.***

3. EXISTING ENVIRONMENT

This section profiles the environmental resources in the vicinity of the proposed HCCP, including the proposed site, the alternative site, and DNPP. The resources discussed include relevant physical, biological, social, and economic conditions that might be altered through the implementation of the proposed action or alternatives to the proposed action.

3.1 SITE DESCRIPTION AND AESTHETICS

The HCCP proposed and alternative sites are located in a region of abundant scenic beauty (Fig. 3.1.1). Situated along the northern base of the Alaska Range, the region is famous for scenic resources, geological formations, plants, and wildlife that attract tourists from all over the world. Because of this abundance of visual resources, aesthetic concerns are of primary importance to any project proposed for the region.

Visual resource management systems, methods by which visual characteristics of areas may be described, assessed, and protected, have been developed by the U.S. Forest Service (USFS) and the U.S. Bureau of Land Management (BLM) (USFS 1974; BLM 1980). Under these management systems, visual resources are considered to have three basic attributes: landscape character, visual condition, and visual resource importance. Landscape character describes the landforms, water bodies, vegetation patterns, and human modifications that give a particular landscape its distinguishing characteristics. Visual condition describes the degree to which humans have modified the landscape. Visual resource importance ascribes relative values to an area within the landscape and is a function of (1) how distinctive a particular area is relative to the characteristic landscape being assessed (scenic quality), (2) the volume of use and degree of user interest (visual resource sensitivity), and (3) the visibility of the landscape of interest (distance zone) (AIDEA 1991a).

This section discusses visual resources in the region and at the potential HCCP sites in terms of the three attributes previously described. The study region includes (1) areas close enough to the HCCP proposed and alternative sites to be affected directly by physical changes in the sites' aesthetic environment and (2) areas in which the aesthetic environment could be changed by indirect effects of the HCCP away from the project site.

3.1.1 Denali National Park And Preserve

3.1.1.1 Landscape Character

The nearest borders of DNPP are about 4 miles south of the proposed site and about 6 miles west of the alternative site (Fig. 3.1.2). Mount McKinley, the tallest mountain in North America (20,320 ft above mean sea level), is DNPP's most famous visual resource. The Mount McKinley group provides a

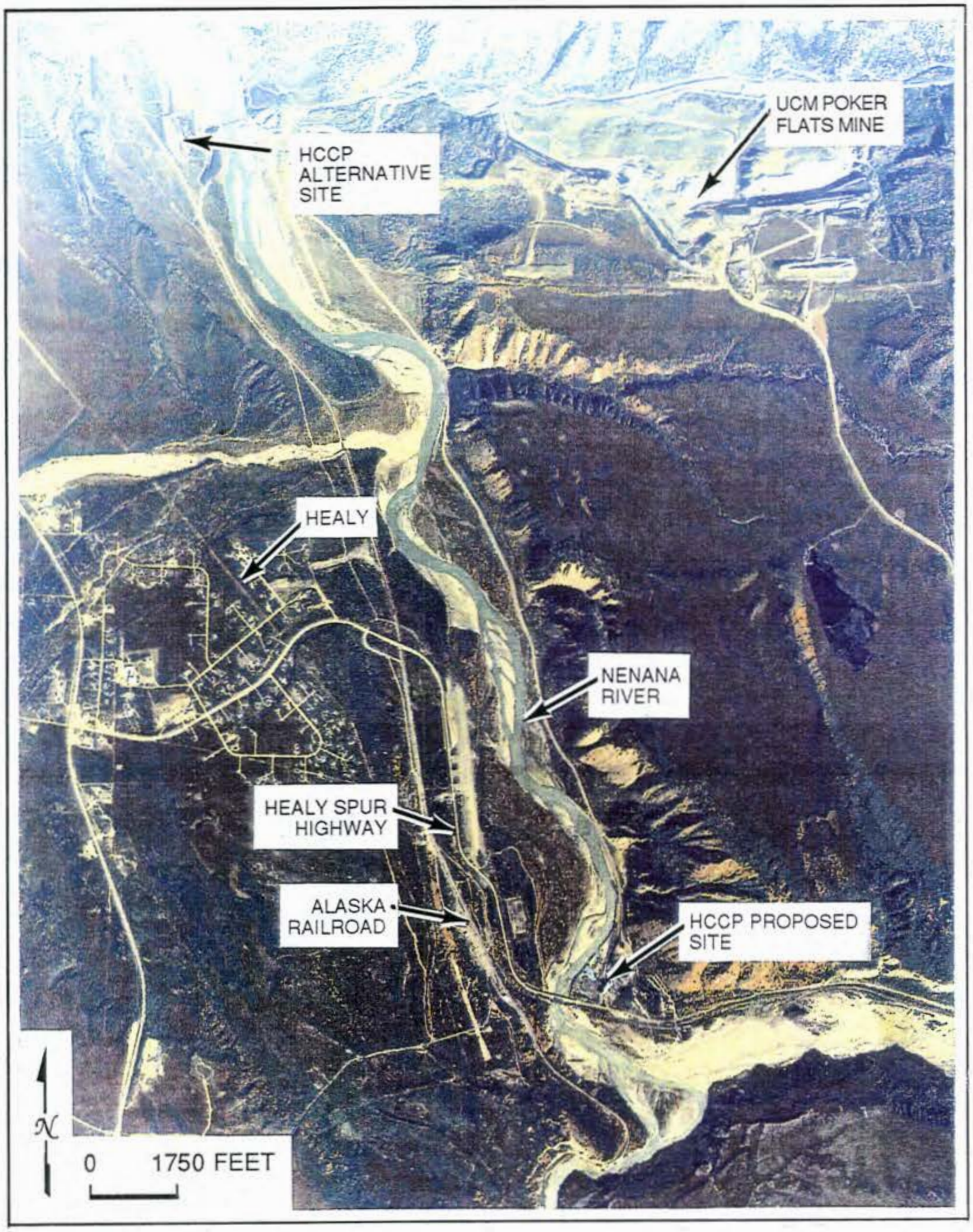


Fig. 3.1.1. Aerial view of the Healy Clean Coal Project proposed and alternative sites.

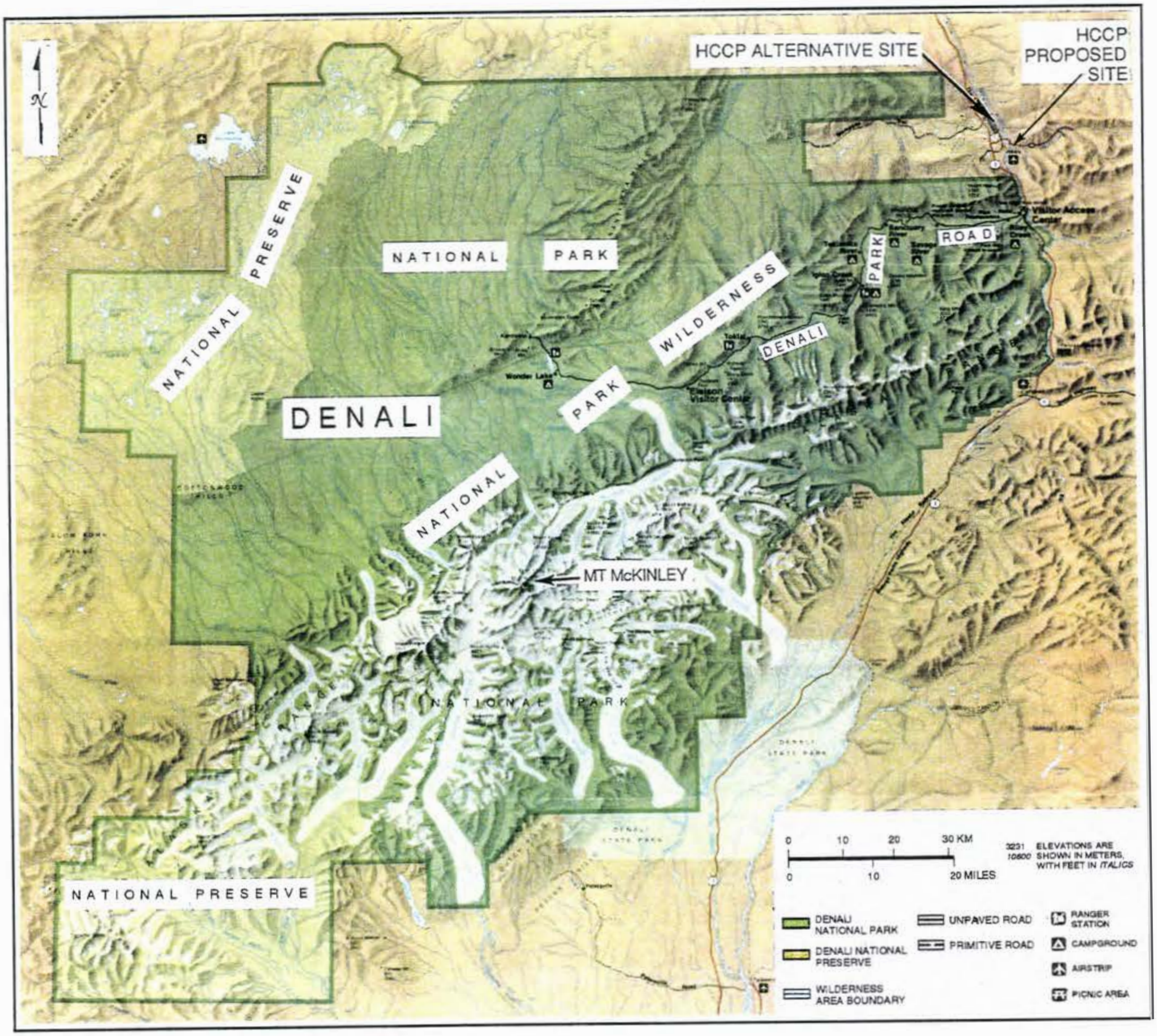


Fig. 3.1.2. Location of Denali National Park and Preserve in relation to the Healy Clean Coal Project proposed and alternative sites.

distinctive viewing opportunity within the Alaska Range, as few peaks elsewhere in the range are higher than 8000 ft. The McKinley group's peaks are spectacular visually because they rise from the relative lowlands of the interior plain rather than from a range of uniformly high mountains. For example, the northern peak of Mount McKinley (19,470 ft) lies within 10 miles of a lowland plain at 3,000-ft elevation.

The aesthetic resources most pertinent to the HCCP include those visible from the ***Denali Park*** Road, which runs west from ***Denali*** Park (at the entrance to DNPP) approximately 90 miles through DNPP to Kantishna. Although Mount McKinley's southern peak (20,320 ft) is higher than its northern peak (19,470 ft), the northern peak is most visible from viewpoints along the ***Denali Park*** Road. The first view of the McKinley group is at mile post (MP) 9, approximately 12 miles from the proposed HCCP site, with the best views beginning at about MP 60. The whole McKinley group comes into view starting at about MP 61.2, and this is also the point at which the ***Denali Park Road*** is closest to the summit of McKinley's northern peak (27 miles). In addition to the McKinley group, many lesser peaks (4000 to 6000 ft) within DNPP also are visible from the ***Denali Park Road*** (AIDEA 1991a).

3.1.1.2 Visual Condition

The landscape of DNPP has experienced very little human modification, and management of DNPP focuses on preserving this natural visual quality. Other than the passage of the Alaska Railroad and the George Parks Highway through a small portion of its eastern margin, the only ***road*** access ***within*** DNPP is along the ***Denali Park*** Road. Automobile traffic is generally restricted to the paved portion of the road from the DNPP entrance to Savage River (approximately 15 miles), with a limited number of private vehicles allowed access to campgrounds beyond ***and private land in the Kantishna Hills***. The remainder of tourist access is provided by NPS and concessionaire ***tour*** buses that travel round trip to ***the park interior***. Once beyond the intensive development in the area of the DNPP Headquarters, virtually the only ***human***-made features are the ***Denali Park*** Road, five campgrounds along the road, ***the Toklat Road Camp,*** the Eielson Visitor Center, ***several ranger stations, three rest stops, and development in the Kantishna area***. Using BLM standards, DNPP's visual condition is rated as relatively high based on the pristine nature of the vast majority of its 6 million acres (AIDEA 1991a).

3.1.1.3 Visual Resource Importance

Mount McKinley is unique in being the highest and one of the most spectacular mountains in North America, and the sheer size of DNPP is testimony to its importance as a national resource. Based on the BLM scenic quality rating system, DNPP as viewed from ***Denali Park*** Road receives a Class A rating. Class A areas are those that combine the most outstanding characteristics of each rating factor (i.e., uniqueness, use, and visibility of the landscape) (AIDEA 1991a).

Visitor use of the ***Denali Park*** Road is heavy; more than 500,000 visitors have toured DNPP annually since 1986. BLM defines high-use routes as those receiving 20,000 or more visits per year or a comparable degree of use on a seasonal basis. Because most of the trips on the ***Denali Park*** Road are made for scenic and recreational purposes, it is assumed that there is high interest in and concern for DNPP's landscape among the road's users. It may also be assumed that concern about changes in landscape features throughout any but the most developed areas of DNPP would be high. High volume of use, coupled with an inferred high degree of public concern over the preservation of a national park and preserve, indicates that a high degree of visual resource sensitivity is likely (AIDEA 1991a).

Visual resources that are closer to the viewer are generally considered to be more important than those at some distance. Areas greater than 5 miles from the viewer, but generally less than 15 miles away, are defined as being in the background distance zone. Almost all of the more spectacular vistas from the ***Denali Park*** Road are more than 5 miles away from any viewpoint along the road and, according to this criterion, would be considered distant. However, at nearly 4 miles high, 70 miles long, and 10 miles wide, the Mount McKinley group is an important visual resource even when viewed from sites more than 25 miles away (AIDEA 1991a).

Another important aspect of viewing scenic resources is the visual quality of the atmosphere through which they are observed. DNPP is a federal PSD Class I air quality area (also see Sect. 3.2.4). Air quality is considered to be excellent, except for dust generated by vehicles using the ***Denali Park*** Road and haze generated during the summer by forest fires. Another cause of reduced visibility within DNPP, particularly when viewing Mount McKinley, is cloudiness. Mount McKinley is so large that it causes cloud formation and is often enshrouded by clouds.

3.1.2 The Nenana River Valley

3.1.2.1 Landscape Character

Another area of important scenic resources in the vicinity of the HCCP is the Nenana River Valley, from the proposed site to Cantwell, about 30 miles to the south. Scenic resources are visible from the George Parks Highway, the Alaska Railroad, and the Nenana River, all of which share this corridor through the Alaska Range. The physical setting of the river, a sculptured glacial valley with sheer walls, provides distinctive viewing opportunities. The Nenana River Valley itself is flat and U-shaped, with walls rising from 2000 to 3000 ft above the river, but it descends from about the 2100-ft-elevation level just north of Cantwell to about 1350 ft at Healy. In the Nenana River Gorge, that part of the Nenana River Valley between ***Denali Park*** and Healy, the river descends approximately 460 ft within about 5 miles. This descent through the sculptured glacial valley provides some of the local area's most spectacular scenery.

3.1.2.2 Visual Condition

The landscape of the floor of the Nenana River Gorge has been modified rather extensively by human activities, while the higher-elevation valley walls have hardly been modified. Modifications have been related primarily to provisions for transportation ***and utility lines*** (i.e., the George Parks Highway, the Alaska Railroad, ***and the Anchorage-Fairbanks Transmission Intertie***) and to the intensive commercial development near the DNPP entrance. According to the BLM's visual condition classification system, the river valley's visual condition is moderate. This means that human activities are evident and attract attention, but that they are subordinate to the inherent features of the landscape (AIDEA 1991a).

3.1.2.3 Visual Resource Importance

The NPS rates various areas within the Nenana River Gorge north of DNPP as the most significant scenic areas along the Nenana River. The *Tanana Basin Area Plan* for state lands recommends preservation of the foreground scenery (0.25 to 0.5 miles away) along the Nenana River by designating the river as a State Recreation River for a stretch extending from the Nenana Glacier to Healy (Alaska Department of Natural Resources ***1991***). Based on this recommendation, the scenic quality of the Nenana River Valley relative to other similar landscapes is considered to be high. According to the BLM system, the area is rated as Class A. Class A areas are those that combine the most outstanding characteristics of each rating factor (i.e., uniqueness, use, and visibility of the landscape) (AIDEA 1991a).

The volume of use of the Nenana River Valley as a transportation corridor is high, as the George Parks Highway and the Alaska Railroad provide key routes for general transit between Anchorage and Fairbanks. This part of the river may be designated as a scenic resource. User attitudes about potential effects on scenic resources in the area probably differ depending on whether use is as tourism or transportation. For the Nenana River Valley, it is assumed that a high volume of use coupled with either a medium or high degree of public concern indicates the likelihood of high visual resource sensitivity (AIDEA 1991a).

Most landscape features visible along the Nenana River Valley are foreground views (0.25 to 0.5 miles away) or middleground views (0.5 to 5 miles away). A few of the peaks visible from this corridor would be considered as background views (more than 5 miles away) (AIDEA 1991a).

3.1.3 The Healy Clean Coal Project Proposed Site

3.1.3.1 Landscape Character

The HCCP proposed site lies at the confluence of Healy Creek and the Nenana River near the northern base of the Alaska Range (Fig. 3.1.3). Topography in the immediate vicinity of the HCCP site is varied. West of the Nenana River, the terrain is gently rolling and covered primarily with resin birch and immature quaking aspen communities. South of Healy Creek are shallow moraine and outwash gravel

Fig. 3.1.3. Aerial view of the Healy Clean Coal Project proposed site.

terraces supporting low shrub and herbaceous tundra, backed by low foothills of the Alaska Range. The dominant landform at the HCCP site is the high plateau to the northeast. Steep faces of this plateau rise above the Nenana River and Healy Creek and support coniferous and deciduous forest types alternating with large gravel slides (AIDEA 1991a).

3.1.3.2 Visual Condition

The proposed HCCP would be constructed adjacent to the existing Healy Unit No. 1 in an area that has experienced a moderate level of human modification. Water vapor that condenses from the Unit No. 1 stack produces a white plume that under certain conditions may be visible for up to 1 mile before it evaporates. The plume is only occasionally visible (during stable atmospheric conditions with light winds and cool temperatures). In addition to the existing power plant and its associated coal pile, coal conveyor, fly ash ponds, and substation, the following man-made features exist within sight of the HCCP:

- the private gravel haul road from the UCM coal mine to the existing power plant;
- a 345-kV power transmission line entering the Healy Unit No. 1 substation from the south and a 138-kV power line leaving the power plant approximately to the west and then north to Fairbanks;
- the paved Healy Spur Highway, which approaches from the George Parks Highway at Healy, crosses the Nenana River by bridge at the HCCP site, and continues up Healy Creek;
- the Suntrana spur of the Alaska Railroad, which parallels the Healy Spur Highway near the HCCP site, crossing the Nenana River on a separate bridge;
- the main line of the Alaska Railroad, including the Healy switchyard and associated buildings, located west of the Nenana River;
- the Healy River Airport and the old Healy airstrip, both located west of the river;
- a large gravel pit west of the Nenana River;
- a recreational vehicle park located just east of the HCCP site beyond a small forested area; and
- a commercial coal pile and associated buildings located to the south and directly across the Healy Spur Highway from the entrance to the recreational vehicle park.

The community of Healy, the George Parks Highway, and the UCM coal mine and its associated conveyor and tipple are additional noticeable man-made features located within a 4-mile radius of the proposed site. Visual condition, as defined by BLM standards, is moderate (AIDEA 1991a).

3.1.3.3 Visual Resource Importance

Although the diversity of landscape is high with respect to landforms, water bodies, and vegetation patterns, the extensive intrusion of man-made features in the landscape changes scenic quality. Lower scenic quality is reflected in recommendations not to extend the designation of the Nenana River as a State Recreation River north of Healy (at the location of the Healy Spur Highway Bridge) (Alaska Department of Natural Resources 1990). Scenic quality of the HCCP site is considered to be moderate relative to other similar landscapes, as reflected by a BLM scenic quality rating of Class B. This rating is assigned to areas in which there is a combination of some outstanding features and some that are fairly common to the physiographic region (BLM 1980; AIDEA 1991a).

The volume of HCCP area use varies among types of transportation. Vehicle traffic on the Healy Spur Highway consists primarily of workers at the existing Healy Unit No. 1 and the UCM mine, as well as users of the recreational vehicle park just beyond the proposed site. This volume of use is low to medium according to the BLM definition. Attitudes of these transportation users concerning preservation of the scenic quality of this area are unknown (AIDEA 1991a).

The HCCP proposed site is also visible from the Alaska Railroad, which follows the Nenana River across from the HCCP site on its north-south route between Anchorage and Fairbanks. Because no regular passenger rail stops exist between ***Denali Park*** and Healy, ridership in this area is probably much the same as that described above for the Nenana River Gorge. According to the BLM definition, this would be considered a medium-use route. Railroad user interest in or concern for preservation of the HCCP site scenery is unknown, but is assumed to be lower than that for preservation of the Nenana River Gorge (AIDEA 1991a).

Whitewater raft and kayak trips traversing the Nenana River Gorge disembark just below the Healy Spur Highway Bridge across the river from the HCCP site. This recreational group constitutes several thousand users per year (see Sect. 3.8.6). In general, this group is assumed to have a moderate to high degree of regard for preservation of scenic quality (AIDEA 1991a).

A fourth type of transportation user comprises hikers and other people who travel by foot to areas in DNPP from which the HCCP site may be viewed. Visitation rates to such areas are unknown, but are estimated to be very small compared with visitation rates to other locations within DNPP. Nevertheless, this group of hikers is assumed to have a moderate to high degree of concern for preserving the area's scenic quality (AIDEA 1991a).

As defined by the BLM classification, the low to moderate use of the surrounding area coupled with moderate concern indicates a low to moderate visual resource sensitivity for the proposed HCCP site (AIDEA 1991a).

3.1.4 The Healy Clean Coal Project Alternative Site

3.1.4.1 Landscape Character

The HCCP alternative site, located approximately 4 miles north-northwest of the proposed site, lies on the west bank of the Nenana River across from the UCM *coal* mine (Fig. 3.1.4). Topography in the immediate vicinity of this site is similar to that described for the proposed site, with the dominant landscape features being the river and the high plateau to the east. However, the alternative site location would be on a broader low-lying terrace of the Nenana River than the proposed site location.

3.1.4.2 Visual Condition

The alternative site has not been as heavily disturbed as the proposed site. However, the alternative site is located adjacent to existing UCM facilities in an area that has experienced human modification. The existing facilities include a coal stockpile, a load-out building, and a tipple on the west bank of the Nenana ***River***; an elevated coal conveyor that spans the Nenana; and a gravel haul road, a coal stockpile, UCM's office/shop building, and other mining facilities on the east bank. Because it has been disturbed by the presence of these coal-related facilities, the visual condition of the alternative site is rated as moderate using BLM standards.

3.1.4.3 Visual Resource Importance

At the alternative site, the diversity of landscape features is high with respect to landforms, water bodies, and vegetation patterns. However, the intrusion of man-made features in the landscape diminishes scenic quality. Lower scenic quality is reflected in the recommendations not to extend the designation of the Nenana River as a State Recreation River north of Healy (Alaska Department of Natural Resources 1990). Scenic quality at the alternative site, as defined by BLM standards, is considered moderate relative to other similar landscapes.

The volume of use in the vicinity of the alternative site is low compared with use near the proposed site. The alternative site is located several miles north of any popular kayaking or rafting areas, and it is not visible to hikers in DNPP. Vehicle traffic near the alternative site consists almost entirely of (1) UCM trucks and equipment operating at the mine and delivering coal to the existing Healy Unit No. 1, and (2) UCM employees going to and from work each day. This volume of use is low according to BLM standards. Attitudes of these transportation users concerning preservation of the scenic quality of this area are unknown.

The alternative site is visible from the Alaska Railroad, and ridership in this area is probably much the same as that of the proposed site. According to the BLM definition, this would be considered a medium-use route. Railroad user interest in or concern for preservation of the alternative site's scenery is unknown.

As defined by the BLM classification, the low to moderate use of the surrounding area coupled with unknown concern indicates a low to moderate visual resource sensitivity for the alternative site.

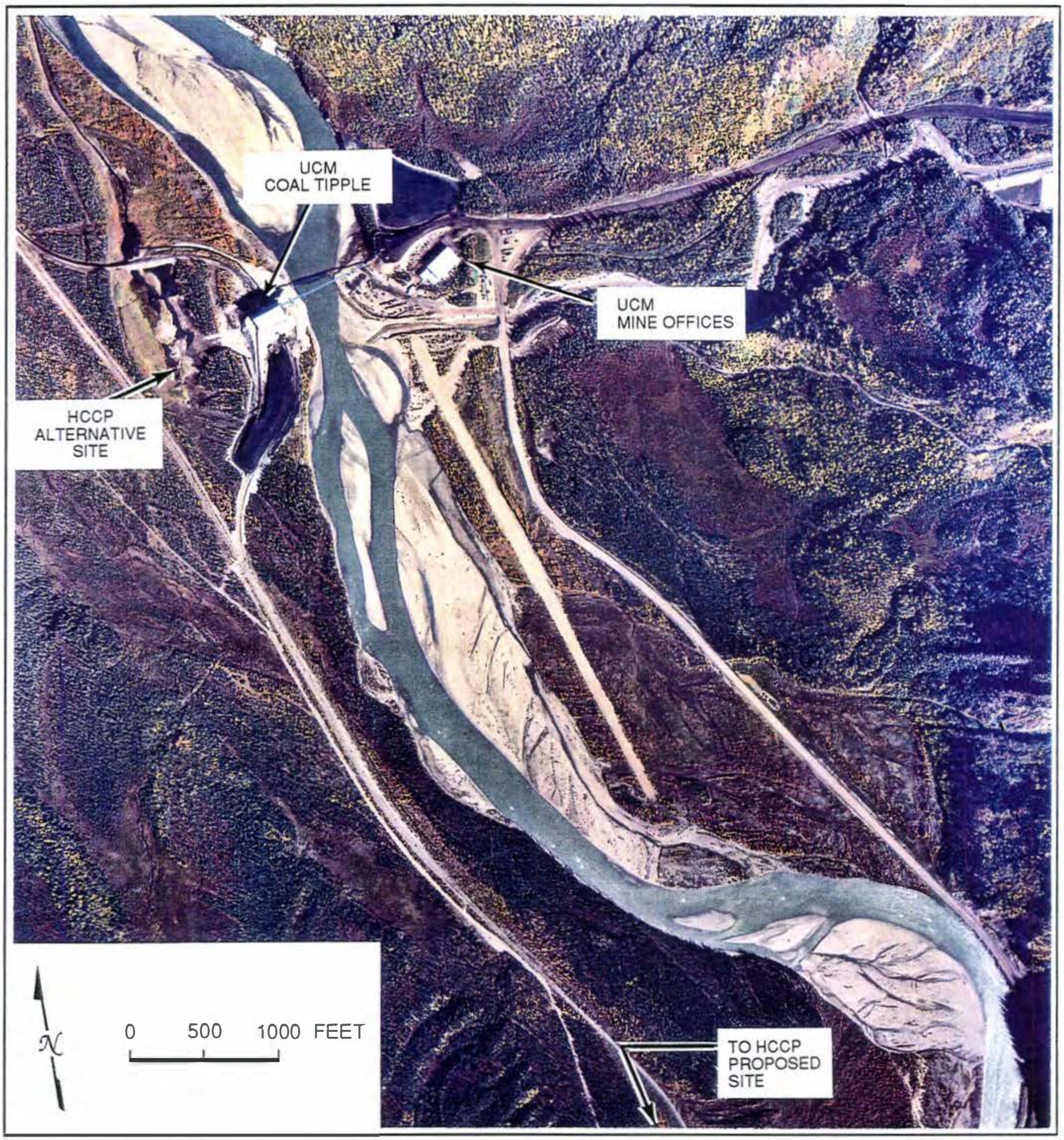


Fig. 3.1.4. Aerial view of the Healy Clean Coal Project alternative site.

3.2 ATMOSPHERIC RESOURCES

3.2.1 Climate

Climatic conditions within Alaska vary considerably depending upon geographic location. Four climatic zones occur within the state (ESSA 1968): (1) a maritime zone, (2) a continental zone, (3) a transition zone between marine and continental influences, and (4) an arctic zone. The continental zone, in which the HCCP would be located, is characterized as cold and dry, with large differences between winter and summer air temperatures.

Meteorological data for the area in which the HCCP would be located are available from several sources. Meteorological data were collected for 12 months (September 1990–August 1991) by the project participant at two meteorological monitoring stations: the HCCP Healy Monitoring Station, located about 0.5 mile west of the HCCP proposed site; and the HCCP Park Monitoring Station, located about 4 miles south of the HCCP proposed site and about 500 ft north and outside the boundary of DNPP (Fig. 2.1.2). Meteorological parameters monitored at the Healy Monitoring Station included wind speed and direction at two levels above ground (10 m and 30 m), temperature at two levels (2 m and 30 m), and precipitation. Mixing height, a parameter used as input to atmospheric dispersion modeling for prediction of HCCP air quality impacts, was also measured using a monostatic acoustic radar unit. Mixing height is defined as the height in the lower atmosphere within which relatively vigorous mixing occurs. Meteorological parameters monitored at the Park Monitoring Station included wind speed and direction at 10 m, temperature at 2 m, and dew point temperature.

Meteorological data also were recorded at the UCM Poker Flats Mine, (located about 4 miles north of the HCCP proposed site) between 1978 and 1984. ***In addition,*** meteorological data are routinely collected by the NPS at a location about 9 miles south of the HCCP proposed site near the DNPP Headquarters. The nearest National Weather Service (NWS) meteorological station is located at Fairbanks, about 80 miles north-northeast of the HCCP site.

During June and July at the HCCP site, the sun is above the horizon for about 18 to 21 h per day, with associated daytime temperatures occasionally reaching highs in the 70s (°F). In contrast, daylight from November to early March ranges from 10 to less than 4 h per day. The lack of solar heating during the winter results in very cold temperatures. A major contributing factor to the cold temperatures is the persistent winter snow cover that reflects much of the solar energy during its limited appearance. Consequently, ambient temperatures regularly fall below 0°F. Temperature data recorded at the UCM ***coal*** mine over a 7-year period (1978–1984) (UCM 1983) indicate that average monthly highs ranged from 10 to 65°F, and average monthly lows ranged from –5 to 45°F. The maximum high recorded was 80°F in July 1982; the minimum temperature recorded was –52°F in January 1983.

The area has low annual precipitation, most of which occurs during the warm summer months. Precipitation data, collected at the UCM ***coal*** mine from 1978 through 1984 (UCM 1983), reveal that measurable precipitation was not observed during 25 of the 84 monthly data collection periods. The maximum precipitation recorded during a single month was 5.7 in. in August 1983, and the maximum annual rainfall during a 1-year period was 19.3 in. Unofficial records suggest that average annual snowfall in the Healy area may approach 60 in.

Relative humidity data are measured by the NWS in Fairbanks at 3 a.m., 9 a.m., 3 p.m., and 9 p.m. Average annual relative humidity readings for these time periods are 73, 68, 57, and 64%, respectively. The highest values (81–85%) normally occur during July, August, and September at 3 a.m., while the lowest values (38–43%) normally occur around 3 p.m. during May and June (NOAA 1988). Relative humidity data measured at the DNPP Headquarters Station from September 1990 through August 1991 are in good agreement with the NWS data.

Because of the complex terrain (mountainous) features in the vicinity of the HCCP site, substantial differences in wind speed and direction can occur between the HCCP site and neighboring areas. The Healy area is located at the foothills of the Alaska Range amid rugged terrain. Nearby hills and mountains surround the area, resulting in a narrow valley sloping and widening to the north. The HCCP site is located on the north side of the narrow Nenana River *Gorge*, which bisects the Alaska Range. Air masses separated by the high terrain frequently produce strong pressure gradients and consequent high wind episodes. High winds from the south-southeast frequently occur during winter; wind speed gusts in excess of 100 mph ***occasionally*** occur in the Healy area. When the wind speed is light, local winds often flow along the drainage axes of Healy Creek and the Nenana River.

Twelve months of validated wind data (September 1990–August 1991) are available from the two HCCP monitoring stations. Figure 3.2.1 displays a wind rose* for winds at the HCCP Healy Monitoring Station (30 m above ground level). Winds at the 30-m elevation at the Healy Monitoring Station are at approximately the same level as stack-top winds would be at the HCCP proposed site. The wind rose indicates that winds are predominantly from the south-southeast with a secondary prevalence of winds from the northwest. The prevailing wind directions clearly reflect the influence of the Nenana River Valley in channeling the winds along the same orientation. Wind speeds usually are greater for winds from the south-southeast than other directions.

Comparisons were made of wind roses for the HCCP Healy Monitoring Station with the HCCP Park Monitoring Station and the DNPP Headquarters Station. The comparisons indicated that wind directions are similar for the HCCP Healy and Park Monitoring Stations, but wind directions differ greatly at the DNPP Headquarters Station, in which prevailing winds are from the northeast quadrant. Wind

*A wind rose is a graph in which the frequency of wind blowing from each direction is plotted as a bar that extends from the center of the diagram. Wind speeds are denoted by bar widths; the frequency of wind speed within each wind direction is depicted according to the length of that section of the bar. Note that because the wind rose displays directions from which the wind blows, emissions would travel downwind in the opposite direction.

ORNL-DWG 93M-8157

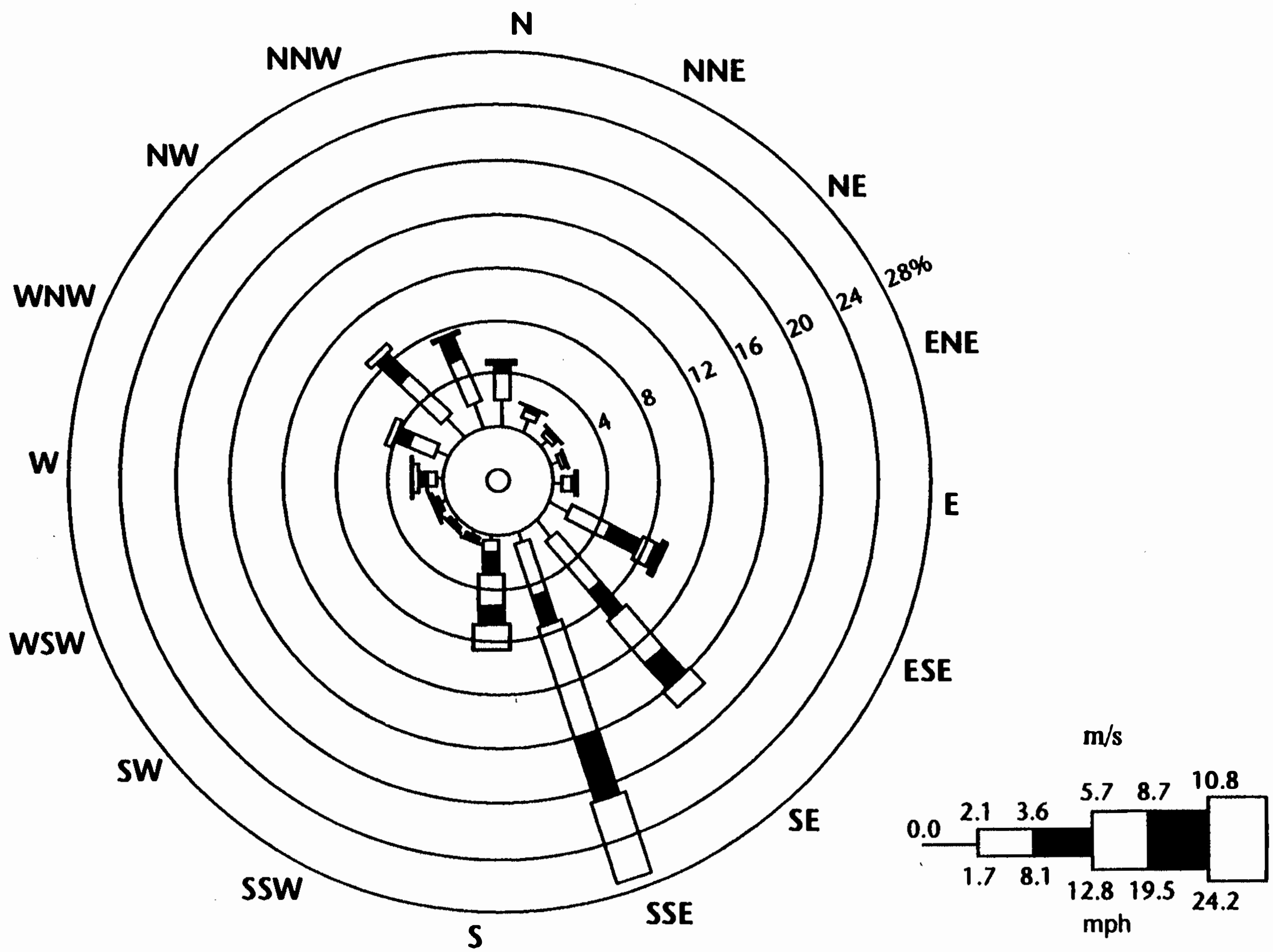


Fig. 3.2.1. Wind rose for the Healy Clean Coal Project Healy Monitoring Station. (Elevation is 30 m; 9/1/90–8/31/91.)

directions at the DNPP Headquarters Station appear to be influenced by southerly winds which are redirected into northeasterly winds by the ridge of mountains immediately to the north of the station. Wind speeds are higher at the Park Monitoring Station than at the Healy Monitoring Station, especially during the winter, partially because northerly winds are accelerated as they are channeled into and through the narrow Nenana River Gorge near the Park Monitoring Station.

Mixing heights were measured at the Healy Monitoring Station using an acoustic sounder during the period from September 1990 through August 1991 to characterize the capability of the lower atmosphere to dilute pollutants in the vertical direction. Data indicate that constraints on vertical mixing occur most often in the winter during which about 50% of the hours have vertical mixing associated with a temperature inversion (the air temperature increases with height).

3.2.2 Ice Fog

During long winter nights with clear skies, extreme radiative cooling of the earth's surface occurs in Alaska. In protected valleys, this radiative cooling is often responsible for strong temperature inversions of extended duration (Benson 1965). Normally, at temperatures below about −22°F, a large concentration of microscopic ice fog particles are present in the inversion layer (Huffman and Ohtake 1971). Ice fog particles form when water vapor condenses on condensation nuclei, such as smoke particles, present in the atmosphere. The supercooled fog droplets then freeze while cooling down to the ambient temperature. The prominent feature of ice fog is that it has the potential, when it accumulates over time and becomes dense during calm winds, to severely restrict light penetration and visibility through the lowest layer of the atmosphere. The inversion layer in which the ice fog is trapped may reach heights of 150 ft or more above ground level.

Three major sources of ice fog in populated areas with arctic climates, such as Fairbanks, are water vapor from automobile exhaust, heating and power plant flue gases, and ice-free water such as that which occurs in association with heating and power plant cooling ponds (Kumai 1969). In the sparsely populated Healy area, sources of ice fog include water vapor from automobile exhaust along the George Parks Highway; burning of wood, coal, and fuel oil in home heating units; and ice-free water in the Nenana River resulting from the discharge of warmed water from the Healy Unit No. 1 heat rejection system. The water vapor plume formed from Unit No. 1 flue gases does not usually contribute to the ground-based ice fog. Water vapor in the flue gases exhausted from Healy Unit No. 1 is discharged upward at high velocity from a 110-ft stack and usually penetrates beyond the lowest ground-based inversion layer. Condensation of this water vapor into a visible plume occurs at higher elevations.

The primary source of ice fog in the immediate vicinity of the HCCP proposed site is the ice-free water in the Nenana River resulting from the warm water discharged by the Healy Unit No. 1 heat rejection system. Except for downstream of Unit No. 1, the Nenana River typically freezes over during

December ***and January***, and the ice cover continues until breakup in late April or May. The ice cover prevents formation of ice fog caused by exposure of open water to the cold arctic air. The length of ice-free water extends from the Unit No. 1 discharge (outfall) on the eastern bank of the Nenana River to a point approximately 3 miles downstream, and a transitional area in which pockets of open water are interspaced with areas of thin ice extends an additional mile to a location near the UCM mine (see Fig. 4.1.3). The area of ice-free water gradually spreads from the east bank on which the thermal discharge occurs to almost the entire Nenana River just past the first bend in the river below the outfall, about 0.5 miles downstream. Beyond the bend, the width of ice-free water stays approximately constant at about 225 ft. Consequently, during winter nights under calm conditions, ice fog occasionally forms in the air immediately above the ice-free water within the first 3 miles downstream of the discharge, and sometimes the ice fog extends as far as 4 miles downstream. The ice fog begins to dissipate during daylight hours or if a wind develops.

3.2.3 Air Quality

Air quality in the vicinity of the HCCP site is very good, as evidenced by ambient concentrations of all air pollutants being well below air quality standards. The area is sparsely populated, and the only major industrial source of air pollutants is Healy Unit No. 1.

Concentrations of SO_2, NO_2, and PM_{10} were monitored by the project participant at the HCCP Park Monitoring Station, located about 4 miles south of the HCCP proposed site and about 500 ft north and outside the boundary of DNPP (Fig. 2.1.2). Validated air quality data collected at the station for the 12-month period from September 1990 through August 1991 are summarized in Table 3.2.1. As indicated in the table, all concentrations are well below the applicable National Ambient Air Quality Standards (NAAQS). Air quality data from the DNPP Headquarters Station also indicate that concentrations are well below applicable standards.

3.2.4 Visibility

This section discusses existing visibility in DNPP and in the interior of Alaska overall.

3.2.4.1 Denali National Park and Preserve

Visibility, or background visual range, is the maximum distance a large, black object can be observed on the horizon. Visibility, as a measure of the clarity of the atmosphere, has been established as an important air-quality–related value (AQRV) of national parks and wilderness areas. The scenic quality of natural landscapes and their color, contrast, and texture are improved by good visibility. DNPP is a federal PSD Class I air quality area for which the AQRV of visibility is of interest. The nearest boundary of DNPP is located approximately 4 miles south of the proposed HCCP site (Fig. 3.1.2).

Table 3.2.1. Existing air quality for the Healy area as measured at the Healy Clean Coal Project Park Monitoring Station during the 12-month period from September 1990 through August 1991

Pollutant	Averaging time	Concentration ($\mu g/m^3$)	NAAQS[a] ($\mu g/m^3$)	Percent of standard
SO_2	3-h	45[b]	1300	4
	24-h	26[b]	365	7
	Annual	5	80	6
NO_2	Annual	6	100	6
PM_{10}	24-h	86[b,c]	150	57
	Annual	5	50	10

[a]National Ambient Air Quality Standards.
[b]Maximum measured concentration.
[c]Concentration resulting from forest fire smoke on July 1, 1991. The maximum 24-h value that was not influenced by an exceptional event was 31 $\mu g/m^3$.

The baseline visibility in DNPP has not been measured directly. However, the NPS has been measuring fine-particulate concentrations, sizes, and chemical composition at the DNPP Headquarters Station since September 1986. Fine particles (those with diameters less than 2.5 μm) and coarser particles (those with diameters greater than 2.5 μm and less than 10 μm) are sampled. Visibility can be estimated from the fine-particulate concentration measurements using light extinction theory (Latimer et al. 1985). A total of 328 24-h or 72-h fine-particulate measurements from DNPP were made during the period from September 1986 through May 1990 (the most recent data available) for calculation of visibility.

Table 3.2.2 provides a measure of the existing visibility, including the range, by displaying the calculated 10th, 50th, and 90th percentile visibility by season for DNPP. Percentile refers to the

Table 3.2.2. Calculated seasonal visibility for the 10th, 50th (median), and 90th percentiles for Denali National Park and Preserve, 1986–1990

		Calculated visibility (km)		
Season	Number of measurements	10th percentile	50th percentile	90th percentile
Winter	69	132	219	329
Spring	91	111	177	257
Summer	74	137	198	291
Fall	94	176	236	318
Annual	328	132	205	309

percentage of values that are less than the displayed value; for example, the annual 90th percentile visibility is 309 km, which means that 90% of the calculated visibilities are less than 309 km. The annual median, or 50th percentile, visibility is 205 km. For comparison, the theoretically best possible visibility of 391 km would occur in a particle- and pollution-free atmosphere. Based on these calculations, the existing visibility at DNPP is excellent, one of the best in the United States. The lowest visibility occurs in the spring, while the highest visibility occurs in fall. The highest 90th percentile visibility occurs in winter and the second highest in fall.

3.2.4.2 Interior Alaska

The visibility calculations include natural visibility impairment associated with forest fires that increase the measured particulate concentrations (see Table 3.2.1). Wildfires are a common summer occurrence in the interior of Alaska, and in recent years they have been allowed to burn unimpeded by human intervention as long as they do not threaten human life or private property. As a consequence, smoke generated from these fires can substantially reduce visibility for several weeks at a time during the summer.

The visibility calculations also include impairment from regional haze. Regional haze is a reduction in visibility associated with stagnant air masses containing pollutants from emitting sources that have mixed with the atmosphere so that distinct plumes from the emissions are not visible. Secondary particulate species (i.e., those formed in the atmosphere from emitted gases) such as sulfate ($SO_4^{=}$) and nitrate (NO_3^{-}) appear to be the major contributors to regional haze.

A type of regional haze known as arctic haze has been documented in the arctic region of Alaska (Shaw 1991). Arctic haze affects much of the arctic, including central Alaska. A substantial amount of this pollution is believed to originate from major sources in Eurasia, particularly in Eastern Europe and the western Soviet Union, and arrives in central Alaska, including the Healy area, about 2 to 4 weeks later via transport by polar winds ***(Soroos 1992)***. It is suspected that the arctic haze results in an air mass bearing the chemical fingerprint of coal smoke containing heavy metal constituents (Shaw 1991). During these episodes, which are strongest in the spring, the entire region is uniformly bathed in arctic haze. The lower visibility measured at DNPP during the spring reflects intrusions of arctic haze.

Natural visibility impairment associated with low clouds or precipitation is not accounted for in the calculations because water droplets are not measured. During these meteorological conditions, actual visibility is less than calculated. Mt. McKinley and the Alaska Range are often enshrouded by low clouds. Low-hanging clouds are common from May to September and block views of the mountain (NPS 1982). The probability of a clear or partially clear day has been estimated at 35% in July and 39% in August. The mountain is visible more often in fall and winter but remains largely in shadow when viewed from the north because of the sun's low angle.

3.3 SURFACE WATER RESOURCES

This section describes surface water resources that could be affected by the following aspects of the proposed project: (1) water consumption during construction and operation; (2) the discharge of treated and/or untreated wastewater from new facilities; (3) spills, leaks, and leaching from chemical and fuel storage areas; and (4) increased mining of coal.

3.3.1 Hydrology

Over 40% of the surface water resources of the United States are found in Alaska (USGS 1990). However, environmental conditions, legal restrictions, and technological problems limit the usability of this abundant supply. Many of Alaska's rivers (1) originate in glaciers and icefields and are silt-laden, (2) are affected by midwinter overflow icing or ice-jam flooding at spring breakup, or (3) are covered with ice year-round. Also, legal precedents regarding water rights and competition for industrial, hatchery, recreational, and fish and wildlife habitat uses affect the availability of Alaska's surface water resources.

Two streams in the immediate vicinity of the Healy site include the Nenana River and Healy Creek (see Fig. 3.3.1), which have drainage areas of approximately 1910 square miles and 190 square miles, respectively (USGS 1991). The HCCP would be located on a gravel terrace between the Nenana River and the existing Healy Unit No. 1. Figure 3.3.1 shows the location of the existing and proposed plants and the surface waters within the Nenana River–Healy Creek drainage basin.

The Nenana River originates at the Nenana Glacier on the south side of the Alaska Range (see Fig. 3.3.1). The river flows northward to a confluence with the Tanana River at Nenana, Alaska, a distance of about 115 miles. Major tributaries of the Nenana River upstream of Healy include Healy Creek, which joins the Nenana River less than 1 mile upstream of Healy Unit No. 1, and Yanert Fork, which originates in the Yanert Glacier and enters the Nenana River near DNPP.

Maximum runoff from the glaciers feeding the Nenana River watershed occurs during July and August, which corresponds to the period of maximum river flow. In the winter, the river is fed by groundwater discharge at a slower, more continuous rate than the glacial feed. As a result, the flow in winter months is usually low and relatively constant. From 1951 through 1979, the U.S. Geological Survey (USGS) measured Nenana River flow upstream and downstream of Healy Unit No. 1. One former gaging station (No. 15518000) was located about 0.75 miles upstream of the Healy Spur Highway Bridge. The ***average*** annual flow for the period of record at this station was 3,500 cfs; the minimum flow ***of record*** was 190 cfs; and the maximum flow ***of record*** was 46,800 cfs.

In August 1990, a 1-year monitoring program was initiated to support the assessment of impacts to water resources from the HCCP and to provide data for permit applications and engineering design. The

ORNL-DWG 91M-8488R3

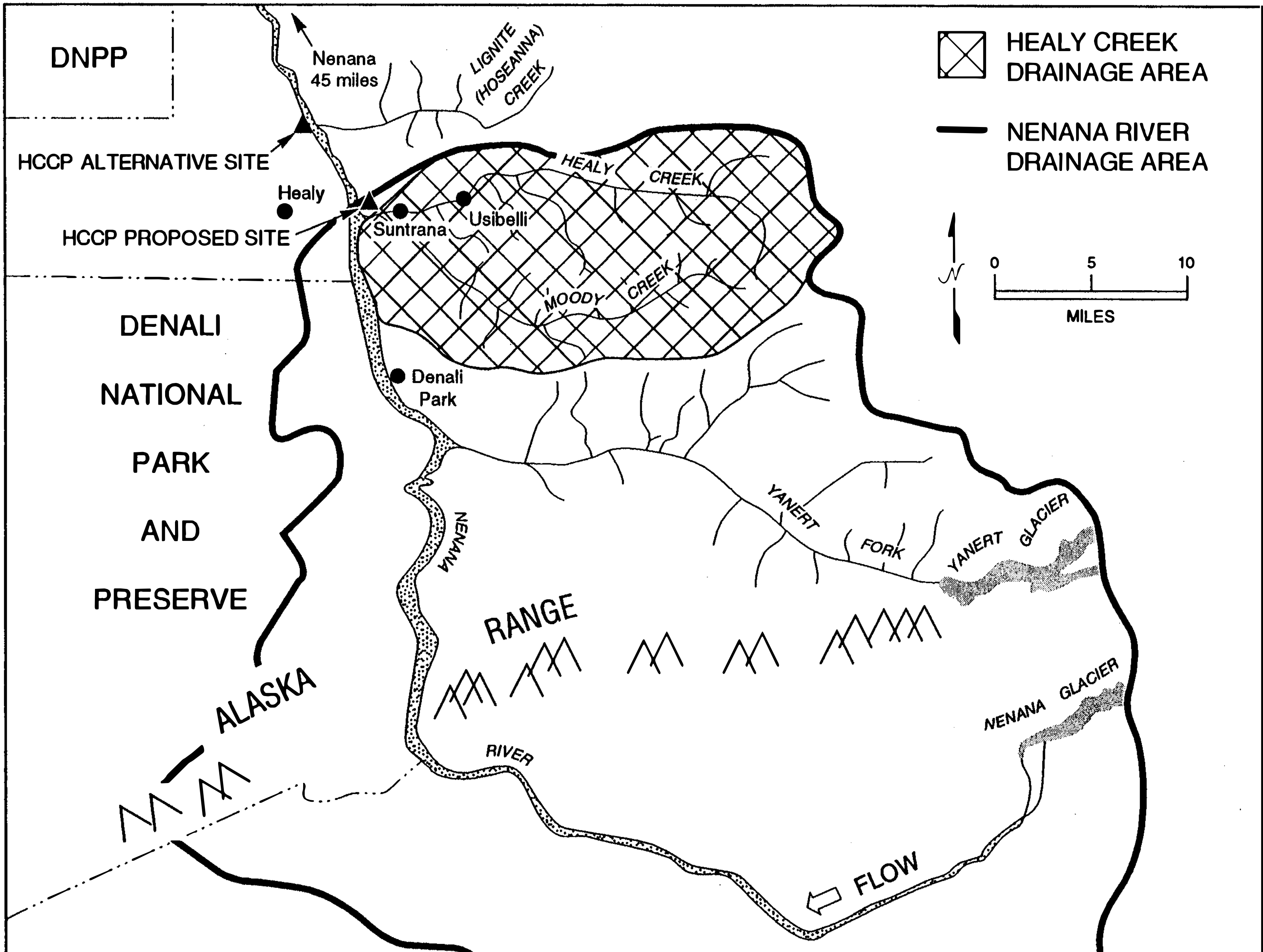


Fig. 3.3.1. Drainage basins of the Nenana River and Healy Creek.

USGS performed both field measurements and laboratory analyses of the physical and chemical parameters of the Nenana River, Healy Creek, and groundwater resources. Maximum flow ***measured*** in the Nenana since August was 13,500 cfs (June 1991), ***while the*** minimum ***recorded*** flow was 800 cfs (March 1991).

3.3.2 Water Quality and Use

Alaska Water Quality Standards (Alaska Administrative Code, Title 18, Chapter 70, February 2, 1979) apply to both fresh and marine waters of the state. Fresh waters are protected for water supply (domestic, agricultural, industrial, aquicultural) and water recreation (contact and secondary) uses. The Nenana River is a freshwater resource used for recreation, fishing, light industrial and agricultural supply, and wastewater assimilation; it is classified by the Alaska Department of Environmental Conservation (ADEC) as a multiple-use stream. Although no public drinking water supplies are drawn from the Nenana River, ***it is protected for all freshwater use classes. Water quality standards*** are listed in Table 3.3.1.

Healy Unit No. 1 withdraws water from the Nenana River for use in the plant's once-through cooling system. The heated water, along with merged low-volume wastewater, is discharged to the Nenana River in accordance with a National Pollutant Discharge Elimination System (NPDES) permit granted by EPA (AK 0022942 issued in 1975). Although the permit expired in 1980, EPA has given GVEA an administrative extension of the permit until a new permit is issued.

Historical water quality data for the Nenana River and Healy Creek are limited. Between 1962 and 1967, the USGS measured the following parameters in the Nenana River: temperature, total suspended solids, total dissolved solids, hardness, pH, calcium, magnesium, potassium, carbonate and bicarbonate alkalinity, sulfate, nitrate, chloride, silica, manganese, and iron (AIDEA 1991a). A comparison of these data with current Alaska primary or secondary drinking water regulations (Alaska Administrative Code, Title 18, Environmental Conservation, Chapter 80, December 31, 1977) indicates no exceedances for any regulated constituent that was monitored. The high concentrations of suspended solids in the Nenana River (average of 948 mg/L) are typical of glacially fed streams. Surface water samples and field measurements of the Nenana River and Healy Creek were taken for 1 year beginning August 1990 by the USGS at the following stations (Fig. 3.3.2):

Site 1. Nenana River at the Highway Bridge gaging station (upstream of the proposed project site);
Site 2. Nenana River at the Healy Unit No. 1 cooling water intake (downstream of the plant outfall);
Site 3. Nenana River, 1000 ft downstream of the Healy Unit No. 1 outfall; and
Site 4. Healy Creek below its confluence with Moody Creek.

Table 3.3.1. Water quality criteria applicable to the Nenana River

1. **Fecal coliform bacteria (FC):** Based on a minimum of five samples taken in a period of 30 d, mean shall not exceed 20FC/100mL, and not more than 10% of the samples shall exceed 40FC/100mL. For groundwater, the FC concentration shall be less than 1 FC/100 mL when using the FC Membrane Filter Technique or less than 3 FC/100 mL when using the fecal coliform Most Probate Number technique.

2. **Dissolved gas:** Dissolved oxygen (DO) shall be greater than 7 mg/L in waters used by anadromous and resident fish. In no case shall DO be less than 5 mg/L to a depth of 20 cm in the interstitial waters of gravel used by anadromous or resident fish, DO shall be greater than or equal to 5 mg/L. In no case shall DO above 17 mg/L be permitted. The concentration of total dissolved gas shall not exceed 110% of saturation at any point of sample collection.

3. **pH:** pH shall not be less than 6.5 or greater than 8.5 and shall not vary more than 0.5 pH unit from natural conditions. If the natural condition pH is outside this range, substances shall not be added that cause an increase in buffering capacity of the water.

4. **Turbidity:** Shall not exceed 5 nephelometric turbidity units (NTU) above natural conditions when the natural turbidity is 50 NTU or less; shall not have greater than a 10% increase in turbidity when the natural condition is more than 50 NTU, not to exceed a maximum increase of 15 NTU.

5. **Temperature:** Shall not exceed 20°C at any time. The following maximum temperatures shall not be exceeded, where applicable:

Migration routes:	15°C
Spawning areas:	13°C
Rearing areas:	15°C
Egg and fry incubation:	13°C

   For all other waters, the weekly average temperature shall not exceed site-specific requirements needed to preserve normal species diversity or to prevent the appearance of nuisance organisms.

6. **Dissolved inorganic substance:** Total dissolved solids from all sources shall not exceed 500 mg/L. Neither chlorides nor sulfates shall exceed 200 mg/L.

7. **Sediment:** The percent accumulation of fine sediment in the range of 0.1 to 4.0 mm in the gravel bed of waters used by anadromous or resident fish for spawning may not be increased more than 5% by weight over natural conditions (as shown from grain size accumulation graph). In no case may the 0.1 to 4.0 mm fine sediment range in the gravel bed of waters used by anadromous or resident fish for spawning exceed a maximum of 30% by weight (as shown from grain size accumulation graph). In all other surface waters no sediment loads (suspended or deposited) shall be present that can cause adverse effects on aquatic animal or plant life, their reproduction, or habitat.

Table 3.3.1 (continued)

8. **Toxic and other deleterious organic and inorganic substances:** Substances shall not individually or in combination exceed 0.01 times the lowest measure 96 h LC_{30} for life stages of species identified by the department as being the most sensitive, biologically important to the location, or exceed criterial cited in Environmental Protection Agency, Quality Criteria for Water or Alaska Drinking Water Standards, whichever concentration is less. Substances shall not be present or exceed concentrations that individually or in combination impart undesirable odor or taste to fish or other aquatic organisms as determined by either bioassay or organoleptic tests.

9. **Color:** This shall not exceed ***50*** color units where water supply is or will be treated. Where water supply is not treated, it shall not exceed 5 color units.

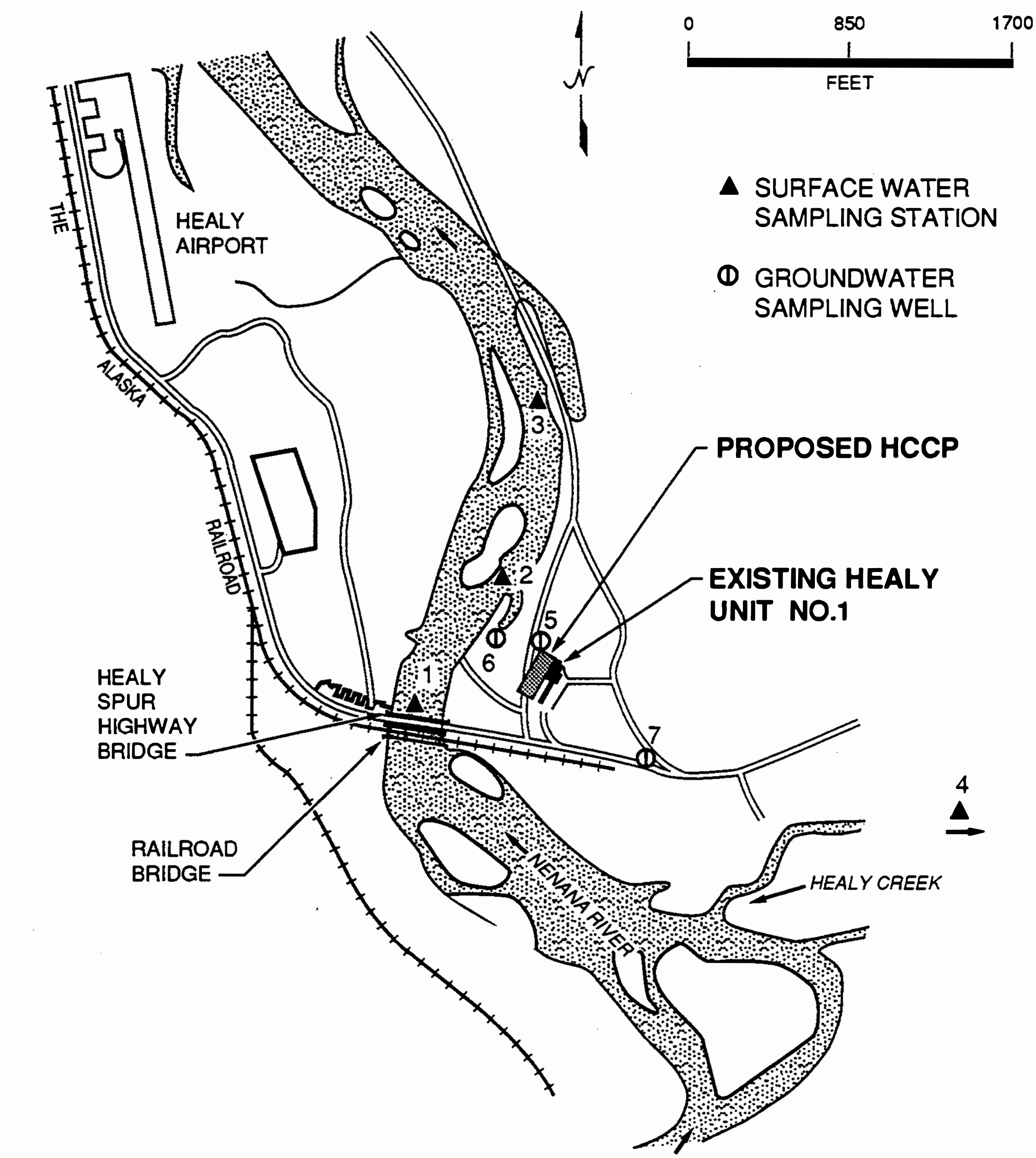
10. **Petroleum hydrocarbons, oils, and grease:** Total hydrocarbons in the water column shall not exceed 15 µg/L, or 0.01 of the lowest measured continuous flow 96 h LC_{30} for life stages of species identified by the department as the most sensitive, biologically important species in a particular location, whichever concentration is less. Total aromatic hydrocarbons in the water column shall not exceed 10 µg/L, or 0.01 of the lowest measured continuous flow 96 h LC_{30} for life stages of species identified by the department as the most sensitive, biologically important species in a particular location, whichever concentration is less. Concentrations of hydrocarbons, animal fats, or vegetable oils in the sediment shall not cause deleterious effects to aquatic life. Shall not cause a film, sheen, or discoloration on the surface or floor of the water body or adjoining shorelines. Surface waters shall be virtually free from floating oil.

11. **Radioactivity:** Shall not exceed the concentrations specified in the Alaska Drinking Water Standards (18 AAC 80) and shall not exceed limits specified in Title 10, *Code of Federal Regulations*, Part 20 and *National Bureau of Standards*, Handbook 69, except concentration factors for organisms involved shall not exceed maximum permissible limits for specific radioisotopes by Title 10, *Code of Federal Regulations*, Part 20, and *National Bureau of Standards*, Handbook 69.

12. **Total residual chlorine:** Shall not exceed 2.0 µg/L for salmonid fish or 10.0 µg/L for other organisms.

13. **Residues (floating solids, debris, sludge, deposits, foam, scum):** Shall not alone or in combination with other substances or wastes cause the water to be unfit or unsafe, or cause acute or chronic problem levels as determined by bioassay or other appropriate methods. Shall not alone or in combination with other substances cause a film, sheen, or discoloration on the surface of the water or adjoining shorelines; cause leaching of toxic or deleterious substances; or cause a sludge, solid, or emulsion to be deposited beneath or upon the surface of the water, within the water column, on the bottom, or upon adjoining shorelines.

ORNL-DWG 91M-8489



Site 1. Nenana River at the Highway Bridge gaging station (upstream of the HCCP proposed site).
Site 2. Nenana River at Healy Unit No. 1 cooling water intake (downstream of the plant outfall).
Site 3. Nenana River, 1000 ft downstream of Healy Unit No. 1 outfall.
Site 4. Healy Creek, about 300 ft below its confluence with Moody Creek.

Fig. 3.3.2. Location of surface water and groundwater monitoring stations near Healy, Alaska.

Three groundwater monitoring wells at the Healy Unit No. 1 site (locations 5, 6, and 7 on Fig. 3.3.2) are also being monitored as part of this program (see Sect. 3.4). Results of water quality analyses are reported in Appendix A. In general, results indicate that water quality in the Nenana River is good, with the exception of very high natural turbidity that occurs in the months of glacial snowmelt. River water quality meets the state water quality standards for its use classification (Table 3.3.1). All chemical constituents of river water have been below EPA primary drinking water standards.

Measures are presently undertaken at the UCM Poker Flats Mine to control sedimentation and prevent acid mine runoff. Surface water runoff from the mine is collected via diversion ditches into a two-stage sedimentation and clarification pond system and pH adjusted before discharge into Lignite (Hoseanna) Creek.

3.4 GEOLOGY AND GROUNDWATER

3.4.1 Local Geology

The HCCP proposed site is on pre-existing, nearly level construction fill that is about 10 ft above the present 100-year floodplain of the Nenana River. The site is about 500 ft from the riverbank, and immediately downstream (north) of the mouth of Healy Creek. A gently sloping alluvial terrace (an ancient floodplain) underlies the construction fill. The terrace consists of Pleistocene and Holocene alluvium and glacial outwash (sand to coarse gravel) which also cover the Nenana River Valley. The terrace is about 20 ft above normal river level.

Three distinctive stratigraphic rock types underlie the HCCP site (AIDEA 1991a) as illustrated in Fig. 3.4.1. In descending order they are (1) 10 to 20 ft of unconsolidated glacial outwash deposits and alluvium (Pleistocene and Holocene); (2) several hundred feet of poorly consolidated sedimentary rocks consisting of conglomerate, sandstone, siltstone, shale, and coal (Miocene and Oligocene); and (3) several thousand feet of metamorphic rocks (Paleozoic or Pre-Cambrian schist). Nenana gravel (Pliocene) underlies Pleistocene-Holocene alluvium ***downriver*** from the power plant. Strata underlying the Pleistocene and Holocene deposits dip steeply to the north. These strata are significant in terms of the geohydrology of the HCCP site (Sect. 3.4.2).

The Nenana Gravel (Pliocene) is a thick stratum which outcrops in the hills immediately northeast of the HCCP site. Although several thousand feet of Nenana Gravel underlie the nearby hills, the gravel is not present beneath the HCCP site.

ORNL-DWG 92M-12359

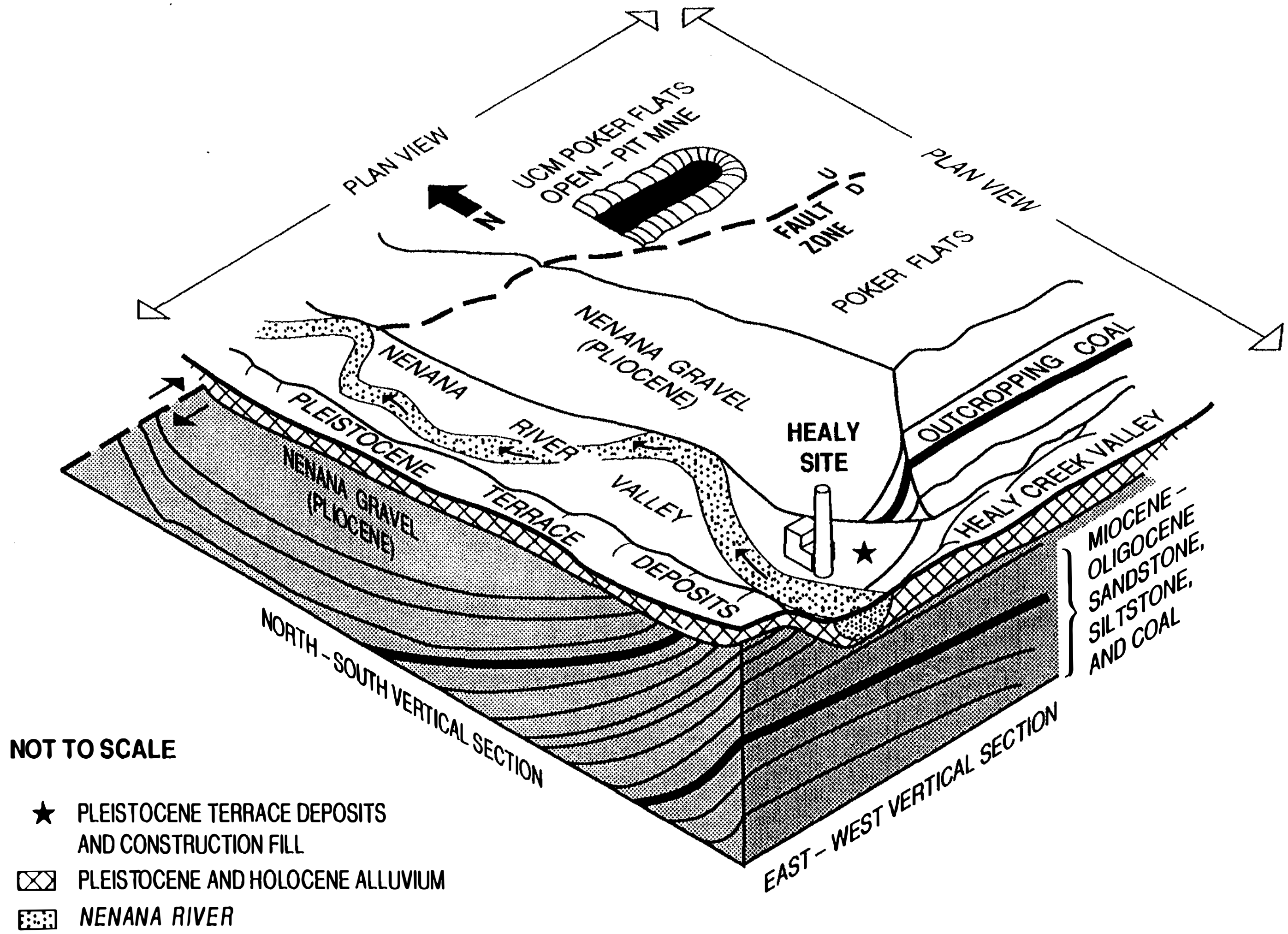


Fig. 3.4.1. Stratigraphy and structure in the vicinity of the Healy Unit No. 1 power plant.

3.4.2 Geohydrology

All of the above strata are water bearing except for the metamorphic rocks. Statewide utilization of Pleistocene and Holocene glacial outwash and alluvial aquifers far exceeds that of other aquifers in Alaska (USGS 1990). There are no nearby domestic or industrial wells in the outwash-alluvial aquifer that lies beneath the proposed HCCP site.

Locally, glacial outwash and alluvial aquifers are recharged by infiltration of precipitation, snowmelt, floodwater from the Nenana River and Healy Creek, and water from the existing unlined fly ash ponds. Groundwater discharges to the Nenana River during normal or low flow conditions.

The existing Healy Unit No. 1 draws its potable water supply from the underlying Miocene-Oligocene strata at a depth of about 200 ft (AIDEA 1991a). The steady-state capacity of the Healy Unit No. 1 well is less than 50 gal/min. Other nearby Miocene-Oligocene wells are at the Waugamon Recreational Vehicle Park, which is approximately 0.25 miles east (upgradient), and the town of Healy, which is approximately 2.5 miles northwest (downgradient).

3.4.3 Groundwater Quality and Use

Groundwater quality monitoring at the HCCP proposed site was obtained from two wells, locations 5 and 7; a third well at location 6 was ***plugged and abandoned because of difficulties experienced in sample collection*** (see Fig. 3.3.2). The well at location 5 is the Healy Unit No. 1 potable water supply well which was drilled in 1967. Wells at locations 6 and 7 were drilled to characterize baseline groundwater conditions before initiation of the HCCP proposed plant construction and to support this EIS. None of these wells were drilled in response to a regulatory mandate. The well at location 5 is screened for water quality sampling at a depth of 200 ft in the Miocene-Oligocene aquifer. Location 6 ***was*** the site of a recently drilled monitor well (MW1), which ***was*** screened at a depth of about 18 ft, below fill material underlying the downgradient extension of the existing fly ash ponds. Location 7 is the site of another recently drilled monitor well (MW2), which is screened at a depth of about 27 ft in Pleistocene-Holocene outwash and alluvium. Location 7 is southeast of the existing fly ash ponds.

The groundwater quality sampling program began in October 1990 (AIDEA 1991a). Samples were collected at monthly and quarterly intervals at locations 5 and 7. These sample intervals are believed to be sufficient for representing seasonal variations and annual ranges in water quality. Samples from locations 5 and 7 were analyzed for a variety of water-quality constituents and EPA priority pollutants.

Table 3.4.1 is a summary of groundwater quality data for major chemical constituents at the HCCP proposed site. Most parameters were measured 9 to 11 times and represent a range of values. Others represent initial unrepeated values. Dissolved constituents in the Pleistocene-Holocene nonpotable aquifer range from 10 to 100 more concentrated than those in the Oligocene-Miocene aquifer. The Pleistocene-Holocene aquifer is unsuitable as potable water supply because its high TDS and barium concentrations fail to meet EPA's interim primary drinking water standards. Furthermore, iron and

Table 3.4.1. Range of on-site well water quality, major dissolved (constituents) in Healy Unit No. 1 well (location 5) and monitor well 2 (location 7)

Parameter (mg/L unless noted)	Healy Unit No. 1 Oligocene-Miocene aquifer		Monitor well 2, Pleistocene-Holocene aquifer	National Drinking Water Standard
	1967	9/90–7/91	11/90–7/91	
Depth of screen (ft)	200	200	27	—
Total dissolved solids	301	257–293	1300–2350	500[a]
Total hardness as $CaCO_3$	136	93–110	620–1100	—
Calcium	40	28–33	210–390	—
Magnesium	9	5–7	22–35	—
pH (pH units)	7.9	8.1–8.3	7.1–7.9	6.5–8.5[a]
Specific conductance (µs/cm)	—	460–508	2940	—
Bicarbonate	—	162–207	228–322	—
Fecal coliform (colonies/100 mL)	—	0[a]	—	1[b]
Sodium	—	62–68	190–390	—
Chloride	—	29–52	530–1400	250[a]
Sulfate	—	19–24	3–23	250[a]
Fluoride	—	0.1[b]	—	2[c]
Nitrogen (total)	—	0.4–0.6	<0.7	10[c]

[a]CFR (Code of Federal Regulations) 1991. 40 CFR Part 143, "National Secondary Drinking Water Regulations."
[b]Fall 1990.
[c]CFR (Code of Federal Regulations) 1991. 40 CFR Part 265, Appendix III, "EPA Interim Primary Drinking Water Standards."

manganese concentrations do not meet secondary standards. Current water quality of the plant potable water supply is similar (improved in terms of TDS and hardness) to the water quality measured in 1967. The lack of change in water quality over 25 years of operation suggests that poor quality groundwater in the overlying alluvium has not co-mingled with groundwater in the Oligocene-Miocene aquifer. The potable water supply from the Oligocene-Miocene aquifer at location 5 (Healy Unit No. 1 well) is alkaline and rated as hard according to the classification for relative hardness by Durfor and Becker (1964). Table 3.4.2 contains a summary of EPA priority pollutant constituent concentrations, including a large number of metals. Phenol, at 12 µg/L, is the only detectable EPA priority pollutant reported from this deep water supply well in the Oligocene-Miocene aquifer. Two heavy metals (iron and manganese) and

Table 3.4.2. Metals and Environmental Protection Agency (EPA) priority pollutant dissolved concentrations in Healy Unit No. 1 well (location 5) and monitor well 2 (location 7)

Parameter	Healy Unit No. 1, Oligocent-Miocene aquifer 9/90-7/91	Monitor well 2, Pleistocene-Holocene aquifer MW2 (7) 11/90-7/91	National Drinking Water Standard
Metals			
Barium	9–23	1100–2500	1000[a]
Copper	BDL[b]	BDL[b]	—
Iron	40–110	3800–11,000	300[c]
Lithium	4[d]	—	—
Manganese	62–91	3100–4900	50[c]
Strontium	57–100	1500–4000	—
Zinc	<3–10	4–29	5000[c]
EPA priority pollutants			
Phenol	12[d]	—	—

[a]CFR (Code of Federal Regulations) 1991. 40 CFR Part 265, Appendix III, "EPA Interim Primary Drinking Water Standards."
[b]Below detection limits.
[c]CFR (Code of Federal Regulations) 1991. 40 CFR Part 143, "National Secondary Drinking Water Regulations."
[d]Fall 1990.

strontium are present in concentrations of approximately 60 µg/L. Manganese concentration slightly exceeds National Secondary Drinking Water Standards. If present, most other metals are in concentrations which are below detection limits (BDL). Except for copper, these BDL metals were sampled and analyzed one time only. Except for phenol, none of these constituent concentrations is indicative of potential contamination from the power plant. Phenol is a coal-tar derivative and a product of the incomplete combustion of coal. Phenol may also have migrated to the well from natural coal seams that are known to be present beneath the HCCP site. Currently, it is uncertain whether the phenol is a contaminant from the existing Healy Unit No. 1 or is naturally occurring. No baseline phenol concentrations are available for Healy Unit No. 1. Iron and manganese, are often present in natural groundwater. Shallow groundwater in the Pleistocene-Holocene aquifer at location 7 (MW2) has 10 to 100 times more dissolved metals than the deep Oligocene-Miocene potable groundwater at location 5. Water samples taken from location 6 (MW1) were strongly alkaline (pH = 11.9), presumably a result of the leaching of fly ash. The fly ash would be removed and replaced by gravel for the HCCP site foundation.

3.4.4 Soils

Natural soils on the HCCP proposed site were removed during construction of Healy Unit No. 1 or covered by unclassified, engineered fill material. The existing fly ash ponds were placed on fill. Both fill material and underlying outwash deposits consist of sand to coarse gravel.

3.4.5 Seismicity

The HCCP site is in seismic zone 3 (ICBO 1988), where major earthquake damage (corresponding to modified Mercalli intensity = VIII [MM VIII] and peak ground accelerations ranging from 0.2 g to 0.4 g) has a 10% probability of occurring at least once in 50 years (Algermissen et al. 1990). The existing Healy Unit No. 1 was constructed in 1967. This facility was constructed to seismic zone 3 standards. *Though final* design of the proposed HCCP facility is incomplete, current *design is in conformance with the* Uniform Building Code guidelines *for* important but low-hazard facilities in seismic zone 3 (Fig. 3.4.2). *A* peak ground acceleration of 0.30 g *is being used for design.*

Thorson (1978) describes a late-Pleistocene fault that is located near the existing power plant. The trace of this fault passes east-northeast along a path that lies about 100 to 200 m south of the plant at its closest approach. According to Thorson, there may have been at least three separate movements along this fault during Pleistocene time with a total of 6.5 m vertical displacement over the past 22,000 years.

Based on Thorson's description, the return period for rupture along this fault is expected to be on the order of several thousands of years. By comparison, the UBC recommended design earthquake (previously decribed) has a return period that is conservatively estimated at 500 years. Although long-return period events (estimated in thousands of years) are considered in the design of high-hazard facilities (e.g., nuclear power plants and plutonium processing facilities), they are not considered in the design of important but low-hazard facilities. No new facilities are planned to be constructed over the inferred location of the fault. Therefore, surface rupture along this fault is not a design consideration. Nearby ground shaking associated with future ruptures along this fault also is not a design consideration because the probability of such an event is extremely low during the 50-year life of the facility (much less than the 10% probability of design ground motion exceedance that is allowed in the UBC guidelines).

Foundations, soils, and fills at the site consist of cohesionless soils that are coarse grained and free draining. According to Seed and Idriss (1971), soils such as these are not expected to fail by liquefaction during an earthquake.

ORNL-DWG 91M-16748

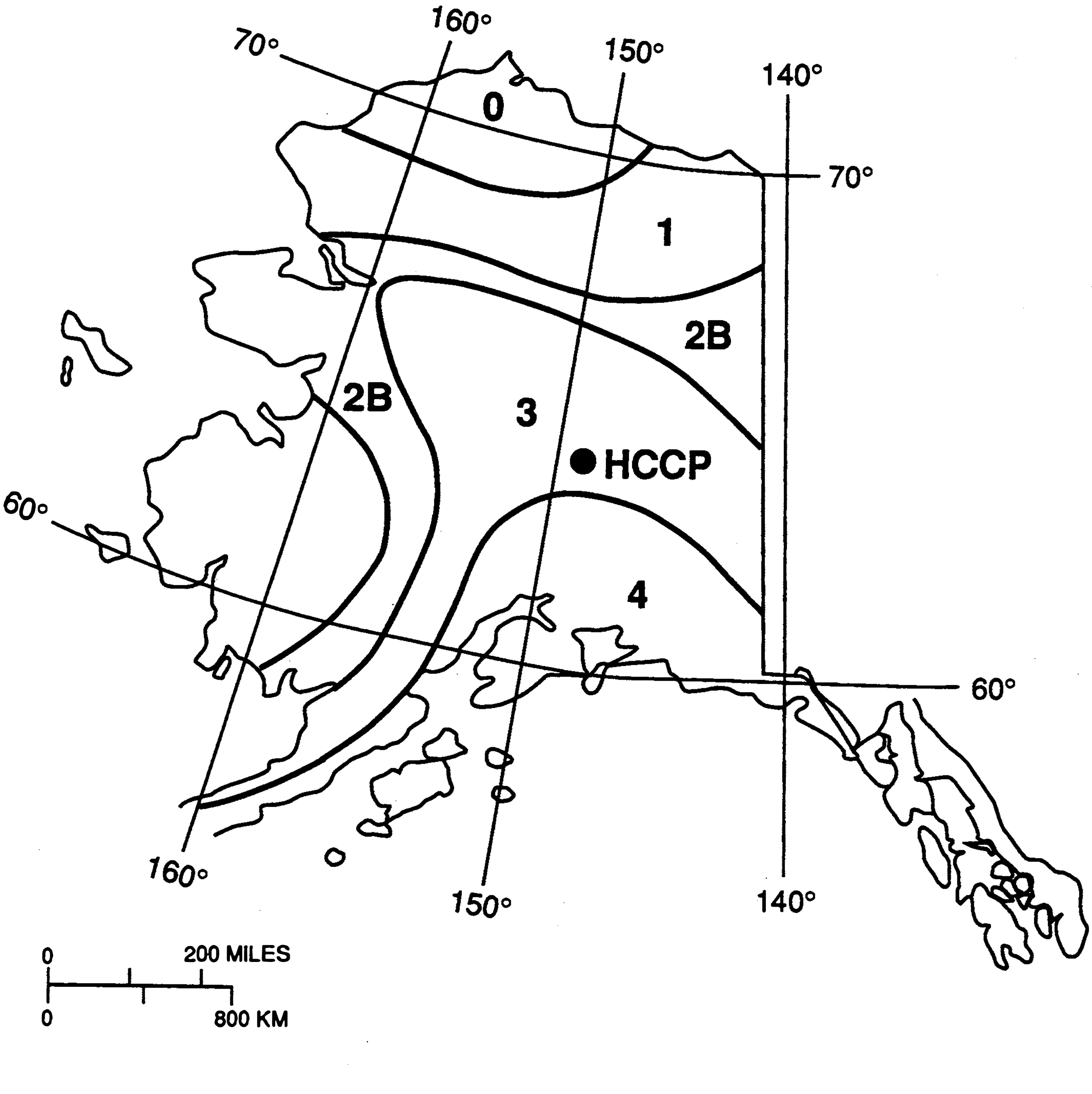


Fig. 3.4.2. Seismic zone map of Alaska (modified after International Conference of Building Officials, 1988, "Uniform Building Code," Whittier, California).

3.5 ECOLOGICAL RESOURCES

The areas of interest related to potential effects on ecological resources include the vicinity of the HCCP proposed site (effects of air pollution and water withdrawal and discharge), DNPP (air pollution effects), and the UCM Poker Flats Mine (coal mining effects). The terrestrial and aquatic resources of each of these areas are described.

3.5.1 Terrestrial

3.5.1.1 Site Vicinity

The HCCP proposed site is a highly disturbed and *unvegetated* area adjacent to the existing Unit No. 1. The vicinity of the site includes a mixture of disturbed areas, formerly disturbed areas with recovering vegetation, and natural vegetation. This area can be divided into the following three zones [based on more extensive descriptions in Woodward-Clyde (1978); Tarbox et al. (1979); and AIDEA (1991a)]:

1. Immediately to the north and northeast of the site, a steep escarpment rises from the floodplain of the Nenana River to a high plateau. The plateau is dominated by natural mixed birch, spruce, and shrub tundra communities. The slopes facing south to west of the escarpment support diverse plant communities apparently because of variations in the slope, aspect, and soils and the occurrence of *snow* slides. Vegetation ranges from a mixture of grasses and pioneer trees on recent slide areas, through a variety of shrubby *vegetation types*, to open forest on the higher slopes where the slope angle is shallower and the soils are deeper.
2. South of Healy Creek and east of the Nenana River are high terraces of tundra. This zone includes low shrub and herbaceous tundra on the terrace surfaces with alder and white spruce woodlands on the intermediate slopes.
3. West of the Nenana River lies an area of rolling topography with railroads, roads, and other disturbances. Because of these disturbances and fire, much of this area is in scrubby successional vegetation. Other parts of the area contain tundra-like vegetation and forest.

Mammals occurring in the vicinity of the site include grizzly bears, caribou, moose, Dall sheep, wolves, red foxes, marten, lynx, wolverines, and snowshoe hares (Woodward-Clyde 1978; Tarbox et al. 1979; Elliott 1984). Little habitat exists for shorebirds or waterfowl in the vicinity of the site; but mallard, American widgeon, green-winged teal, *bufflehead*, spotted sandpiper, and northern phalarope have been observed to nest in the area (AIDEA 1991a). Many species of upland birds occur in the area, including a relatively high density of nesting golden eagles (Roseneau and Springer 1991).

3.5.1.2 Denali National Park and Preserve

DNPP contains large areas of natural vegetation disturbed only by a few roads, a railroad line, visitor facilities, ***placer and lode mined areas,*** and NPS operations (***borrow pits***, equipment storage, etc.). NPS (1990) describes the vegetation of the park as tundra and taiga (coniferous woodlands and forests). Most of the central portion of the park is covered by tundra or bare rock and ice; tundra generally occurs at higher elevations. ***Tundra*** includes grasses, sedges, and other herbaceous plants; low shrubs; mosses; and lichens. The taiga occurs below 2300 ft, particularly in the northwestern portion of the DNPP. The trees are larger and grow more densely at lower elevations; the taiga in most of the park is open, with a dense understory of shrubs and herbs. Areas of shrub vegetation occur at intermediate elevations, with tall ***shrubs*** on moist slopes and in drainages and low ***shrubs*** on dryer slopes and higher elevations.

DNPP is visited as much for its wildlife as for its scenery (such as views of Mt. McKinley). DNPP supports 39 species of mammals, 159 species of birds, and 1 amphibian species (NPS 1990). Prominent mammals include caribou, moose, Dall sheep, grizzly bears, black bears, and wolves.

3.5.1.3 Usibelli Coal Mine, Inc., Poker Flats Mine

The UCM mine occurs in an area of mixed taiga (predominantly open black spruce) and tall-shrub and low-shrub tundra (Helm 1985). Much of the area has been disturbed by mining and has ***bare soil that will be revegetated or areas that have already been revegetated*** with introduced grasses and herbs. The wildlife is similar to surrounding areas, as discussed in the previous section.

3.5.2 Aquatic

3.5.2.1 Site Vicinity

The proposed facility would withdraw water from and discharge water to the Nenana River just below its confluence with Healy Creek. Five species of fish have been documented in this segment of the river: round whitefish, longnose sucker, burbot, arctic grayling, and slimy sculpin. In a study by Tarbox et al. (1979), round whitefish and longnose sucker constituted most of the catch (74% and 22%, respectively). Fish abundance has not been measured because of the difficulty of sampling in this relatively large high-velocity stream, particularly in winter. The available sampling data, which the Alaska Department of Fish and Game has deemed adequate to characterize the site (A. H. Townsend, letter to Glenn W. Suter II, ORNL, Oak Ridge, Tenn., Aug. 22, 1990), suggest that fish abundance is low in the Nenana River near the proposed site (Tarbox et al. 1979). However, this section of the river is portrayed by Wolfe (1988) as a "documented resource harvest area" for nonsalmon fish (i.e., people have reported that they fish there).

The density of aquatic microinvertebrates (i.e., river bottom and other planktonic organisms) was found to be 35 organisms/m^2 (Tarbox et al. 1979) and was the lowest of any fauna studied. No obvious effect of the thermal component of GVEA's discharge on river bottom fauna density, composition, or distribution was evident. However, sample size and geographic coverage were limited.

Fish eggs and larvae have not been sampled in the Nenana near the site. Round whitefish and burbot may spawn there, but conditions do not appear to be favorable. Tarbox et al. (1979) caught small juvenile whitefish (24–44 mm) in the Nenana River, suggesting that spawning occurs in the area, but not small juvenile longnose suckers, burbot, or arctic grayling. Most spawning and larval rearing appears to occur in tributary streams.

Coho salmon spawning and rearing have been documented in downstream tributaries (Lignite Spring, Panguingue Spring, and Panguingue Creek), but apparently salmon spawning does not occur in upstream tributaries (Tarbox et al. 1979). These spawning areas occur ***in tributaries*** more than 3.5 miles downstream (north) of the site and would not be affected by the project.

3.5.2.2 Denali National Park and Preserve

DNPP contains two types of stream communities. Most are glacial streams originating at high elevations in the Alaska Range. These glacial streams support little aquatic life because of their high silt burden. The nonglacial streams originate at lower elevations, are clear, and support relatively productive aquatic communities. The DNPP harbors 16 fish species, including 4 anadromous Pacific salmon species and the arctic grayling, which is the primary sport fish in DNPP (NPS 1990).

3.5.2.3 Usibelli Coal Mine, Inc., Poker Flats Mine

The mine ***area*** drains to Lignite (Hoseanna) Creek. Sampling in this creek with seines (23 hauls) and minnow buckets (for 228 h) yielded 3 arctic grayling and 1 round whitefish (Tarbox et al. 1979). Sampling results and poor habitat quality (high levels of suspended sediments and fine textured substrate) in the creek suggest that Lignite (Hoseanna) Creek constitutes a poor aquatic habitat.

3.5.3 Threatened and Endangered Species

U.S. Fish and Wildlife Service (FWS) has determined that two threatened or endangered species may occur in the area: the threatened arctic peregrine falcon, which could occur as a migrant, and the endangered American peregrine falcon, which could be resident (P. J. Sousa, Field Supervisor, Fish and Wildlife Service, Northern Alaska Ecological Services, letter to E. W. Evans, DOE, Pittsburgh, May 29, 1991, see Appendix C). Tarbox et al. (1979) noted a possible peregrine falcon eyrie on the east bank of the Nenana River upstream of the proposed site, but saw no falcons. However, a raptor (birds of prey) survey conducted in May 1991 failed to find evidence of peregrine falcons within 5 miles (8 km) of the proposed site (Roseneau and Springer 1991).

FWS indicated that no listed or candidate/threatened or endangered plant species were known to occur in the area of the proposed site. (P. J. Sousa, Field Supervisor, Fish and Wildlife Service, Northern Alaska Ecological Services, letter to E. W. Evans, DOE, Pittsburgh, May 29, 1991).

Some species that occur in the area are listed as candidates for threatened or endangered status (FWS 1989, 1990). These have no protected status but may be listed in the future and deserve special consideration. Those that may occur in or around the DNPP include the following:

1. The *flesh-colored* dandelion is described as occurring in DNPP by the NPS (1989).
2. A mustard is described as occurring in DNPP by the NPS (1990).
3. The North American lynx occurs in DNPP and in the vicinity of the proposed site. It is listed primarily because of concern for populations in the lower 48 states.
4. Swainson's hawk is a category-three species (it was once considered for listing but is no longer because it is more abundant or widespread than previously thought). Therefore, it is not really a candidate but is still on the list.

Of these candidate species, only the lynx has been detected in the vicinity of the proposed site (Tarbox et al. 1979; Elliott 1984).

3.6 FLOODPLAINS AND WETLANDS

The National Wetlands Inventory *identifies* wetlands along the Nenana River and tributary streams. No wetlands occur on the proposed site. The proposed site is not within the 100-year floodplain of the Nenana River (Grey and Lehner 1983; AIDEA 1991a). The site may have been in the floodplain and may have included wetlands before the construction of Healy Unit No. 1.

3.7 PREHISTORIC AND HISTORIC RESOURCES

This section identifies prehistoric and historic resources in the region, defined as that section of the Nenana River Corridor that stretches from 4 miles upstream (south) of the HCCP proposed site to 2 miles downstream (north) of the HCCP alternative site and the drainage basins of Lignite (Hoseanna) Creek, Healy Creek, and Dry Creek (see Fig. 2.1.2). The exact locations of many of the prehistoric and historic sites identified in this section are unknown; therefore, the locations are described but not depicted on a map.

3.7.1 Prehistoric Resources

The Alaska State Historic Preservation Office (SHPO) has identified two prehistoric sites in the vicinity of the HCCP proposed location *(Bittner 1991)*. The sites, identified as HEA-026 and HEA-210, are located south of the Nenana River Railroad Bridge, within 1 mile of, but across the river from, the HCCP proposed site. No known prehistoric resources are located at the proposed site (Judith E. Bittner, Alaska State Historic Preservation Office, letter to T. C. Ruppel, DOE, Pittsburgh, July 11, 1991, Appendix D).

In recent years, statistical correlations between known prehistoric sites and the surrounding terrain have been applied to the Healy area to identify locations with high, medium, and low probabilities of containing prehistoric sites (Greiser et al. 1986). Using similar correlations along with systematic pedestrian surveys, three potential prehistoric sites have been identified in the vicinity of the HCCP alternative site (Alaska Heritage Research Group, Inc. 1987). The sites, HEA-140, HEA-141, and HEA-142, are located more than 1 mile northeast of the alternative site on the opposite side of the Nenana River.

3.7.2 Historic Resources

The Alaska SHPO has identified four state historic sites in the vicinity of the HCCP proposed location (Judith E. Bittner, Alaska State Historic Preservation Office, letter to W. D. Steigers, Stone and Webster Engineering Corp., Denver, Colo., January 1991). The sites, identified as HEA-080, HEA-083, HEA-119, and HEA-229, include the old Healy townsite, the Nenana River Railroad Bridge, and two cabins on the west bank of the Nenana River. The first three sites are about 0.75 miles from the HCCP site, and the fourth site is about 1.5 miles away.

The *Alaska Heritage Resources Survey* lists two additional state historic sites near the HCCP alternative location. The sites, HEA-237 (the Arctic Coal Company Camp) and HEA-238 (the Popovitch Creek Camp Site), are located more than 4 miles northeast of the alternative site on the opposite side of the Nenana River.

No known historic resources are located at the proposed site (Judith E. Bittner, Alaska State Historic Preservation Office, letter to T. C. Ruppel, DOE, Pittsburgh, July 11, 1991, Appendix D).

3.8 SOCIOECONOMICS

This section provides information on socioeconomic resources in the region most likely to be affected by the HCCP. The socioeconomic study region is the Denali Borough, but it is expected that most impacts will be confined to the communities of Healy and ***Denali Park***, the communities closest to the HCCP proposed location (see Fig. 3.8.1). Therefore, emphasis is placed on socioeconomic resources in Healy and ***Denali Park***.

3.8.1 Population

In 1990, the total population of the Denali Borough was estimated to be 1797 (ADCRA 1992). Table 3.8.1 provides historic population data for Healy and ***Denali Park***. Between 1980 and 1990, Healy

ORNL-DWG 91M-8088R2

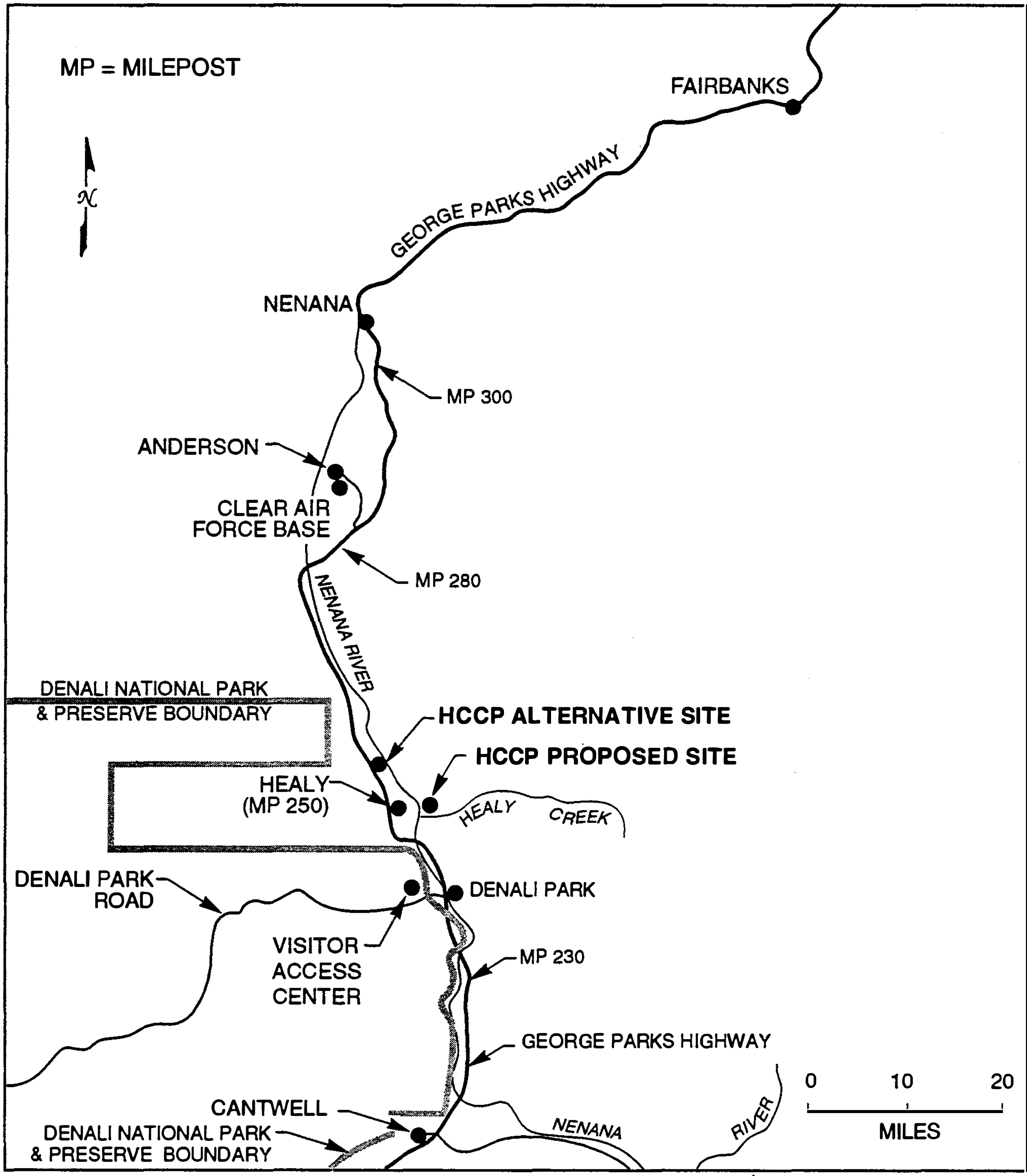


Fig. 3.8.1. Socioeconomic resources study area *and surrounding region.*

Table 3.8.1. Population in Healy and *Denali Park*

Community	1970	1980	1985	1990
Healy	79	334	414	487
Denali Park	*a*	32	65	171

[a]Data not available.

Source: U.S. Census of Population, 1970, 1980 and 1990; AIDEA (Alaska Industrial Development and Export Authority) *Second Draft Environmental Information Volume, Healy Clean Coal Project, Healy, Alaska*, prepared by Stone and Webster Engineering Corp., Denver, September 1991.

experienced moderate population growth and ***Denali Park*** experienced rapid population growth, with average annual increases of 4.6% and 43.4%, respectively. This growth was the result of increased UCM mining activities in Healy and increased government and commercial activities associated with the DNPP in ***Denali Park***.

3.8.2 Employment and Income

In the Denali Borough, opportunities for year-round employment are somewhat limited by the seasonal nature of the area's tourist industry and the general lack of commercial and industrial development. In 1986, the Yukon-Koyukuk Census District, which includes much of what is now the Denali Borough, had an estimated unemployment rate of 17%, compared with 10.8% for the state of Alaska and 7% for the United States (U.S. Bureau of the Census 1988). Employment in the study region is particularly affected by seasonal variation, reaching its peak during the summer when tourist-oriented services are in demand and declining during the winter off-season.

The largest employer in the borough is Clear Air Force Base (AFB), a U.S. Air Force ballistic missile early warning station near Anderson that employs 308 civilians. The NPS is the second-largest employer for much of the year, providing 122 jobs during the tourist season (52 of these positions are year-round). In all, the NPS estimates that approximately 3000 persons work in DNPP or in tourist-related businesses near the park during the summer, but many of the employees are not permanent local residents. Other major employers include UCM (103 employees), the Railbelt Regional Educational Attendance Area (60), and GVEA (29).

Table 3.8.2 lists 1989 annual average and annual peak employment by occupation for residents of the Denali Borough. As indicated by differences between peak and average employment, many residents find temporary jobs at local retail and service establishments during the tourist season.

Table 3.8.2. Employment in the study region (1989)

Area	Annual average	Annual peak
Mining	103	103
Construction	12	16
Transportation, utilities, communication	87	110
Retail trade	59	90
Services	128	257
Local government	48	60
State government	15	16
Federal government	81	129
Civilian employment at Clear Air Force Base	308	308
Total	841	1089

Source: AIDEA (Alaska Industrial Development and Export Authority) Second Draft Environmental Information Volume, Healy Clean Coal Project, Healy, Alaska, prepared by Stone and Webster Engineering Corp., Denver, September 1991.

Residents of the Denali Borough, especially those in Anderson and Healy, have relatively high incomes. Table 3.8.3 compares average taxable income in the study region communities with the same variable for the state of Alaska and the United States. Incomes are highest in Anderson, where almost all the city's work force is employed at Clear AFB, and in Healy, because of wages provided by GVEA and UCM.

3.8.3 Housing

The Denali Borough's housing stock includes both permanent residences and temporary lodging facilities. Most of the permanent residences are in and around Healy and Anderson. Of the approximately 200 single-family residences in Healy, 12 to 15 are vacant (AIDEA 1991a). The largest concentration of homes is the Healy Subdivision, a 400-acre tract on which approximately 180 building lots have been cleared and 90 homes constructed. UCM, the company responsible for the subdivision's development, plans to develop another 39 acres (10 lots) in the future (AIDEA 1991a). There are approximately 66 permanent dwelling units in ***Denali Park***. The vacancy rate for ***Denali Park*** is unknown, but is assumed to be similar to that in Healy (7.5%).

Table 3.8.3. Average taxable income for selected Denali Borough communities, Alaska, and the United States (1985)

Anderson[a]	$36,013
Cantwell	$19,426
Healy	$42,776
Denali Park	$19,847
State of Alaska	$28,071
United States	$22,683

[a]Data for employees of Clear Air Force Base only.

Sources: AIDEA (Alaska Industrial Development and Export Authority) 1991 *Second Draft Environmental Information Volume, Healy Clean Coal Project, Healy, Alaska,* prepared by Stone and Webster Engineering Corp., Denver, September 1991; U.S. Bureau of the Census, 1987.

The borough's temporary housing stock consists of the hotels, motels, and lodges built in Healy and ***Denali Park*** to accommodate visitors to DNPP. Combined, these establishments provide approximately 560 temporary housing units. However, few of the units are available during the summer tourist season, when occupancy nears 100% for all establishments.

3.8.4 Local Government Revenues

Before December 1990, the only incorporated municipality within the study region was the city of Anderson, which is a second-class city under state law. The study region itself was part of Alaska's unorganized borough, which includes all areas outside the state's incorporated boroughs and has no powers of taxation. Thus, Healy and ***Denali Park*** have relied on state funding for public services, because all unincorporated communities of at least 25 residents located within the unorganized borough are eligible to receive revenue-sharing funds directly from the state. In the November 1990 general election, however, voters passed a referendum approving the formation of the Denali Borough, which was incorporated as a ***home rule*** borough under Title 29 of Alaska state law on December 7, 1990.

With incorporation, the Denali Borough has the authority to levy and collect taxes. In the referendum, voters authorized a 4% tax on the rental of overnight accommodations and a severance tax of five cents per ton ***(or equivalent) on all natural resources.*** Along with local tax payments, the borough will have a variety of revenue sources, including both state and federal funding programs. Most of the state money will be in the form of education revenue funds (which the borough will receive beginning in FY ***1993***), organizational grants (which all new boroughs receive in their first 3 years of existence), and municipal assistance funds, as indicated in Table 3.8.4.

Table 3.8.4. Projected revenues for the Denali Borough

Category	Source	FY 1992	FY 1993
4% bed tax	Local	***$400,000***	***$440,000***
Severance tax	Local	85,000	85,000
Misc./user fees	Local	15,000	***141,000***
Municipal assistance	State	***120,000***	***101,340***
Revenue sharing	State	—	***32,673***
Organizational grants	State	***200,000***	***100,000***
Education revenue	State/federal	5,712,265	5,658,631
Total		***$6,532,265***	***$6,558,644***

Sources: AIDEA (Alaska Industrial Development and Export Authority) *Second Draft Environmental Information Volume, Healy Clean Coal Project, Healy, Alaska*, prepared by Stone and Webster Engineering Corp., Denver, September 1991; ***letter from R. Brewer, Mayor of the Denali Borough, to E. W. Evans, U.S. Department of Energy, Pittsburgh Energy Technology Center, January 4, 1993.***

3.8.5 Public Services

Forming the Denali Borough created a new structure for funding public services in the study region. Before borough formation, the unincorporated communities applied directly to the state for revenue-sharing funds to help finance public services provided by private and quasi-governmental organizations. This system of providing public services will not change dramatically, but certain changes in how the services are financed will result from the borough's incorporation.

Under Alaska state law, boroughs are granted taxing authority because they are required to provide public services such as education and land-use planning. In addition, unincorporated communities within an incorporated borough are not eligible to apply directly for state revenue-sharing funds; any state funding must be received through the borough. Therefore, many of the public services previously provided by the local communities are now the responsibility of the Denali Borough. Specifically, the borough must provide for education and land-use planning, although planning may be delegated to a first- or second-class city within the borough. The borough may also provide other services (e.g., water, sewer, police and fire protection), if such provision is not prohibited by law or the borough charter. Table 3.8.5 lists the Denali Borough's projected public service expenditures.

Table 3.8.5. Projected public service expenditures for the Denali Borough

Category	FY 1992	FY 1993
Borough assembly	*$97,800*	*$92,800*
Mayor's office	*115,450*	*146,800*
Attorney	*25,000*	*10,000*
Planning	*1,500*	*1,500*
Education	5,712,300	5,712,300
Total	*$5,952,050*	*$5,963,400*

Source: AIDEA (Alaska Industrial Development and Export Authority) *Draft Environmental Information Volume, Healy Clean Coal Project, Healy, Alaska*, prepared by Stone and Webster Engineering Corp., Denver, Jan. 1991.

Education in the Healy area is provided by the Denali Borough School District, which operates schools that offer kindergarten through 12th grade in the towns of Anderson, Healy, and Cantwell. The district is in the process of planning an $8.6 million expansion/remodeling project at the Tri-Valley School in Healy to mitigate overcrowding and accommodate future growth (Novak 1992). Current school enrollment, capacity, and faculty are listed in Table 3.8.6.

The Alaska Foundation Funding Program requires that boroughs contribute a minimum of 4 mils of their assessed property valuation to their school districts. Because the Denali Borough is a newly formed borough, its education funding contribution will be phased in. The Denali Borough will be required to contribute the equivalent of 2 mils in 1994–95, 3 mils in 1995–96, and 4 mils in 1996–97

Table 3.8.6. Enrollment, capacity, and faculty in *Denali Borough School District schools*

School	*1992–93* Enrollment	Capacity	Teachers/aides	Projected 1995–96 enrollment
Anderson School	*118*	*160*	*9/2*	*135*
Cantwell School	*29*	*60*	*3/1*	*33*
Healy (Tri-Valley)	*217*	*165*	*16/2*	*285*
Correspondence	*2*	—	—	—
Total	*366*	*385*	*28/5*	*453*

Source: Letter from J. Novak, Superintendent, Denali Borough School District, to E. W. Evans, U.S. Department of Energy, Pittsburgh Energy Technology Center, December 14, 1992.

and beyond. The current assessed property valuation in the borough, as certified by the Alaska State Assessor, is $72,572,400. Thus, in 1993 a 1 mil equivalent would be $72,572. Assuming the same mil equivalent through 1997, the borough would be required to contribute $145,144 in 1994–95; $217,716 in 1995–96; and $290,288 in 1996–97 and beyond. With a projected enrollment of 453 students in the 1995–96 school year, the borough's contribution would represent approximately $481 per student (Novak 1992).

No public provision of water and sewer services exists in the study region, and the borough does not plan to provide such services in the near future. Water is obtained from individual wells or small water systems that serve residential developments. Sewer services typically are provided by on-site private septic systems.

Solid waste disposal is available at community landfills in Cantwell, Healy, and Anderson. The Healy landfill, located 4 miles east of Suntrana, is operated by the Tri-Valley Volunteer Fire Department and has an expected capacity of about 20 years at current disposal rates. Although there are no immediate plans to do so, the borough might have to assume authority over landfills in the future as landfill capacity and siting become more important local issues.

The major transportation route in the Denali Borough is Alaska State Highway 3 (the George Parks Highway), a two-lane highway from Fairbanks to Palmer. ***Denali Park*** is located along the ***George*** Parks Highway, and Healy is accessed from the ***George*** Parks Highway by Healy Spur Highway, a spur road just off the main highway. Annual average daily traffic (AADT) on the Parks Highway between Denali National Park Road and Hilltop Drive (near Healy) was approximately 1450 vehicle trips in 1989 (Alaska Department of Transportation and Public Facilities 1990). AADT on roads near the proposed HCCP is shown in Table 3.8.7.

Table 3.8.7. Annual average daily traffic in the Healy vicinity (1989)

Primary road	Junction	Average annual daily traffic
Healy Spur Highway	Parks Highway	725
Healy Spur Highway	Healy School Access Road	350
Healy Spur Highway	Healy Access	300
Healy School Access Road	Healy Road	175
Healy New Townsite Road	Healy Road	150
Healy Access	Healy Road	125
Hilltop Drive	Otto Lake Road	100

Police protection in the Denali Borough is provided by one Alaska state trooper stationed in Cantwell ***and another stationed in Nenana.*** This level of service will not be expanded in the near future due to funding shortages that have required the closure of other Alaska state trooper stations. The borough does not intend to provide police protection in the near future.

Firefighting capability is provided by volunteer fire departments in Healy, Anderson, ***Denali Park***, and Cantwell. Healy's Tri-Valley Volunteer Fire Department serves the Healy area and the Parks Highway from MP243 to MP261. The Tri-Valley Volunteer Fire Department has 19 volunteers and 4 pieces of firefighting equipment (1 tanker, 1 combination tanker/fire truck, and 2 fire trucks). In ***Denali Park***, the NPS operates three fire trucks manned by volunteer firefighters and has a mutual response agreement with the Tri-Valley Volunteer Fire Department. This system of fire protection is not expected to change with borough incorporation.

Medical services are provided by clinics in the Denali Borough. The Healy Clinic, which serves Healy, ***Denali Park***, Cantwell, Anderson, and Clear AFB, is staffed by two nurses and ***one physician's assistant.*** The Railbelt Mental Health ***and Addictions Program, with permanent offices in Nenana and Healy and itinerant offices in Anderson, Denali Park, and Cantwell, serves the borough with two full-time clinicians and a director/clinician.*** The nearest full-time physician and hospital are located in Fairbanks, about 110 road miles away. Typically, emergency medical services (EMS) are provided by the communities' volunteer fire departments. The Tri-Valley Volunteer Fire Department has one emergency medical truck/ambulance and ***two ambulances.*** In ***Denali Park***, the NPS has an ambulance operated by ***emergency medical technicians (EMTs).***

3.8.6 Tourism and Recreation

3.8.6.1 Denali National Park and Preserve

Because DNPP and the Nenana River are popular recreation areas for tourists and local residents, tourism and recreation are important to the borough's economy. DNPP, whose entrance is located 11 miles south of Healy, offers a variety of activities, including wildlife observation, photography, hiking, backpacking, camping, fishing, biking, and mountain climbing. Since 1986, DNPP has had over one-half million visitors annually; peak visitation months are June, July, and August.

The revenue produced by tourism at DNPP is vital to the region, especially the communities of ***Denali Park*** and Healy. The 1989 DNPP visitor total of 543,640 generated expenditures estimated to be in excess of $41 million. During the summer, DNPP and tourism-related businesses in the area provide approximately 3000 jobs, and tourists generate 100% occupancy rates for local hotels, motels, and lodges (AIDEA 1991a).

3.8.6.2 The Nenana River

The Nenana River is also a major recreation area for the Denali Borough. Popular activities include rafting, canoeing, and kayaking. Several commercial operators in ***Denali Park*** rent canoes and kayaks and offer raft tours on the Nenana between May and September each year. These commercial operators cater to tourists and serve approximately 20,000 visitors annually. In addition, the river is a popular rafting, kayaking, and canoeing destination for residents of south-central Alaska.

3.9 NOISE

Generally, ambient sounds in the vicinity of the town of Healy result from highway and rail traffic, the rapids in the Nenana River, wind rustling in the trees, and activities at Healy Unit No. 1. To provide baseline data for this EIS, ambient sound levels were measured both during the day and at night in the town of Healy and at Healy Unit No. 1 (AIDEA 1990). Measurements were recorded from August 31 through September 3, 1990, at the five locations shown in Fig. 3.9.1. Measurements were ***also*** taken 500 ft ***to the*** northwest, 1500 ft to the east, and 1000 ft to the southwest ***of Healy Unit No. 1.*** Sources of sound at the power plant included coal dozers and conveyors, induced draft and forced draft fans, and transformers.

Because ambient sound levels vary with time, a continuous noise monitor was used to measure and statistically analyze sound levels. Exceedance levels (i.e., the noise levels which were exceeded 10, 50, and 90% of the time) were reported by the monitor as L10, L50, and L90, respectively. The exceedance levels of L10 and L50 represent the intrusive noise and the median sound level, respectively. The L90 level is referred to as the background or residual sound level. Because the noise impact of a source is the greatest when the ambient sound level is the lowest, the L90 level is generally used to assess noise impacts and is the exceedance level in this survey.

Data were collected during three daytime and three nighttime sampling periods. Repeated measurements at the same locations allowed the consistency and representativeness of the data to be checked from day to day. The collection of both daytime and nighttime data ensured that measurements were taken during both active and quiet times. The continuous noise monitor data demonstrated that no unusual noise events occurred between the staffed survey periods.

Two types of measurement methodologies were used to collect the ambient sound level data previously described:

- Ten-minute statistical sound levels and octave-band sound levels were manually measured at each of the five locations during each of the six sampling periods.
- Statistical A-weighted sound levels were continuously monitored at Location 3 for the duration of the survey.

ORNL-DWG 91M-8490R

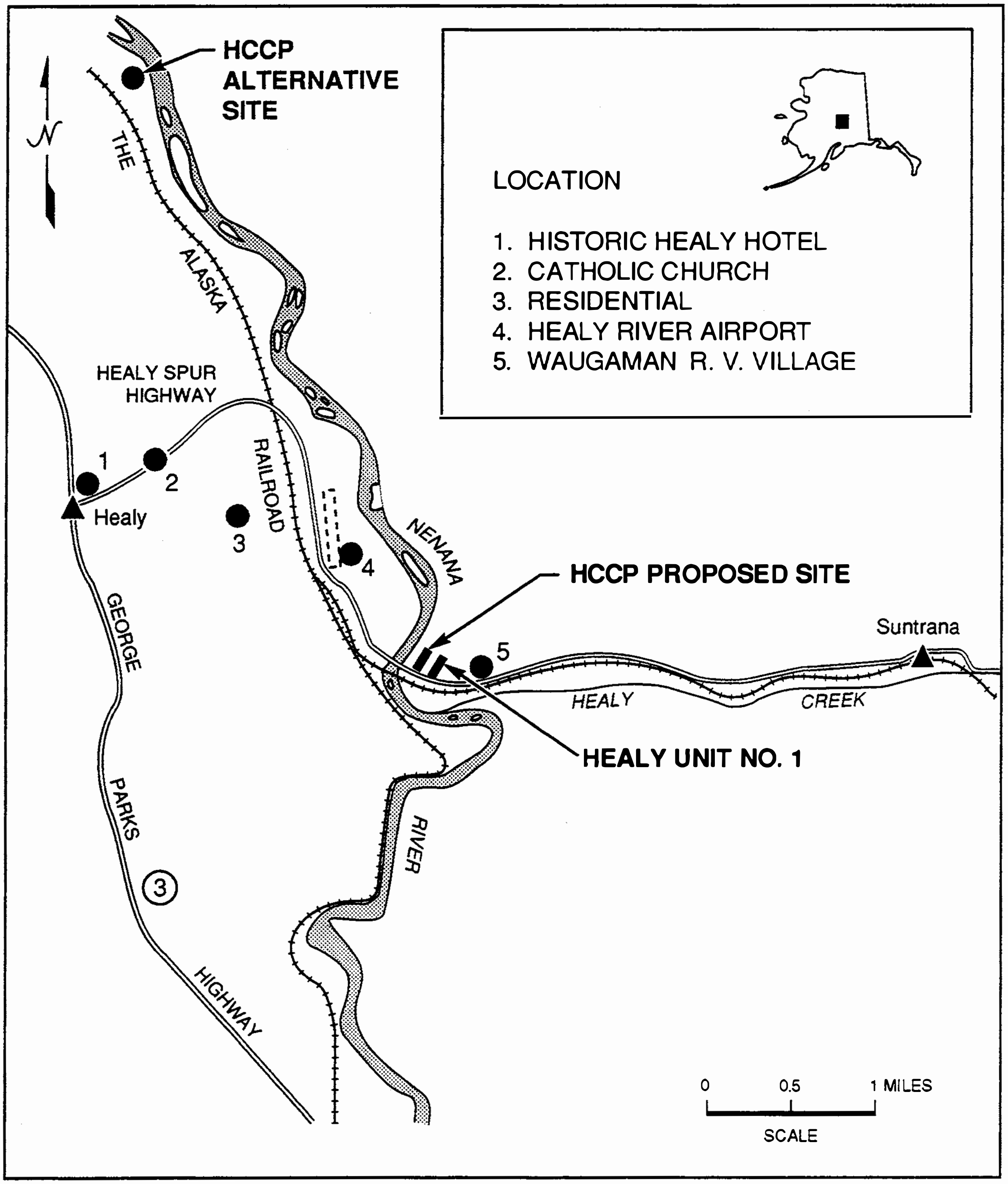


Fig. 3.9.1. Location of ambient noise monitoring sites near Healy, Alaska.

Results of the survey indicate that the *five locations (Fig. 3.9.1)* have ambient sound levels typical of quiet, rural areas (32 dBA to 38 dBA) (AIDEA 1990). Sound levels near the George Parks Highway (*Location* 1) and Healy Unit No. 1 were approximately 10 dBA higher than those in town (40 dBA to 54 dBA). Diurnal variation was low (5 dBA). Ambient levels during winter would be expected to be less in the *five* locations because of decreased highway traffic and the presence of an ice cover on *part of* the Nenana River.

4. ENVIRONMENTAL CONSEQUENCES *OF THE DEMONSTRATION*

This section analyzes the potential impacts to human and environmental resources resulting from construction and ***demonstration*** of the HCCP at the proposed and alternative site. Potentially affected physical, biological, social, and economic resources are included. The analysis for the alternative site focuses on a comparison of impacts with those anticipated for the proposed site.

Special consideration is given to the potential impacts to DNPP (Sect. 4.3). Impacts to DNPP are analyzed and discussed separately to emphasize the importance in preserving the pristine nature of DNPP, including prevention of significant degradation to air quality and visibility.

The cumulative impacts of Healy Unit No. 1 and the HCCP are also analyzed in this section because the resulting effects from the combined operation of HCCP and Unit No. 1 are so intertwined. The analyses in this section characterize the unmitigated impacts of Unit No. 1 prior to its planned retrofit, discussed in Sect. 2.1.3.2. The analyses that include the retrofitted Unit No. 1 are presented in Sect. 5.4.6 because the retrofit is expected to be completed during the commercial operation of the HCCP. Those analyses indicate that impacts associated with air quality, visibility, and regional haze would decrease following the Unit No. 1 retrofit, while changes in impacts to other resources would be minimal. Therefore, if the retrofit of Unit No. 1 is completed and mitigation is implemented prior to the completion of the HCCP demonstration, then the analyses presented in this section would overstate the impacts on air quality, visibility, and regional haze during the demonstration period.

4.1 ENVIRONMENTAL IMPACTS OF THE PROPOSED ACTION

This section analyzes the potential impacts to human and environmental resources resulting from construction and operation of the HCCP at the proposed site.

4.1.1 Aesthetics

Construction and operation of the HCCP would create impacts to the visual resources discussed in Sect. 3.1. Areas from which an observer could perceive aesthetic impacts include the immediate surroundings of the HCCP proposed site, the community of Healy, the Healy Spur Highway, the Nenana River, the Alaska Railroad near the HCCP site, and portions of the George Parks Highway. The view from two small portions of DNPP also may be affected and are discussed in Sect. 4.3.1. Also affected are other distant, high-elevation areas from which the proposed HCCP may be viewed.

Construction at the HCCP proposed site would produce some short-term visual impacts related to increased activity in the area, including delivery of construction equipment and supplies, site preparation and construction work, and transit of construction workers to and from the site. Some short-term disturbance to the Nenana River would occur in the process of installing cooling water intake and outfall facilities.

Long-term visual impacts that would be initiated during construction include (1) the physical presence of the new plant, (2) the disturbance of additional land at the site, and (3) the removal of some native vegetation. Healy Unit No. 1 utilizes approximately 40 acres east of the Nenana River and north of the Healy Spur Highway; all but 2 acres are disturbed. The HCCP and Unit No. 1 together would occupy approximately 65 acres, including some property between the Healy Spur Highway and Healy Creek. No construction of new access roads or coal haul roads is planned. Long-term disturbance would be restricted to the river terrace on which the existing plant is situated and possibly to a small portion of the Healy Creek floodplain. ***Following*** HCCP construction, the existing Unit No. 1 would be converted to dry ash disposal. ***Ash ponds at the site would only be used when the dry ash system is inoperable.*** The ground surface of the coal pile storage area would be graded to direct coal pile runoff waters to a new unlined catchment pond. Of the total 65 acres at the site, a maximum of approximately 10 acres of native vegetation would be removed. Areas not occupied by permanent facilities would be planted with grass.

Visual impacts from HCCP operation in terms of visibility impairment and regional haze are discussed in ***Sects. 4.3.2.3 and 4.3.2.4, respectively.*** Long-term visual impacts would result from the generation of a plume of condensed water vapor from the HCCP stack. The HCCP plume is expected to be visible only during stable atmospheric conditions with light winds and cool temperatures. The plume would resemble that from Unit No. 1, in which a plume occasionally is visible for about 2 miles before it evaporates. Under ***extremely*** cold ***(less than –20°F) and stable meteorological*** conditions, the water droplets would freeze and the plume would turn into ice particles. ***Time-lapse cameras operating from January 1992 until April 1993 detected ice plumes from Unit No. 1 on three occasions (January 20, 21, and 24, 1993) under such conditions. The ice plumes traveled about 4 miles from Unit No. 1 to the nearest boundary of DNPP in the Nenana River Gorge.***

The HCCP stack would be approximately 315 ft high and, because of its greater capacity and different emissions process, would produce greater quantities of water vapor than the existing 110-ft stack at Unit No. 1. However, the water vapor emitted by the HCCP stack would be at a lower temperature than that emitted by the existing stack. It is anticipated that because it would contain more water, the plume from the HCCP would be larger than the Unit No. 1 plume and would extend for up to ***about 3 or 4*** miles downwind. Also, because it would be released at a higher elevation above ground level, the HCCP plume would generally rise higher than the Unit No. 1 plume. Because the HCCP's water vapor would be cooler than that of Unit No. 1, the HCCP plume would equilibrate with ambient temperatures more rapidly, thus curtailing upward movement. ***Under extremely cold and stable meteorological conditions, an ice plume from the HCCP may travel slightly more than 4 miles.***

Visual characteristics of the HCCP proposed site would not differ appreciably over the long term from those that exist now for the following reasons:

- The site is located in an area that has already experienced human disturbance.
- The net amount of land that would be disturbed for the HCCP is relatively small (approximately 10 acres).
- A relatively small amount of native vegetation would be removed.
- The HCCP would be of the same basic structure and on a similar scale as Healy Unit No. 1, and would be located immediately adjacent to it.
- The HCCP would use existing transmission lines (there would be a new 300-ft-long overhead line from the HCCP transformer to a proposed extension of the existing substation).
- The vapor plume from the HCCP would be larger than, would rise higher than, and would be separate from that of Unit No. 1; however, it would occur under similar conditions and would behave in a similar manner.

Because the area in the immediate vicinity of the HCCP proposed site is already developed, and the visual condition, scenic quality, and visual resource sensitivity are not outstanding (see Sect. 3.1.3), the aesthetic impacts of HCCP construction and operation would not be large.

Construction activities or a vapor plume from HCCP operations would not be visible from those portions of the Nenana River Valley considered to have important scenic resources (see Sect. 3.1.2), ***except for a few infrequent occasions during the winter***. People who raft or kayak on the Nenana River could observe the plant from the take-out site across the river during construction and operation. Likewise, passengers on the Alaska Railroad could see the HCCP site while passing through the Nenana River ***Valley near the site***. The presence of such a prominent industrial site may be aesthetically objectionable to some of these people. However, because the HCCP proposed site is in an area of industrial development that has been visible for many years, HCCP construction and operations are not expected to create major additional impacts.

4.1.2 Atmospheric Resources

Potential impacts to atmospheric resources are discussed, including degradation of ambient air quality, ice fog formation, acidic deposition, and global warming.

4.1.2.1 Construction

Atmospheric effects during construction of the HCCP would occur intermittently during a 4-year period and be limited primarily to emissions of fugitive dust and exhaust emissions from construction equipment and vehicles. Combustion of diesel fuel and gasoline in medium- and heavy-duty construction vehicles would generate localized emissions of NO_x, CO, PM, and hydrocarbons. Fugitive particulate emissions would be generated from vehicles traveling on unpaved roads and dirt and during periods of earth removal and transport by heavy construction vehicles. Fugitive emissions would also occur from loosened earth being lifted and transported by strong winds. Fugitive dust consists primarily of large particles that settle quickly and pose minimal adverse public health effects.

The total surface area disturbed during construction of the HCCP would be about 10 acres. However, construction within this area would be staggered to minimize the area of disturbance at any one time. Because construction would occur in the existing plant yard, much less site clearing would be necessary than for an undisturbed site. Thus, levels of fugitive dust should be relatively low. Approximately 6 additional acres ***of a previously disturbed site*** would be disturbed ***slightly*** during construction camp development, located about 0.5 mile northwest of the HCCP proposed site.

As a mitigation measure, sprinkler trucks would spray the roads and construction areas with water to minimize fugitive dust. In summary, minimal air quality impacts are expected during the construction period.

4.1.2.2 Operation

National Ambient Air Quality Standards (NAAQS) and Prevention of Significant Deterioration (PSD) Increments

Ambient air quality impacts are characterized and implemented under the Clean Air Act (CAA) by means of National Ambient Air Quality Standards (NAAQS) and Prevention of Significant Deterioration (PSD) increments. NAAQS are fixed, absolute limits of concentration for the "criteria" pollutants (SO_2, NO_2, PM_{10}, CO, O_3, and lead) in the ambient air, applicable all over the United States, and are set by the EPA. Their purpose is to protect public health and welfare with an adequate margin of safety by setting a ceiling for ambient concentrations resulting from the combination of new sources (e.g., the HCCP), existing sources of pollution in the area (e.g., Healy Unit No. 1), and natural sources (e.g., windblown dust).

PSD "increments" are allowable levels of increase of certain pollutants above a baseline established for the area in which a new source (e.g., the HCCP) has been proposed. The baseline levels of pollutants are established by the EPA or the environmental agency having jurisdiction in the area. The objective of PSD increments is to preserve air quality in areas of the country that already are considered to be good (i.e., areas in attainment with NAAQS).

NAAQS and PSD increments are used as yardsticks to measure the potential of the HCCP and Healy Unit No. 1 to affect human health and the environment. PSD increments are not appropriate measures of impacts for existing sources like Unit No. 1 that were built before the establishment of the increments in 1977. Unit No. 1 alone was added to the HCCP to evaluate cumulative impacts because no other major pollutant source is located in the Healy region. The estimated total impact includes the conservative assumption of summing contributions from Unit No. 1 predicted by modeling and those actually measured by monitoring ("double counting" Unit No. 1 concentrations to some extent).

Ambient Air Quality Impacts

Air emissions from the stack during operation of the HCCP include approximately 103 tons per year of SO_2, 480 tons per year of NO_x, 36 tons per year of PM_{10}, and 480 tons per year of CO (based on an 85% capacity factor and the demonstration case described in Sect. 2.1.7.1). Trace emissions of other pollutants include beryllium, sulfuric acid mist, mercury, hydrochloric acid, hydrofluoric acid, benzene, and arsenic. Other PM sources include the limestone storage silo, the coal handling system, the primary crusher, and the fly ash storage silo. All four of these facilities would employ high-efficiency (*>90%* PM removal) fabric filter collectors that would reduce PM_{10} emissions to about 4 tons per year for the fly ash storage silo, 0.05 tons per year for ***the limestone storage silo, 3 tons per year for the coal handling system, and 2 tons per year for the primary crusher.***

Air emissions were compared with their PSD significant emission rates (threshold values for ambient air quality monitoring requirements) as a "flag" for potential impacts to health or the environment. Only SO_2, NO_x, PM_{10}, and CO exceeded their threshold values. ***Ambient*** (at or beyond the facility perimeter) concentrations of other pollutants, ***including trace elements,*** resulting from HCCP operation should be minimal and are not considered further. A cursory analysis for CO revealed that ambient concentrations are expected to be an extremely small percentage (about 1%) of the NAAQS; therefore, the minor impacts resulting from CO emissions are not considered further.

The air quality impacts of SO_2, NO_x, and PM_{10} emissions from the HCCP were evaluated using EPA-approved atmospheric dispersion models. A dispersion model refers to a computer program that incorporates a series of mathematical equations used to predict the ground-level concentrations resulting from emissions of a pollutant. Inputs to a dispersion model include the emission rate; characteristics of the emission release such as stack height, exhaust temperature, and flow rate; and atmospheric dispersion parameters such as wind speed and direction, air temperature, atmospheric stability, and mixing height.

The models chosen for use were the EPA Industrial Source Complex Short Term (ISCST) model (Wackter and Foster 1987; Bowers, Bjorklund, and Cheney 1979), and the EPA Rough Terrain Diffusion Model (RTDM) (ENSR 1987). RTDM is a steady-state, multiple-source, Gaussian dispersion model designed for use with stack emission sources situated in terrain where ground-level elevations exceed the stack heights of the emission sources. The ISCST model is similar, except that it is used at receptors (specific modeled locations) with elevations that do not exceed effective stack height (stack height plus plume rise). Both of these models are approved techniques in EPA's Guideline on Air Quality Models (EPA 1990b). Receptors were selected in sufficient density surrounding the HCCP and Unit No. 1 facilities to determine impacts locally, and in areas where the plumes from the emissions may impinge upon high terrain. In addition, potential impacts to DNPP were analyzed and are discussed in Sect. 4.3.2.1.

The air dispersion models were run using HCCP emissions corresponding to the demonstration case, but conservatively assuming a 100% capacity factor. Both models were run, and the model producing higher concentrations was used, provided that it was appropriate for that receptor. The ISC2 model, which was released in March 1992 as a replacement for the ISCST model, was also run for several test cases to compare results with ISCST results. The differences were negligible. Throughout the air quality analyses, for the 3-h and 24-h averaging periods, the maximum modeled concentration is actually the second-highest concentration predicted at any receptor to correspond with the guidelines for the NAAQS. Meteorological inputs were obtained from the HCCP Healy Monitoring Station for the 12-month period from September 1990 through August 1991. Details of similar air dispersion modeling for the proposed project can be found in the PSD permit application (AIDEA 1992).

The predicted maximum impacts from the HCCP are shown in Table 4.1.1. For each pollutant, modeled concentrations were compared with PSD Class II increments as a yardstick to measure the HCCP's potential to affect human health and the environment. PSD increments are standards established in accordance with existing CAA provisions to limit the degradation of ambient air quality in areas in attainment with the NAAQS ***(National Ambient Air Quality Standards, which are absolute limits of pollutant concentrations established to protect public health and welfare with an adequate margin of safety)***. In contrast to the NAAQS, these standards are called increments because they allow a relative, or incremental, amount of degradation from a source or sources. PSD increments provide a more stringent level of air quality protection in areas (such as the Healy region) with air quality much better than the NAAQS. No other major pollutant source has been constructed in the Healy region since the establishment of the PSD increments in 1977; therefore, the HCCP is the only source that is appropriate for comparison with the PSD increments ***to evaluate air quality degradation***. The area surrounding the

Table 4.1.1. Prevention of Significant Deterioration (PSD) impact analysis for the Healy Clean Coal Project (HCCP) outside of Denali National Park and Preserve (DNPP)

Class	Pollutant	Averaging period	PSD increment[a] ($\mu g/m^3$)	Maximum modeled concentration[b] ($\mu g/m^3$)	Percentage of PSD increment
II[c]	SO_2	3-h	512	57	11
		24-h	91	11	12
		Annual	20	0.8	4
	NO_2	Annual	25	3.4	14
	PM_{10}	24-h	30	17	56
		Annual	17	2.4	14

[a]PSD increments are standards established in accordance with existing Clean Air Act provisions to limit the degradation of ambient air quality in areas in attainment with the National Ambient Air Quality Standards.

[b]Maximum concentrations predicted by computer models resulting from HCCP emissions alone.

[c]The area surrounding the HCCP site outside of DNPP is designated a PSD Class II area where moderate, well-controlled industrial growth is allowed.

HCCP site outside of DNPP, including the town of Healy, is designated a PSD Class II area where moderate, well-controlled industrial growth is allowed. All SO_2 and NO_2 concentrations, which reflect emissions from the HCCP stack alone, were predicted to be less than 15% of the PSD Class II increments. PM_{10} concentrations, which result from HCCP stack emissions and other new sources such as the fly ash storage silo, were estimated to be less than 60% of the increments.

During operation of the HCCP, minor atmospheric impacts are expected from the slightly increased level of UCM Poker Flats mining. The active mining area would be about the same, but the rate of mining would increase by about 10%. Fugitive particulate emissions would increase very slightly from the additional mining. Fugitive dust consists primarily of large particles that settle quickly and pose minimal adverse public health effects. Transport of the run-of-mine coal and waste coal to the HCCP would increase traffic on the haul road by about 20%. Localized emissions of NO_x, CO, PM, and hydrocarbons from the coal trucks would increase correspondingly. Additional fugitive dust, estimated at less than 1 ton per year, would be generated from the vehicles traveling on the haul road. In addition, fugitive emissions from the existing coal pile would increase slightly (also estimated at less than 1 ton per year).

The only major individual source of air emissions that would contribute to cumulative impacts to atmospheric resources is the existing Healy Unit No. 1. During the winter heating season, emissions from coal- and wood-burning stoves are expected to contribute to air quality and visibility degradation. During the summer, emissions and fugitive dust from buses transporting visitors within DNPP are expected to degrade air quality and visibility in the immediate vicinity of the buses. Other vehicles generate emissions throughout the year, but their impacts are expected to be negligible because of the limited number of vehicles.

Cumulative air quality impacts of SO_2, NO_x, and PM_{10} emissions resulting from the simultaneous operation of the HCCP at the proposed site and Healy Unit No. 1 were evaluated using the ISCST and RTDM atmospheric dispersion models. The predicted maximum impacts are shown in Table 4.1.2. For each pollutant, modeled concentrations were added to ambient background concentrations and the sum (the total impact) was compared with the NAAQS. Ambient background concentrations were obtained from the HCCP Park Monitoring Station for the 12-month period from September 1990 through August 1991.

All total impacts were predicted to be less than the respective NAAQS. PM_{10} and NO_2 concentrations were found to be ***no more*** than 80% of their NAAQS, while SO_2 concentrations were just under the NAAQS. The percentages ranged from ***50%*** for the annual concentration of PM_{10} to 96% for the 24-h concentration of SO_2. Almost all of the modeled concentrations occurred at the site perimeter resulting from downwash (downward movement) of the Unit No. 1 stack plume caused by the new HCCP boiler building. These high concentrations would be localized (within about 0.5 miles of the site) and

Table 4.1.2. National Ambient Air Quality Standards (NAAQS) impact analysis for the combined effects of the Healy Clean Coal Project (HCCP) and Healy Unit No. 1

Pollutant	Averaging period	NAAQS[a] (μg/m³)	Modeled concentration[b] (μg/m³)	Ambient background concentration[c] (μg/m³)	Total impact[d] (μg/m³)	Percentage of NAAQS
SO_2	3-h	1300	*1100*	45	*1145*	*88*
	24-h	365	*326*	26	*352*	96
	Annual	80	*64*	5	*69*	*86*
NO_2	Annual	100	*61*	6	*67*	*67*
PM_{10}	24-h	150	*89*	31	*120*	*80*
	Annual	50	*20*	5	*25*	*50*

[a]NAAQS are absolute limits established in accordance with existing Clean Air Act provisions to protect public health and welfare with an adequate margin of safety.

[b]Maximum concentrations predicted by computer models resulting from HCCP and Healy Unit No. 1 emissions.

[c]Background concentrations are based on Park Monitoring Station data from the 12-month monitoring period from September 1990 through August 1991.

[d]Total impact is calculated as the sum of the ambient background concentrations and the modeled concentration.

would diminish quickly with distance. Therefore, other potential future sources in the region would not cause violations of the NAAQS unless they were sited near the HCCP proposed site. Emissions from the HCCP stack contributed negligibly to these predictions, but would contribute more at other receptors with smaller total impacts.

Ice Fog

The HCCP discharge of warmed water would be double the existing Healy Unit No. 1 heat discharge to the Nenana River, so that combined operation would effectively triple the existing discharge. The discharge points for Unit No. 1 and the HCCP are shown in Fig. 4.1.1. The addition of the HCCP discharge would result in a greater downstream distance remaining ice-free during the winter. As discussed in Sect. 4.1.3.2, it is estimated that the ice-free downstream distance would increase from the existing 4 miles to about 10 miles (including the 1-mile transitional area).

Under the meteorological conditions conducive to ice fog formation (cold air temperatures and calm wind), an extended area of ice-free water would enhance the formation of ice fog along the Nenana River. It is expected that the downstream distance for ice fog would increase from the existing 3 or 4 miles to about 9 or 10 miles. The larger discharge of heated water would result in more rapid buildup of ice fog and would likely increase the density of the ice fog. The ice fog is not expected to increase in thickness in the atmosphere and would continue to be a ground-based phenomenon. The ice fog would begin to dissipate during daylight hours or if a wind develops.

ORNL-DWG 91M-14251R2

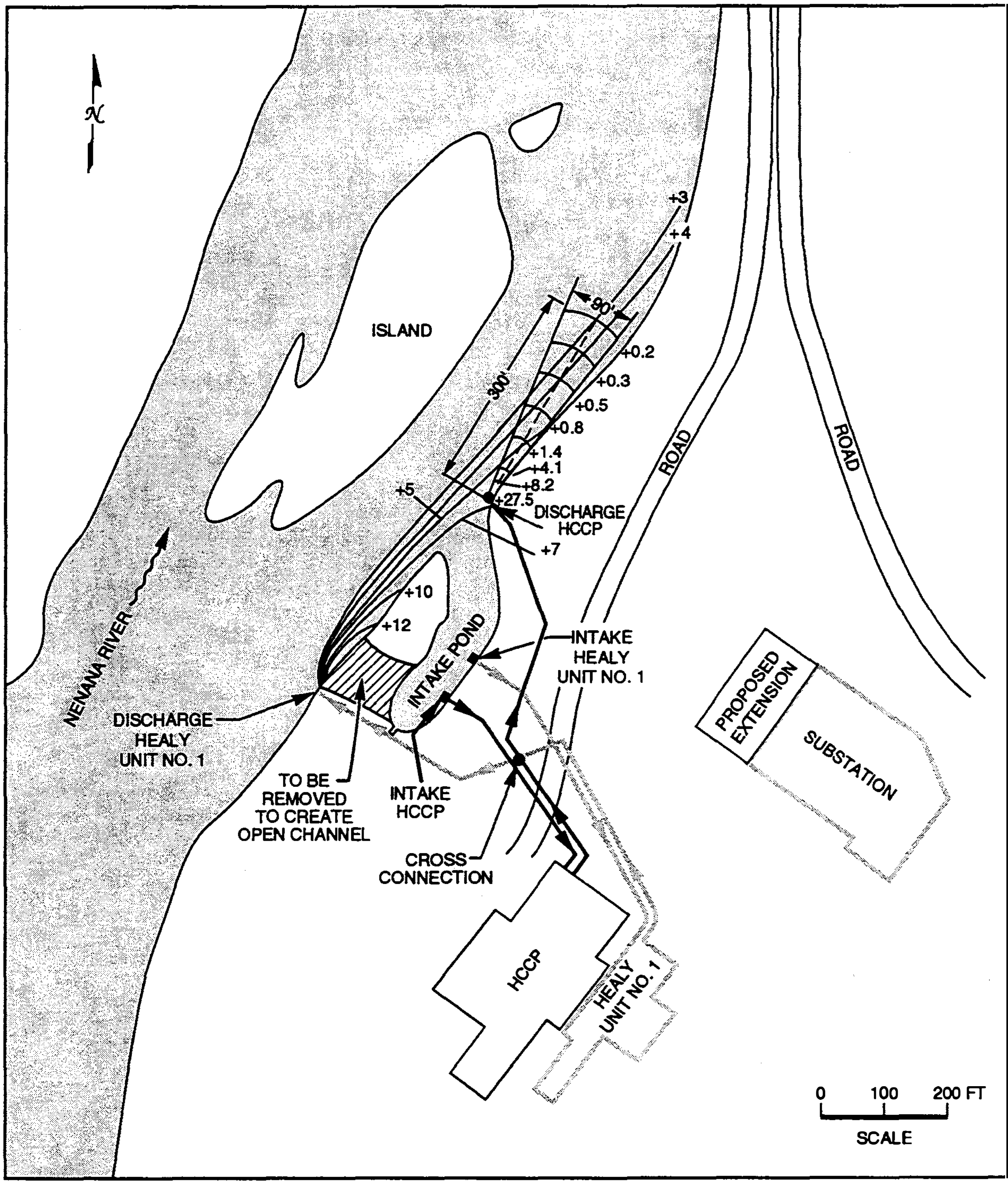


Fig. 4.1.1. The Healy Clean Coal Project and Healy Unit No. 1 once-through cooling systems. The isotherms indicate estimated elevations in temperature above ambient river temperature resulting from thermal discharges from each unit during winter (see Table 4.1.4 for further data). *Source:* Alaska Industrial Development and Export Authority. 1993. *Final Thermal Discharge Impact Analysis Elements of Technical Analysis*, prepared by Stone & Webster, January.

The UCM haul road parallels the Nenana River on its east bank downstream from Healy Unit No. 1 to the UCM mine. Dense ice fog limits visibility for vehicles using the haul road; however, the existing frequency of ice fog occurrence during the winter due to Unit No. 1 is low (3 to 6 days per month) and is not expected to increase substantially from the addition of the HCCP. The haul road is restricted to coal trucks and associated vehicles. The vehicles travel at maximum speeds of 20–25 mph when the ice fog is dense, and the coal trucks are equipped with fog lights. To date, no vehicular accidents have occurred on the haul road as a result of ice fog. The additional ice fog is not expected to affect haul road traffic. The ice fog does not reach the elevation of the neighboring Healy River Airport. While additional ice fog generated by the HCCP is not expected to affect air traffic at the Healy River Airport, it would likely affect use of the private UCM airstrip located about 4 miles north of the HCCP proposed site. Because the additional area that would experience ice fog downstream beyond the UCM mine is uninhabited, impacts to this area are unlikely. It is unlikely that the village of Ferry, located about 13 miles downstream of the proposed site, would be affected.

Acidic Deposition

Coal combustion generates atmospheric emissions of SO_2 and NO_x that contribute to the formation and deposition of acidic compounds. The effect of atmospheric emissions of SO_2 and NO_x on acidic deposition (acid precipitation and dry deposition) is difficult to quantify. The complex chemical reactions that transform SO_2 and NO_x into acidic compounds that contribute to acid rain are not fully understood, and the source-receptor relationships between power plant emissions and acidic deposition have not been fully quantified (DOE 1989). Establishment of a clear source-receptor relationship for acid rain is hampered by the long travel times between emission sources and the occurrence of acid rain.

Acidic deposition is currently most evident in the eastern United States and is not a major concern in Alaska or western Canada. The lack of large coal-burning or other sources in the region has prevented the widespread occurrence of acidic deposition. The relatively low HCCP stack (315 ft) and the topography of the area would keep most deposition localized under most meteorological conditions and impede the long-range transport of pollutants. Acidic deposition resulting from HCCP air emissions is expected to be minor (see Sects. 4.1.5.1 and 4.3.2.2).

Global Climatic Change

A major worldwide environmental issue is the possibility of major changes in the global climate (e.g., global warming) as a consequence of increasing atmospheric concentrations of "greenhouse" gases (Mitchell 1989). ***The atmosphere allows a large percentage of incoming solar radiation to pass through to the earth's surface, where it is converted to heat energy (infrared radiation) that does not pass back through the atmosphere as easily as the solar radiation passes in. The result is that heat energy is "trapped" near the earth's surface. This phenomenon is commonly called the greenhouse effect***

because of an analogy with the glass in a greenhouse. However, the use of the term greenhouse effect to describe these radiative processes is somewhat of a misnomer because the main effect of the glass in a greenhouse is to keep the warm air inside the glass from escaping and mixing with the colder air outside (the atmosphere does not have a similar physical barrier).

Greenhouse gases include water vapor, CO_2, methane, nitrous oxide, ozone, and several chlorofluorocarbons. The greenhouse gases constitute a small percentage of the earth's atmosphere; however, their collective effect is to keep the temperature of the earth's surface about 60°F warmer, on average, than it would be if there were no atmosphere. Water vapor, a natural component of the atmosphere, is the most abundant greenhouse gas. The second-most abundant greenhouse gas is CO_2, which has increased about 25% in concentration over the last century. It is generally agreed that fossil fuel burning is the primary contributor to increasing concentrations of CO_2 (DOE 1989). Because CO_2 is stable in the atmosphere and essentially unifonnly mixed throughout the troposphere and stratosphere, the climatic impact does not depend on the geographic location of sources. Therefore, an increase in CO_2 emissions at a specific source is effective in altering CO_2 concentrations only to the extent that it contributes to the global total of fossil fuel burning that increases global CO_2 concentrations.

Federal guidance on the need to address global climate change and greenhouse gas emissions in proposed federal projects is being developed; however, the specific details of the policy have not been determined. In his 1993 Earth Day address, President Clinton announced our nation's commitment to reducing our emissions of greenhouse gases to their 1990 levels by the year 2000. Numerous existing and proposed activities will help us meet this commitment. The Energy Policy Act enacted by Congress will play a critical role in reducing greenhouse gas emission levels. In the absence of final guidance on greenhouse gas emissions, an analysis was prepared that focuses on a comparison of CO_2 emissions from the HCCP with CO_2 emissions from U.S. and global fossil fuel and coal combustion. The proposed HCCP is expected to emit about 512,000 tons per year of CO_2. Table 4.1.3 compares this amount with CO_2 emissions generated by U.S. and global fossil fuel and coal combustion in 1986 (DOE 1989). The percentage increase in CO_2 emissions contributed by the HCCP compared with U.S. coal combustion is about 0.03%. The percentages are even less when compared with U.S. and global

Table 4.1.3. Comparison of annual carbon dioxide (CO_2) emissions from the Healy Clean Coal Project with U.S. and global CO_2 emissions[a]

HCCP CO_2 emissions[b] (tons/year)	Percentage of U.S. coal combustion[b]	Percentage of U.S. fossil fuel combustion[c]	Percentage of global fossil fuel combustion[d]
511,*600*	0.03	0.01	0.002

[a]*Source*: DOE 1989.
[b]U.S. coal combustion produces 1750 million tons of CO2 per year.
[c]U.S. fossil fuel combustion produces 4800 million tons of CO2 per year.
[d]Global fossil fuel combustion produces 22,000 million tons of CO2 per year.

fossil fuel combustion. ***This analysis presents a balanced approach because it indicates that the HCCP CO_2 emissions are very large in terms of amounts released to the atmosphere (when compared with emissions of other gases), while the percentages are very small in comparison with U.S. and global emissions.***

The amount of CO_2 emitted by the HCCP would be very similar to the amount expected from an equivalently sized conventional pulverized-coal power plant with conventional flue gas desulfurization. While some of the clean coal technologies (e.g., pressurized fluidized-bed combustion, integrated gasification combined cycle) are expected to operate at a slightly greater efficiency so that approximately 10% less CO_2 would be emitted to the atmosphere, the HCCP's design which allows slag to exit the combustor also limits the efficiency of the combustion process to the efficiency of a conventional coal-fired power plant.

4.1.3 Surface Water Resources

In general, impacts to surface water resources are related to changes in the hydrologic cycle or to the introduction of suspended and dissolved substances into receiving waters. The hydrologic cycle can be affected by large withdrawals of water for consumptive use or by alteration of drainage patterns that affect the rate and direction of streamflow. Surface water quality can be altered by the inorganic and organic constituents of point and nonpoint pollutant streams. Ultimately, degradation of water quality, or hydrologic changes, can adversely affect aquatic ecosystems and downstream uses of the resource, including water supply and recreation.

Both construction and operation of the HCCP have the potential to impact the Nenana River in the immediate vicinity of the proposed plant and downstream from the project area. Activities at the HCCP should not affect Healy Creek or other smaller tributaries of the creek or river.

Sources of impacts during construction include erosion and sedimentation resulting from excavation and other land disturbances and spills of chemicals and construction materials. During operation, impacts could result from (1) the discharge of wastewater from the plant; (2) the use of river water for the plant's once-through cooling system; (3) runoff from the coal pile; (4) uncontained spills of process and pollution control chemicals, including sulfuric acid, sodium hydroxide, and ammonia; and (5) acidic deposition from HCCP atmospheric emissions.

The following sections describe the nature and significance of potential surface water impacts from these sources, cumulative impacts that could result from HCCP operation in combination with Healy Unit No. 1, and mitigation measures that could be implemented to reduce the severity of impacts.

4.1.3.1 Construction

Erosion and Sedimentation

Clearing, grading, excavation, and surfacing operations that use heavy equipment, such as bulldozers and backhoes, and dredging and shoreline excavation for cooling water intake and discharge structures would increase the erosion rate at the proposed HCCP site because of the disturbance of soil. Construction activities generally result in erosion rates of approximately 48,000 tons per square mile per year, or about 2000 times the erosion rate of a forested area (Canter 1977). Because the HCCP site consists primarily of glacial outwash gravel and a limited quantity of soil, the erosion rate is expected to be much less. Assuming the higher rate as an upper bound for conservatively predicting impacts, construction on a maximum of 12 acres (0.02 mile^2) at the 65-acre GVEA site for a period of approximately 30 months would generate about 2250 tons of sediment that could then be transported to the adjacent Nenana River.

The volume of construction-related sediment that eventually reaches the river would depend on the nature and extent of precipitation events that occur during the construction period and the success of mitigation used to retain eroded materials. Standard erosion control measures, such as straw barriers, diversion trenches, and riprap, would be implemented to minimize sediment transport. Storm water discharges related to construction activities would be subject to effluent limitations and monitoring requirements of an NPDES permit.

Because the Nenana River has a high ambient concentration of suspended solids (see Sect. 3.3.2), sediment in runoff that flows to the stream during construction, which would be ongoing during the period of maximum river flow (spring and summer), would not likely substantially degrade water quality. Potential effects of increased sedimentation on aquatic life and fisheries are discussed in Sect. 4.1.5.2.

A temporary construction camp is to be developed on about 6 acres in a gravel borrow pit west of the river near the Healy River Airport (see Fig. 2.1.2). Very little erosion and sedimentation runoff would result from land disturbance within the pit because it is below grade and surface runoff is away from the river channel. The pit is adjacent to a former channel of the river but above the 100-year floodplain.

Alteration of Drainage Patterns

Site preparation for the HCCP would not alter the topography of the area; therefore, drainage patterns from the watershed would not change, and no effect on the flow of the Nenana River is expected. The introduction of new structures would not affect the Nenana River floodplain (see Sect. 4.1.6).

Spills

Spills of chemicals, lubricants, and construction materials would primarily threaten groundwater at the HCCP site. However, because of the proximity of the site to the river, groundwater discharge could affect surface water quality. Spill contingency plans would be developed before construction to ensure prompt and complete treatment and cleanup of spilled materials (a further discussion is provided in Sect. 4.1.3.2). The significance of adverse effects to the aquatic environment would depend ultimately on the quantity and toxicity of the spilled substance.

Consumptive Use

Consumptive water requirements during construction (e.g., concrete batching, cleaning, dust control, and potable supply) would be met by groundwater wells at the HCCP site, and the river flow would not be affected. The effects of groundwater withdrawal are discussed in Sect. 4.1.4.

Sewage Plant and Concrete Batch Plant Discharges

A small sewage treatment facility would be necessary for the construction camp. The discharge from the facility to surface waters would be subject to the NPDES requirements of EPA, and the facility would require an ADEC wastewater disposal permit. If a discharge is proposed from a concrete batch plant that operates during construction, the same permits would be needed. Neither the sewage plant nor the batch plant is expected to generate waste streams that would have unique chemical compositions. However, the chemical composition of these plant effluents ***has not been established***. Although each new effluent discharge would introduce pollutants to receiving waters, federal and state permitting authorities would establish limitations to maintain water quality and would provide oversight to ensure that the limitations are not exceeded.

4.1.3.2 Operation

Consumptive Use

The estimated mean consumptive water requirement during operation (e.g., for use as makeup water for potable, service, and boiler feedwater systems) would be approximately 120 gal/min (0.26 ft^3/s) met primarily by groundwater wells at the HCCP site. River water may be drawn occasionally from the discharge side of the cooling system for supplemental use. The flow of the river (see Sect. 3.3.1) would not be substantially affected. Figure 4.1.2 is a water balance diagram of intake and discharge associated with HCCP operations.

Thermal Effects

The HCCP would use a once-through cooling system that would draw about 28,000 gal/min (62.4 ft^3/s) of Nenana River water for use in removing waste heat from the condenser. ***The intake for the HCCP would be placed in a modified intake pond near the existing Unit No. 1 intake (see Fig. 4.1.1).*** After use in the HCCP, water would be returned to the river at an outfall located about ***200*** ft downstream of the ***existing*** intake and approximately ***370*** ft downstream from the Healy Unit No. 1 outfall ***(see*** Fig. 4.1.1). ***The two thermal plumes generated by both units would interact downstream from the HCCP outfall.*** To minimize impact from the HCCP discharge to the Nenana River, the ***submerged***

ORNL-DWG 92M-14126

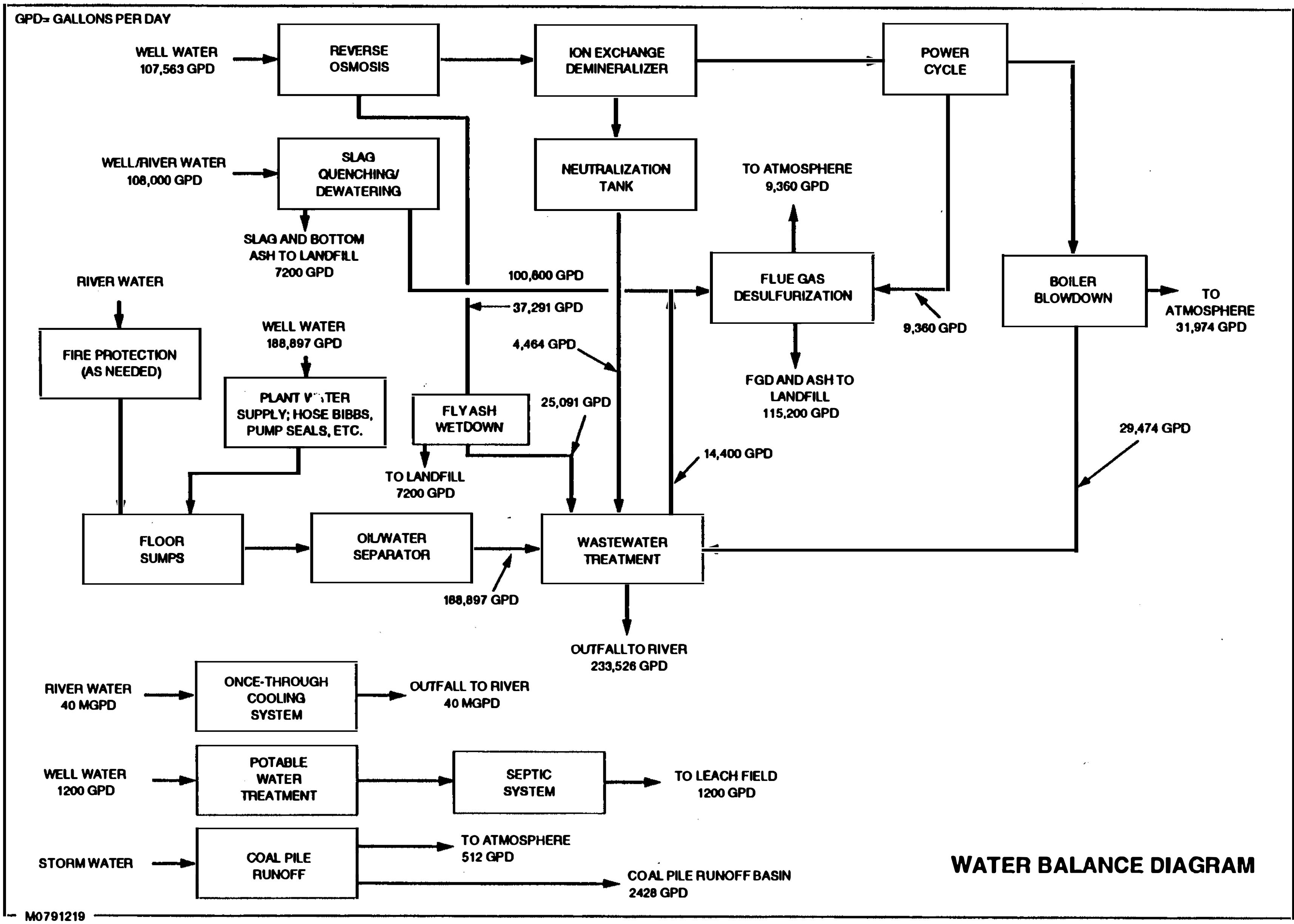


Fig. 4.1.2. Water balance diagram of intake and discharge associated with Healy Clean Coal Project operations.

discharge nozzle would be *located 1 ft above* the river bottom and would discharge perpendicular to the river flow under pressure from gravity. The discharge nozzle would consist of a 60-in.-diameter outlet pipe, reduced to a short length of *36*-in. pipe before the discharge point. ***During low-flow winter months, the HCCP discharge nozzle would be partially rather than completely submerged.*** This ***nozzle*** design ***would promote*** mixing ***in the Nenana River*** sufficient to maintain water ***temperatures*** below 13°C (55.4°F) ***(the ADEC limit) at the point of compliance*** downstream from the HCCP discharge ***(AIDEA 1993).***

Because the existing Healy Unit No. 1 outfall is located upstream of the existing intake, ***the*** winter discharge of Unit No. 1 circulating water would keep both intakes free of ice. To maintain this ice-free condition during times when Unit No. 1 is shut down in winter, a cross connection would be installed to allow part of the HCCP circulating water to discharge to the upstream Unit No. 1 outfall. ***During summer months, both units would discharge their circulating water at the proposed HCCP discharge nozzle through use of the 60-in. cross connection (see Fig. 4.1.1); thus, no upstream Unit No. 1 thermal plume would exist during the summer.***

The design cooling water flow for Healy Unit No. 1 is 13,700 gal/min (30.5 cfs) (Stanley Engineering Company 1967). Nenana River water withdrawal from the two-unit complex (92.9 cfs) would represent 49% of the historical low flow of record (190 cfs), but only 2.7% of the historical average annual flow (3500 cfs), based on USGS records (see Sect. 3.3.1). Although elevated temperatures would slightly enhance evaporative losses from the Nenana River, cooling water cycling would not substantially affect the flow or quantity of water available for downstream uses of the river; therefore, hydrologic impacts would be negligible ***except possibly during conditions of extremely low flows. The design temperature increase across the Unit No. 1 condenser is 13.6°C (24.5°F), while the corresponding design temperature increase attributable to the HCCP condenser would be 15.3°C (27.5°F). For uniformity and conservatism, the higher HCCP condenser temperature increase was used to model both the HCCP and Unit No. 1 thermal plumes.***

The nature of the thermal plumes would depend on ambient water temperature and flow, both of which vary dramatically with each season. The plumes were modeled using representative summer and winter Nenana River flows of 7000 and 500 cfs, respectively (AIDEA 1993). Flows in the Nenana River occasionally decrease below 500 cfs; the 30-year minimum flow of record is 190 cfs (see Sect. 3.3.1). Slightly increased heating effects would be expected when flows below 500 cfs occur in the Nenana River during extreme drought. For multiple-use water resources, such as the Nenana River, the ADEC limitation on maximum water temperature at the mixing zone is 13°C (55.4°F). According to ADEC, this temperature has been determined as the highest temperature that can be allowed for waters of a multiple-use waterway, such as the Nenana River, that also is used for fish spawning and migration. EPA thermal plume prediction models were used for the HCCP and Healy Unit No. 1 discharges (AIDEA 1993), and a summary of the thermal plume analysis is given in Table 4.1.4. The effects of the thermal plume and increased river temperature on aquatic organisms and the ecosystem are discussed in Sect. 4.1.5.2.

During winter months, the cumulative water temperatures, calculated by adding the temperature increases caused by the Healy Unit No. 1 and HCCP discharges to the ambient river temperature, are predicted to be below 55.4°F at 30 ft downstream from the HCCP outfall and beyond. These cumulative temperatures do not include heating effects within the intake pond attributable to the Healy Unit No. 1 thermal plume (which would increase the intake cooling water temperature entering the HCCP), or extreme drought flows in the Nenana River approaching or exceeding the historical low flow of record (190 cfs). Either of these effects could increase the winter temperature predictions by several degrees;

Table 4.1.4. Estimated once-through system discharge plume temperatures (°F) at distances downstream from the Healy Clean Coal Project (HCCP) discharge point

	Distance downstream from HCCP discharge point (ft)	Width of HCCP plume (ft)	Temperature above ambient for HCCP plume	Temperature above ambient for Unit No. 1 plume	Cumulative water temperature[a]
Average summer flow (7000 cfs, 5.7-ft depth, 50°F ambient water temperature)[c]	30	12	8.3	0.0[b]	58.3
	50	15	4.1	0.0[b]	54.1
	100	27	1.4	0.0[b]	51.4
	150	39	0.8	0.0[b]	50.8
	200	51	0.6	0.0[b]	50.6
	250	66	0.4	0.0[b]	50.4
	300	75	0.3	0.0[b]	50.3
Average winter flow (500 cfs, 1.2-ft depth, 32°F ambient water temperature)[c]	30	12	8.3	6.5	46.8[d]
	50	18	4.1	6.0	42.1[d]
	100	33	1.4	5.5	38.9[d]
	150	48	0.8	5.3	38.1[d]
	200	60	0.5	5.0	37.5[d]
	250	78	0.3	4.8	37.1[d]
	300	90	0.3	4.5	36.8[d]

[a]The cumulative water temperature is calculated by adding the incremental temperatures caused by Healy Unit No. 1 discharge and HCCP discharge to the ambient Nenana River temperature.

[b]No upstream thermal plume would be produced by the existing Healy Unit No. 1 discharge structure during the summer. Both units would discharge to the proposed HCCP outfall.

[c]Ambient water temperature is the average river water temperature upstream from the Healy Unit No. 1 discharge.

[d]These cumulative water temperatures do not account for the heated water from Healy Unit No. 1 that enters the intake pond and would be used to cool the proposed HCCP. During the winter, the water temperature at the HCCP intake could increase by an additional several degrees when river flows are low; however, the cumulative water temperatures would remain below Alaska Department of Environmental Conservation limitations because ambient river temperatures are near freezing.

Source: AIDEA (Alaska Industrial Development and Export Authority) 1993. Final Thermal Discharge Impact Analysis, Elements of Technical Analysis, Healy Clean Coal Project, Healy, Alaska, prepared by Stone & Webster Engineering Corp., Denver, January.

however, their combined effect would not be expected to exceed the ADEC limit of 55.4°*F*. ***The impacts of increased water temperature are not expected to be major and are discussed in Sect. 4.1.5.2.***

During the summer, the cumulative water temperature from the HCCP and Unit No. 1 thermal plumes was calculated to be below 55.4°F beyond 50 ft downstream from the HCCP *outfall*. The ambient river temperature used in the thermal plume prediction model was 50°F. However, the temperature in the Nenana River reached 52.5°F during June 1991; therefore, to ensure compliance AIDEA has requested a ***100-ft-wide*** mixing zone extending ***600*** ft downstream of the HCCP *outfall* in its application for wastewater discharge permit to ADEC.

Ice Bridge Formation

During the winter, the frozen Nenana River serves as an ice bridge for residents of the village of Ferry, located near the east bank of the river, about 13 miles downstream and to the north of the proposed HCCP site (Fig. 2.1.1). Vehicles transport heavier supplies and materials across the frozen river. During the summer, only a walkway on a railroad bridge is available to cross the river. Inconveniences would occur if the thermal discharges from Healy Unit No. 1 and the HCCP impaired the formation of an ice bridge in the vicinity of Ferry.

Observations of ice cover on the Nenana River have documented the occurrence of ice-free water throughout the year resulting from the discharge of warmed water from Healy Unit No. 1 (Dames and Moore 1975). The length of ice-free water extends from the Unit No. 1 discharge (outfall) on the eastern bank of the Nenana River to a point approximately 3 miles downstream; a transitional area in which pockets of open water are interspaced with areas of thin ice extends an additional mile to a location near the mouth of Lignite (Hoseanna) Creek *by* the UCM Poker Flats Mine (see Fig. 4.1.3). The area of ice-free water gradually spreads from the east bank on which the thermal discharge occurs to almost the entire Nenana River just past the first bend in the river below the outfall, about 0.5 miles downstream. Beyond the bend, the width of ice-free water stays approximately constant at about 225 ft. Although the extent of ice-free water varies somewhat during the winter, the minimum extent occurs from January through March when much of the Nenana River is frozen.

An analysis was performed to estimate the extent of ice-free water downstream from the proposed HCCP during winter (Appendix B). The area of ice-free water resulting from the thermal plume is proportional to the magnitude of the thermal discharge. The proposed HCCP would have twice the generating capacity and thermal discharge of Healy Unit No. 1. The heat load discharged into the Nenana River by both units would be three times that of Unit No. 1 alone. As shown in Fig. 4.1.4, ice-free water resulting from the combined effects of the Healy Unit No. 1 and HCCP thermal discharges is estimated to extend down the Nenana River approximately 9 miles, and the total extent including the 1-mile transitional area would be about 10 miles. The estimate's accuracy is about ±2 miles.

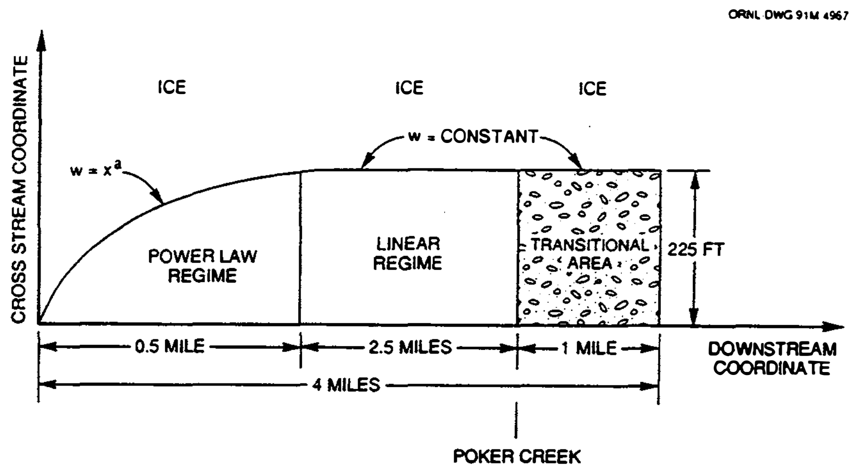


Fig. 4.1.3. Ice-free water area attributable to the thermal discharge from Healy Unit No. 1 (not drawn to scale).

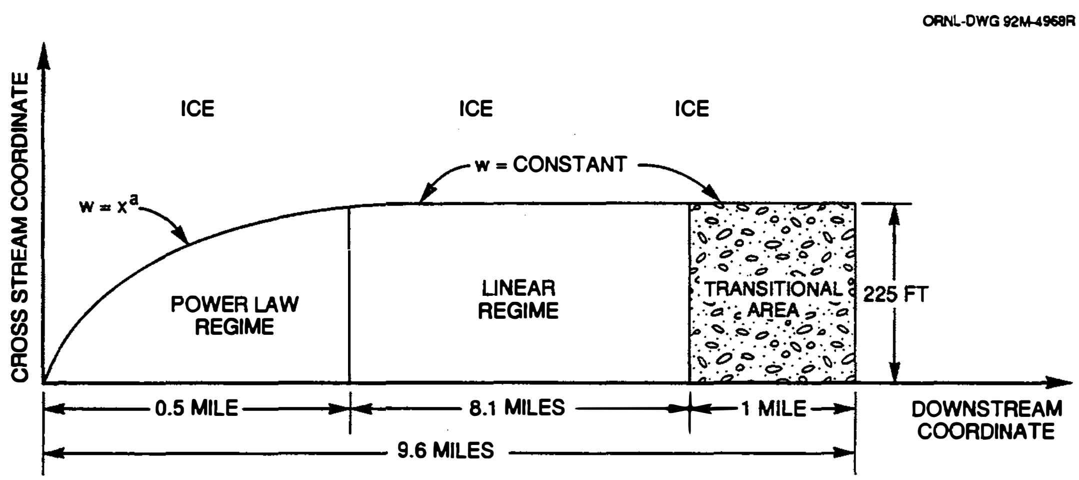


Fig. 4.1.4. Ice-free water area attributable to the combined thermal discharge from Healy Unit No. 1 and the proposed Healy Clean Coal Project (not drawn to scale).

Ice bridge formation over the Nenana River in the vicinity of the village of Ferry may be affected by the combined thermal discharges from Healy Unit No. 1 and the proposed HCCP. Although it is expected that the river would continue to freeze at Ferry, remnants of the thermal plume reaching Ferry could cause a delay in the formation of the ice bridge at the beginning of winter and an earlier breakup of the ice sheet in the early spring. However, meteorological conditions (e.g., a warm winter) also have a large influence on the formation or breakup of the ice bridge. Potential socioeconomic consequences arising from changes in ice bridge formation are discussed in Sect. 4.1.8.5.

Effects of Wastewater Streams

During routine operation, HCCP wastewater effluent is not expected to have a major adverse effect on the water quality of the Nenana River. Concentrations of substances would be within the regulatory (NPDES) limits established to protect the environment, and the river would quickly dilute these substances. Untreated effluent discharge during upset conditions has a very low probability of occurrence because the wastewater treatment sump, which would be located within the plant, would be designed to handle about 150% more wastewater than the plant is expected to produce and overflow would be contained within the building.

The HCCP would not generate unique wastewater streams; the liquid wastes that would be produced are common to most pulverized coal-fired power plants. Low-volume waste streams would include boiler blowdown and cleaning fluids, demineralizer regenerants, floor and equipment drain water, and coal pile runoff and leachate. Estimated flow, pH, and total dissolved solids (TDS) concentrations of these wastes are listed in Table 4.1.5. The TDS concentrations and pH for these streams are before treatment in the wastewater treatment system. A more detailed description of wastewater streams and their treatment is given in Appendix E.

Table 4.1.5. Expected characteristics of low-volume waste streams from the proposed Healy Clean Coal Project

	Flow (gal/d)	Total dissolved solids (ppm)	pH (units)
Demineralizer regeneration wastewater	25,000–30,000	3,000–3,500	5–9
Boiler blowdown	7,000–30,000	50–100	10–11.5
Miscellaneous wastewater	50,000–80,000	400–450	6–9
floor and equipment drains	*~14,000*		
pump seal water	*~43,000*		
equipment leakage	*~14,000*		

The design philosophy for the HCCP is to allow for maximum water reuse and minimal wastewater discharge. Wastewater streams (with the exception of metal cleaning fluids, sanitary wastewater, FGD water, fly ash wetdown, and slag/bottom ash quenching and conveying waters) would be treated and discharged to the once-through cooling system effluent. No direct chemical treatment (e.g., biocides) of cooling water ***would occur.***

Most of the boiler blowdown and demineralizer regenerants would be recycled within the plant for use as makeup water in the flue gas desulfurization system, in fly ash dust control, and in slag quenching and conveying. Excess would be periodically pumped to the plant wastewater treatment system. Cleaning fluid wastes, which would contain high concentrations of metals, would be collected and managed by a licensed contractor for disposal in compliance with applicable regulations. Drain water would be collected in plant sumps and pumped intermittently to the wastewater treatment system. Floor and equipment drain water would likely contain coal fines (particles), oil, and grease. Fire protection runoff would be generated only during emergency situations and would discharge to the Nenana River.

The existing coal pile would serve both the HCCP and Healy Unit No. 1. Coal pile runoff would depend on the frequency and intensity of precipitation events. Runoff would be collected in a new unlined catchment pond (no controls for coal pile runoff exist presently) designed to contain the 10-year, 24-h precipitation event of approximately 2 in. ***In addition, Healy Unit No. 1 bottom ash would be sluiced to the pond when the HCCP is not operating.*** Overflow from this pond is not anticipated. However, if overflow should occur, such water would be caught in ***an*** unlined ***emergency overflow*** pond between the Healy Spur Highway and the Alaska Railroad Suntrana Spur. ***No discharge of coal pile runoff to the Nenana River would occur.*** Sect. E.4 contains a further discussion of the coal pile runoff treatment system.

Before sedimentation in the catchment pond, coal pile runoff may have a high concentration of suspended coal fines. Leachate would probably contain (in solution) common metals, such as iron, and trace concentrations of heavy metals. Concentrations of metals in leachate would depend on leachate pH and the metals' respective solubilities. Table 4.1.6 displays the results for trace metals of toxicity characteristic leaching procedure (TCLP) tests of HCCP performance coal, flash-calcined material ("fly ash"), and slag. Performance coal is a blend of 50% UCM run-of-mine coal and 50% waste coal. Waste coal is low-grade and overburden-contaminated coal. No extraction values exceed the ***TCLP*** limits established for metals, as given in 40 CFR ***Part*** 261.24. ***To determine if these leachates would be considered toxic to aquatic life with respect to metals, the whole effluent toxicity of each wastewater stream would be determined according to the proposed criteria in the Water Quality Standards under the NPDES permit. These criteria include direct monitoring of impact to the most sensitive and biologically important life stages of resident species.***

Table 4.1.6. Results of toxicity characteristic leaching procedure (TCLP) tests of Healy Clean Coal Project (HCCP) performance coal, flash-calcined material ("fly ash"), and slag[a] (in parts per million)

Element	HCCP performance coal leachate[b]	Flash-calcined material leachate[c]	Slag leachate[d]	TCLP limit[e]
Arsenic	<0.5	<0.05	<0.5	5.0
Barium	<1.0	4.3	<1.0	100.0
Beryllium	<0.2	<0.01	<0.2	None
Cadmium	<0.2	0.14	<0.2	1.0
Chromium	<0.2	0.36	<0.2	5.0
Copper	<0.5	0.13	<0.5	None
Mercury	<0.1	0.01	<0.1	0.2
Manganese	<0.5	2.7	<0.5	None
Nickel	<0.5	1.0	<0.5	None
Lead	<2.0	0.5	<2.0	5.0
Rubidium	<5.0	0.02	<5.0	None
Selenium	<0.5	0.14	<0.5	1.0
Silver	<0.5	<0.05	<0.5	5.0
Strontium	<10.0	11.2	<10.0	None
Vanadium	<2.0	0.79	<2.0	None
Zinc	<0.5	1.4	<0.5	None
Zirconium	<5.0	<0.1	<5.0	None

[a]Fly ash and slag produced by combustion in the TRW slagging combustor, which would be used at the proposed HCCP.
[b]HCCP performance coal is a blend of 50% Usibelli Coal Mine run-of-mine coal and 50% waste coal. No extraction values exceed existing TCLP limits.
[c]Mean value of *five* samples. No extraction values exceed existing TCLP limits.
[d]No extraction values exceed existing TCLP limits.
[e]Limits given in 40 CFR *Part* 261.24.

Toxicity tests would be performed on a composite sample of wastewater from Outfall 001 and 002. Outfall 001 is the new outfall for the HCCP, and Outfall 002 is the existing outfall of Unit No. 1. The whole toxicity tests would consist of two chronic toxicity tests and one acute toxicity test. The chronic tests would include analysis for static renewal, larval survival, and growth using Pimephales promelas (fathead minnow), and analysis for 7-d static renewal, survival, and growth using Ceriodaphnia dubia (a tiny aquatic crustacean). The acute test would be conducted for 96-h LC_{50} (the concentration that is fatal to 50% of the population) and 7-d static renewal analysis using Oncorhynchus kisutch (coho salmon). All test procedures would be conducted according to EPA-specified protocols with appropriate quality control.

The flash-calcined material was also analyzed for pH, organic carbon, and volatile matter. The results indicate that the material is alkaline with a pH of about 12.5 and contains approximately 0.6% organic carbon and 8% volatile matter.

The HCCP wastewater treatment process would meet EPA regulations set forth in 40 CFR *Part* 125 (Criteria and Standards for the National *Pollutant Discharge Elimination System*) and 40 CFR *Part* 423 (*Effluent Guidelines and Standards for Steam Electric Power Generating Point Source Category*), as amended by 48 *FR* 31404 (July 1983). Treatment would consist of batch neutralization and sedimentation in a double-lined sump with a leak detection system and located inside the power plant building. Overall, the process would adjust the pH of the combined streams, separate oil and grease, and allow suspended solids to precipitate out of solution.

Discharge to Nenana River at three outfalls (see Fig. 2.1.8) would be in accordance with an EPA NPDES permit and an ADEC wastewater disposal permit. One permit would be issued for the combined wastewater of the HCCP and Healy Unit No. 1. Two outfalls would discharge condenser cooling water from Healy Unit No. 1, the HCCP once-through cooling system, and treated operational wastewater from both systems. A third outfall (located inside the HCCP plant) would discharge the treated operational wastewater to the two previously mentioned. The Healy site would be contoured with large interceptor containment ponds to retain stormwater runoff. The large ponds would be designed to allow percolation of stormwater and thus eliminate discharge to the Nenana River. Any stormwater runoff from the coal pile would go to the new coal pile runoff basin. Water from this basin would not be discharged to the Nenana River.

Coal, fly ash, and slag materials will be handled separately in the HCCP materials flow. Therefore, their wastewater streams including leachates, will not be combined into one waste stream. ***None of these wastewater streams would be discharged to the river.*** Compositions and characteristics of the three outfall streams are provided in Table 4.1.6.

The approximate average daily flows of total effluent to be discharged to the river have been calculated as follows:

Waste stream	*Discharge flow (gal/min)*
Once-through cooling water	28,000
Service water	72
Fire water	0.2

In addition to the discharge of wastewater effluent into the Nenana River, various wastewater streams would be disposed of to the plant septic system, to the atmosphere, and with moist solid residues.

The potable water system would generate about 1 gal/min of sanitary wastewater during the course of normal operation. The sanitary wastewater would be discharged into the septic and leach field system.

Wastewater discharged to the atmosphere by evaporation would consist of water vapors from the boiler blowdown flash tank; the FGD system; the slag quenching and conveying system; the coal pile runoff catchment basin and ditch; and, to a minor extent, from open sumps, tanks, and washdown surfaces. The average total evaporative losses from all of the described sources would be approximately 13 gal/min.

Wastewater disposed of in moist, solid residues would include the residual moisture in waste bottom slag ash, the FGD slurry, and the water used to wet down the dry fly ash for dust control. The calculated disposal of wastewater to these solid wastes has been established to be between 85 and 90 gal/min. Approximately 80 gal/min of this disposal would be from water of hydration (water lost via chemical reaction) and absorbed water in the FGD slurry.

Low-volume wastewater streams from Unit No. 1 are similar in nature but less in volume than those expected from the HCCP. These streams are currently discharged in the plant to the cooling system effluent line and discharged to the river in accordance with the Unit No. 1 NPDES permit. Effluent discharge to the river from both facilities would not occur at a common location. Substances contained in effluent discharges from both facilities would be limited by federal and state permits and would be rapidly diluted in the river.

Spills

A Spill Prevention, Control, and Countermeasures Plan (SPCCP) is required for the HCCP in accordance with EPA CWA requirements [Section 311(j)], as amended by the Oil Pollution Act of 1990. The existing SPCCP for Healy Unit No. 1 is being revised to incorporate contingency measures for spills of diesel fuels as well as other nonpetroleum chemicals that would be stored and utilized in the HCCP. These materials would be stored outside the power plant building in paved, curbed areas designed to retain 110% of the volume of the tanks. An additional precaution would be taken to reduce the potential for in-plant oil contamination in the NPDES-permitted wastewater effluent from the HCCP. An oil-water separator would be installed in the wastewater sump to remove oil contamination from the wastewater stream. If, ***during the permitting process,*** EPA requires a sump for the coal pile runoff stream, an ***oil sorbent boom*** would be installed in that system as well.

Environmental impacts related to catchment basins and failure of holding tanks would be unlikely during a damaging earthquake. Based on data provided by the Applied Technology Council (1978), most design exceedance earthquakes do significant structural damage to no more than about 1% of buildings, pipes, and tanks that are designed according to the Uniform Building Code (ICBO 1988). Earthquakes that threaten structural collapse produce peak ground motions that exceed structural design ground motions by a factor of two or more. Such destructive earthquakes have probabilities of exceedance on the order of 1% in 50 years.

If a destructive earthquake occurs, there is little likelihood of loss of containment when a liquid storage tank ruptures. Although excessive ground shaking may cause the collapse of chemical storage tanks, the entire contents of these tanks would be contained in enclosed areas behind curbs (dikes that completely surround the tanks) during an accidental spill. Curbs around storage tanks and the low berm around the coal pile runoff catchment basin would be unlikely to rupture during excessive ground motion unless surface rupture along an active fault, a landslide, or liquefaction occurs. ***Although liquefaction is***

an unlikely ***event*** at the HCCP site (see Sect. 3.4.*5*), ***the potential for surface rupture along an active fault or a landside along a topographic scarp are somewhat more likely events. Facilities containing hazardous materials should be located at safe distances from such features.***

Increased Surface Mining of Coal

Surface mining can adversely affect water quality by increasing erosion and sedimentation and by altering drainage patterns. It is projected that surface mining at the UCM would increase by about 10% to supply the HCCP with fuel. As a result of this increase, a corresponding percentage increase in erosion and sedimentation is expected in disturbed areas. Successful current practices of sedimentation control at the mine, which include diversion ditches and a series of sedimentation and clarification ponds before discharge into Lignite (Hoseanna) Creek, would continue to be used during the HCCP demonstration. With the continuation of this mitigation and compliance with federal and state oversight requirements for mining activities in the region, major adverse impacts to water quality are not expected.

Solid Waste Disposal

Wastewater from the Nenana River would be used to wet fly ash for dust control and to convey bottom ash and slag to a storage silo. It is expected that about 15% of the ash volume would be residual water that would remain in the solid waste after dewatering. The dewatered ash would be disposed of at the UCM mine in accordance with state and federal requirements (Sect. 7.2). Effects from this activity would more likely affect local groundwater than surface water. These effects are discussed in Sect. 4.1.4.

Acidic Deposition

Except for Healy Unit No. 1, the region is relatively free of man-made sources of the atmospheric pollutants, SO_2 and NO_x, that have been linked to acidic deposition on land, water, and vegetation. Operation of the HCCP in addition to Unit No. 1 operation would increase ambient SO_2 and NO_x concentrations in the atmosphere (see Sect. 4.1.2), which would result in an increased likelihood of acidic deposition. The projected increase, however, should not cause a measurable change in the pH of regional surface waters because their natural pH levels are generally ***7.0*** or higher and their buffering capacities are high. Therefore, substantial adverse changes in water quality would not be attributable to acidic deposition from operation of the HCCP. Effects of acidic deposition on ecological resources are discussed in Sect. 4.1.5.

4.1.4 Groundwater Resources

This section discusses the potential impacts on groundwater quality, groundwater use conflicts, and effects of dewatering on the elevation of the water table related to HCCP construction and operation.

4.1.4.1 On-Site Impacts

Potential groundwater quality impacts on the Holocene-Pleistocene aquifer would be somewhat less than those under existing conditions. Unlined fly ash ponds would ***not be used under normal operating conditions by either*** Healy Unit No. 1 ***or*** the proposed HCCP. Because of short duration needs for wet ash disposal from Unit No. 1, an unlined ash pond would be developed near the coal pile that is large enough for both coal pile runoff and for temporary ash disposal. Treated plant wastewater would be clarified by filtration before its release to the Nenana River. Sludge from wastewater treatment would be collected on filters. In turn, the filters would be backwashed. Effluent from the backwash operation would be used to dampen fly ash and would ultimately be placed in the UCM Poker Flats open-pit mine along with the fly ash. The treatment process consists of removal of oil and grease and adjusting the pH to between 6.5 and 8.5. The treated and clarified wastewater would contain several thousand milligrams per liter of total dissolved solids. Damp ash would be stored in a silo.

The unlined pond for coal pile runoff (see Fig. 2.1.8) would be sized to hold runoff for storms up to a 10-year, 24-h event (about 2 in.). Seepage to shallow groundwater (the Pleistocene-Holocene aquifer) would be less than existing seepage because fly ash would only be stored intermittently, rather than year round. The coal pile is about 325 × 225 ft and average annual precipitation is about 12 in. Assuming all the coal pile runoff seeps into the underlying aquifer, the seepage rate would be 0.002 cfs. Ultimately, this seepage would enter the Nenana River. The average annual flow rate of the Nenana River is 3500 cfs (***2 million*** times that of the seepage rate). Overflow from this pond is not anticipated. However, if overflow should occur, such water would be caught in an unlined emergency overflow pond between the Healy Spur Highway and the Alaska Railroad Suntrana Spur. No discharge of coal pile runoff to the Nenana River would occur.

All fly ash from operations at Healy Unit No. 1 (stored temporarily in the existing fly ash ponds) is now being partially dewatered and trucked off-site for disposal in the UCM Poker Flats open-pit mine. All future fly ash generated at both the HCCP and Healy Unit No. 1 would also be trucked off-site for disposal at the UCM mine. Excess water from the fly ash would be recycled through the plant and eventually would enter the wastewater treatment loop and disposal system.

No other on-site groundwater quality impacts are anticipated. No upgradient contamination is expected by operation of the HCCP. Data in Table 3.4.1 suggest that the quality of Miocene-Oligocene groundwater in the Healy Unit No. 1 well has not degraded in 25 years of operation despite its proximity to the overlying and unlined fly ash ponds. Large chemical holding tanks (3000-gal tanks of sulfuric acid and sodium hydroxide) would be installed over sumps designed to hold 110% of a tank's capacity in case of an accidental spill (AIDEA 1991a). Smaller drums of chemicals would be stored and used in curbed areas to contain spills.

Groundwater withdrawal impacts are also expected to be minor. Maximum combined HCCP–Healy Unit No. 1 groundwater consumption is expected to be about 200 gal/min compared with 50 gal/min for Healy Unit No. 1 alone. Although uncertainty exists concerning the magnitude of the cones of depression around the new HCCP wells, they are not expected to impact the well at the Waugaman Recreational Vehicle Village. Regardless, this is not a major issue because any potential impact on the well at Waugamon Recreational Vehicle Village could be mitigated by deepening the well or laying a pipeline from the HCCP to the village. The applicant has expressed a willingness to provide such mitigation if it is demonstrated that plant well production is negatively impacting production or water quality at the village well.

The water table on the terrace may be temporarily depressed during construction activities. Foundations and pipeline trenches require dewatering before construction can proceed. The water table adjacent to these construction sites may temporarily decline in response to dewatering activities. Although dewatering is not likely to affect availability of groundwater, it may have a temporary adverse impact on riparian vegetation (Sect. 4.1.5.1).

4.1.4.2 Off-Site Impacts

Potential off-site groundwater quality impacts related to construction and operation of the HCCP are expected to be minor. Solid, noncombustible construction rubble would be trucked off-site to a landfill operated by the town of Healy. The Healy municipal landfill already holds a permit for disposal of nonhazardous solid waste. Groundwater quality impacts of HCCP construction rubble would be incremental to any existing impacts related to the operation of Healy's municipal landfill. Slag/fly ash and wastewater treatment sludge would be trucked off-site to the UCM mine. The chemical composition and quantity of sludge are not well known. Before disposal at the UCM mine, such sludge would be thoroughly analyzed to ensure that it is nonhazardous and suitable for burying at the mine site. ***If the sludge is determined to be hazardous, it would be shipped off-site to an approved hazardous waste landfill.***

The UCM mine site also has a permit for the disposal of fly ash from Healy Unit No. 1. Groundwater quality impacts related to disposal of HCCP ash would be minor compared with any existing impacts related to operation of the UCM mine. Toxicity/leachability tests were performed on Usibelli coal, slag, and fly ash using the standard TCLP. Table 4.1.6 provides the results of these tests. None of the metals tested exceeded TCLP regulatory limits.

Groundwater quality at the UCM mine is not well known. However, current coal production at the mine ranges from 1.4 to 1.6 million tons/year. The proposed HCCP would require an additional 0.172 million tons/year of run-of-mine coal, or an 11% increase. It is assumed that current impacts on groundwater would increase proportionately as a result of operation of the HCCP. ***This incremental increase is not expected to change the groundwater use category.***

The rate of fly ash delivery to the UCM mine would increase by a factor of nearly two (from about 14,000 tons/year to about 25,400 tons/year). The rate of alkaline leachate generation may be expected to increase by a similar amount. Exposed coal seams, temporarily stockpiled coal, and mine-waste rock at the UCM mine are leached naturally but produce negligible acidic leachate because of the negligible amount of pyritic sulfur in the coal. Most of the water that comes in contact with various stockpiles or that drains from the mine is diverted to a settling basin. Any water that fails to reach the settling basin either evaporates or seeps into the ground. The rate of slag/bottom ash delivery to the UCM mine would increase from about 1500 *tons/year* to 47,300 tons/year. This relatively coarse-grained material is less leachable than the fine-grained fly ash because it is partially vitrified, and it also has less surface area per unit volume. A minimal amount of leachate is expected to be generated by this material.

Finally, the existing Healy unit produces no scrubber waste whereas the proposed HCCP would annually produce about 5500 tons of scrubber waste (fly ash commingled with limestone sorbent). The scrubber waste consists mainly of calcium sulfate that is fairly soluble in water. Although the scrubber waste would contribute little or no toxic metals to the leachate, an increase in calcium sulfate would be expected. This leachate would be diluted when comingled with other leachates and surface water runoff.

Ash from Healy Unit No. 1 has been disposed of at the UCM mine for several years, and no measurable effects on surface or groundwater have been documented. The volume of ash proposed for disposal at the mine from the HCCP is a small quantity relative to the total amount of overburden used for backfilling of mined out pits. This, coupled with the lack of impacts from current ash disposal practices, suggests that the addition of HCCP ash to the pit backfill would probably not be measurable.

UCM has a permit for disposal of the previously described wastes.

4.1.5 Ecological Resources

4.1.5.1 Terrestrial

Construction

A maximum of about 10 acres of the 65-acre plant site would be cleared of native vegetation at the plant site. This area consists of small stands of the following vegetation types: woodland white spruce (1 acre), closed alder shrubland (0.5 acres), open white spruce–paper birch forest (6 acres), and open poplar (3 acres). These vegetation types are all common in the area. Areas not occupied by facilities would be planted with grass. Because the site is nearly level and the substrate is very coarse, little soil erosion is expected during construction. No disturbance is required for transmission lines because no new or expanded transmission corridors are required; *little disturbance is required* for the construction camp because the site is already *largely unvegetated.*

Clearing 10 acres of common vegetation types is not expected to result in a substantial loss of wildlife habitat in the region. It is likely that most of the habitat loss due to human presence and noise is already occurring because of the existing plant, and any wildlife that is accustomed to using habitat in the vicinity of the existing plant is already somewhat habituated to human presence and loud noises. Therefore, habitat loss due to increased numbers of people and increased frequency of loud noises on the site should also be minimal. This judgment includes consideration of habitat needs of moose, bears, and lynx.

The project participant has committed to a program to minimize human-bear interactions and unnecessary habitat disturbance in the site vicinity. This program will cover ***incineration*** of food wastes, removal of ash, removal of litter, educating employees about bears, and general environmental education concerning environmental regulations and avoidance of environmentally sensitive areas. As a result of these precautions, the construction site and camp should be considerably less attractive to bears and create much less of a risk of human-bear interactions than the existing residences, businesses, and open dump in the Healy area. The presence of these existing facilities is not known to have resulted in destruction of bears due to bear-human interactions other than hunting.

The presence of construction workers in the area may result in roadkills of wildlife and wildlife behavioral disturbance or habitat disturbance associated with outdoor recreation. However, these effects are expected to be minor. The proposed construction site and camp are already disturbed areas that do not lie in known wildlife migration corridors. ***Some workers may live outside the construction camp, and their housing needs could result in disturbance of small areas of natural vegetation in the vicinity of existing towns (Sect. 4.1.8.5). Also, the waste disposal needs associated with the construction and workforce would hasten the need for a new sanitary landfill which would require additional land (Sect. 4.1.8.5).***

Operation

The coal for the HCCP would be obtained by strip mining at the existing UCM Poker Flats Mine. This would result in loss of native vegetation and wildlife habitat, which would eventually be replaced through revegetation and succession. The reclamation plan for the mine (UCM 1983) specifies that the mined areas will be returned to approximately original contour, stabilized, and revegetated with a mixture of nonnative grasses and candle rape. UCM management has committed to a program of replanting trees and shrubs; however, success has been mixed, and reliable and efficient methods are still being developed. Elliott (1984) indicated that little invasion of the revegetated areas by native plants had occurred even after 9 years, ***but that study addressed results of reclamation practices prior to current regulatory controls.***

The revegetated areas act as islands of grassland habitat that benefit grassland species including tundra vole, short-eared owl, and savannah sparrow but reduce habitat for species common in the native forest and shrub vegetations including moose, snowshoe hare, red-backed vole, willow ptarmigan, and most passerine (perching) birds (Elliott 1984). Caribou were commonly observed on the reclaimed areas, and the planted grasses, particularly red fescue (*Fescuta rubra*), made up approximately 30% of the caribou diet in the mine area (Elliott 1984). Planted grasses made up more than 50% of both the summer and winter diets of Dall sheep occurring in the mine area (Elliott 1984). Elliott (1984) concluded that most wildlife would benefit from more rapid introduction of woody species in revegetated areas; that is a goal of the current reclamation program (UCM 1983).

The project would require mining approximately 172,000 tons of run-of-mine coal per year in addition to the 1.4 to 1.6 million tons currently extracted per year. The UCM mine disturbs approximately 25 acres per million tons of coal including roads and other support facilities, so the project would require disturbing and revegetating approximately 4 additional acres per year. However, the negative ecological effects that would occur as a result of increased coal mining would be minor.

The coal mine would serve as the disposal site for nonhazardous solid combustion wastes from the proposed project. Soluble constituents of the buried wastes can leach into springs, seeps, or near-surface groundwater. However, ***terrestrial biota would not be affected*** at this site.

Atmospheric emissions could have ecological effects by exposing plants and animals to gaseous pollutants, deposition of fly ash particles, and deposition of acidic chemicals formed from gaseous emissions. Effects of pollutant inhalation on wildlife are not assessed, because no evidence exists that wildlife populations are affected at concentrations below the NAAQS.

Two major pollutant gases, SO_2 and NO_2, would be emitted by the HCCP (Sect. 4.1.2.2). The concentrations of these gases in the emissions from the proposed clean coal plant in addition to those from the existing power plant and background are not expected to exceed primary NAAQS. Because these standards are intended to prevent health effects in sensitive humans and because no evidence exists that wildlife is substantially more sensitive than humans, it is assumed that no effects on wildlife populations would occur during plant operation due to respiring those gases. However, compliance with standards does not ensure that plants will not be affected.

Predicted maximum total SO_2 concentrations (Table 4.1.2) are equal to concentrations that have been found to be marginally toxic to plants under experimental conditions and at field sites outside Alaska. EPA (1982) identified a range of 790–2100 $\mu g/m^3$ in 3-h exposures as likely to cause injury "from time to time" in sensitive and intermediately responsive vegetation. This range includes the estimated 3-h maximum at the Healy site of ***1145*** $\mu g/m^3$. At a Tennessee Valley Authority coal-fired plant, exposure to concentrations ***approximately*** equal to the predicted 3-h maximum concentration at Healy caused visible injury to over 20% of 84 native and crop species (McLaughlin and Taylor 1985). The sensitivity of Alaskan native vegetation to SO_2 injury is not well characterized. However, both birch (*Betula papyrifera*) and aspen (*Populus tremuloides*) have been reported to be very sensitive to SO_2 injury (Davis and Wilhour 1976). AIDEA (1991a) conducted a preliminary survey for visible injury in the late summer of 1990, but the results were inconclusive because the ***symptoms resembling*** leaf injury they found *were* not clearly related to the existing Healy power plant and could be interpreted as a result of summer drought. It should be remembered that visible injury can occur without reductions in plant production and that production can be reduced without visible injury. Therefore, visible foliar injury is simply one easily detected indicator of acute exposure levels.

Reduced retention of needles is a common response of coniferous trees to air pollutants. The vegetation survey performed for AIDEA (1991a) found an inverse relationship between the number of needles per unit length of white spruce branches, which is the opposite of the trend that would be expected if emissions from the existing Unit No. 1 were causing toxic effects. Although it cannot be concluded from this study that Unit No. 1 is having a beneficial effect, the study does suggest that the local vegetation is not extraordinarily sensitive to SO_2 and is not experiencing stress that would be amplified by the proposed HCCP.

Reduction of productivity is a more serious effect than visible injury, but it is more difficult to characterize and has not been studied in as many species. Sensitive crop species experienced small reductions in yield when exposed in the laboratory and field to SO_2 concentrations and durations in the range predicted for the maximum 3-h, 24-h, and annual total concentrations at Healy (McLaughlin and Taylor 1985). In particular, if we use McLaughlin and Taylor's (1985) model of yield reduction in soy and snap beans, the predicted annual average total concentration of *69* $\mu g/m^3$ (0.026 ppm) SO_2 would reduce production by approximately 16% in a growing season of 52 days averaging 10 h long. However, reviews of SO_2 effects on trees and other native plants have not demonstrated reductions in growth or yield at SO_2 exposures equivalent to those predicted for this site (EPA 1982; Westman, Preston, and Weeks 1985; Keller 1985). In addition, both crops and natural herbaceous vegetation growing on sulfur-deficient soils have shown increased productivity when exposed to SO_2 concentrations considerably higher than the predicted annual average concentration (EPA 1982). Hence, the effects of SO_2 on plant production are highly uncertain because the predicted concentrations are near the threshold for effects in some sensitive species in some conditions. However, positive or negative effects should not be large.

Lichens are generally believed to be highly sensitive to air pollution in general and SO_2 in particular. However, Nash (1973) found that the threshold for lichen injury in acute (12-h) studies was approximately 1500 $\mu g/m^3$ and concluded that lichens are no more sensitive in such exposures than vascular plants (ferns, conifers, and flowering plants). That threshold is higher than the predicted 3-h maximum concentration at the Healy site (*1145* $\mu g/m^3$). The threshold for SO_2 effects in chronic (annual mean) field exposures is approximately 30 $\mu g/m^3$ (0.01 ppm) (LeBlanc and Rao 1975), which is less than the predicted maximum annual average concentration at the Healy site (*69* $\mu g/m^3$). Given the variance in response with conditions and species, the predicted SO_2 concentration cannot be distinguished from the effects threshold (i.e., the threshold for effects on lichens at the Healy site may be higher or lower than the maximum annual average concentration). However, the presence of *Usnea* sp., which are generally considered to be relatively sensitive to SO_2, within 400 ft of the existing Unit No. 1 (AIDEA 1991a) suggests that the current pollution levels are not substantially affecting lichens. It also suggests that lichens in this area are not much more sensitive than those in more temperate areas.

Predicted NO_2 concentrations are well below levels that are known to be toxic to plants. However, NO_2 has been shown to increase the level of visible injury and photosynthesis reduction in plants exposed to SO_2 (EPA 1982; Whitmore 1985). Therefore, the predicted NO_2 emissions at Healy increase the likelihood that SO_2 will cause effects on vegetation. This effect cannot be quantified because the $SO_2 + NO_2$ exposure levels used in the available quantitative studies were greater than those predicted for the Healy area.

Because SO_2 and NO_2 contain the nutrient elements sulfur and nitrogen, low-level exposures such as those predicted for the HCCP often cause increased plant production (Shriner et al. 1990). The occurrence of this effect depends on the nutrient status of the vegetation, which is unknown for the Healy area, but concentrations of sulfur and nitrogen in local soils are low to moderate (AIDEA 1992). Fertilization effects may compensate for any toxic effects on production and may occur in areas where exposure levels are too low to cause toxicity. Therefore, if sulfur or nitrogen deficiencies occur in the receiving environment, fertilization effects could be much more extensive than toxic effects. Although it is possible that fertilization by either SO_2 or NO_2 could change the competitive relationships among plant species, which could change the relative abundance or distribution of species in the exposed plant communities, the occurrence of this effect at the Healy site is unknown.

It has been suggested that the declines of high elevation conifer forests in the eastern United States and Europe have been caused by nitrogen fertilization which prolongs vegetative growth and thereby reduces winter hardiness (Shriner et al. 1990). Although it is clear that exposure to acidic deposition leads to loss of winter hardiness, fertilization by the associated nitrogen was never more than a hypothetical cause of hardiness reduction. Recent studies cast severe doubt on that hypothesis. DeHayes, Ingle, and Waite (1989) fertilized the soil of red spruce stands with nitrogen and found an increase in winter hardiness. Klein, Perkins, and Meyers (1989) exposed red spruce seedlings grown in nitrogen deficient and nitrogen sufficient soils to aerosols containing nitrate, ammonium, or both and then exposed them to winter chilling. They found that improving the nitrogen nutrient status of the deficient seedlings improved their hardiness and the treatment had no effect on the nitrogen sufficient seedlings. They concluded that "there is no evidence to support the hypothesis that anthropogenic nitrogen supplies significantly reduce winter hardiness of spruce foliage. It is improbable that winter injury due to elevated anthropogenic nitrogen is a casual factor in contemporary forest decline." This conclusion was supported by a recent review (DeHayes 1992).

To summarize, the best estimate of negative effects of pollutant gases on vegetation in the maximally exposed locations includes some erratically occurring visible foliar injury of sensitive plant species, some small and localized decrease in growth of sensitive plant species, and possibly some injury of sensitive species of lichens. These effects are not expected to be major because they are small and limited to the maximally exposed area, which ***would be*** at the HCCP site perimeter. Increased production due to sulfur or nitrogen fertilization may occur, is likely to affect a wider area than toxic effects, and may be the only direct effect of SO_2 and NO_2 emissions. It must be reiterated that these predictions are based on research that does not involve central Alaskan populations, ecotypes, or conditions.

Another potential source of environmental effects on ecological resources is atmospheric emissions of particulate matter. The project participant used conservative (upper bound) assumptions to estimate accumulation of deposited particulate matter (AIDEA 1992). Assumptions included a deposition velocity of 1 cm/s and accumulation for 40 years in the top 3 cm of a 1.47 g/cm^2 soil. At the maximum deposition location, this resulted in accumulation of 3.59 μg/g due to the HCCP and 14.3 μg/g due to the HCCP plus Unit No. 1. This amount of material is too small to affect the physical properties of the soil substantially. The project participant used the same assumptions to estimate accumulation of elements released at significant rates (significant in terms of PSD terminology): fluorine, beryllium, lead, and mercury (except that, because of its greater mobility, fluorine was assumed to accumulate in the top 50 cm). The resulting concentration estimates were added to average U.S. or world background concentrations. These totals were found to be lower than screening concentrations for effects of elements in soil on plants and grazers (Smith and Levenson 1980). Although the results rely more on assumptions than on data, the assumptions are likely to be conservative, and therefore, the results suggest that particulate deposition would not have major toxic effects.

More comprehensive conclusions concerning effects of particulate deposition can be drawn from studies at other power plants and from general principles. Direct effects on vegetation from deposition of particles on leaves have been demonstrated only at deposition rates that are much higher than is credible for power plants (Dvorak et al. 1978; EPA 1982). Heavy metal deposition and accumulation was a major concern in the 1970s, which resulted in a number of studies and reviews of this issue relative to coal combustion (Dvorak et al. 1977 and 1978; NRC 1980; Van Hook and Shults 1977). It has been possible to demonstrate an increase in soil metal concentrations at some of the coal-fired power plants that have been studied, but increased metal concentrations in vegetation have seldom been demonstrated (Van Hook and Shults 1977; NRC 1980). Ecological effects of metal deposition in coal ash have not been reported in the literature. Terrestrial ecological effects of metals have been demonstrated at very high soil concentrations (several hundred to several thousand parts per million, depending on the metal mixture and ecosystem) associated with smelters, mines, and other metal processing facilities; addition of materials to soil intended to change soil properties that contain large amounts of metals; use of agricultural chemicals that contain large amounts of metals; and laboratory studies (Gough, Shacklette, and Case 1979; Suter and Sharples 1984). However, the measured additions of metals by power plants and worst-case models of metal addition to ecosystems by large power plants in arid areas (where metal loss is minimal) suggest that, in general, metals will accumulate to toxic concentrations only if the background concentrations are high (Dvorak et al. 1978; NRC 1980). In summary, the available literature suggest that deposition of coal ash particles may measurably increase metal concentrations in some ecosystem components at the Healy site but would not have substantial negative effects on the local ecosystems.

This conclusion is supported by the results of a study conducted by the U.S. Geological Survey and NPS (Crock et al. 1992). Elemental concentrations were determined in samples of feather moss (*Hylocomium splendens*), a lichen (*Peltigera aphthosa*), white spruce (*Picea glauca*), and the upper layer of the soil (Oa horizon). Samples were collected on transects radiating away from Healy Unit No. 1, and also collected on a control transect. For those elements with statistically significant variation among sites, concentrations tended to decrease with distance from the Healy site along the two transects radiating from the site and with distance from the Nenana River on the control transect. The trends on the control transects were attributed to dust from the river bed. The trends away from the Healy site may be attributed to the emissions from Unit No. 1, residential and commercial coal combustion in the Healy area, dust from the large areas of bare soil at the confluence of Healy Creek and the Nenana River, unpaved roads, or other sources. A definitive cause of the trends cannot be established for three reasons: (1) the trends observed on the two transects extending away from Unit No. 1 are not consistent; (2) significant trends were found on the control transect for all of the elements but arsenic that showed trends away from Unit No. 1; and (3) the transect that runs away from Unit No. 1 perpendicular to the Nenana River and the prevailing wind direction and parallel to the control transect yielded more and stronger trends than the transect that parallels the Nenana River and the prevailing wind direction. Crock et al. (1992) concluded that Unit No. 1 and other Healy area sources influenced concentrations out to 6 km, and beyond that distance concentrations were at effective background levels. Crock et al. (1992) also found "no unusually high concentrations of any of the elements, including the rare-earth elements" in soil and no unusually high concentrations in lichens relative to their sites. Moss concentrations were reported to be high for As, Cr, Cu, Mn, Ni, V, and rare earth elements, but moss measurements were complicated by high ash content of the samples which the authors attributed to soil contamination. Of the elemental concentrations in white spruce, only copper was higher than white spruce concentrations at another Alaskan site, and no trend away from Unit No. 1 was detected.

The most reasonable conclusion from this study is that, after 24 years of operation, Unit No. 1 has probably contributed to small local increases in the levels of some elements in some environmental receptors. The proposed HCCP would probably cause similarly small and localized increases. This study did not consider whether ecological effects had occurred as a result of the deposited elements. However, the fact that the investigators were able to find sites with similar vegetation at all distances from Unit No. 1 suggests that if effects have occurred, they are subtle. This apparent lack of effects is consistent with the results of prior studies at power plants previously discussed.

The final issue with respect to ecological effects of air pollutants is formation and deposition of acids. Both SO_2 and NO_2 can combine with water and oxygen to form mineral acids. The alkalinity of surface waters and most mineral soils in the area suggests that they are not particularly susceptible to acid deposition. However, local ecosystems, including small high-altitude watersheds with little soil development, could be sensitive to acidification. Bulk deposition measurements from 39 events collected over a year at the HCCP Healy Monitoring Station ranged from pH 5.55 to 7.86 (ENSR 1992). These values are higher than background wet deposition (Sect. 4.3.5) even though the nearby Unit No. 1 is a source of acidifying gases. This suggests that in the vicinity of Unit No. 1, any acidifying emissions are more than compensated for by some alkaline source, possibly dust. It seems unlikely that the proposed HCCP would cause substantial effects through its contribution to acid deposition, given the relatively high values of mean and minimum pH compared with regions where acid deposition has caused ecological effects on aquatic communities (Baker et al. 1990) and forests (Shriner et al. 1990). It is expected that sulfur emissions from Unit No. 1 are not contributing substantially to soil acidification, even in areas of maximum deposition, because sulfur concentrations were low in moss and lichen samples near Unit No. 1 and because there were no consistent trends in sulfur concentrations away from the Healy site. Sulfur decreased slightly in lichens with distance from the river on the control transect, in moss with distance from the Healy site on one transect, and increased in soil away from the site on both transects, but with low statistical significance (Crock et al. 1992). Given this lack of evidence of environmental acidification from Unit No. 1, the high background pH, and the low emissions estimated for the HCCP, it appears unlikely that the HCCP would cause substantial acid deposition.

The discharge of heated water by the project would increase the extent of ice-free water and thin ice in the Nenana River (Appendix B). This could reduce the movement of wildlife across the river in the winter or increase the distance that they must travel to cross. The importance of this effect is unknown; however, no major migrations are involved and the quality of wildlife habitat immediately downriver of the site is not exceptionally high, so the effects are likely to be minor.

4.1.5.2 Aquatic

Construction

Constructing the plant would result in erosion, discharge from a concrete batch plant and treated construction camp sewage, and any spills of fuel or other construction-related liquids (see Sect. 4.1.3.1). Erosion should have negligible effects because of the relatively flat site, coarsely textured soil (large particles are difficult to suspend and keep suspended in water), and highly silt-burdened Nenana River.

The most direct aquatic ecological effects would result from constructing the water intake and discharge structures, which would involve excavating the bank and benthic (river bottom) substrate of the Nenana River. This would introduce sediment into the water column and remove the existing invertebrate community in the disturbed benthic substrate. The suspended sediments would not be expected to have substantial effects on the aquatic community because (1) the sediment burden in the river is naturally very high during the summer when this construction would occur (Sect. 3.3.2), (2) the bank and bed materials are coarse, and (3) no known fish-spawning beds are in the river downstream of the plant where eggs might be smothered by silt. Disturbed riverine benthic communities usually recover within 2 years and nearly always recover in 3 years (Niemi et al. 1990), so the effects of excavation should be temporary.

Operation

Plant operation. The effects on aquatic systems of operating the proposed plant would result from discharge of treated wastewaters, deposition of atmospheric pollutants, intake of cooling water, discharge of cooling water, and mining of coal and limestone. The effects of wastewater and atmospheric deposition on water quality in the Nenana River are discussed in Sect. 4.1.3. The largest source of aquatic toxic effects at most plants, the cooling water, is not expected to be a problem at the HCCP because the project participant does not expect to use biocides or water treatment chemicals (AIDEA 1991a). They have not been needed in the cooling system of the existing Unit No. 1.

Cooling water intakes entrain small aquatic organisms (plankton), pass them through the condenser, and kill some fraction of them. The number entrained depends on the density of plankton, and the fraction killed depends on the species entrained and the design of the cooling system. Effects of entrainment on the Nenana River ecosystem are expected to be small because the river is likely to support relatively low densities of plankton. No plankton sampling has been done in the area, but high-velocity turbid rivers like the Nenana provide very poor habitats for phytoplankton and invertebrate zooplankton. As previously discussed (Sect. 3.5.2), little fish reproduction is believed to occur in the upper Nenana River, so densities of ichthyoplankton (fish eggs and larvae) should also be very low. The intake will be covered with screening that is 0.25 in. or smaller (AIDEA 1991a). This will tend to reduce entrainment mortality but increase impingement mortality. Fish sampling conducted by Tarbox et al. (1979) found very few fish in the Nenana River near the present Unit No. 1 facility.

Impingement is the capture of larger aquatic organisms (principally fish) on the screens of cooling water intakes. The entrainment potential of an intake design is largely a function of the approach velocity to the screens, the volume of the intake, and the position of the intake structure (EPA 1976; Langford 1983). The approach velocity should be 0.5 ft/s or less to comply with Alaska Department of Fish and Game (ADF&G) guidelines (AIDEA 1991a). This is considerably less than the velocity of the Nenana River, so fish that are active in the river should be able to resist the intake current. However, in the Nenana River, Tarbox et al. (1979) caught small juvenile round whitefish that, given their size, would be expected to have swimming speeds less than 0.5 ft/s (Langford 1983). Such small fish must use low-velocity microhabitats in the river and could be impinged even by a relatively low-velocity intake. The volume of the intake determines the number of fish that will be impinged, given that the river contains a certain density of fish that will not be able to avoid the screens, but it is essentially a constant for a given plant size. The position of the screens determines the ability of fish to escape them. A shoreline or offshore intake allows fish to avoid impingement easily by moving laterally relative to the intake flow. An intake at the end of a canal is the worst design in terms of allowing lateral movement to avoid the intake current. The intake for the existing unit is in a dredged pond connected to the river by a canal. This design allows lateral movement, but the relatively calm waters of the pond may attract fish with low swimming speed or stamina that could be susceptible to impingement.

Cold shock could kill fish that are (1) acclimated to the temperatures of the cooling water plume and (2) deprived of that warmed effluent when the plant shuts down. No instances of thermal shock from the existing unit have been reported, but it could easily go unnoticed because the swift currents of the Nenana River would rapidly carry the dead fish away. The HCCP would increase the area of the river that is warmed, but it would also reduce the probability of cold shock because the cross connection (Fig. 4.1.1) would allow the flexibility to continue discharging to both outfalls if one of the units shuts down.

Heat shock is ***more*** likely to kill fish than cold shock, because fish can avoid localized stressful temperatures. Both in the laboratory and at actual thermal plumes, fish have been found to select preferred temperatures (Langford 1983). Hence, the effects of ***a*** heated discharge could be to (1) make a portion of the river unavailable as habitat for fish because of their ability to avoid ***higher*** temperatures, (2) create a thermal barrier to movement of fish, or (3) concentrate fish in an area of the river more thermally attractive than the ambient river temperature. Fish crowded into a warmed area during the winter have increased metabolisms and may have diminished food resources (due to competition or disruption of invertebrate life cycles) resulting in a decrease in condition. On the other hand, the warmth may increase invertebrate production, thereby increasing resources for fish production. Although the thermal ecology of ecosystems like the Nenana River is not known well enough to predict the consequences of localized warming, experience with thermal discharges in other areas indicates that the effects of heat are usually inconsequential because they are localized.

The silt-laden water of the Nenana River scours the biological activity from the river bottom and also prevents light penetration into the water during the spring and summer months. Therefore, the biological activity of the river is low, but does exist. This activity will be enhanced by the heat from the aqueous discharge plume. If it were not for the scouring action of the glacial silt, the river would become more fertile and support a larger number and kind of fish as well (see Sect. 2.1.7.2).

Concerning the potential effects of the aqueous thermal plume upon fish, it appears from the thermal plumes developed that there will be an area approximately 20 ft wide by 30 ft long where fish would not survive if held in one place. There appears to be a slightly larger area where the fish would not be comfortable. Most fish could pass through most of the discharge plume without harm to themselves, but would not choose to do so. The area occupied by the plume is small, because the river is in a range of 400 to 500 ft wide during the summer months at the location of the proposed discharge structure.

In summary, the proposed HCCP may cause a small amount of entrainment, impingement, and cold-shock mortality and may cause some local effects on fish production due to the thermal plume. However, the effects are expected to be minor because they would occur in a river reach that is not highly productive; does not contain important commercial, recreational, or subsistence resources; and apparently does not support high densities of the susceptible early life stages of fish.

Mining. Run-off from the UCM mine is collected into rock-lined channels and directed to settling ponds where it is treated by neutralization, sedimentation, and flocculation. As a result, the quality of the discharge water is higher than the water in the receiving stream, Lignite (Hoseanna) Creek, particularly in terms of suspended sediment levels (UCM 1983, 1989). Mining for the proposed project would not increase the area being actively worked at any time (the mining face would just move forward a little faster), so it would not create an additional strain on the existing water collection and treatment system. Adverse effects of additional coal mining on aquatic communities are highly unlikely because of the water treatment system; the monitoring of water quality in controlled discharges, springs, seeps, groundwater, and stream water; the absence of acid-forming minerals or high metal concentrations in the coal (UCM 1983); the small increment in coal mining; and the sparse aquatic community of Lignite (Hoseanna) Creek.

The aquatic communities of Lignite (Hoseanna) Creek and the Nenana River might also be affected by leachate from disposal of the solid combustion wastes as backfill in the UCM mine. Because of the circumstances of disposal, these wastes are not expected to affect water quality in Lignite (Hoseanna) Creek or the Nenana River (Sects. 4.1.3 and 4.1.10); therefore, aquatic communities should not be affected.

4.1.5.3 Threatened and Endangered Species

The ranges of the threatened arctic peregrine falcon (*Falco peregrinus tundrius*) and the endangered American peregrine falcon (*F. p. anatum*) include the HCCP proposed site, but a recent raptor survey (Roseneau and Springer 1991) conducted upon recommendation by FWS (P. J. Sousa, Field Supervisor, U.S. Fish and Wildlife Service, Northern Alaska Ecological Services, letter to E. W. Evans, U.S. Department of Energy, Pittsburgh, Penn., May 29, 1991, Appendix C) did not find them in the area. The site is not near any cliffs that appear to be particularly suitable for eyries (sites on mountains or cliffs where birds of prey will lay eggs and raise their young). The proposed project would not substantially diminish prey habitat and would not introduce human activity and noise into previously undisturbed areas, so the HCCP is unlikely to diminish any future peregrine falcon use of the area. Because no new transmission lines would be built, there would not be increased risk of collisions with lines.

DOE has consulted with FWS under Section 7 of the Endangered Species Act. FWS has reviewed the project for potential effects on threatened or endangered species and documented its findings by letter (P. J. Sousa, Field Supervisor, U.S. Fish and Wildlife Service, Northern Alaska Ecological Services, letter to E. W. Evans, Department of Energy, Pittsburgh, Penn., May 29, 1991, Appendix C).

4.1.6 Floodplains and Wetlands

The proposed construction would occur on a site that probably contained wetlands and was in the floodplain, but it has been cleared and graded for the existing Healy Unit No. 1. The proposed HCCP would not further intrude on wetlands and would be "above the ordinary high water mark of the Nenana River" (T. R. Jennings, Chief, Northern Unit, Permit Processing Section, U.S. Army Engineer District, Alaska, letter to John Olson, Stone and Webster Corp., Denver, Apr. 26, 1990). A hydrologic analysis (AIDEA 1991a) and the maps in Grey and Lehner (1983) also indicate that the site is above the level of the 100-year flood. It is expected that all construction-related activities would occur in disturbed areas without wetlands; however, a slight possibility exists that 1 or 2 acres of wetlands would be used temporarily as a construction laydown area. In this unlikely event, ***the disturbed area eventually may revert to wetland if existing hydrologic features are maintained or restored.***

In summary, no intrusion on the floodplain or loss of wetlands is expected. DOE regulatory responsibilities related to floodplains and wetlands are cited in Sect. 7.1.5 and have been followed.

4.1.7 Prehistoric and Historic Resources

No known prehistoric or historic resources are located at the HCCP proposed site. DOE has consulted with the Alaska State Historic Preservation Office (SHPO) under Section 106 of the National Historic Preservation Act. The SHPO has reviewed the project for potential impacts and documented its findings by letter (Judith E. Bittner, Alaska State Historic Preservation Office, letter to T. C. Ruppel, DOE, Pittsburgh, July 11, 1991, Appendix D). The Alaska SHPO does not foresee any direct impacts to prehistoric or historic resources from plant construction or operation.

Of the prehistoric sites listed in Sect. 3.7.1, two (HEA-026 and HEA-210) are located within 1 mile of the proposed HCCP location. Because the sites are located south of the Nenana River Railroad Bridge, across the river from the proposed HCCP site, plant construction would ***not likely*** have any impacts on them. Section 3.7.2 lists four historic sites in the vicinity of the proposed HCCP location, the three closest being within 0.75 miles of the existing Healy Unit No. 1 (HEA-080, HEA-083, and HEA-119). Construction activities, such as the movement of vehicles and equipment from the ***George*** Parks Highway to the construction site via the Healy Spur Highway, would have negligible impacts on these historic sites.

4.1.8 Socioeconomics

While Sect. 3.8 identifies the Denali Borough as the study area and provides information on the borough's existing socioeconomic resources, this section discusses the socioeconomic impacts of constructing and demonstrating the HCCP. Many socioeconomic impacts would likely be confined to Healy and ***Denali Park***, especially those driven by population growth due to the in-migration of plant construction and operations workers. As discussed in Sect. 2.1.6.1, the project participant ***would*** provide a construction camp to mitigate socioeconomic impacts associated with construction of the proposed project. The construction camp scenario described in Sect. 4.1.8.1 is used to evaluate the potential socioeconomic impacts of HCCP construction. The demonstration period ***(1997)*** is used as an upper bound to evaluate the impacts of HCCP operations because the peak operating work force would be on-site during the demonstration. It is expected that the number of workers required to operate the HCCP would gradually be reduced following the demonstration as experience is gained in operating the facility. The impacts of normal operations after demonstration are discussed in Sect. 5.

Some residents in the Healy vicinity are concerned that the HCCP might have a boomtown effect on the area. In the past, sudden population growth and economic prosperity that accompanied resource development projects caused some Alaskan communities to develop haphazardly, with little regard for planning. During ***more*** prosperous economic times, communities built facilities that they no longer can afford to operate or maintain. Residents of the Healy–***Denali Park*** area wish to avoid similar boomtown development with the proposed HCCP.

4.1.8.1 Population

The communities in the Denali Borough experienced rapid population growth in the 1980s (see Sect. 3.8.1). A slower rate of growth is expected in the 1990s. Table 4.1.7 contains population projections through 1998 for the borough, Healy, and ***Denali Park***. The projections, which do not include HCCP-related growth, assume an average annual growth rate of 1.5%. The Institute of Social and Economic Research, University of Alaska, Anchorage, uses this rate to project population in the Railbelt region (Institute of Social and Economic Research 1988).

The HCCP would generate additional population growth in the Denali Borough in two ways. First, growth would occur as workers (some bringing families) in-migrate for direct employment in plant construction or operation. Second, indirect growth would occur as workers (some bringing families) in-migrate for employment created by expenditures of HCCP workers and by the additional demand for coal from ***the*** UCM Poker Flats Mine. Most of the construction-related growth would be temporary, lasting over the ***3***-year construction period ***(1994–1996)***, while operations-related growth would be permanent.

Table 4.1.7. Population projections for Denali Borough, Healy, and *Denali Park* (1993–1998)

Community	1993	1994	1995	1996	1997	1998
Denali Borough	1879	1907	1936	1965	1994	2024
Healy	509	517	525	533	541	549
Denali Park	180	183	186	189	192	195

Sources: ORNL staff projections based on data from AIDEA (Alaska Industrial Development and Export Authority) *Second Draft Environmental Information Volume, Healy Clean Coal Project, Healy, Alaska*, prepared by Stone and Webster Engineering Corp., Denver, September 1991; Institute of Social and Economic Research, *Economic and Demographic Projections for the Alaska Railbelt: 1988–2010*, prepared for the Alaska Power Authority, August 1988; U.S. Census of Population, 1990.

Population Growth Due to Construction

To estimate construction-related growth, some assumptions are made about the number of construction workers required and about characteristics of the work force. The construction work force is expected to peak at 300 on-site workers in ***summer 1995***, and to continue at that level through ***late 1996***. Given the employment skills required for HCCP construction, it is anticipated that most of the work force would come from outside the Denali Borough (probably from Anchorage and Fairbanks). Because the proposed HCCP site is nearly 250 miles north of Anchorage and over 100 miles south of Fairbanks, the workers likely would relocate to the Healy area temporarily (at least during work weeks) rather than commute each day.

For this analysis, a construction camp housing scenario was used to calculate population growth due to construction employment. The scenario assumes that camp housing would be provided on a site about 0.5 miles northwest of the HCCP proposed site, that 90% of the work force would live in camp housing without families, and that 10% would live with their families outside the camp in Healy or ***Denali Park***. The construction camp scenario also assumes that the workers' average household size would be similar to the state of Alaska's 1990 average of 2.8 per household (U.S. Bureau of the Census 1990), and that 80% of their children would be school aged.

Projecting construction-related growth also requires assumptions about the number of indirect jobs that would be created and about characteristics of the indirect work force. Based on a review of studies of 25 power plant construction projects in the western United States, Leistritz and Murdock (1986) conclude that construction period employment ratios typically range from ***1 : 8*** to ***2 : 5*** indirect jobs for every direct job created. For the HCCP, AIDEA assumes that the ***indirect : direct*** job ratio would be ***1 : 4***, so that one indirect job is created for every four construction jobs created. It is expected that most of the indirect jobs (about 75%) would be filled by current borough residents rather than by persons in-migrating for employment (see Sect. 4.1.8.2). Of those who do in-migrate, it is projected that 25% would be accompanied by their families (AIDEA 1991a). As with the construction work force, it is assumed that the indirect workers who in-migrate with their families would have an average household size of 2.8. (U.S. Bureau of the Census 1990), and that 80% of the children would be school aged.

Given these assumptions about the direct and indirect work forces, it is possible to project total construction-related growth for the Denali Borough. Table 4.1.8 contains population growth projections for the peak construction period ***in 1995 and 1996.*** The borough's population would increase by approximately 382 persons by ***1996*** as a result of HCCP construction.

Population Growth Due to Demonstration

As with construction-related growth, some assumptions are made about the number of workers required and the characteristics of the work force to estimate demonstration-related growth. In addition to present staff at Healy Unit No. 1, whose responsibilities would be expanded to include tasks associated with the joint operation of Unit No. 1 and the proposed HCCP, the number of workers required to operate the HCCP during demonstration would peak at 39 in ***1997***. Seven of the workers would be non-GVEA personnel temporarily on-site to monitor the HCCP demonstration. . Therefore, growth calculations are based on a demonstration staff of 32. Given the employment skills required for HCCP operation, the majority of the work force would in-migrate from outside the Denali Borough.

Based on characteristics of the GVEA work force at Healy Unit No. 1, it is estimated that 95% of the HCCP work force would reside in Healy, and 5% would reside in ***Denali Park***. Further, it is assumed that 85% would be accompanied by their families, that average household size would be 2.8, and that 80% of the children would be school aged.

Projecting operations-related growth also requires assumptions about the number of indirect jobs created and about characteristics of the indirect work force. Some permanent jobs would be created by the expenditures of operations workers during HCCP demonstration, but these jobs likely would be filled by borough residents who filled temporary employment positions created during construction. Thus, indirect employment created by operations workers' expenditures would not result in population growth. However, the additional coal required to demonstrate and operate the HCCP is expected to create eight permanent jobs at UCM. As with the HCCP operations workers, it is assumed that the UCM workers would in-migrate, that 85% of them would be accompanied by their families, that average household size would be 2.8, and that 80% of their children would be school aged.

With assumptions about the HCCP, indirect, and UCM work forces, total operations-related population growth can be projected for the Denali Borough (Table 4.1.9). Assuming the demonstration work force size (32), the borough's population would increase by approximately 102 people by 1996 as a result of HCCP operations.

Table 4.1.8. Projected population growth related to the Healy Clean Coal Project during the peak construction period *(1995–1996)*

Direct growth	
Construction work force	300
Number accompanied by family (10%)	30
Average household size	× 2.8
Workers plus families	84
Number unaccompanied by family	+270
Total direct growth	354
Indirect growth	
Direct jobs	300
Indirect/direct job ratio	× 0.25
Indirect jobs created	75
Current borough residents (75%)	56
In-migrants (25%)	19
Number accompanied by family (25%)	5
Average household size	× 2.8
In-migrants plus family	14
Number unaccompanied by family	+ 14
Total indirect growth	28
Total population growth (direct growth plus indirect growth)	382

Sources: ORNL staff projections based on data from AIDEA (Alaska Industrial Development and Export Authority) *Second Draft Environmental Information Volume, Healy Clean Coal Project, Healy, Alaska*, prepared by Stone and Webster Engineering Corp., Denver, September 1991; Institute of Social and Economic Research, *Economic and Demographic Projections for the Alaska Railbelt: 1988–2010*, prepared for the Alaska Power Authority, August 1988; U.S. Department of Commerce, 1990.

Table 4.1.9. Projected Healy Clean Coal Project–related population growth during the demonstration *(1997)*

Direct growth	
Operations work force	32
Number accompanied by family (85%)	27
Average household size	× 2.8
Workers plus families	76
Number unaccompanied by family (15%)	+ 5
Total direct growth	81
Indirect growth	
Indirect jobs created (Usibelli Coal Mine)	8
Number accompanied by family (85%)	7
Average household size	× 2.8
Workers plus family	20
Number unaccompanied by family (15%)	+ 1
Total indirect growth	21
Total population growth (direct growth plus indirect growth)	102

Implications of Population Growth

The peak year for total HCCP-related growth would be ***1996***, when both the construction and demonstration work forces would be on-site simultaneously. As indicated in Table 4.1.8, construction-related growth is projected to be approximately 382 persons by ***1996***. Because the demonstration workers would also be on-site, operations-related growth would add 102 people in late

1996 and early *1997* (see Table 4.1.9). Therefore, it is projected that total HCCP-related growth would add approximately 484 people to the Denali Borough's population in *1996–1997*.

Based on the projections in Table 4.1.7, HCCP-related growth would represent approximately 25% of the Denali Borough's *1996* population. Assuming that the growth would occur in Healy and ***Denali Park***, the increase represents *67%* of the two communities' projected *1996* populations combined. A population increase this large is likely to have long-term socioeconomic impacts in the Denali Borough, especially in Healy and ***Denali Park***. These socioeconomic impacts are discussed in the subsections on housing, local government revenues, public services, and tourism and recreation.

4.1.8.2 Employment and Income

HCCP would generate employment and income for residents of the Denali Borough and of other parts of the state. Direct employment and income would result from jobs in plant construction and operations. Indirect employment and income would be generated by direct workers' expenditures and by the need to acquire additional coal from UCM mine. The following subsections discuss the impacts of the HCCP to employment and income.

Impacts of Construction

HCCP construction would require up to 300 workers during the peak construction period, and average annual employment would be 210 in *1995* and 230 in *1996* (Table 4.1.10). Construction jobs are not expected to lower unemployment in the Denali Borough directly, however, because ***most of the work force is expected to come from outside the Denali Borough.***

The major employment impact for borough residents would be the indirect jobs created by the construction workers' expenditures in the local economy. Indirect employment during the peak construction period is projected to be 75 jobs, with average annual employment growing from 15 to 58 jobs (Table 4.1.10). Indirect employment projections for the construction period are based on an indirect/direct job ratio of 0.25, or one indirect job created for every four direct jobs created.

Table 4.1.10. Projected average annual employment related to the Healy Clean Coal Project during construction

Employment type	*1994*	*1995*	*1996*
Direct (construction)	60	210	230
Indirect	15	53	58
Total	75	263	288

Source: AIDEA (Alaska Industrial Development and Export Authority) *Second Draft Environmental Information Volume, Healy Clean Coal Project, Healy, Alaska*, prepared by Stone and Webster Engineering Corp., Denver, September 1991.

Because most of the indirect jobs would be temporary, lasting only through the construction period, and because the unemployment rate is relatively high in parts of the Denali Borough (see Sect. 3.8.2), it is projected that most of the indirect jobs (about 75%) would be filled by current borough residents rather than by persons in-migrating for employment. The rest of the jobs (about 25%) would be filled by in-migrants. Based on these assumptions, 56 of the 75 indirect jobs created would be filled by current residents, and 19 would be filled by in-migrants.

The creation of 75 indirect jobs would have economic impacts in the Denali Borough. With approximately 841 jobs in the local economy (see Table 3.8.2), 75 jobs would increase local employment by 9%. These jobs would supplement existing temporary employment opportunities, as thousands of jobs are created each summer by the tourist industry (see Sect. 3.8.6). However, because opportunities for borough residents would be limited to temporary jobs, the local employment impacts of HCCP construction would be minor.

HCCP construction would generate direct wages in excess of $14 million (Table 4.1.11) during the peak construction period, and total annual wages would average over $8 million. ***Appreciable construction*** wages are not expected to go to local residents directly, however, because ***most of the work force is expected to come from outside the Denali Borough***. Direct wages would have an indirect effect on the local economy because workers would purchase goods and services and pay rents in Healy and ***Denali Park***. It is likely that these indirect effects would be greater without a construction camp because more rental income would be generated. Because a construction camp is planned, most of the direct wages would benefit areas from where the work force is drawn. Also, expenditures on supplies for the construction camp would likely benefit other parts of the state, particularly Fairbanks and Anchorage.

The major impact to borough residents' incomes would be indirect wages from jobs created by construction workers' expenditures. Indirect wages associated with the peak construction period are projected to exceed $789,000 (Table 4.1.11), with total annual wages averaging over $460,000. The average annual wage for indirect workers is projected to be approximately $14,800 in ***1994***, and approximately $15,600 in ***1995*** and ***1996*** (AIDEA 1991a).

Table 4.1.11. Projected annual Healy Clean Coal Project–related wages during construction (in thousands of dollars)

Wage type	*1994*	*1995*	*1996*
Direct (construction)	3,255	14,169	14,088
Indirect	195	789	785
Total	3,450	14,958	14,873

Source: AIDEA (Alaska Industrial Development and Export Authority) *Second Draft Environmental Information Volume, Healy Clean Coal Project, Healy, Alaska*, prepared by Stone and Webster Engineering Corp., Denver, September 1991.

As with indirect employment, the indirect wages earned during construction would have economic impacts in the Denali Borough. The average income projected for an indirect job is low compared with the average income of most borough residents (see Sect. 3.8.2), but the additional income would promote some economic growth. However, the impacts generated by indirect income would be small, particularly when compared with the impacts of income generated by the borough's tourist industry (see Sect. 3.8.6).

Impacts of Demonstration

It is expected that 32 workers would be required to operate the HCCP during demonstration (7 additional non-GVEA personnel would be on-site to monitor the HCCP demonstration in ***late 1996 and 1997***, but they would not be permanent workers and are not included in this analysis). These jobs are not expected to affect local employment directly, however, because the additional workers would be brought in from outside the Denali Borough.

The major employment impact for the borough would be the likelihood that some of the temporary indirect jobs created during construction would become permanent jobs. AIDEA projects that indirect employment during operations would create approximately 13 permanent jobs for borough residents. It is expected that these jobs would be filled by residents who held temporary jobs during HCCP construction. The need to produce additional coal for the HCCP would also create eight jobs with UCM, but these workers are expected to come from outside the borough.

The creation of 13 permanent jobs would have minor impacts on employment in the Denali Borough. With approximately 841 jobs in the local economy (see Table 3.8.2), 13 jobs would increase local employment by 1.5%.

Total annual wages for HCCP operating staff would average $1.76 million during the demonstration (Table 4.1.12). In addition, total annual wages generated at UCM mine are projected to average $384,000. Unlike direct wages during construction, the wages paid to GVEA and UCM employees would affect local income levels directly because the workers would be permanent borough residents.

Total annual wages associated with the indirect jobs are projected to average over $200,000 in ***1997*** (Table 4.1.12), as the average annual wage for the 13 indirect workers would be $15,600. As with indirect employment, indirect wages earned during HCCP operations would have minor economic impacts in the Denali Borough. The average income projected for indirect employment is low for the Denali Borough, but indirect income would promote some economic growth. Overall, however, the economic impacts of indirect income would be minor.

Table 4.1.12. Projected annual Healy Clean Coal Project–related wages during the demonstration (in thousands of dollars)

Wage type	*1997*
Direct (operations)	1,760
Usibelli Coal Mine	384
Indirect	203
Total	2,347

Source: AIDEA (Alaska Industrial Development and Export Authority) *Second Draft Environmental Information Volume, Healy Clean Coal Project, Healy, Alaska*, prepared by Stone and Webster Engineering Corp., Denver, September 1991.

4.1.8.3 Housing

The influx of workers associated with HCCP construction and operation would create additional demand for housing in the Denali Borough, particularly in Healy and ***Denali Park***. The following subsections assess the impacts of this additional demand on housing availability.

Impacts of Construction

The extent to which construction would affect housing in the study area depends on how many workers reside in the camp housing. It is assumed that 90% of the work force would live in the camp about 0.5 miles northwest of the HCCP proposed site, and that 10% would live in Healy or ***Denali Park*** with their families. Using the peak construction period as a worst case, 270 workers would live in the camp, and 30 would live in the local communities for ***one*** year (see Table 4.1.8). In addition, 19 indirect workers (5 with families) would require housing during the same time period. Thus, total demand for housing in Healy and ***Denali Park*** would be 49 units, 35 of which would be family units and 14 of which would be single units.

HCCP-related housing demand would impact housing availability in the Healy–***Denali Park*** area in ***1995 and 1996***. The impacts might not be severe because of existing vacancies in permanent units, the availability of temporary units, and the possibility of developing 100 lots in the Healy Subdivision (see Sect. 3.8.3). However, if additional housing is not built in the Healy Subdivision, the demand for 35 family units could create major impacts to housing availability. Because demand for 49 units represents the worst case, impacts are expected to be smaller in ***1994***.

Impacts of Demonstration

Based on the residential distribution of the current GVEA work force at Healy Unit No. 1, 95% of the proposed HCCP demonstration work force (30 workers) would reside in Healy, and 5% (2 workers) would reside in ***Denali Park***. In addition, eight UCM workers would require permanent housing in the Healy–***Denali Park*** area.

As with demand during construction, housing demand due to HCCP demonstration alone (40 units) is expected to impact housing availability. However, because demonstration-related demand would overlap with construction-related demand ***in late 1996***, there would be more severe impacts to housing availability than during operations alone. Using the construction camp scenario for ***1996***, housing demand for the construction and operations work forces combined would be 89 units. It is expected that demand this great may have major impacts on housing availability.

4.1.8.4 Local Government Revenues

Construction and operation of the HCCP would generate additional local government revenues through local tax payments and user fees and state municipal assistance, revenue sharing, and education revenue programs. The following subsections discuss the HCCP's impacts on local government revenue.

Impacts of Construction

The Denali Borough would be the major beneficiary of increased local government revenues during HCCP construction. Table 4.1.13 contains projections of the additional revenue that the borough could receive during the peak construction period. The projections are based on a number of assumptions about the construction camp housing scenario, as follows.

With a construction camp, no additional revenue would come from the borough's 4% bed tax because all unaccompanied workers would live in the camp and all accompanied workers would live in houses or apartments in Healy or ***Denali Park***. The amount of state municipal assistance and revenue sharing funds received would be based on population. The projections in Table 4.1.13 assume the average per capita municipal assistance funding ($50) and revenue sharing funding ($19.25) provided by the state

Table 4.1.13. Projected Healy Clean Coal Project–related increases in Denali Borough revenues during the peak construction year *(1995)*

State municipal assistance	$19,100
State revenue sharing	7,356
State education revenue	*428,196*
Miscellaneous/user fees	1,920
Total	*$456,572*

Sources: AIDEA (Alaska Industrial Development and Export Authority) *Second Draft Environmental Information Volume, Healy Clean Coal Project, Healy, Alaska*, prepared by Stone and Webster Engineering Corp., Denver, September 1991; ***Letter from J. Novak, Superintendent, Denali Borough School District, to E. W. Evans, U.S. Department of Energy, Pittsburgh Energy Technology Center, December 14, 1992.***

of Alaska in FY 1991. The annual state education revenue contribution is based on ***information provided by the Denali Borough School District (Novak 1992). Miscellaneous/user fee projections are based on borough population at a rate of $5 per person per year. Given these assumptions, the Denali Borough would receive an additional $456,572 in 1995–1996 because of HCCP construction. The impacts of this revenue are discussed under public service impacts in Sect. 4.1.8.5.***

All unincorporated communities in the state receive the same amount of funding ($11,920 for FY 1991) from the Alaska Department of Community and Regional Affairs (ADCRA), regardless of population. Thus, Healy and ***Denali Park*** would not receive additional state funding because of population growth. However, the volunteer fire departments in Healy and Denali Park would receive increased revenues because of increases in population. For FY 1991, the departments received $4.915 per person from ADCRA. Assuming the same per capita rate for the peak construction period, the Tri-Valley Volunteer Fire Department would receive an additional $1784 and the Denali Park Volunteer Fire Department would receive an additional $93.

Impacts of Demonstration

The Denali Borough would also be the major beneficiary of increased local government revenues during demonstration of the HCCP. Table 4.1.14 contains projections of the additional revenue that the borough could receive during demonstration. The projections are based on the following assumptions.

No additional revenue would come from the borough's 4% bed tax during operations because workers would live in permanent housing. However, the borough would receive revenue from the severance tax (5¢ per ton) levied on coal produced by UCM for the HCCP. Based on a coal consumption

Table 4.1.14. Projected Healy Clean Coal Project–related increases in Denali Borough revenues during the demonstration *(1997)*

Severance tax	$16,750
State municipal assistance	5,100
State revenue sharing	1,964
State education revenue	***428,196***
Miscellaneous/user fees	510
Total	***$452,520***

Sources: AIDEA (Alaska Industrial Development and Export Authority) *Second Draft Environmental Information Volume, Healy Clean Coal Project, Healy, Alaska*, prepared by Stone and Webster Engineering Corp., Denver, September 1991; ***Letter from J. Novak, Superintendent, Denali Borough School District, to E. W. Evans, U.S. Department of Energy, Pittsburgh Energy Technology Center, December 14, 1992.***

rate of 335,000 tons/year, the borough would receive $16,750 from the severance tax during demonstration and each year of normal operations.

The borough also would benefit from population growth in terms of additional revenues from user fees and state municipal assistance, revenue sharing, and education revenue funds. Table 4.1.14 assumes the per capita rate of funding discussed in Sect. 4.1.8.4. Based on the current funding rates, the Denali Borough would receive an additional **$452,520** because of HCCP demonstration. The impacts of this revenue are discussed under public service impacts in Sect. 4.1.8.5.

Using the per capita rate used for FY 1991 ($4.915), the Tri-Valley Volunteer Fire Department would receive an additional $477 from ADCRA during demonstration. The Denali Park Volunteer Fire Department would receive additional funding of $25.

4.1.8.5 Public Services

The influx of workers associated with HCCP construction and operation would create additional demand for public services, particularly in Healy and Denali Park. Conversely, population growth would generate additional local government revenues that could offset the cost of increased demand. It is important that additional revenues cover the cost of additional services because, without the HCCP, the borough's revenues are projected to exceed expenditures by only $9700 (see Tables 3.8.4 and 3.8.5). The following subsections assess the impacts of HCCP-related demand on public services, as well as the Denali Borough's ability to meet the increased demand.

Impacts of Construction

During the HCCP peak construction period, 363 additional residents are anticipated in Healy and 19 additional residents are anticipated in Denali Park. An additional ***$456,572*** in borough revenues would be generated to provide public services. The HCCP's impacts to particular services are discussed in the following paragraphs.

Education. Projected Tri-Valley School enrollment in 1995–96 without the HCCP is ***285*** students, ***120 more*** than the current capacity of ***165*** (see Table 3.8.6). With an average household size of 2.8 and 80% of the children of school age, population growth (see Table 4.1.8) would increase Tri-Valley enrollment by approximately 22 students. These additional students would increase projected enrollment to ***307***, exceeding ***current*** capacity by ***142*** students. ***However,*** annual state education funding would increase by ***over $400,000 and*** the borough's annual contribution would increase by ***approximately $217,716. It is expected that current plans to expand and remodel the Tri-Valley School would accommodate the growth related to HCCP construction, and that impacts to education would not be major (Novak 1992; Brewer 1993).***

Public utilities. Under the construction camp scenario, 35 permanent housing units would be required for workers accompanied by their families. Given the existing housing stock in the

Healy–Denali Park area, this demand would require some residential construction. However, the impacts of installing additional private septic systems are not expected to be major. The local water supply is also considered adequate to meet the additional demand of 35 new residences.

Solid waste disposal. A waste disposal company would be contracted to dispose of solid wastes from HCCP construction and from the construction camp. Workers living in Healy and Denali Park would take their solid wastes to the Healy landfill. Residents of Alaska were estimated to generate an average of 4.3 lb of landfill waste per day in 1989 (Glenn 1990). Assuming the same rate for 1995, the additional residents living outside the construction camp would generate approximately 300 tons of waste in the Healy landfill each year. This would represent about a 50% increase in current disposal rates.

When the Healy landfill was new, it was estimated to have a capacity of 20 years at normal disposal rates. However, the additional solid waste generated by increases in tourism and facility construction at DNPP filled much of the landfill's space. Because of this additional waste, it is likely that the borough will have to locate new landfill space before the year 2000. Additional waste generated by workers living in Healy and ***Denali Park*** during HCCP construction would exacerbate the area's existing need for a new landfill. Although relocation of municipal landfills is often a problem, there is ample space for a new landfill in the Healy area. ***Alternative landfill sites are discussed in Sect. 4.1.10.***

Transportation. HCCP construction would generate additional traffic on roads in the Healy area in two ways. First, traffic would increase as trucks transporting construction materials from Anchorage travel the George Parks Highway and the Healy Spur Highway to the work site. However, the estimated two deliveries of materials per day should create negligible traffic impacts. Second, traffic would increase as direct and indirect workers and their families travel to and from work and other destinations in the region. Because HCCP would have a construction camp near the project site, it is expected that direct workers would not drive to and from work each day. However, it is estimated that direct workers' family members and indirect workers and their families would generate between 100 and 150 additional trips (one way) per day on the George Parks Highway and the Healy Spur Highway. These newly generated trips are not expected to create traffic congestion at particular times of the day (e.g., during construction shift changes), because most of the trips would not be made to or from the construction site. Using the low estimate (100 trips), this additional traffic would represent increases of 14% and 29% over the existing traffic on the Healy Spur Highway at the George Parks Highway and Healy School Access Road intersections, respectively (see Table 3.8.7).

Police and fire protection. HCCP construction is expected to affect police protection in the Healy vicinity, regardless of the fact that a construction camp would be provided. The presence of a 300-person construction work force would stretch the resources of the Alaska state ***troopers*** who ***service*** the area, adding to the difficult task of providing police protection for the entire borough. Even so, it is extremely unlikely that additional troopers would be assigned to the area because funding cutbacks have forced the closure of state trooper stations elsewhere in Alaska.

Construction would likely impact fire protection in Healy and ***Denali Park***, as the communities' combined population is projected to increase by ***67% by 1996*** (see Sect. 4.1.8.1). The volunteer fire departments in Healy and ***Denali Park*** would receive increased state funding with population growth (see Sect. 4.1.8.4), but the influx of people still might make it difficult for the departments to maintain their current levels of service. The project participant would mitigate impacts by providing trained fire-fighting personnel during the construction period with adequate equipment and supplies to protect the HCCP site and the work force in the construction camp.

Medical services. ***Although*** HCCP construction would ***increase the Healy area's population by 67%, local medical personnel have stated that the project would not have substantial impacts on medical services in the area (Price 1992; Winklmann 1992). If impacts did become severe,*** the project participant would mitigate impacts by providing a trained emergency medical technician on staff during the major construction period to service both the HCCP site and the construction camp. Also, arrangements would be made for helicopter medivac services out of Fairbanks in the event of life-threatening emergencies.

Impacts of Demonstration

During the demonstration, there would be 97 additional residents in Healy and 5 additional residents in Denali Park. An additional $452,520 in borough revenues would be generated to provide public services. Given these figures, the HCCP's impacts to particular services are discussed below.

Education. With an average household size of 2.8 and 80% of the children of school age, population growth during demonstration (see Table 4.1.9) would increase Tri-Valley School enrollment by approximately 22 students. Tri-Valley enrollment in 1996–97 without the HCCP is projected to be approximately 290 students, 125 more than the current capacity of 165. The addition of 22 students would increase projected enrollment to 312, exceeding capacity by 147 students. Annual state education funding would increase by over $400,000, and the borough's annual contribution would be approximately $290,288. If the Tri-Valley School's capacity is permanently expanded to meet HCCP-construction related growth, additional expansion would not be required as a result of the demonstration, ***and impacts to education would not be major (Novak 1992; Brewer 1993).***

Public utilities. During the demonstration, 40 permanent housing units would be required for HCCP and UCM workers. Given the existing housing stock in the Healy–Denali Park area, and the fact that additional homes would be built during HCCP construction, this demand would not require new residential construction. Thus, no new impacts would arise from installing additional private septic systems. The local water supply is considered adequate to meet the additional demand of 40 new residences.

Solid waste disposal. Workers living in Healy and Denali Park would take their solid waste to the Healy landfill. On average, residents of Alaska generated an estimated 4.3 lb of landfill waste per day in 1989 (Glenn 1990). Assuming the same rate for **1997**, the additional residents would generate over 80 tons of waste in the Healy landfill per year. This would represent about an 13% increase in current disposal rates. It is likely that the borough will have to locate additional landfill space before the year 2000 (see Sect. 4.1.8.5); if a new landfill becomes operational, it is expected that impacts to that landfill would be minimal.

Transportation. During HCCP demonstration, traffic in the Healy area would increase as direct and indirect workers and their families travel and from work and other destinations in the region. Direct and indirect workers and their families are expected to generate between 50 and 100 additional trips (one way) per day on the George Parks Highway and on the Healy Spur Highway. With a low estimate (50 trips), this additional traffic would increase the existing traffic on Healy Spur Highway at the George Parks Highway and Healy School Access Road intersections by 7% and 14%, respectively (see Table 3.8.7). Increases of this size are not expected to create substantial impacts on traffic volumes in the Healy area.

Because ice-free water from the combined thermal discharge of Healy Unit No. 1 and the HCCP would extend down the Nenana River approximately 10 miles (including the transitional area) (Sect. 4.1.3.2), elevated water temperatures could shorten the length of time the river remains frozen each year near the village of Ferry which is located on the east bank about 13 miles downstream of the HCCP proposed site. Consequently, the ability of Ferry residents and small, local mining operators to cross the frozen river by vehicle during winter months could be impaired. The ability to drive across this ice bridge is very important to the community because the only other means of access is a railroad bridge. Although the railroad bridge has a walkway that is used by Ferry residents when the river is not frozen, it is inconvenient and very expensive for residents and local mining operations to bring supplies and equipment to Ferry by rail. Also, most Ferry residents prefer driving across the ice bridge to walking across the railroad bridge during the cold Alaskan winters.

In most years, it is possible to drive vehicles and heavy mining equipment across the frozen Nenana River at Ferry from early January until early April. In the unlikely event that HCCP thermal discharge prevented the river from freezing solid near Ferry, and thus prevented residents and miners from using the ice bridge, major socioeconomic impacts would result. Heavy supplies and equipment would have to be brought to Ferry by rail, resulting in higher costs and increased time spent coordinating and scheduling rail service.

In the more likely event that HCCP thermal discharge caused the river to freeze later and thaw earlier than usual, socioeconomic impacts would not be substantial. Residents and miners would still be able to transport supplies and equipment across the frozen river, but for a shorter time period each winter.

Because the people who live and work near Ferry are accustomed to using alternative means of transportation for 9 months each year, a reduction in the period of ice bridge availability would likely have only minor socioeconomic impacts.

Police and fire protection. HCCP demonstration is expected to have minor impacts on police protection in the Denali Borough. Although the arrival of 102 new residents (an increase of approximately 6% over current population) would create more casework for the Alaska state ***troopers***, the impacts would not be as large as those expected with the construction work force.

The demonstration is expected to create minor impacts on fire protection in the Healy vicinity. The volunteer fire departments in Healy and ***Denali Park*** would receive increased state funding with population growth (see Sect. 4.1.8.4), but it is likely that new housing development in the Healy Subdivision would make it more difficult for the departments to maintain their current levels of service.

Medical services. HCCP demonstration would ***not*** impact medical services in the Healy vicinity. Both the Healy Clinic and the Railbelt Mental Health ***and Addictions Program have indicated that they could accommodate the*** influx of persons associated with the demonstration (a 6% increase over current borough population) ***(Price 1993; Winklmann 1992).***

4.1.8.6 Tourism and Recreation

Several aspects of HCCP construction and operation could affect tourism and recreation in the study area. The following subsections discuss potential causes and the significance of these impacts.

Impacts of Construction

Potential direct impacts of HCCP construction on tourism and recreation were evaluated. Direct impacts would be those generated by construction noise and traffic and by changes in the site's visual appearance. Given the HCCP's location and the area's terrain, it is unlikely that construction-related noise would be heard along the more heavily used portions of the Nenana River (see Sect. 4.1.9). Blasting would not occur at the project site. Some noise might be noticeable on the Nenana River within a 500-ft radius of the construction site, but most recreational boating occurs south of the site.

Because traffic generated by HCCP construction would not substantially affect traffic on the Parks Highway, it is not expected to have major impacts on tourism and recreation. Given existing levels of traffic from tourism and recreation in the summer, and the fact that the Parks Highway is the main route for transporting materials between Anchorage and Fairbanks and on to the North Slope, construction is not expected to affect the regional transportation system.

HCCP construction would create adverse visual impacts at the construction site, including increased dust levels. Given the nature of the terrain, however, visual impacts to recreation activities would be limited to the Nenana River Valley in the immediate vicinity of the project site and some high elevation areas in the northeast section of DNPP (see Sect. 4.3.1). Because most recreational boating occurs south of the site, impacts are expected to be minor.

Impacts of Demonstration

Demonstration of the HCCP could potentially affect tourism and recreation by generating noise and by altering the area's aesthetic environment. The noise generated by the HCCP is expected to be similar to that generated by the existing Healy Unit No. 1 (see Sect. 4.1.9). Given the HCCP's location and the area's terrain, it is unlikely that operations-related noise would be heard along the more heavily used portions of the Nenana River. Some noise might be noticeable on the Nenana River within a 500-ft radius of the project site, but most recreational boating occurs south of the site in the Nenana River Gorge.

The demonstration would create visual impacts at the project site, including the visual presence of the new power plant, increased levels of coal dust, and increased dust generated along the coal haul road from the UCM mine. Given the nature of the terrain, however, visual impacts to recreation activities would be limited to the Nenana River Valley in the immediate vicinity of the project site and some high elevation areas in the northeast section of DNPP (see Sect. 4.3.1). Because most recreational boating occurs south of the site, visual impacts are expected to be negligible.

4.1.9 Noise

The most obvious adverse impact to humans and their environment associated with moderate noise levels (65 dBA) in a community is the disturbance of the local ambience. Extremely loud (75 dBA) noise interferes with human speech intelligibility and can physiologically damage hearing in humans and wildlife. Noise can also disturb wildlife behavior patterns. In particularly sensitive species, mating rituals can be affected; this, in turn, can affect species populations. Such changes can ultimately upset the balance of an ecosystem. Table 4.1.15 provides sound intensity levels associated with familiar sources of sound.

A discussion of the increased noise expected in the Healy area as a result of construction and operation of the HCCP follows.

4.1.9.1 Construction

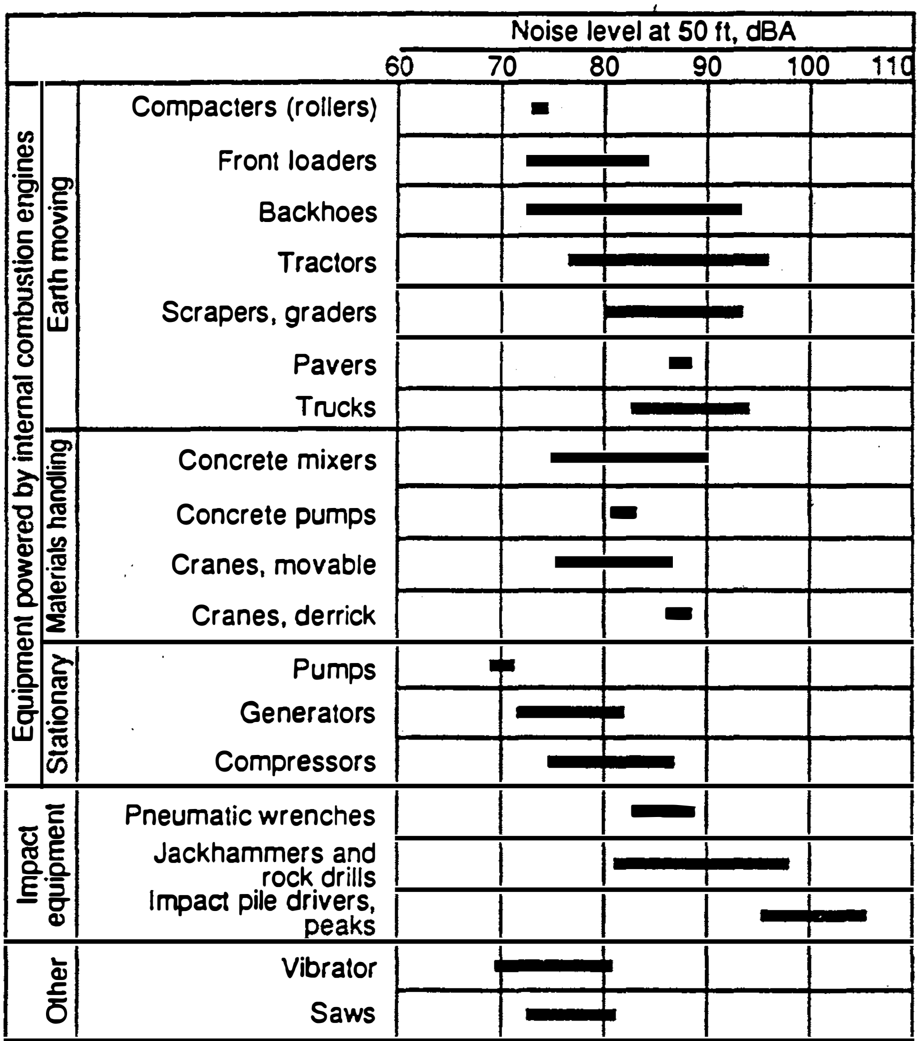
Ambient noise levels would temporarily increase in the immediate vicinity of Healy Unit No. 1 during construction of the HCCP because of heavy equipment operation, traffic from large haul and delivery vehicles, increased commuter traffic, and machinery operation. Ranges of noise emitted by various types of construction equipment are listed in Table 4.1.16. Noise would be intermittent and would vary during construction with the different activities in progress (i.e., with ground clearing, excavation, demolition, and paving).

Table 4.1.15. Sound intensity levels associated with familiar sources of sound

Description or Effect	Sound Pressure (dyn/cm^2)	Sound Intensity at Eardrum (W/cm^2)	Intensity Level (dB above 10^{-16} W/cm^2)	Familiar Sources of Sound (number in parentheses shows distance from source)
Impairs hearing		10^{-1}	150	
				jet engine
Pain	2040	10^{-2}	140	
				largest air raid siren (100 ft)
Threshold of pain		10^{-3}	130	level of painful sound
				pneumatic hammer (5 ft) airplane 1600 rpm (18 ft from propeller)
Threshold of discomfort	204	10^{-4}	120	automobile horn
				engine room of submarine (at full speed) bass drum (maximum)
Deafening		10^{-5}	110	
				boiler factory loud bus horn thunder clap subway (express passing a local station)
Discomfort begins	20.4	10^{-6}	100	
				can manufacturing plant very loud musical peaks noisiest spot at Niagara Falls
Very loud		10^{-7}	90	
				loudest orchestral music noisy factory heavy street traffic
	2.04	10^{-8}	80	loud speech police whistle very loud radio
				average factory average orchestral volume
Loud		10^{-9}	70	busy street noisy restaurant
				average conversation (3 ft) quiet typewriter average (quiet) office
	0.204	10^{-10}	60	hotel lobby quiet residential street
Moderate		10^{-11}	50	church quiet automobile
				average residence
	0.0204	10^{-12}	40	
				lowest orchestral volume quiet suburban garden
Faint		10^{-13}	30	
				average whisper very quiet residence
	0.00204	10^{-14}	20	
				faint whisper (5 ft) ordinary breathing (1 ft) outdoor minimum (rustle of leaves)
Very faint		10^{-15}	10	
				anechoic room normal threshold of hearing
Threshold of hearing	0.000204	10^{-16}	0	reference level

*From Graf, R. F., "Electronic Design Data Book," Van Nostrand Reinhold Co., New York, 1971.

Table 4.1.16. Typical construction equipment noise ranges



Source: **Canter 1977 (based on limited available data samples).**

The maximum noise level from the sources listed in the table would be that associated with peak operation of pile drivers (105 dBA at 50 ft from the source). This level approximates the noise emitted by a loud motorcycle 20 ft away (Canter 1977). At 400 ft from a pile driver, noise has attenuated to about 77 dBA (Golden et al. 1979), which is a few decibels less than the noise from a light truck. The distance to the community of Healy is about 1.5 miles or 7960 ft (see Fig. 3.9.1, ***Location*** 3). Because noise attenuates with distance, construction noise would not be perceptible in the Healy residential area; therefore, impacts are expected to be negligible. Noise from construction would be perceptible in the Waugaman Recreational Village about 0.3 miles from the HCCP site, and it could annoy residents. However, because high levels of noise would not be continuous, major adverse impacts are not expected.

Impacts to wildlife from increased noise would not be substantial either, because birds and animals in the vicinity are most likely accustomed to the existing noise from Healy Unit No. 1, the Alaska Railroad, and the frequent coal haul trucks from the UCM Poker Flats Mine. Although additional noise from construction may cause wildlife to avoid the power plant area, only temporary, minor adverse effects to wildlife are expected (see Sect. 4.1.5.1).

4.1.9.2 Operation

Noise from HCCP operation would be generated by sources similar to those at Unit No. 1. These include forced draft and induced draft fans, baghouse operations, coal handling operations, and light and heavy vehicular traffic (delivery of coal and limestone, ash removal, and workers). Bradley (1985) reported that noise levels at a power production facility increase by 3 dBA for every doubling in megawatt rating. Because the HCCP would have a rating double that of Unit No. 1, a 3-dBA increase in noise is expected. At Unit No. 1, the ambient sound level at 500 ft was reported to be 54 dBA (AIDEA 1990). Therefore, the sound level from the HCCP should be about 57 dBA at 500 ft. This level has been reported to cause mild annoyance (5% of the population) and sleep disturbance (Golden et al. 1979) but does not interfere with speech or cause hearing impairment. In the Waugaman Recreational Village about 0.3 miles (1500 ft) east of the plant site, only a slight perceptible increase in noise might be noted. Impacts would be minor. Because the residential population at Healy is located more than a mile to the north and west of the HCCP proposed site, attenuation would make operational noise from the HCCP indistinguishable from ambient noise in the Healy community. Therefore, impacts from increased noise would be negligible.

During the combined operation of the HCCP and Healy Unit No. 1, a noise level of 59 dBA is expected at a distance of 500 ft (an increase of 5 dBA from operation of Unit No. 1 alone). This calculation is based on information from Canter (1977), which assists in calculating the cumulative dBA when the difference between two or more sound levels is known. Such an increase may be perceptible at the Waugaman Recreational Village, but noise at this level should at worst annoy residents only mildly (Golden et al. 1979). Nevertheless, the proposed design of the HCCP includes a silencer for the intake of the forced-draft fan to decrease the cumulative noise from the two units to 48 dBA at Waugaman Village, which is 4 dBA above the existing level. With this mitigation, perception of noise from operation of the HCCP and Unit No. 1 would be slight at Waugaman Recreational Village, and major impacts are not expected. Because of attenuation with distance, cumulative noise levels in the Healy community would be imperceptible from ambient sounds, and impacts would be negligible.

Impacts of increased noise on wildlife populations are discussed in Sect. 4.1.5.1. Although additional noise from operation may cause wildlife to avoid the power plant area, no adverse effects to wildlife are expected.

4.1.10 Waste Management

As part of the proposed project, the existing fly ash ponds at Healy Unit No. 1 would be eliminated. Undisturbed contaminated soils would be buried beneath new construction fill. *Dry fly* ash from the HCCP and Unit No. 1 would be stored in silos. Ash would be trucked to the UCM Poker Flats mine for disposal; ash from Unit No. 1 is already being placed there, along with some contaminated soils from the base of the existing fly ash pond. Ash from the HCCP would contain two new constituents: calcium sulfate and calcium sulfite from desulfurization of the flue gas. The presence of calcium sulfate and calcium sulfite in the ash is not a major waste management concern because they are nontoxic components. The combined disposal rate from the HCCP and Unit No. 1 would be more than five times the current disposal rate. However, there is no risk of exceeding the ash disposal capacity of the large, deep, open-pit mine. The combined annual disposal rate of ash from Unit No. 1 and the HCCP would be less than 1% of the annual coal and overburden combined production rate at the UCM mine.

Construction rubble and construction camp garbage and trash may be trucked to the community landfill near the town of Healy. Permanent residents would continue to have access to this facility. However, the additional waste generated during HCCP construction likely would hasten the borough's search for additional landfill space (see Sect. 4.1.8.5).

The Healy landfill's existing permit may expire or be withdrawn before HCCP construction begins. If the existing permit is not renewed before HCCP construction begins, there are other alternatives for the disposal of construction rubble and construction camp garbage. Closure and decommissioning of Healy's present landfill may force the borough to select a new landfill site to be permitted by the state. Solid waste from the HCCP may be disposed of at one of the several permitted sites: a possible new landfill at Healy, the Nenana Municipal Landfill (which has a long-term permit), the UCM mine (where construction rubble has been placed in the past), or some other site to be determined later. In one possible scenario, the relatively small quantity of construction camp garbage would be hauled to Nenana (approximately 50 miles to the north), and the relatively large quantity of

construction rubble would be hauled to the UCM mine by returning coal trucks. Delivery of construction camp garbage to the UCM mine is not being considered.

4.1.11 Electromagnetic Fields

Electrical power transmission lines produce electromagnetic fields around them. Transmission lines currently are being used to convey electricity at Healy Unit No. 1, and the HCCP at the proposed site would tap into these existing lines. The issue of electromagnetic fields potentially affecting human health has become increasingly visible over the past several years. The following summary of public health effects of electromagnetic fields is excerpted from Sagan (1988).

> The question of the carcinogenicity of electric and magnetic fields has been raised in several epidemiological studies. Whether electric and magnetic fields are a cancer hazard remains a matter of scientific debate. The risk to individuals, if it exists, is probably small. Human, laboratory, and basic research in the United States and elsewhere is now in progress to resolve this issue. As a result, it is likely that answers will emerge in the next few years. Other possible effects, such as those involved in human reproduction or in learning or behavior, should also receive research attention. At this moment, however, there is no convincing evidence of hazard in these or other facets of human health.

More recently, the National Radiological Protection Board (1992) has stated: "The epidemiological findings that have been reviewed provide no firm evidence of the existence of a carcinogenic hazard from exposure of paternal gonads, the fetus, children, or adults to the extremely low frequency electromagnetic fields that might be associated with residence near major sources of electricity supply, the use of electrical appliances, or work in the electrical, electronic, and telecommunications industries."

EPA is currently undergoing a review of available evidence to determine whether electromagnetic fields may be classified as carcinogens (EPA 1990a). Because the HCCP would use existing transmission lines and the electricity generated would replace electricity currently being bought from Anchorage utilities, the HCCP is not expected to change the existing level of effects, if any.

4.1.12 Worker Health and Safety

Worker protection during the construction and operation of power generating facilities is fairly well established. With proper safety training, audits, and enforcement of safety rules, on-the-job accidents would be low. Two potential hazards that may increase the possibility of worker exposure are (1) leaks and spills of gases or hazardous chemicals and (2) contaminated equipment. These hazards would be minimized by frequent training sessions to define the work area and its potential hazards and subsequent internal audits to assess the effectiveness of the training.

Worker health and safety would be enhanced through worker awareness of proper eye, ear, head, foot, and other protective devices to be used during construction and operation of the HCCP. HCCP management would ensure use of such protective devices in accordance with the requirements of the Occupational Health and Safety Act. Safety information would also be properly posted in employee break areas.

Table 4.1.17 presents a generic list of chemicals associated with coal-fired power plants that may be present as part of the solid, liquid, and airborne wastes from the proposed HCCP. Health effects associated with the chemicals are also listed. During construction and operation of the HCCP, employees would be informed of the health effects of chemicals actually present and the means to avoid exposure.

Reductions in atmospheric emissions from the proposed HCCP would have corresponding increases in solid wastes. Because the ash is to be contained in a disposal silo until it can be transported to the UCM Poker Flats mine site for mine pit disposal, impacts to solid waste sites would be negligible. The return of ash to the mine would minimize potential impacts to health and safety. Although the responsibility of disposal methodology at the mine belongs to UCM, disposal would be conducted according to the requirements of the Surface Mining Control and Reclamation Act of 1977 (SMCRA), ***regulations and a permit pursuant to the Alaska Surface Coal Mining Control and Reclamation Act***, and other appropriate local, state, and federal regulations.

4.1.13 Transportation Accident Involving Hazardous Materials

Caustic soda and sulfuric acid would be trucked routinely to the HCCP site during the operational phase. Safe transportation of these products to the HCCP would be the responsibility of vendors. Appropriate vendors would be required to follow U.S. Department of Transportation (DOT) regulations with respect to transportation of hazardous materials in their custody on public highways. DOT regulations pertaining to safe transport of hazardous materials include spill prevention, control, and countermeasures. The use of public roads for off-site transportation of hazardous wastes from the HCCP (if there are any) to an approved hazardous waste landfill also would be subject to DOT regulations.

Mitigation measures for potential hazardous materials spills on public highways would be negotiated between vendors and DOT. In one suggested mitigation measure, caustic soda and sulfuric acid trucks would travel together. If an accidental spill were to occur, one of these products could be used to neutralize the other as a rapid response countermeasure. Within a few days, a cleanup crew would either decontaminate or remove contaminated soils. Although the pH would be controlled, affected surface water bodies would be temporarily enriched in sodium sulfate. The previously suggested countermeasure would require approval from DOT.

Table 4.1.17. Health effects of compounds potentially associated with the Healy Clean Coal Project

Chemical	Health effects
Amines	
Morpholine	Irritating to eyes, skin, mucuous membranes; can cause skin necrosis.[a]
Cyclohexylamine	Caustic effects on skin, mucous membranes, skin sensitization.[a,b]
Ammonia	Intense acute irritation upon inhalation. No evidence of chronic effects from prolonged exposure to tolerable concentrations.
Coal dust	Respiratory irritant; very fine dust poses explosion hazard.
Nitrogen dioxide	Delayed lung irritation and edema; probably increases susceptibility to pulmonary infectious diseases.[c]
Nitrosamines	It is hypothesized that nitrogen oxides from combustion processes might react with amines to produce these potent carcinogens.
Sodium hydroxide	Strong alkali; bums of eyes, skin, mucous membranes; pulmonary edema or pneumonitis with possible shock reaction; respiratory distress from epiglottal edema possible.[c]
Sodium hypochlorite	Strong alkali; similar range of acute toxic reactions as NaOH.[c]
Sulfur dioxide	Upper respiratory tract irritant; possible cocarcinogen. May include asthmatic attacks.
Sulfuric acid	Strong acid; burns, eye injury, strongly corrosive to GI tract.
Trace elements	
Arsenic	Anemia, gastric disturbance, renal symptoms, ulceration; skin and lung carcinogen in humans; a suspected teratogen.
Beryllium	Respiratory disease and lymphatic, liver, spleen, kidney effects; an animal and probable human carcinogen.
Cadmium	Emphysema and fibrosis of the lung, renal injury, possible cardiovascular effects; an animal and possible human carcinogen; testicular toxicity in mice and rats; teratogenic in rodents.
Lead	Neurological, cardiovascular, growth retarding, and gastrointestinal effects; anemia, some compounds are animal and probable human carcinogens; fetotoxic and probably teratogenic to humans.
Manganese	Respiratory and other effects.
Mercury	Neural and renal damage, cardiovascular disease; methyl mercury is teratogenic in humans.
Nickel	Dermatitis, intestinal disorders; nickel and nickel oxide dusts are carcinogenic to guinea pigs and rats; nickel refining is associated casually with cancer in humans.
Selenium	Gastrointestinal disturbance, liver and spleen damage, anemia; a possible carcinogen, a suspected teratogen.
Vanadium	Acute and chronic respiratory dysfunction.

[a]Gosselin, R. E., Smith, R. P., Hodge, H. C., Braddock, J. E. 1984. *Clinical Toxicology of Commercial Products*, 5th Edition, Williams & Wilkins, Baltimore/London.

[b]Budavari, S., O'Neil, M. J., Smith, A., Heckelman, P. E. (editors) 1989. *The Merck Index, An Encyclopedia of Chemicals, Drugs, and Biologicals*, 11th Edition, Merck & Co., Inc., Rathway, New Jersey.

[c]Doull, J., Klaassen, C. D., Amdur, M. O. (editors) 1991. *Toxicology, The Basic Science of Poisons*, 4th Edition, MacMillan, New York.

Source: Abstracted in part from Munro, N. B., Fry, J. M., Gammage, R. B., Haschek, W. M., Calle, E. E., Klein, J. A., and Schultz, T. W. 1983. *Indirect Coal Liquefaction: A Review of Potential Health Effect s and Worker Exposure During Gasification and Synthesis*. ORNL-5938, Oak Ridge National Laboratory, Oak Ridge, Tennessee.

4.2 ENVIRONMENTAL CONSEQUENCES OF THE ALTERNATIVE SITE

This section analyzes the potential impacts to human and environmental resources resulting from construction and operation of the HCCP at the alternative site. Comparisons are made with the level of impacts at the proposed site.

4.2.1 Aesthetics

The alternative site is located in a partially industrialized area that supports development typically associated with coal extraction and exportation (see Sect. 3.1.4). If the alternative site were chosen, the HCCP would be located adjacent to the existing UCM Poker Flats mine coal loadout area along the Alaska Railroad.

At the alternative site, ***the*** HCCP would occupy approximately 40 acres. In addition, it would be necessary to construct a 4-mile 115-kV transmission line that would cross the Nenana River close to the UCM mine coal conveyor at the alternative site and follow the UCM haul road to Unit No. 1 and to upgrade a 1.8-mile access road to the plant from the Healy Spur Highway. Long-term disturbance would be restricted to the river terrace on which the plant and access road would be built. Some short-term disturbance to the Nenana River would occur in the process of installing cooling water intakes and outfall facilities.

The alternative site would be used for the HCCP power-generating facility and associated equipment and as a laydown area for construction materials. Of the 40 acres that would be disturbed, a maximum of approximately 12 acres of native vegetation would be removed. ***Disturbed areas not occupied by permanent facilities would be revegetated to grasses.***

Long-term visual impacts would also result from HCCP operations at the alternative site because of the occasional visibility of condensed water vapor from the stack. This plume would be similar to the one described for the proposed site. ***However, because of the 4-mile separation between the alternative site and Healy Unit No. 1, the two distinct plumes of condensed water vapor from the two units may accentuate visual impacts compared with the proposed site in which the two adjoining plumes would usually merge into a single plume near the site. Other*** visual attributes of the alternative site would be affected more than those of the proposed site for the following reasons:

- The alternative site is located in an area that has experienced less human modification than the proposed site.
- The net amount of land that would be disturbed at the alternative site is greater than the amount that would be disturbed at the proposed site.
- Larger areas of native vegetation would be removed at the alternative site than at the proposed site.

- The new transmission line required for the alternative site would not be needed at the proposed site.

However, because the area in the immediate vicinity of the alternative site is already developed, and visual condition, scenic quality, and visual resource sensitivity are not outstanding (see Sect. 3.1.4), the visual impacts of HCCP construction and operation likely would be minor.

4.2.2 Atmospheric Resources

Because the alternative site is less disturbed than the proposed site, construction of the HCCP at the alternative site would require greater clearing and grading (about 37 vs 10 acres). Therefore, emissions of fugitive dust and exhaust would increase compared with the proposed site. However, by using sprinkler trucks to spray the roads and construction areas ***with water***, air quality impacts associated with clearing and grading are expected to be minor.

Overall, operation of the HCCP at the alternative site would result in reductions in impacts to air quality compared to the proposed site. Table 4.2.1 displays the predicted maximum concentrations from the HCCP at the proposed and alternative sites compared with PSD Class II increments for the area outside of DNPP (predicted concentrations at the proposed site are taken from Table 4.1.1). Maximum SO_2 and NO_2 concentrations at the alternative site would be reduced compared with the proposed site. The maximum annual PM_{10} concentration would increase, primarily because of the location of the new sources with respect to the alternative site perimeter. The maximum concentration for 24-h PM_{10} would remain essentially unchanged. Potential impacts to DNPP for the alternative site were analyzed and are discussed in Sect. 4.3.2.1.

As indicated in Table 4.2.2, maximum cumulative concentrations from the simultaneous operation of the HCCP at the alternative site and the existing Healy Unit No. 1 would be reduced compared with those predicted for the HCCP at the proposed site (predicted concentrations at the proposed site are taken from Table 4.1.2). As discussed in Sect. 4.1.2.2, the reason for this is that the peak concentrations at the proposed site were predicted to occur at the site perimeter resulting from downwash (downward movement) of the Unit No. 1 stack plume caused by the new HCCP boiler building. The maximum concentrations for the proposed site would be localized and would quickly diminish with distance. By siting the HCCP at the alternative site, the Unit No. 1 plume would not be influenced by the new structure. Some of the reductions attainable by siting the HCCP at the alternative site are very large. For example, the maximum annual SO_2 concentration would decrease from ***86%*** of the NAAQS for the proposed site to only 8% of the NAAQS for the alternative site.

Because the ice-free distance downstream of the HCCP thermal discharge at the alternative site is expected to extend about 7 miles (about 11 miles downstream of Healy Unit No. 1) during the winter (see Sect. 4.2.3), ice fog is expected to extend about 6 or 7 miles downstream of the HCCP. The frequency of

Table 4.2.1. Prevention of Significant Deterioration (PSD) impact analysis outside of Denali National Park and Preserve (DNPP) for the Healy Clean Coal Project (HCCP) at the proposed and alternative sites

Class	Pollutant	Averaging period	PSD increment[a] ($\mu g/m^3$)	Proposed site		Alternative site	
				Maximum modeled concentration[b] ($\mu g/m^3$)	Percent of PSD increment	Maximum modeled concentration[b] ($\mu g/m^3$)	Percent of PSD increment
II[c]	SO_2	3-h	512	57	11	22	4
		24-h	91	11	12	5.5	6
		Annual	20	0.8	4	0.5	2
	NO_2	Annual	25	3.4	14	2.2	9
	PM_{10}	24-h	30	17	56	17	55
		Annual	17	2.4	14	3.6	21

[a]PSD increments are standards established in accordance with existing Clean Air Act provisions to limit the degradation of ambient air quality in areas in attainment with the National Ambient Air Quality Standards.
[b]Maximum concentrations predicted by computer models resulting from HCCP emissions alone.
[c]The area surrounding the HCCP site outside of DNPP is designated a PSD Class II area where moderate, well-controlled industrial growth is allowed.

Table 4.2.2. National Ambient Air Quality Standards (NAAQS) impact analysis for the combined effects of Healy Unit No. 1 and the Healy Clean Coal Project (HCCP) for the proposed and alternative sites

				Proposed site			Alternative site		
Pollutant	Averaging period	NAAQS[a] ($\mu g/m^3$)	Ambient background concentration[b] ($\mu g/m^3$)	Modeled concentration[c] ($\mu g/m^3$)	Total impact[d] ($\mu g/m^3$)	Percent of NAAQS	Modeled concentration[c] ($\mu g/m^3$)	Total impact[d] ($\mu g/m^3$)	Percent of NAAQS
SO_2	3-h	1300	45	*1100*	*1145*	*88*	275	320	25
	24-h	365	26	*326*	*352*	96	43	69	19
	Annual	80	5	*64*	*69*	*86*	1	6	8
NO_2	Annual	100	6	*61*	*67*	*67*	9	15	15
PM_{10}	24-h	150	31	*89*	*120*	*80*	17	48	32
	Annual	50	5	*20*	*25*	*50*	4	9	18

[a]The NAAQS are absolute limits established in accordance with existing Clean Air Act provisions to protect public health and welfare with an adequate margin of safety.
[b]Background concentrations are based on Park Monitoring Station data from the 12-month monitoring period from September 1990 through August 1991.
[c]Maximum concentrations predicted by computer models resulting from HCCP and Healy Unit No. 1 emissions.
[d]Total impact is calculated as the sum of the ambient background concentration and the modeled concentration.

ice fog occurrence during the winter is anticipated to remain low (several days per month). Impacts are unlikely because the area that would experience ice fog downstream of the HCCP alternative site is uninhabited. It is unlikely that the village of Ferry, located about 9 miles downstream of the alternative site, would be affected by ice fog.

4.2.3 Surface Water Resources

The only surface water resource that could be affected by the construction and operation of the HCCP at the alternative site is the Nenana River. The confluence of Lignite (Hoseanna) Creek with the Nenana River is less than 0.25 miles from the alternative site, but on the opposite side of the river (see Fig. 2.1.2). Therefore, effluents or runoff would ***not likely*** affect the creek. The water quality and flow rate of the Nenana River at the alternative site would be similar to that of the proposed site. State of Alaska water quality standards (see Sect. 3.3.2) would be applicable.

With the exception of thermal effects, impacts to the Nenana River at the alternative site would be the same as those described for the proposed site (Sect. 4.1.3). Because the alternative site is about 4 miles downstream of Healy Unit No. 1, the cumulative thermal effects (elevated water temperature/thermal plume) that would occur as a result of the HCCP and Unit No. 1 simultaneous operation at the proposed site would not result at the alternative site. The expected maximum elevation in river water temperature from discharge from the once-through cooling system at the alternative site would be less than that expected at the proposed site because the ambient river temperature would not be elevated by Unit No. 1 thermal discharge.

Ice-free water during the winter caused by the Healy Unit No. 1 thermal plume extends down the Nenana River approximately 3 miles, and a transitional area extends an additional mile, for a total of 4 miles (Dames and Moore 1975). Ice-free water in the Nenana River resulting from HCCP discharge at the alternative site would extend about 7 miles downstream (including the transitional area). The methodology described in Appendix B was used to obtain this result based on an HCCP thermal discharge that would be twice that of Healy Unit No. 1. The analysis accounts for the change in plume width as the plume migrates downstream. The total downstream extent of ice-free water (including the transitional areas) attributable to both Healy Unit No. 1 and the HCCP would be about 11 miles.

Ice bridge formation over the Nenana River in the vicinity of the village of Ferry (located about 9 miles downstream of the HCCP alternative site and 13 miles downstream of Unit No. 1) would probably be affected by the HCCP thermal discharge. Although it is expected that the river would continue to freeze at Ferry, remnants of the thermal plume reaching Ferry would probably cause a delay in the formation of the ice bridge at the beginning of winter and an earlier breakup of the ice sheet in the early spring. However, meteorological conditions (e.g., a warm winter) also have a large influence on the formation or breakup of the ice bridge.

4.2.4 Groundwater Resources

Natural groundwater characteristics at the alternative site are similar to those at the proposed site. Both sites are located on Pleistocene and Holocene glacial outwash deposits that dip less steeply at the alternative site than at the proposed site. Potable aquifers are in the older strata beneath the outwash deposits as they are at the proposed site and the town of Healy. Outwash deposits are underlain by sandstone, siltstone, shale, and coal.

Groundwater beneath the alternative site is probably less contaminated from human activity than that beneath the proposed site. Coal from the UCM Poker Flats mine is currently stockpiled and loaded onto rail cars on land adjacent to the alternative site. Although some groundwater contamination from coal pile runoff may be expected from coal handling at the alternative site, none has been documented. In contrast, groundwater beneath the proposed site is probably contaminated by seepage from unlined fly ash ponds as well as coal pile runoff from Healy Unit No. 1 (*see Sects. 3.4.2 & 4.1.4.1*).

Groundwater is a potable water source for the town of Healy. ***The water table at the*** proposed site is upgradient from ***the water table at*** Healy, while ***the water table at the*** alternative site is downgradient. Therefore, the alternative site would have less potential for impacting Healy's groundwater resources.

HCCP site selection would have no effect on waste disposal options, except that the existing unlined fly ash ponds would not be filled and decommissioned if the alternative site is used. The existing ponds would continue to be used for temporary storage of fly ash to be trucked off-site to ***the*** UCM mine. Consequently, seepage from the existing ponds at Healy Unit No. 1 would continue.

4.2.5 Ecological Resources

4.2.5.1 Terrestrial

Use of the alternative site would result in greater direct destruction of terrestrial ecosystems than the proposed site, because the alternative site is currently less disturbed and clearing would be required for the access road, construction camp, and transmission line construction. The following description of terrestrial impacts at the alternative site is based on a letter to R. Miller, ORNL, Oak Ridge, Tennessee from W. D. Steigers, Stone & Webster Engineering Corp., Denver, dated July 19, 1991. Of the 40-acre north site, 28 acres are currently disturbed. The areas that would be cleared currently support 10 acres of open white spruce vegetation and 2 acres of young balsam poplar vegetation. The road upgrade would require the removal of 4 acres of native vegetation, of which more than half is white spruce with less than 0.5 acres each of wet sedge-grass and young balsam poplar-willow vegetation. Construction of a temporary construction camp would require clearance of 5 acres of open white spruce vegetation.

In addition, an electrical transmission line would need to be constructed over the 4 miles to the existing substation at Healy. The single-pole line would require clearing a 50-ft-wide right-of-way of all vegetation that could grow taller than 15 ft. In addition, 2500 ft^2 would be completely cleared for each pole. A total of 15.5 acres would be disturbed for the line, consisting of 6.5 acres of immature and young balsam poplar and 7 acres of open white spruce vegetation. The line would cross the Nenana River next to the coal conveyor, which would minimize collisions of large birds with the lines.

In sum, the alternative site would require clearance of 36.5 acres versus 10 acres at the proposed site. In addition, while the disturbance at the proposed site would be confined to the periphery of an area already disturbed by the construction and operation of the existing plant, the disturbance for the alternative site would be distributed across the landscape, including currently undisturbed areas.

4.2.5.2 Aquatic

The aquatic ecological effects at the alternative site would be similar to those at the proposed site because the same water intake, treatment, and discharge designs would be used; the receiving river is the same and has approximately the same hydrology; and the aquatic community is likely to be similar. The principal difference is that the thermal plume would not be combined with heated water from the existing Healy Unit No. 1. Therefore, the temperatures would be lower in the river following mixing. However, the alternative site would not have the flexibility of the proposed site to mitigate cold shock by using the cross connection to discharge to both outfalls if one of the units shuts down. The potential for cold shock would be greater at the alternative site.

Another difference is the greater proximity of salmon spawning areas at the alternative site. Coho salmon spawning is documented in Lignite Spring, roughly 1 mile downstream (north) of the alternative site, and in streams further downstream. Because no known spawning sites are upriver of this site, entrainment and impingement of salmon and severe thermal effects would not occur. However, temperatures at ***the mouth of*** Lignite Spring may be slightly elevated. This is not expected to substantially affect salmon spawning.

4.2.5.3 Threatened and Endangered Species

As at the proposed site (see Sect. 4.1.5.3), no effects on threatened or endangered species are anticipated if plant construction and operation occurred at the alternative site. As requested by FWS, a raptor survey was conducted which encompassed the alternative site. The survey found no peregrine falcons (Roseneau and Springer 1991).

4.2.6 Floodplains and Wetlands

No floodplain determination has been performed for the alternative site. Wetlands have been identified at the alternative site ***based on the National Wetlands Inventory (NWI)*** (W. D. Steigers, Stone & Webster Engineering Corp., Denver, letter to R. Miller, ORNL, Oak Ridge, Tenn., July 19, 1991). Approximately half of the 40-acre alternative site is ***designated as*** wetlands ***by the NWI***; however, they are highly disturbed, and filling them would not ***result in alteration*** of the local hydrology, which is controlled by the Nenana River rather than by overland flow or seepage. Road widening would disturb approximately 0.5 acres of wet sedge-grass wetlands and even smaller wetland areas at the crossing of Dry Creek. An area of 1.5 acres of young balsam poplar vegetation that would be disturbed by the transmission line would also be considered wetland because it occurs on the second terrace of the Nenana River. Hence, ***an estimated*** 22 acres of wetland could be disturbed by construction at the alternative site, of which approximately 2 acres currently supports wetland botanical and zoological life. The rest of the wetlands are highly disturbed and largely ***unvegetated.***

4.2.7 Prehistoric and Historic Resources

No known prehistoric or historic resources are located at the alternative HCCP site. Consequently, the Alaska SHPO does not foresee any direct impacts to prehistoric or historic resources from plant construction or operation (Bittner 1991).

Of the prehistoric sites listed in Sect. 3.7.1, three (HEA-140, HEA-141, and HEA-142) are located closer to the alternative site than to the proposed site. However, these prehistoric sites are all located more than 1 mile from the alternative site; that distance makes impacts from plant construction unlikely. The historic site closest to the alternative HCCP location (HEA-237) is more than 4 miles away and, consequently, ***would*** not likely be affected by plant construction.

4.2.8 Socioeconomics

Because the alternative site is only about 4 miles north-northwest of the proposed site, the socioeconomic impacts expected during construction at the alternative site are generally similar to those expected at the proposed site. However, it is expected that 45 workers would be required to demonstrate the HCCP at the alternative site (compared with the 32 employees at the proposed site because some jobs could be combined if the HCCP were adjacent to Unit No. 1). After including the families of the direct and indirect workers, the larger work force would result in greater long-term socioeconomic impacts in the Denali Borough. The socioeconomic impacts of HCCP demonstration at the alternative site are discussed in the following sections.

4.2.8.1 Population

The number of workers required to demonstrate the HCCP at the alternative site would peak at 52 in ***1997***. Seven of the workers would be non-GVEA personnel temporarily on-site ***to*** monitor the HCCP demonstration. Therefore, growth calculations are based on a demonstration staff of 45. Given the employment skills required for HCCP operations, the majority of the work force would in-migrate from outside the Denali Borough.

With the same assumptions about the HCCP, indirect, and UCM work forces as in Sect. 4.1.8.1, total population growth during demonstration at the alternative site can be projected for the Denali

Borough (Table 4.2.3). Assuming the demonstration work force size (45), the borough's population would increase by approximately 134 people by *1997*.

Table 4.2.3. Projected Healy Clean Coal Project–related population growth during demonstration at the alternative site *(1997)*

Direct growth	
Operations work force	45
Number accompanied by family (85%)	38
Average household size	× 2.8
Workers plus families	106
Number unaccompanied by family (15%)	+ 7
Total direct growth	113
Indirect growth	
Indirect jobs created (Usibelli Coal Mine)	8
Number accompanied by family (85%)	7
Average household size	× 2.8
Workers plus family	20
Number unaccompanied by family (15%)	+ 1
Total indirect growth	21
Total population growth (direct growth plus indirect growth)	134

Sources: ORNL staff projections based on data from AIDEA (Alaska Industrial Development and Export Authority) *Second Draft Environmental Information Volume, Healy Clean Coal Project, Healy, Alaska*, prepared by Stone and Webster Engineering Corp., Denver, September 1991; Institute of Social and Economic Research, *Economic and Demographic Projections for the Alaska Railbelt: 1988–2010*, prepared for the Alaska Power Authority, August 1988; U.S. Department of Commerce, 1990.

Implications of Population Growth

The peak year for total HCCP-related growth would be *1996–1997*, when both the construction and operations work forces would be at the alternative site simultaneously. As indicated in Table 4.1.8, construction-related growth is projected to be approximately 382 persons by *1996*. Because the demonstration workers would also be on-site, operations at the alternative site would add 134 people in ***1996 and early 1997*** (see Table 4.2.3). Therefore, it is projected that total HCCP-related growth would add approximately 516 people to the Denali Borough's population if the alternative site is chosen.

Based on the projections in Table 4.1.7, HCCP-related growth would represent approximately ***26%*** of the Denali Borough's ***1996*** population. Assuming that the growth would occur in Healy and ***Denali Park***, the increase represents ***71%*** of the two communities' projected ***1996*** populations combined. A population increase this large is likely to have even greater long-term socioeconomic impacts than population growth projected for the proposed site.

4.2.8.2 Employment and Income

It is expected that 45 workers would be required to demonstrate the HCCP at the alternative site (7 additional non-GVEA personnel would be on-site to monitor the demonstration, but they would not be permanent workers and are not included in this analysis). These jobs are not expected to affect local employment directly, however, because the additional workers would be brought in from outside the Denali Borough.

The major employment impact for the borough would be the likelihood that some of the temporary indirect jobs created during construction would become permanent jobs. AIDEA projects that indirect employment during operations would create approximately 13 permanent jobs for borough residents. It is expected that these jobs would be filled by residents who held temporary jobs during HCCP construction. The need to produce additional coal for the HCCP would also create eight jobs with UCM but ***most of*** these workers are expected to come from outside the borough.

The creation of 13 permanent jobs would have minor impacts on employment in the Denali Borough. With approximately 841 jobs in the local economy (see Table 3.8.2), 13 jobs would increase local employment by 1.5%.

Total annual wages for HCCP operating staff at the alternative site would average $2.48 million (Table 4.2.4). In addition, annual wages generated ***by the eight additional jobs*** at UCM are projected to average $384,000. Unlike direct wages during construction, the wages paid to GVEA and UCM employees would affect local income levels directly because the workers would be permanent borough residents. The economic impacts of direct wages would be greater for the alternative site than the proposed site.

Total annual wages associated with the indirect jobs are projected to average over $200,000 in ***1997*** (Table 4.2.4), as the average annual wage for the 13 indirect workers would be $15,600. As with indirect employment, indirect wages earned during HCCP operations would have minor economic impacts in the Denali Borough.

Table 4.2.4. Projected annual Healy Clean Coal Project–related wages during demonstration at the alternative site (in thousands of dollars)

Wage type	*1997*
Direct (operations)	2,475
Usibelli Coal Mine	384
Indirect	203
Total	3,062

Source: AIDEA (Alaska Industrial Development and Export Authority) *Second Draft Environmental Information Volume, Healy Clean Coal Project, Healy, Alaska*, prepared by Stone and Webster Engineering Corp., Denver, September 1991.

4.2.8.3 Housing

Based on the residential distribution of the current GVEA work force at Healy Unit No. 1, 95% of the proposed HCCP demonstration work force (43 workers) would reside in Healy, and 5% (2 workers) would reside in *McKinley* Park. In addition, eight UCM workers would require permanent housing in the Healy–*Denali Park* area.

As with demand during construction, housing demand due to demonstration at the alternative site (53 units) is expected to impact housing availability. However, because demonstration-related demand would overlap with construction-related demand in *late 1996*, there would be more severe impacts to housing availability than during operations alone. Using the construction camp scenario for *1996*, housing demand for construction and operations work forces at the alternative site combined would be 102 units. It is expected that demand this great would have even larger impacts on housing availability than if the proposed site were chosen.

4.2.8.4 Local Government Revenues

The Denali Borough would be the major beneficiary of increased local government revenues during demonstration of the HCCP. Table 4.2.5 contains projections of the additional revenue that the borough could receive during demonstration at the alternative site. The projections are based on the same assumptions as in Sect. 4.1.8.4.

No additional revenue would come from the borough's 4% bed tax during operations because workers would live in permanent housing. However, the borough would receive revenue from the severance tax (5¢ per ton) levied on coal produced by UCM for the HCCP. Based on a coal consumption rate of 335,000 tons/year, the borough would receive $16,750 from the severance tax during demonstration at the alternative site.

Table 4.2.5. Projected Healy Clean Coal Project–related increases in Denali Borough revenues during demonstration at the alternative site

Severance tax	16,750
State municipal assistance	6,700
State revenue sharing	2,580
State education revenue	*428,196*
Miscellaneous/user fees	670
Total	*$454,896*

Sources: AIDEA (Alaska Industrial Development and Export Authority) *Second Draft Environmental Information Volume, Healy Clean Coal Project, Healy, Alaska*, prepared by Stone and Webster Engineering Corp., Denver, September 1991; *Letter from J. Novak, Superintendent, Denali Borough School District, to Dr. E. W. Evans, U.S. Department of Energy, Pittsburgh Energy Technology Center, December 14, 1992.*

The borough also would benefit from population growth in terms of additional revenues from user fees and state municipal assistance, revenue sharing, and education revenue funds. Table 4.2.5 assumes the per capita rate of funding discussed in Sect. 4.1.8.4. Based on *current funding* rates, the Denali Borough would receive an additional *$454,896* because of HCCP demonstration at the alternative site. The impacts of this revenue are discussed under public service impacts in Sect. 4.2.8.5.

Using the per capita rate used for FY 1991 ($4.915), the Tri-Valley Volunteer Fire Department would receive an additional $624 from ADCRA during the demonstration. The *Denali Park* Volunteer Fire Department would receive additional funding of $34.

4.2.8.5 Public Services

During demonstration at the alternative site, there would be 127 additional residents in Healy and 7 additional residents in *Denali Park*. An additional *$454,896 in borough revenues would be generated to provide public services. Given these figures, the HCCP's impacts to particular services are discussed in the following paragraphs.*

Education. With an average household size of 2.8 and 80% of the children of school age, population growth during demonstration at the alternative site (see Table 4.2.3) would increase Tri-Valley School enrollment by approximately 35 students. Tri-Valley enrollment in 1996–97 without the HCCP is projected to be *approximately 290 students, 125 more* than the current capacity of *165*. The addition of 35 students would increase projected enrollment to *325*, exceeding capacity by *160* students. Annual state education funding would increase by *over $400,000 and* the borough's annual contribution would increase by *approximately $290,288.* If the Tri-Valley School's capacity is permanently expanded to meet HCCP construction-related growth, additional expansion would not be required as a result of demonstration, ***and impacts to education would not be major.*** The $53,669 deficit in education funding projected for the borough without the HCCP (see Tables 3.8.4 and 3.8.5). Funds would have to be diverted from sources other than state education revenue to offset this shortage, thereby creating an overall budget deficit larger than that projected for population growth associated with the proposed site.

Public utilities. During demonstration at the alternative site, 53 permanent housing units would be required for HCCP and UCM workers. Given the existing housing stock in the Healy–***Denali Park*** area, and the fact that additional homes would be built during HCCP construction, this demand would not require new residential construction. Thus, no new impacts would arise from installing additional private septic systems. The local water supply is considered adequate to meet the additional demand of 53 new residences.

Solid waste disposal. Workers living in Healy and ***Denali Park*** would take their solid waste to the Healy landfill. On average, residents of Alaska generated an estimated 4.3 lb of landfill waste per day in 1989 (Glenn 1990). Assuming the same rate for ***1997***, the additional residents would generate over 105 tons of waste in the Healy landfill per year. This would represent about a 17% increase in current disposal rates. It is likely that the borough will have to locate additional landfill space before the year 2000 (see Sect. 4.1.8.5); if a new landfill becomes operational, it is expected that impacts to that landfill would be minimal.

Transportation. During HCCP demonstration, traffic in the Healy area would increase as direct and indirect workers and their families travel and from work and other destinations in the region. Direct and indirect workers and their families are expected to generate between 50 and 100 additional trips (one way) per day on the George Parks Highway and on the Healy Spur Highway. With a low estimate (50 trips), this additional traffic would increase the existing traffic on Healy Spur Highway at the George Parks Highway and Healy School Access Road intersections by 7% and 14%, respectively (see Table 3.8.7). Increases of this size are not expected to create substantial impacts on traffic volumes in the Healy area.

HCCP demonstration at the alternative site could affect use of the ice bridge near the village of Ferry (see Sect. 4.2.3). Thermal discharge from the HCCP alternative site, which is located closer to Ferry, would be more likely to reduce the amount of time the ice bridge could be used each winter than thermal discharge from the proposed site, resulting in slightly greater socioeconomic impacts.

Police and fire protection. HCCP demonstration at the alternative site is expected to have minor impacts on police protection in the Denali Borough. Although the arrival of 134 new residents (an increase of over 7% of current population) ***could*** create more casework for the Alaska state ***troopers***, the impacts would not be as large as those expected with the construction work force.

Demonstration at the alternative site is expected to create minor impacts on fire protection in the Healy vicinity. The volunteer fire departments in Healy and ***Denali Park*** would receive increased state funding with population growth (see Sect. 4.2.8.4), but it is likely that new housing development in the Healy Subdivision would make it more difficult for the departments to maintain their current levels of service.

Medical services. HCCP demonstration at the alternative site would *not* have major impacts on medical services in the Healy vicinity. ***Both the Healy Clinic and the Railbelt Mental Health and Addictions Program have indicated that they could accommodate the influx of persons associated with demonstration at the alternative site (a 7% increase over current borough population) (Price 1993; Winklmann 1992).***

4.2.8.6 Tourism and Recreation

Demonstration of the HCCP at the alternative site could potentially affect tourism and recreation by generating noise and by altering the area's aesthetic environment. The noise generated by the HCCP is expected to be similar to that generated by the existing Healy Unit No. 1 (see Sect. 4.1.9). Given the location of the alternative site and the area's terrain, it is likely that operations would have less impact on the more heavily used portions of the Nenana River than operations at the proposed site. Some noise might be noticeable on the Nenana River within a 500-ft radius of the project site, but most recreational boating occurs south of the site in the Nenana River Gorge, closer to the proposed site.

Demonstration at the alternative site would create visual impacts, including the visual presence of the new power plant, increased levels of coal dust, and increased dust generated along the coal haul road from the UCM mine. Given the nature of the terrain, however, visual impacts to recreation activities would be limited to the Nenana River Valley in the immediate vicinity of the alternative site. Because most recreational boating occurs south of the proposed site, visual impacts from the alternative site are expected to be negligible.

4.2.9 Noise

The alternative site is currently less disturbed and would require clearing and grading during construction of the HCCP. Consequently, a slight increase in the level of noise would be expected during the additional period required for clearing and grading at the alternative site. Because the distance to the residential area of Healy is about 1.5 miles and noise attenuates with distance, major adverse impacts are not expected from HCCP construction at the alternative site. The level of operational impacts is expected to be the same as at the proposed site.

4.2.10 Waste Management

As with the proposed site, ash from the HCCP would be disposed of in the UCM Poker Flats mine. Therefore, the level of impacts is not expected to change. It is expected that the ash would be trucked to the mine, crossing the Nenana River near the existing Unit No. 1, so that the distance of transport to the mine would effectively double compared with the proposed site.

4.2.11 Electromagnetic Fields

At the alternative site, generated power would be transmitted about 4 miles to the existing substation at Healy Unit No. 1 via a new 115-kV transmission line that would cross the Nenana River close to the UCM Poker Flats mine coal conveyor at the alternative site and follow the UCM haul road to Unit No. 1. This routing would minimize conflicts with the Healy River Airport west of the river. Potential public health effects from the electromagnetic fields associated with this transmission line are not clear (see Sect. 4.1.11), but because the line would be located greater than 0.5 miles from the nearest residential area, no adverse impacts are expected.

4.2.12 Worker Health and Safety

The level of impacts at the alternative site would be the same as at the proposed site.

4.3 ENVIRONMENTAL CONSEQUENCES ON DENALI NATIONAL PARK AND PRESERVE

This section analyzes the potential impacts to human and environmental resources within DNPP resulting from construction and operation of the HCCP. NPS, a cooperating agency by virtue of their role as an FLM for DNPP, has expressed concerns about potential impacts to DNPP from HCCP emissions. These concerns are discussed in Sect. 4.3.13.

4.3.1 Aesthetics

Except for two isolated areas of high elevation located along the DNPP boundaries to the northwest and southwest of the site, the HCCP's 315-ft stack would not be visible from DNPP (see Fig. 4.3.1). Any condensed water vapor plume emanating from the stack would be visible from a few additional adjoining areas at slightly lower elevations because of plume rise from the stack. The plume would evaporate before reaching DNPP. The visibility of the stack and its plume are not likely to result in major impacts because the areas from which they would be viewed are rarely visited by people in DNPP.

Under extremely cold (less than –20°F) and stable meteorological conditions, an ice plume from the HCCP may be visible within DNPP in the Nenana River Gorge north of the Visitor Access Center. Time-lapse cameras operating from January 1992 until April 1993 detected ice plumes from Healy Unit No. 1 on three occasions (January 20, 21, and 24, 1993) under such conditions. The ice plumes traveled from Unit No. 1 to the nearest boundary of DNPP in the Nenana River Gorge, but were not visible from the Visitor Access Center. Visitor use of DNPP is virtually zero during the winter.

ORNL-DWG 91M-8467R2

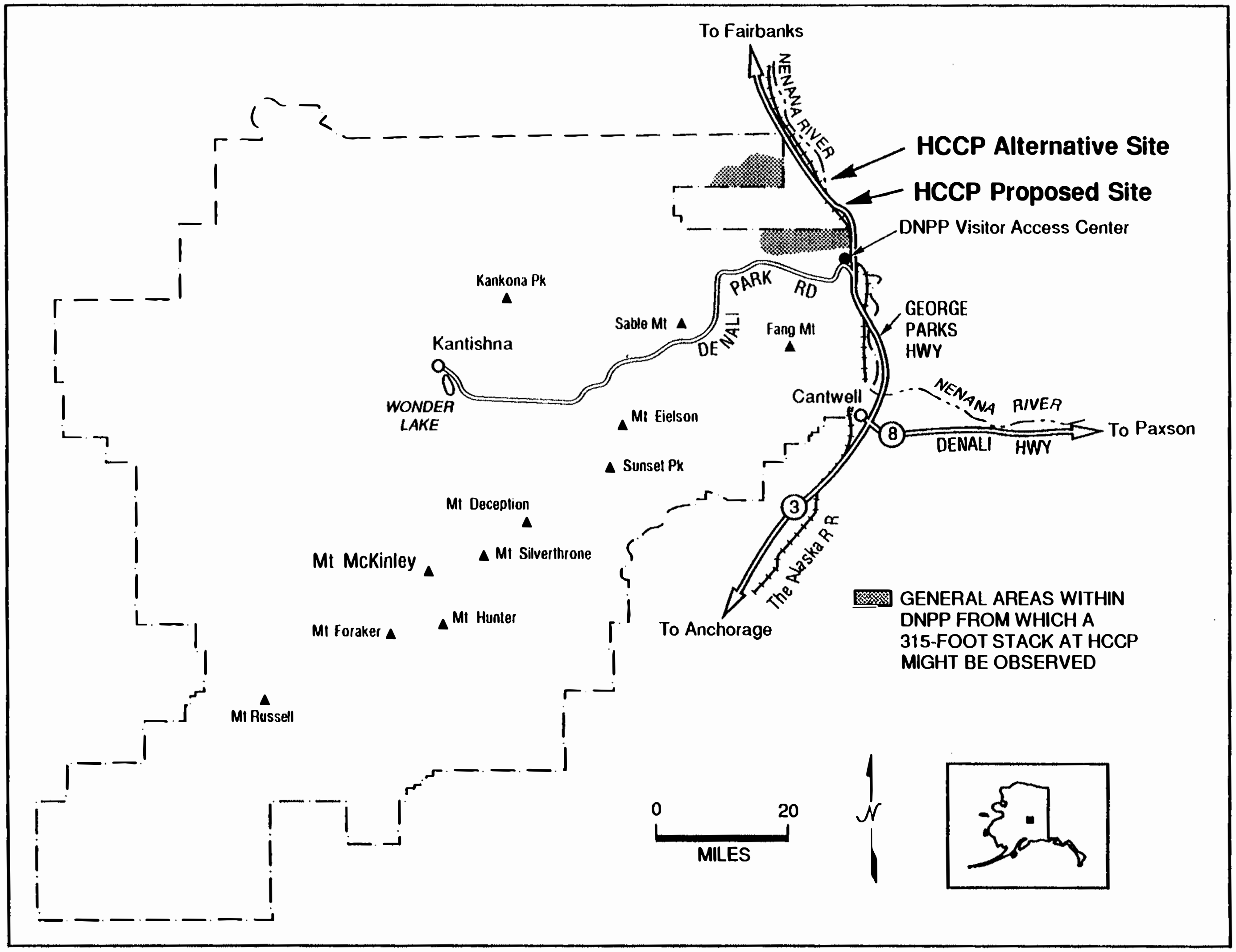


Fig. 4.3.1. Areas within Denali National Park and Preserve from which a 315-ft stack at the Healy Clean Coal Project proposed site might be observed.

Because almost all of the construction activities would take place at a lower elevation than the stack and plume, these activities would not be visible from DNPP. Consequently, the construction activities would not have direct aesthetic impacts to the visual resources in DNPP. Similarly, the indirect impacts of plant construction, such as increased residential development and increased traffic in Healy and Denali Park, are not expected to affect DNPP's aesthetic resources.

4.3.2 Atmospheric Resources

Potential impacts to ambient air quality, including acid deposition, and visibility, including regional haze formation, within DNPP are discussed.

4.3.2.1 Ambient Air Quality Impacts

In parallel with the analyses of Sect. 4.1.2.2 for potential impacts outside DNPP, the air quality impacts within DNPP of SO_2, NO_x, and PM_{10} emissions from the HCCP were evaluated using EPA-approved atmospheric dispersion models. The Industrial Source Complex Short Term (ISCST) model (Wackter and Foster 1987; Bowers, Bjorklund, and Cheney 1979) and the Rough Terrain Diffusion Model (RTDM) (ENSR 1987) were again chosen. Receptors were selected in sufficient density to determine impacts within the DNPP boundaries to the south and northwest of the HCCP (locations of maximum potential impacts). Maximum concentrations were consistently predicted for receptors located at the nearest boundary of DNPP about 4 miles south of the HCCP proposed site.

The air dispersion models were run using HCCP emissions corresponding to the demonstration case, but conservatively assuming a 100% capacity factor. Both models were run, and the model producing higher concentrations was used, provided that it was appropriate for that receptor. Meteorological inputs were obtained from the HCCP Healy Monitoring Station for the 12-month period from September 1990 through August 1991. Details of similar air dispersion for the proposed project can be found in the PSD permit application (AIDEA 1992).

The predicted maximum impacts to DNPP from the HCCP are shown in Table 4.3.1. For each pollutant, modeled concentrations were compared with PSD Class I increments as a yardstick to measure the HCCP's potential to affect the pristine DNPP environment. PSD increments are standards established in accordance with existing CAA provisions to limit the degradation of ambient air quality in areas in attainment with the NAAQS, and thus provide a more rigorous level of air quality protection in areas (such as DNPP) with air quality much better than the NAAQS. Stringent PSD Class I increments apply to areas such as DNPP where almost any deterioration of air quality is undesirable and little or no major industrial development would be allowed. No other major pollutant source has been constructed in the Healy region since the establishment of the PSD increments in 1977; therefore, the only source that is appropriate for comparison with the PSD increments is the HCCP.

Table 4.3.1. Prevention of Significant Deterioration (PSD) impact analysis for the Healy Clean Coal Project (HCCP) within Denali National Park and Preserve (DNPP)

Class	Pollutant	Averaging period	PSD increment[a] (μg/m^3)	Maximum modeled concentration[b] (μg/m^3)	Percent of PSD increment
I[c]	SO_2	3-h	25	9.4	38
		24-h	5	2.0	40
		Annual	2	0.2	9
	NO_2	Annual	2.5	0.8	32
	PM_{10}	24-h	8	0.7	8
		Annual	4	0.1	2

[a]PSD increments are standards established in accordance with existing Clean Air Act provisions to limit the degradation of ambient air quality in areas in attainment with the National Ambient Air Quality Standards.

[b]Maximum concentrations predicted by computer models resulting from HCCP emissions alone.

[c]Stringent PSD Class I increments apply to areas such as DNPP where almost any deterioration of air quality is undesirable and little or no major industrial development would be allowed.

All maximum concentrations from the HCCP were predicted to be less than the PSD Class I increments. PM_{10} and annual SO_2 concentrations were predicted to be less than 10% of the increments. For NO_2 and the 3-h and 24-h SO_2 concentrations, the HCCP was predicted to consume no more than 40% of the increments.

Operation of the HCCP at the alternative site would result in reductions in impacts to DNPP air quality compared with the proposed site (Table 4.3.2) because the alternative site is located about 6 miles east of the nearest border of DNPP (and 8 miles north of the DNPP border that is downwind of frequent winds), while the proposed site is only about 4 miles north of DNPP. Air dispersion modeling has indicated that the maximum 3-h SO_2 concentration within DNPP would be reduced from 38% of the PSD increment for the proposed site to 23% of the increment for the alternative site. Similarly, the maximum 24-h SO_2 concentration would decrease from 40% of the PSD increment for the proposed site to 25% of the increment for the alternative site. The annual NO_2 concentration would be reduced from 32% of the PSD increment for the proposed site to 15% of the increment for the alternative site.

Cumulative air quality impacts to DNPP resulting from the simultaneous operation of the HCCP and Healy Unit No. 1 were evaluated (Table 4.3.3). The total impacts ***are predicted to*** be less than those presented in Tables 4.1.2 and 4.2.2 for the areas surrounding the HCCP proposed and alternative sites outside of DNPP. All total impacts are expected to be less than 25% of the NAAQS, ***and most are expected to be less than 20% of the NAAQS. Except for the 3-h and 24-h SO_2 concentrations***, the ambient background concentrations are the largest component of the total impacts. ***A comparison of Table 4.3.1 with Table 4.3.3 shows that Healy Unit No. 1 is predicted to contribute much more than the HCCP to the maximum modeled concentrations within DNPP.***

Table 4.3.2. Prevention of Significant Deterioration (PSD) impact analysis for the Healy Clean Coal Project (HCCP) within Denali National Park and Preserve (DNPP) for the proposed and alternative sites

				Proposed site		Alternative site	
Class	Pollutant	Averaging period	PSD increment[a] ($\mu g/m^3$)	Maximum modeled concentration[b] ($\mu g/m^3$)	Percent of PSD increment	Maximum modeled concentration[b] ($\mu g/m^3$)	Percent of PSD increment
I[c]	SO_2	3-h	25	9.4	38	5.8	23
		24-h	5	2.0	40	1.3	25
		Annual	2	0.2	9	0.1	4
	NO_2	Annual	2.5	0.8	32	0.4	15
	PM_{10}	24-h	8	0.7	8	0.4	6
		Annual	4	0.1	2	0.03	1

[a]PSD increments are standards established in accordance with existing Clean Air Act provisions to limit the degradation of ambient air quality in areas in attainment with the National Ambient Air Quality Standards.

[b]Maximum concentrations predicted by computer models resulting from HCCP emissions alone.

[c]Stringent PSD Class I increments apply to areas such as DNPP where almost any deterioration of air quality is undesirable and little or no major industrial development would be allowed.

Table 4.3.3. National Ambient Air Quality Standards (NAAQS) impact analysis for the combined effects of the Healy Clean Coal Project (HCCP) and Healy Unit No. 1 within Denali National Park and Preserve

Pollutant	Averaging period	NAAQS[a] (μg/m^3)	Modeled concentration[b] (μg/m^3)	Ambient background concentration[c] (μg/m3)	Total impact[d] (μg/m^3)	Percent of NAAQS
SO_2	3-h	1300	188	45	233	18
	24-h	365	28	26	54	15
	Annual	80	2	5	7	9
NO_2	Annual	100	2	6	8	8
PM_{10}	24-h	150	2	31	33	22
	Annual	50	0.1	5	5	10

[a]NAAQS are absolute limits established in accordance with existing Clean Air Act provisions to protect public health and welfare with an adequate margin of safety.
[b]Maximum concentrations predicted by computer models resulting from HCCP and Healy Unit No. 1 emissions.
[c]Background concentrations are based on Park Monitoring Station data from the 12-month monitoring period from September 1990 through August 1991.
[d]Total impact is calculated as the sum of the ambient background concentrations and the modeled concentration.

4.3.2.2 Acid Deposition

Potential impacts to DNPP resulting from acid deposition of HCCP pollutants are expected to be minor and are discussed in Sect. 4.1.5.1 which describes impacts to ecological resources in the Healy area including DNPP. This conclusion is based on an evaluation of existing data and studies. Bulk deposition measurements from 39 events collected over 1 year at the HCCP Healy Monitoring Station ranged from pH 5.55 to 7.86 (ENSR 1992). These values are higher than background wet deposition (Sect. 4.3.5) even though the nearby Unit No. 1 is a source of acidifying gases. This suggests that in the vicinity of Unit No. 1, any acidifying emissions are more than compensated for by some alkaline source, possibly dust. It seems unlikely that the proposed HCCP would cause substantial effects through its contribution to acid deposition, given the relatively high values of mean and minimum pH compared with regions where acid deposition has caused ecological effects on aquatic communities (Baker et al. 1990) and forests (Shriner et al. 1990). It is expected that sulfur emissions from Unit No. 1 are not contributing substantially to soil acidification, even in areas of maximum deposition, because sulfur concentrations were low in moss and lichen samples near Unit No. 1 and because no consistent trends in sulfur concentrations away from the Healy site were found (Crock et al. 1992). Given this lack of evidence of environmental acidification from Unit No. 1, the high background pH, and the low emissions estimated for the HCCP, it appears unlikely that the HCCP would cause substantial acid deposition.

The expected minor level of impacts is further supported by the results of Crock et al. (1992), who sampled elemental concentrations in feather moss, a lichen, white spruce, and the upper layer of the soil. The study found that Healy Unit No. 1 and other Healy area sources influenced concentrations out to 4 miles (the distance of the nearest DNPP boundary), but beyond that distance concentrations were at effective background levels. The study found no unusually high concentrations of any of the elements, including the rare-earth elements in soil, and no unusually high concentrations in lichens. Moss concentrations were reported to be high for As, Cr, Cu, Mn, Ni, V, and rare-earth elements, but moss measurements were complicated by the high ash content of the samples which the authors attributed to soil contamination. Of the elemental concentrations in white spruce, only copper was higher than concentrations at another site. Consequently, it is suspected that Unit No. 1 has probably contributed to small local increases in the levels of some elements in some ecological resources within about 4 miles of the site, but negligible increases beyond that distance. The proposed HCCP would probably cause similarly small and localized increases that would result in negligible impacts on DNPP.

4.3.2.3 Visibility

Through a number of physical and chemical processes, air emissions have the potential to result in a plume ***that is*** visible to a human observer. ***The perceptibility of a plume is a function of plume contrast and discoloration.*** Directly emitted PM can scatter light. NO_x emissions are chemically converted in the atmosphere to NO_2, a reddish-brown gas that absorbs light. SO_2 emissions can be converted in the atmosphere to create sulfate particles that scatter light. The combined effects of all emissions, in some cases, can result in a visible power plant plume. ***When*** coal-fired power plant plumes ***are visible, they most commonly*** appear either yellow or brown due to light absorbed by NO_2, whitish compared with the viewing background because of light scattered by particles, or dark when viewed against a bright background and when the light removed from the sight path by particle scattering ***and NO_2 absorption*** is greater than the light added by scattering of the plume illumination.

In performing the analysis of the potential for visibility impacts at DNPP, DOE consulted extensively with EPA and NPS. Over time, consensus was reached on the appropriate model to use for this analysis. However, disagreements still exist concerning some of the assumptions required to conduct the modeling, as well as the manner in which the results should be interpreted. In particular, NPS and EPA urged DOE to use recommended EPA regulatory guidelines, which tend to be conservative (i.e., predicting greater impacts), in view of the importance of protecting DNPP and the uncertainties inherent with visibility modeling as an analytical technique. DOE agrees that a conservative approach to modeling should be taken, but believes that the assumptions it used are sufficiently conservative and are appropriate for this application of the model. More importantly, steps have been taken to ensure that DNPP would be protected if DOE's modeling predictions are not borne out during operation. These steps render the disagreements over modeling largely academic. As discussed in detail below, a mechanism would be put in place, as part of implementation of the Memorandum of Agreement (see Sect. 2.1.3.2) which requires the site operator to reduce combined emissions to protect DNPP from observed plume impacts.

In response to the discussions over model assumptions, DOE agreed to test the sensitivity of the model results to using more conservative assumptions. These results are provided later in this section for the HCCP demonstration case without mitigation of Unit No. 1, as originally proposed in the draft EIS, and again in Sects. 5.2 and 5.4.6 for the HCCP permitted case without mitigation of Unit No. 1 and the Unit No. 1 retrofitted case, respectively. The results are presented in a side-by-side tabular format along with the results obtained using DOE's preferred assumptions. The DOE and NPS perspectives of these results are also discussed later in this section. However, first the development of the model and the results obtained by DOE are discussed. It should be noted that the tables in Sect. 4 do not reflect emission reductions required to be effected by the mitigation measures under the Memorandum of Agreement. Those tables appear in Sect. 5.4.6.

DOE Approach. As discussed in Sect. 3.2.4.1, visibility has been established as an important AQRV of national parks, including DNPP. Potential visibility impacts of an HCCP plume on DNPP (designated a PSD Class I area) were evaluated using a technique consisting of a detailed set of calculations described as a Level-3 plume visibility impact analysis in the EPA visibility workbook (Latimer and Ireson 1988). The analysis focused on the perceptibility of an HCCP plume as viewed from the DNPP Visitor Access Center, located about 8 miles south-southeast of the HCCP proposed site and about 5 miles south-southeast *of* the northern boundary of DNPP (Fig. 4.3.2). The DNPP Visitor Access Center is situated on a knoll overlooking the Nenana River near the entrance to DNPP and is visited by most travelers to DNPP. The primary views are to the north (down the Nenana River Valley toward the HCCP site) for about 5 miles to the DNPP boundary and to the south (up the Nenana River Valley away from the HCCP site) for about 9 miles to the boundary. The view to the east is limited to about 0.25 miles within DNPP. The view to the west is not expected to be affected greatly by northerly (from the north) winds that tend to continue transporting a plume to the south up the Nenana River Valley.

The PLUVUE I computer model as modified (Sonoma Technology, Inc. 1993c) was used as a tool to estimate visibility impacts at DNPP. The PLUVUE I model assumes a Gaussian plume cross section (a normal or bell-shaped curve distribution) without accounting for the effects of terrain features on plume direction or dispersion. *The modification involved using part of PLUVUE I to calculate the ambient concentrations of species in the plume that have the potential to cause visible effects. These calculations used the plume rise, plume transport, plume diffusion, and plume chemistry modules in PLUVUE I, but did not use the optical module; the optical effects were determined in separate calculations. White et al. (1985) found that the optical effects of the plume were described at least as well by these alternate calculations as they were by any of the plume visibility models, including PLUVUE I. In general, the alternate calculations tend to predict greater effects than actually would be measured (White et al. 1985). For the sake of simplicity, further discussion concerning this visibility modeling will be referred to as use of the PLUVUE I model.* Data used for modeling plume visibility

ORNL-DWG 92-13314

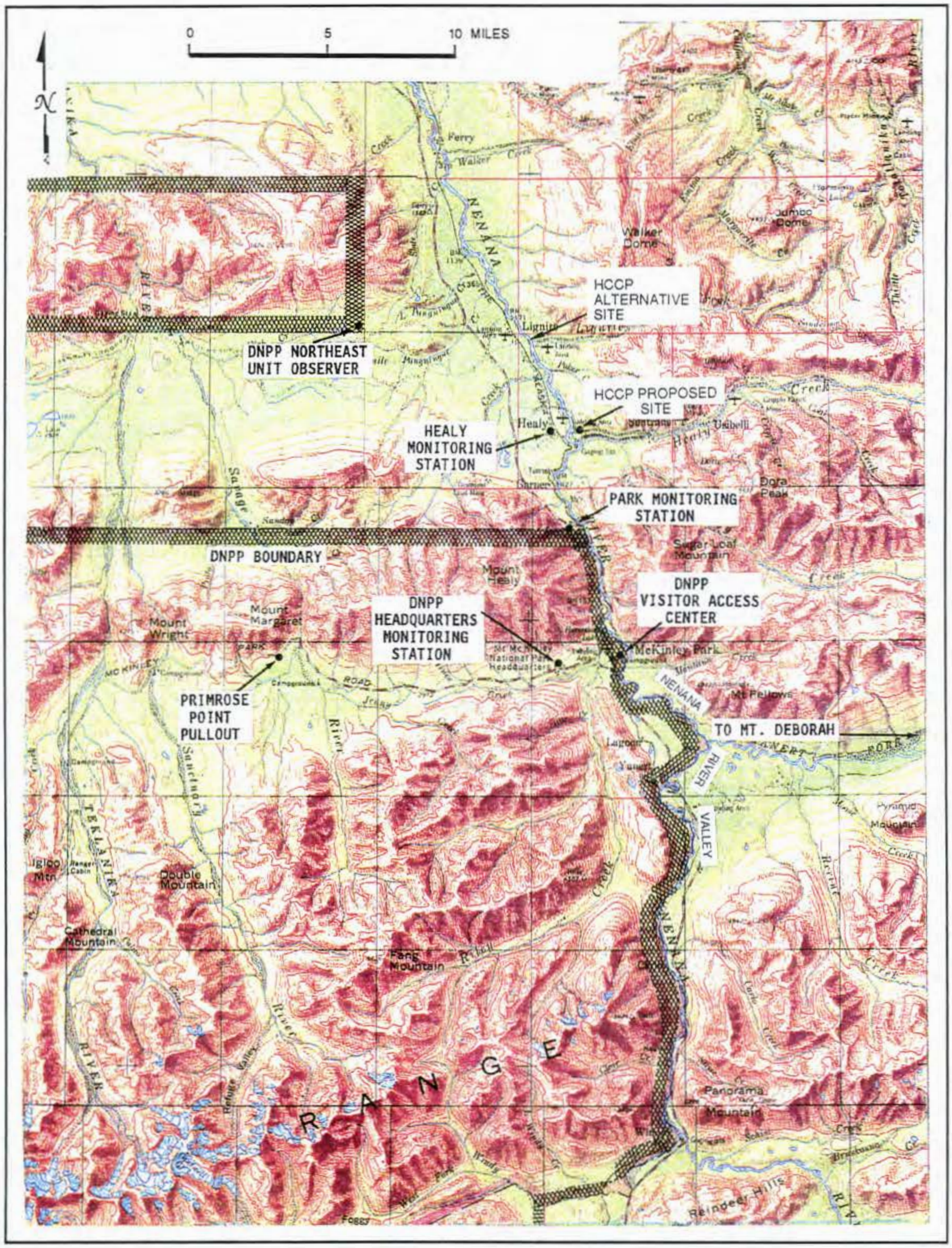


Fig. 4.3.2. Relevant features associated with potential visibility impacts resulting from Healy Clean Coal Project air emissions.

impacts were on-site air quality and meteorological data collected from September 1990 through August 1991. ***The visibility analysis used the atmospheric*** stability classes calculated from the data. ***The visibility analysis used an assumption for the threshold for perception of a visible plume that is different from the assumption that is standard for regulatory applications. In addition, the analysis used an assumption for the length of the sight path of a visible plume that may be different from the assumption used in some regulatory applications (EPA has not yet established a formal policy for plume sight path length). Both of these assumptions and their rationale are discussed in more detail later in this section.*** Details of the modeling can be found in a study ***and three addenda*** prepared by Sonoma Technology, Inc. (***1992a, 1992b, 1993a, and 1993c***). The study ***and addenda represent*** the culmination of efforts by a panel of visibility experts commissioned by the project participant to evaluate the potential visual impacts of the plume from the HCCP on DNPP. After reviewing the methodology and results of the modeling, DOE has accepted the study ***and addenda*** and incorporated ***their*** results as part of this EIS.

Results from the PLUVUE I model indicated that almost all of the potential visibility impacts would be caused by HCCP NO_x emissions. ***The visual effects of particles in the HCCP plume, including sulfate particles formed from SO_2, were considered and it was found that in almost all cases, any reasonable concentration of particles in the emissions would counteract and diminish the visual effects of NO_2 and cause the plume to be less visible. For most viewing conditions, omitting the effects of particles causes the visibility impacts of the HCCP emissions to be overestimated.***

As the NO_x emissions exit the stack, they would be primarily in the form of NO, a colorless gas. Therefore, a visible NO_2 plume is not expected at the stack. However, NO is rapidly oxidized by natural ozone (O_3) in the atmosphere to form NO_2, a reddish-brown gas. When looking through a sufficiently long segment of an NO_2 plume, the plume would be visible as a yellow or brown ribbon. For this analysis, ***the PLUVUE I model accounted for the conversion of NO to NO_2 as the plume disperses.*** The ***NO_2*** concentrations were integrated along each sight path to calculate so-called ***NO_2*** burdens (in units of parts per billion by volume times kilometers, or ***ppbv·km***) as a ready measure of plume perceptibility. ***A detailed analysis in the first addendum (Sonoma Technology, Inc. 1992b) indicated that the threshold for perception of a visible plume from the HCCP within DNPP would be a plume contrast of 4%, which corresponds to a color difference of 4. Optical calculations showed that these thresholds correspond to an NO_2 burden of 150 ppbv·km. All plume simulations that resulted in an NO_2 burden of at least 150 ppbv·km*** were assumed to have a perceptible plume. ***This assumption differs from EPA guidelines for typical regulatory applications, which recommend a perceptibility threshold corresponding to a burden of 69 ppbv·km (see discussion of NPS and EPA views below). DOE believes that there is research data to support a threshold of 150 ppbv·km, or twice as great as the values typically used in plume perceptibility analyses. Observers in the valley where the DNPP Visitor Access Center is located, and in the Northeast Unit would be positioned within the plume or under the plume centerline, causing*** *the plume to be more difficult to distinguish because it would cover a wide angle of view. The guidance in Appendix A of the EPA Workbook for Plume Visual Impact Screening and Analysis (1988) for the perception thresholds for wide plumes is based on the data of Howell and Hess (1978). As decribed in the first addendum (Sonoma Technology, Inc. 1992b), these data provide the basis for the perception thresholds that were used by DOE. The NPS recommended that the data of van der Wildt and Waarts (1983) also be consulted. DOE's interpretation of these data concludes that the appropriate perception threshold for the geometry of the HCCP plume viewed from the valley containing the DNPP Visitor Access Center should be at least 6% contrast, and more likely about 10% contrast (equivalent to an NO_2 burden of 375 ppbv·km). Thus, DOE believes that the van der Wildt and Waarts data confirm that the thresholds used in DOE's analyses are conservative and appropriate for use in the EIS.*

DOE believes that its approach and the assumptions made in the visibility modeling are both reasonable and appropriate for predicting visual impacts from the HCCP. Certain variations from EPA's guidance for typical regulatory applications were made to conform the modeling approach to a realistic representation of the topography and viewer geometry which a visitor would actually experience in DNPP. DOE believes its visibility modeling presents results for the highest Class I impact area (DNPP Visitor Access Center) and second highest Class I area (Northeast Unit) and that those results form the upper bounds of potential impacts to DNPP sensitive areas.

For the observer at the Visitor Access Center, the model *was* run for all *daytime* hours *(hours that the sun was above the horizon halfway through the hour)* with wind directions within 15° of a straight line that would transport the plume to the Visitor Access Center and with wind speeds less than 15 mph (as measured at the HCCP Healy Monitoring Station, 30 m above ground level), a total of 372 h. Other hours were excluded because a perceptible plume would not be expected at the Visitor Access Center under other conditions. The range of wind directions was selected to allow transport of the plume to the Nenana River Gorge and the Visitor Access Center. The wind speed threshold was introduced to prevent calculations for hours when wind speed would dilute the plume enough so that there could be no perceptible effects. However, only 1 h was eliminated by this criterion. For *each of* the 372 h, *NO_2* burdens were calculated along lines of sight to the north and south of the DNPP Visitor Access Center for *60 oblique (sloping)* sight paths through the plume. *The oblique sight path generating the maximum NO_2 burden was used for each hour.*

Table *4.3.4* summarizes results from the PLUVUE I *model* of the number of *daytime* hours per year that the *HCCP* plume *during the demonstration* is *predicted* to be perceptible from the DNPP Visitor Access Center for views to the north and south *and the total number of hours*. The predicted number of hours is extremely low: *2 h for the north sight path, 2 h for the south sight path, and a total of 2 h. The total is less than the sum of the north and south sight paths because the threshold was simultaneously exceeded in both sight paths during the same 2 h.* The percentage of hours affected is much less than 1%

Table 4.3.4. Number of daytime hours during the year calculated by the PLUVUE I model that the NO_2 plume burden from Unit No. 1 and the Healy Clean Coal Project (HCCP) (demonstration case) exceeded a visual threshold of 150 ppbv·km in the sight paths from the Denali National Park and Preserve (DNPP) Visitor Access Center

Emission source	*North sight path*	*South sight path*	*Total*[a]
HCCP	*2*	*2*	*2*
Unit No. 1	*5*	*5*	*6*
Unit No. 1 plus HCCP[b]	*8*	*13*	*15*

[a] The total is less than the sum of the north and south sight paths because of some hours in which the threshold was simultaneously exceeded in both sight paths.

[b] Based on modeling the NO_2 emissions from both sources rather than summing the previous two lines (the columns do not add up because the modeling was performed separately for each emission source and the combination of the two emission sources).

of the approximately 4380 h per year of ***daytime.*** Cumulative visibility impacts of air emissions resulting from the simultaneous operation of the HCCP at the proposed site and Healy Unit No. 1 also were evaluated ***and are summarized in Table 4.3.4.*** Although the estimates are greater than for the HCCP alone, the number of hours is still small: ***8 h for the north sight path, 13 h for the south sight path, and a total of 15 h.*** Again, the percentage of hours affected is ***much*** less than 1% of ***daytime*** hours during the year.

Table ***4.3.4*** also displays the results for Unit No. 1 alone. The columns in Table ***4.3.4*** do not ***tally*** because the ***modeling was performed*** separately for each emission source and the combination of the two emission sources. The ***model predicts*** a perceptible plume ***from Unit No. 1 alone for 5 h for each of the north and south sight paths, and a total of 6 h.*** There have been no ***published*** sightings from or within DNPP of a visible ***NO_2*** plume from Unit No. 1, ***suggesting*** that DNPP is not currently experiencing a visibility problem ***of concern to NPS or its visitors*** caused by Unit No. 1.

As further evidence, time-lapse cameras operating within ***and adjacent to*** DNPP ***from*** January 1992 ***through April 1993 did*** not detect any plumes in the Nenana River Gorge ***except for three instances of ice plumes from Unit No. 1 on January 20, 21, and 24, 1993. These three events occurred under extremely cold temperatures (–29°F to –40°F), light winds, and clear to partly cloudy skies. The ice plumes traveled from Unit No. 1 to the nearest boundary of DNPP in the Nenana River Gorge, but were not visible from the DNPP Visitor Access Center. The visible component of an ice plume is composed of water rather than a pollutant such as SO_2, NO_2, or PM. See Sects. 4.1.1 and 4.3.1 for a more detailed discussion of ice plumes.***

The camera monitoring program was established by the participant as part of the PSD permit application for the purpose of determining if plumes from Unit No. 1 are visible from or within DNPP. Two cameras (35-mm and 8-mm) were sited at the DNPP Visitor Access Center for viewing along the north site path through the Nenana River Gorge. Four 8-mm cameras were positioned on Garner Hill (about 1.5 miles southwest of Unit No. 1) to provide a panorama of overlapping views ranging from Unit No. 1 to the northeast through the DNPP boundary to the south-southeast. Camera monitoring was only performed during daylight hours. The 35-mm photographs were taken at 1- or 2-h intervals, and 8-mm time-lapse film was exposed at one frame per minute. NPS personnel participated in the camera monitoring program.

Because of its proximity to the HCCP proposed site, plume perceptibility was also estimated at the "finger" of DNPP (Northeast Unit) located about 9 miles west-northwest of the HCCP proposed site (see Fig. 4.3.2). Model predictions indicated ***no*** hours in which a plume might be perceptible, ***based on a threshold for perception of 150 ppbv·km. For cumulative emissions from the simultaneous operation of the HCCP and Unit No. 1, the maximum NO_2 burden was predicted to be 112 ppbv·km. Based on a threhold for perception of 69 ppbv·km (favored by the NPS and EPA), a scaling of model predictions indicated 6 h in which a plume might be perceptible for the combined operation of the two units.***

Views from the interior ***of DNPP would*** not ***likely*** be subject to visibility impairment ***from plumes***. For both the HCCP alone and for cumulative emissions, calculations similar to those described previously were performed for the view from the Primrose Point Pullout (Fig. 4.3.2) toward Mt. Deborah, located about 65 miles east. From the Primrose Point Pullout, an observer would be viewing the plume at an approximate 90° angle. A plume would affect the line of sight toward Mt. Deborah only if the plume were vertically mixed more than 1500 ft above the floor of the Nenana River Valley. Under such circumstances, calculations indicated that a plume would not be visible. In summary, the Nenana River Valley portion of DNPP is the only area which potentially would be adversely affected by a plume from the cumulative emissions of Healy Unit No. 1 and the HCCP. Comprising an area of about 16 $miles^2$, the Nenana River Valley is only about 0.2% of the total land area of DNPP.

Visibility impacts at DNPP from operation of the HCCP at the alternative site are not expected to change substantially from impacts predicted during operation at the proposed site. Although maximum pollutant concentrations ***would be*** expected to decrease within DNPP as a consequence of siting the HCCP at the alternative site, the longer transport time from the alternative site to DNPP would allow for a greater conversion of NO to NO_2 (NO_2 is the cause of yellowish-brown ***plumes***).

NPS question***ed*** the appropriateness of modifications that were made to the ***PLUVUE I*** visibility ***model*** used to predict visibility impacts and expressed concern that the modifications result***ed*** in an underprediction of the potential effects. ***NPS identified the PLUVUE II model as the preferred and most appropriate model for evaluating the visual effects of a plume from the HCCP on visibility within***

DNPP. However, the version of PLUVUE II available to the public was not used in the public draft EIS because it had known coding errors and was under revision by EPA. In April 1993, EPA released to the public a new version of PLUVUE II that incorporated corrections for many errors in the computer code. The project participant and DOE immediately began an investigation of the application of the PLUVUE II model to evaluate potential visibility impacts from HCCP emissions. On May 5, 1993, representatives of the project, EPA, and NPS attended a workshop in Seattle, Washington, at which agreement was generally reached regarding the assumptions and methodologies that should be used for performing a supplemental plume analysis for the HCCP using the revised PLUVUE II model.

During the implementation of the revised model, it was discovered that the computer code still contains errors, but the direction and magnitude to which the results would be biased are unknown (Sonoma Technology, Inc. 1993a). Furthermore, EPA provided a technical evaluation which stated that PLUVUE II cannot currently be relied upon to produce technically credible results for the EIS because it contains an error in its computer code that lacks a confirmed and fully understood correction (technical evaluation by Robert B. Wilson, Regional Meteorologist, EPA Region 10, dated September 20, 1993). Nevertheless, the results of PLUVUE II are presented in this final EIS so as to be responsive to the NPS concerns.

One major difference in the two models is that PLUVUE I as modified used NO_2 burdens to predict a perceptible plume, while PLUVUE II used both a contrast and color difference parameter in its predictions. Under DOE's approach, all PLUVUE I calculations in which the NO_2 burden was at least 150 ppbv-km were assumed to have a perceptible plume. For PLUVUE II, hours were counted by DOE when both the contrast and color difference thresholds were exceeded for the viewing background [i.e., when the color difference parameter Delta E exceeded a threshold of four (equivalent to an NO_2 burden of 150 ppbv·km) and the contrast differed from zero by more than 4%].

Table 4.3.5 summarizes results from the PLUVUE II model of the number of daytime hours per year that the HCCP plume is expected to be perceptible from the DNPP Visitor Access Center for views to the north and south during the demonstration. Results from the PLUVUE I model (presented in Table 4.3.4) are repeated in Table 4.3.5 to provide a ready comparison of model predictions. PLUVUE II results are very similar to those of PLUVUE I in showing that the predicted number of hours in which an HCCP plume is expected to be perceptible is very low: 1 h for the north sight path and 5 h for the south sight path. Cumulative visibility impacts of air emissions resulting from the simultaneous operation of the HCCP and Healy Unit No. 1 also were evaluated using PLUVUE II and are summarized in Table 4.3.5. Although the estimates are greater than for the HCCP alone, the number of hours is still small: 4 h for the north sight path and 7 h for the south sight path.

PLUVUE II predicts a perceptible plume from Unit No. 1 alone for 3 h for the north sight path and for 1 h for the south sight path. Because there have been no published sightings from or within

Table 4.3.5. Number of daytime hours during the year calculated by the PLUVUE I and PLUVUE II models that a plume from Unit No. 1 and the Healy Clean Coal Project (HCCP) would be perceptible in the sight paths from the Denali National Park and Preserve (DNPP) Visitor Access Center

	North sight path		South sight path	
Emission source	*PLUVUE I*	*PLUVUE II*	*PLUVUE I*	*PLUVUE II*
HCCP	2	1	2	5
Unit No. 1	5	3	5	1
Unit No. 1 plus HCCP[a]	8	4	13	7

[a] *Based on modeling the NO_2 emissions from both sources rather than summing the previous two lines (the columns do not add up because the modeling was performed separately for each emission source and the combination of the two emission sources).*

DNPP of a visible NO_2 plume from Unit No. 1, effects predicted by PLUVUE II (like those of PLUVUE I) are expected to be greater than actual effects.

As with PLUVUE I, the results from PLUVUE II indicate that there would be no hours when an observer located in the DNPP Northeast Unit would perceive a plume from the HCCP alone, Unit No. 1 alone, or during the simultaneous operation of the two units. Also like PLUVUE I, the visual effects of particles in the HCCP plume were considered in PLUVUE II modeling. The results of a sensitivity analysis indicated that changes in particle concentration had little effect on the number of hours of predicted visual impact within DNPP. In summary, the results obtained using PLUVUE II are very similar to those using PLUVUE I.

As discussed above, the NPS also expressed concern regarding other aspects of DOE's visibility modeling. In response, a workshop was held in Washington, D.C., on September 22, 1993, that included representatives of AIDEA, DOE, EPA, and NPS. The participants at the workshop agreed that the PLUVUE I model, as modified by DOE, provided a reasonable tool for predicting the visibility impacts of the HCCP, although some participants expressed preferences for model assumptions different from those used in DOE's modifications. There also was general agreement that results obtained from the visibility modeling are very uncertain because of the uncertainties inherent in the models and because of uncertainties associated with the assumptions used for the input and output parameters. As a consequence of these uncertainties, the NPS and EPA believed that the results should err on the side of conservatism (form an upper bound of expected results). Specifically, the NPS and EPA preferred to use a perceptibility threshold for a visible plume corresponding to that which is provided in EPA *guidelines for typical regulatory applications (a burden of 69 ppbv·km) or an even more stringent threshold. In response to these concerns, an analysis was performed to evaluate the sensitivity of visibility modeling to the value used for the perceptibility threshold (Sonoma Technology, Inc. 1993c).*

Also at the workshop, several participants expressed concern that visitors at the DNPP Visitor Access Center viewing the scenery beyond the DNPP boundary would see a perceptible plume (visibility modeling in the public draft EIS and this final EIS terminated the north and south sight paths from the Visitor Access Center at the DNPP boundary). A discussion at the workshop revealed that EPA has not yet established a formal policy dealing with sight paths for regulatory applications, but NPS and EPA favored extending the sight paths as part of full disclosure for NEPA applications. Therefore, in response to the request at the workshop, the analysis also assessed the sensitivity of the modeling to extending the sight paths beyond the DNPP boundary.

Table 4.3.6 presents the results of the sensitivity analysis. The first column for each sight path and for the total, denoted as the "DOE case," gives the results as presented in Table 4.3.4. The second column indicates how the results change by extending the sight path, while the third column shows how the results change by using 69 ppbv·km rather than 150 ppbv·km for the perceptibility threshold. Finally, the fourth column indicates the results of using both the extended sight path and the 69 ppbv·km threshold. The modeling is more sensitive to changing the perceptibility threshold than extending the sight paths, as indicated by a greater increase from the DOE case in the number of hours in the third column than in the second column. The modeling is extremely sensitive to changing both parameters simultaneously, as indicated by the greatest increase in the number of hours in the fourth column. The north sight path is more sensitive than the south sight path.

DOE believes that the "DOE case" is the most appropriate approach because the results most nearly match monitoring and actual observation experience of the existing Unit No. 1. As mentioned previously, time-lapse cameras and human observers have not detected any plumes from Unit No. 1. Using assumptions which extend the sight path or lower the perceptibility threshold increases the predicted number of hours for a visible plume beyond credible levels. The results of changing both parameters simultaneously are particularly beyond credible estimates based on the actual experience with Unit No. 1: the results predict that a plume from Unit No. 1 would be perceptible during a total of 145 h per year, which is 3% of the approximately 4380 h of daytime, and 39% of the 372 h in which the wind direction and speed would allow transport of a potentially perceptible plume to the Visitor Access Center. Therefore, DOE believes that the results presented previously (Table 4.3.4) form reasonable estimates of the number of hours that a plume from the HCCP alone and in combination with Unit No. 1 may be perceptible.

NPS and EPA Views. *[This section was provided by NPS in consultation with EPA.] NPS and EPA recognize that there are scientific uncertainties regarding plume modeling and interpretation of*

Table 4.3.6. Sensitivity analysis of the number of daytime hours during the year that a plume from Unit No. 1 and the Healy Clean Coal Project (HCCP) is predicted to be perceptible

	North sight path				South sight path				Total[a]			
Emission source	DOE case	Extended sight path	Threshold of 69 ppbv·km	Change in both parameters	DOE case	Extended sight path	Threshold of 69 ppbv·km	Change in both parameters	DOE case	Extended sight path	Threshold of 69 ppbv·km	Change in both parameters
HCCP	2	2	2	77	2	4	13	20	2	4	14	78
Unit No. 1	5	13	42	143	5	9	29	46	6	17	42	145
Unit No. 1 plus HCCP[b]	8	42	52	259	13	20	47	60	15	53	57	262

[a]The total is less than the sum of the north and south sight paths because of some hours in which the threshold was simultaneously exceeded in both sight paths.

[b]Based on modeling the NO_2 emissions from both sources rather than summing the previous two lines (the columns do not add up because the modeling was performed separately for each emission source and the combination of the two emission sources).

results, but disagree with the assumption made by DOE for DOE's case of a perception threshold of 150 ppbv·km. After reviewing the sensitivity results, the NPS and EPA still believe that the perceptibility threshold of 69 ppbv·km is more appropriate, and have recommended that it be used to predict the visibility impacts for the project. They point out that EPA's standard regulatory guidance recommends it for assessing impact to the "casual" observer in the field, and contend that a more discerning observer can detect visibility changes even at much lower thresholds. NPS also has indicated that, in their opinion, the studies DOE used to support selection of a 150 ppbv·km threshold have been shown in the technical literature to be in error (van der Wildt and Waarts 1983).

Consistent with EPA modeling guidance, the NPS and EPA remain opposed to trying to correlate the monitored and DOE modeled results. Attempting correlation analyses is especially suspect in this circumstance, because the modeled year and the monitored period are not the same. Furthermore, neither period was of sufficient duration to capture a representative range of meteorological conditions. In addition, NPS has indicated that based on past experience, photographic monitoring alone has not always been reliable for detecting plumes. There could well be subtle visibility impairment detected by human observers that would not be detected by camera monitoring systems due to insufficient film resolution and sensitivity. Furthermore, limited photographic monitoring cannot document all views at all times.

Finally, NPS has expressed concern about the limited number of viewer locations used in the DOE modeling. DOE bases many of its conclusions on observations at the DNPP Visitor Access Center. NPS views its responsibility as protecting the visual experience of all visitors to the park from all accessible viewing locations. At a minimum, the description of the visibility impacts from HCCP should routinely include the modeling performed to predict impacts visible from an observer location in the Northeast "finger" of the park.

Memorandum of Agreement. *In recognition of NPS and EPA concerns and the range of possible actual visual impacts from the operating facilities, a Memorandum of Agreement (Appendix I) has been signed by AIDEA, GVEA, DOI, and DOE (see Sect. 2.1.3.2) which provides for several actions designed to minimize effects on DNPP resulting from the construction and operation of the HCCP (see Sect. 5.4.6). The terms of the Memorandum of Agreement establish a binding requirement that the operator of Healy Unit No. 1 would reduce that facility's total annual allowable emissions of SO_2 and NO_x, through the use of retrofit technologies, to levels which are approximately 25% and 50% lower than existing emission levels, respectively. The Memorandum of Agreement also contains provisions for a ceiling on total site emissions, resulting in a level for both facilities comparable to the existing Unit No. 1 emissions from the site. If one or both of the facilities is shown to generate an NO_2 or other pollutant plume or a sulfate or other pollutant haze within DNPP during the course of their operation, the Memorandum of Agreement provides for the immediate implementation of administrative controls* *sufficient to reduce combined site emissions to levels comparable to those for the existing Unit No. 1. The effect of the latter provision is to ensure that air pollutants reaching DNPP would not contribute to the formation of perceptible visual impacts within the Class I area, and that any such impacts would be rapidly mitigated through reduced site emissions. In addition, the Memorandum of Agreement has a provision which allows the NPS to re-open the provisions of the Memorandum of Agreement in the event that frequent visibility impacts within DNPP cannot be contained by administrative control actions and require other, more affirmative, actions on the part of the facility operator. The terms of the Memorandum of Agreement would be included within the permit to operate for the facilities and the applicable implementation plan under the Clean Air Act, and would be enforceable by the State of Alaska, EPA, and citizens. DOE believes that, in spite of the uncertainty inherent in computer modeling of visibility impacts, any visibility effects of the HCCP alone and in combination with Unit No. 1 would be mitigated by the terms of the Memorandum of Agreement. The NPS concurs with this conclusion.*

4.3.2.4 Regional Haze

As discussed in Sect. 3.2.4.2, regional haze is a reduction in visibility associated with air masses containing pollutants from emitting sources that have mixed in the atmosphere so that distinct plumes from the emissions are not visible. Secondary particulate species (i.e., those formed in the atmosphere from emitted gases) such as sulfate ($SO_4^{=}$) and nitrate (NO_3^{-}) appear to be the major contributors to regional haze. *Primary particulate species (i.e., those directly emitted into the atmosphere), such as dust, sea salt, and fly ash from power plants, do not appear to be major considerations since they are present in such low concentrations in the pristine atmosphere of Alaska.*

As with the plume visibility analysis, there were elements of the haze analysis on which DOE, NPS, and EPA reached consensus, but they still disagree on other issues (primarily involving modeling assumptions). As discussed below, additional analyses were performed to test the sensitivity of the model to varying assumptions. NPS and EPA views are presented separately, as was done for plume visibility. However, DOE believes that, as in the case of potential plume impacts, sufficient steps have been taken in the Memorandum of Agreement to protect against actual haze impacts from the HCCP, and that the modeling disagreements are largely academic.

DOE Approach. *Analyses of atmospheric chemistry reactions expected in pristine areas and the modeling of haze caused by particulate scattering have indicated that HCCP emissions would rarely make a perceptible contribution to any potential regional haze phenomenon in DNPP (Sonoma Technology, Inc. 1992a, 1993b). Studies have indicated that the long-range transport of sulfur species from Eurasia is an important source of existing Arctic regional haze (Shaw 1991; Soroos 1992; Bodhaine and Dulton 1993). The HCCP could contribute to regional haze in the summer but, in DOE's opinion, it would be an unusual event because the air typically is well dispersed in the summer. DOE* *believes it is unlikely to do so in the winter, because all of the chemical reactions discussed below occur slowly in the winter.*

In order to form a hazy air mass consisting of secondary particles in the region, at least one of the following two conditions is necessary: (1) sufficient time, either through calm winds or long transport distances to form secondary particles (homogeneous oxidation), or (2) cloud presence and stronger oxidant concentrations [e.g., ozone (O_3) or hydrogen peroxide (H_2O_2)] in the atmosphere to allow conversion of emissions to secondary particles in a shorter residence time (heterogeneous oxidation). Furthermore, winds are seldom calm in the Healy area; no average hourly calms *were* documented at the Healy Monitoring Station or Park Monitoring Station during the 12-month period from September 1990 through August 1991. Winds are predominantly from the south-southeast with a secondary prevalence of winds from the northwest, reflecting the influence of the Nenana River Valley in channeling the winds *(see Fig. 3.2.1)*. Wind directions very seldom alternate between up-valley and down-valley *flows* on a time scale of less than 8–12 h. *The time available for chemical reactions in the Healy area was estimated by using a computer model to track HCCP emissions for every hour during a 1-year period (September 1990 to August 1991) (ENSR Consulting and Engineering 1992; Sonoma Technology, Inc. 1992a). It was found that there were only a few occasions with at least a 24-h period during which the simulated puffs of emissions remained within a 30-mile by 30-mile area surrounding the proposed HCCP. These occasions occurred in December 1990 and January 1991.*

When emissions from a coal-fired power plant contribute to regional haze, the greatest contribution is believed to be caused by sulfate particles which are formed by oxidation of the SO_2 emissions. The reactions that form sulfate require sunlight and water vapor or they require liquid water in clouds combined with H_2O_2 (which is formed by the same reactions that form photochemical smog). These are all in very short supply during the Alaska winters, when the longer plume residence times are more likely to occur. As a consequence, it is expected that the rate of conversion of SO_2 to sulfate is very small in the Healy area in the winter. The rate of these reactions is also reduced in the summer by the clean atmospheric conditions.

HCCP emissions are not expected to contribute appreciably to regional haze via the formation of nitrate particles. The NO_x emitted by coal-fired power plants is primarily in the form of nitric oxide (NO), an invisible gas. NO is oxidized in the atmosphere to form NO_2, a reddish-brown gas, by the O_3 in the ambient air. NO_2 is then oxidized by the hydroxyl radical (HO) to form nitric acid (HNO_3), an invisible gas. When the atmosphere contains sufficient ammonia (NH_3) gas, HNO_3 will react with NH_3 to form ammonium nitrate (NH_4NO_3) particles, which can contribute to haze. However, it is unlikely that NH_4NO_3 particles would form from the HCCP emissions because the necessary concentrations of NH_3 are unlikely to be present. The reactions that oxidize NO_2 to HNO_3 also oxidize SO_2 to sulfuric acid (H_2SO_4), which then reacts irreversibly with NH_3 to form ammonium bisulfate (NH_4HSO_4) and *ammonium sulfate [$(NH_4)_2SO_4$] particles. NH_4NO_3 particles will not form unless there is more than enough NH_3 to neutralize all of the sulfate (the SO_4 in H_2SO_4). Measurements conducted during February and June in a power plant plume in northern Alberta revealed that the sulfate present in the plume typically was not fully neutralized (Lusis et al. 1978). Similar results have been observed at other sources that are well removed from agricultural and urban sources of NH_3 (Richards, Blanchard, and Blumenthal 1991). Therefore, it is expected that any NH_3 in the HCCP emissions would be consumed by the H_2SO_4 formed from SO_2 emissions, and that insufficient NH_3 would remain to form NH_4NO_3 particles.*

The NPS and EPA have expressed concern regarding the HCCP's potential to contribute to regional haze in DNPP. On May 5, 1993, a workshop was held in Seattle, Washington, with representatives from the NPS, EPA, and the project participant to discuss and attempt to reach agreement on methodologies to assess regional haze. Although a consensus was not reached on all issues, a supplemental analysis was performed following the workshop to address concerns related to regional haze in DNPP (Sonoma Technology, Inc., 1993b).

The analysis was performed for two areas in DNPP: one south of the DNPP Visitor Access Center and the other in the northeast corner of DNPP west of the HCCP proposed site. Much of the terrain in these areas has elevations in excess of 3,000 ft msl. Plume materials are not transported to such high elevations under the limited-mixing conditions associated with the formation of regional haze. Other portions of these areas are in corners of DNPP or canyons where sight paths are limited to a length of only a few miles. The results of the analyses presented below show that the sulfate concentrations formed from the HCCP emissions are not high enough to cause perceptible effects in short sight paths. Sulfate formation calculations were performed for the remaining areas, which are indicated in Fig. 4.3.3. The areas north of the Visitor Access Center and near the location of the plume observer in the Northeast Unit were not included because the visual effects were addressed separately by the plume visibility modeling that evaluated the HCCP's potential to produce a perceptible distinct plume (Sect. 4.3.2.3). Visual effects in more distant portions of DNPP would be extremely unlikely because HCCP emissions would be partially blocked from passage by the mountainous terrain and diluted with distance.

DOE believes that perceptible regional haze in the Stampede Valley between the "northeast finger" and the main body of DNPP, which is a Class II area, could not be perceived from DNPP because the sight paths would generally be perpendicular to the direction of transport of the plume materials. Therefore, the portion of the sight path within the plume would generally be less than 1 mile in length, which is too short for the amounts of sulfate that could be formed that close to the source to cause perceptible effects.

ORNL-DWG 93M-11365A

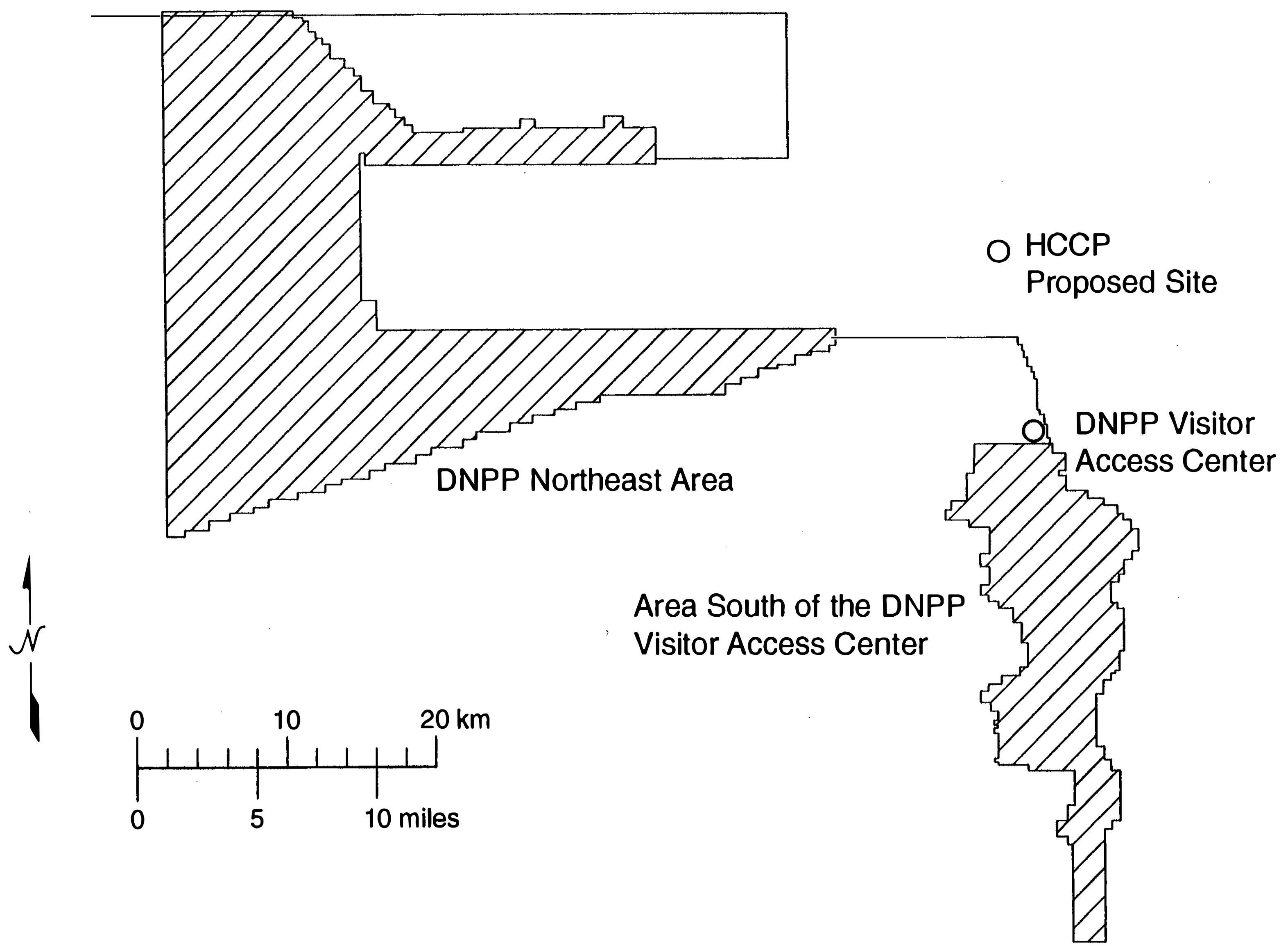


Fig. 4.3.3. Location of the two areas in which regional haze analyses were performed.

Because the two areas included in the analysis are located only 8 to 24 miles from the HCCP proposed site, the methodology used was not characteristic of most regional haze analyses. Instead, the modeling approach used SO_2 concentration profiles that typically are used to simulate the effects of distinct plumes. The ISC2 air dispersion model was used to predict SO_2 concentrations in the two areas (see Sect. 4.1.2.2 for a discussion of the model). Concentrations were estimated at ground level and 500 ft above ground level for each of the receptors (modeled locations). Although terrain elevations were not used in the modeling, the topography of the area was accounted for by examining only those locations in which it would be possible to have sight paths greater than 6 to 9 miles. Modeling was performed for 6-h time periods to predict maximum SO_2 concentrations associated with stagnant conditions. The percentage conversion of SO_2 to sulfate required to increase the light extinction coefficient of the atmosphere by 20% were calculated. These percentage conversion data were then compared with the amount of conversion that might occur to determine the number of time periods with perceptible haze.

For the homogeneous conversion of SO_2 to sulfate, which takes place during the daytime in cloud-free air, the analysis assumed a 20% change in b_{ext} (the light extinction coefficient) would be required to perceive regional haze. The analysis also assumed homogeneous oxidation rates of SO_2 to sulfate of 0.1%/hr from December through February, 0.2%/hr in March and November, 0.5%/hr in April and October, and 1%/hr during the remainder of the year.

DOE believes that the analysis assumed viewing conditions representative of maximum impacts. The assumed sight path length was 9.4 miles, which is the length most sensitive to regional haze. For both the sight paths at ground level and 500 ft above ground level, it was assumed that both an observer and a terrain background were present at each end of the 9.4 mile sight path containing the maximum SO_2 concentration during each time period at the proper height above ground level. There was no case during the year simulated that the homogeneous oxidation of SO_2 would cause the sulfate concentration to exceed the perception threshold.

Sulfate concentrations high enough to exceed the threshold for visual effects could occasionally be produced by the heterogeneous reactions that occur only in clouds, and then only during the warm months when the necessary H_2O_2 could be present. To produce perceptible effects, it would be necessary for (1) the emissions to be entrained in clouds containing sufficient quantities of H_2O_2, (2) the clouds to evaporate to reveal the resulting sulfate, (3) the emissions to be transported to DNPP without much dilution, and (4) an observer to view the resulting sulfate haze approximately in line with the plume centerline. DOE believes that the probability of the simultaneous occurrence of all these conditions is low. It was assumed that these conditions were satisfied in 10% of the 6-hour time periods during which 30% conversion of SO_2 to sulfate would cause a 20% increase in the background light *extinction in a 9.4-mile-long sight path in the areas shown in Fig. 4.3.3. DOE believes that this is an upper limit to the number of cases that might actually occur.*

Table 4.3.7 presents the estimated number of events per year that heterogeneous oxidation of SO_2 could cause a sulfate concentration greater than or equal to the threshold for visual effects. The effects from the HCCP during the demonstration were predicted to be negligible and therefore are not presented in the table; instead, the results using the higher level of emissions corresponding to the HCCP permitted case are presented (see Sect. 5.2 for a discussion of the HCCP permitted case). The results presented in the table for elevations at ground level and 500 ft above ground level should not be summed because in most cases the threshold is exceeded at both heights during the same event. However, it is appropriate to sum the events for the two modeled areas to obtain an estimate of the total number of events being predicted. Based on the 30% conversion of SO_2 to sulfate, the analysis predicts that haze would be perceptible a total of about once per year for the HCCP alone. For Unit No. 1 emissions alone, haze would be perceptible a total of three times per year: twice per year in the area to the south of the DNPP Visitor Access Center and once per year in the northeast corner of DNPP west of the HCCP proposed site. During the simultaneous operation of the HCCP and Unit No. 1, haze is predicted a total of four times per year: twice in the area to the south of the DNPP Visitor Access Center and twice per year in the northeast corner of DNPP. Thus, adding HCCP emissions (even at the permitted level) to those from Unit No. 1 increased the estimate by only one event per year.

Table 4.3.7. Estimated number of events per year that heterogeneous oxidation of SO_2 could cause a sulfate concentration greater than or equal to the threshold for visual effects.

Modeled area	Height agl	HCCP (permitted case)	Unit No. 1	HCCP and Unit No. 1[a]
South	Surface	0	2	2
South	500 ft	<1[b]	2	2
Northeast	Surface	0	1	1
Northeast	500 ft	<1[b]	1	2

[a]Based on modeling the SO_2 emissions from both sources rather than summing the results from the previous columns.
[b]Indicates an event would occur occasionally, but on a frequency of less than once per year.

At the workshop held in Washington, D.C., on September 22, 1993, representatives of EPA and NPS again expressed concern regarding the assumptions used in the supplemental regional haze analysis. These participants felt that a 10% change in b_{ext} (rather than the 20% change assumed in the analysis) would be sufficient to perceive regional haze formed during homogeneous oxidation of SO_2. Furthermore, they believed that homogeneous oxidation rates of SO_2 to sulfate should be greater than assumed in the analysis: they expressed the view that rates of 1.4%/hr from October through March and

1.9%/hr from April through September were more appropriate. In addition, they noted that the background aerosols are not as hygroscopic as assumed by DOE's analysis. EPA and NPS stated that DOE's assumptions about the hygroscopic nature of the background aerosols would tend to underestimate regional haze formation. In response to a request made at the workshop, it was agreed that an analysis would be performed to assess the sensitivity of the modeling to varying assumptions.

The background clarity of the air assumed in DOE's analyses was much greater than the clarity of the air as measured by the National Weather Service visibility observer in the Healy area. Consequently, the sensitivity of varying the assumptions about the hygroscopicity of the background aerosols was not analyzed further.

Table 4.3.8 presents the results of DOE's sensitivity analysis. The first column gives the "DOE case" as evaluated in the supplemental regional haze analysis for the HCCP (permitted case), Unit No. 1, and simultaneous operation of the two units. The second column indicates how the results change by considering a 10% change in b_{ext} as the threshold for perception. The third column shows how the results change by using the higher oxidation rates. Finally, the fourth column indicates the results of changing both assumptions simultaneously. For the HCCP permitted case, the results are not very sensitive to the change in assumptions: no regional haze was predicted under any of the assumptions except for six events predicted in the northeast area at 500 ft above ground level after changing both assumptions simultaneously. For Unit No. 1, the results are more sensitive; they increase from the DOE case of four events per year for both areas (two events for the south area and two events for the northeast area) to 71 events per year for both areas (38 events for the south area and 33 events for the northeast area) after changing both assumptions. Similarly, for the simultaneous operation of the two units, the predictions increase from the DOE case of ten events per year for both areas (two events for the south area and eight events for the northeast area) to 85 events per year for both areas (44 events for the south area and 41 events for the northeast area) after changing both assumptions.

At the workshop on September 22, 1993, some participants reiterated concern regarding the assumption of using a 30% total conversion of SO_2 to sulfate during heterogeneous oxidation. In response to this concern, a sensitivity analysis was performed using a total conversion of 50%. Table 4.3.9 presents side-by-side results of using 50% vs 30% conversion. The results indicate a very slight increase in the predicted number of events per year by assuming 50% total conversion. Based on the higher 50% conversion, the analysis predicts that haze would be perceptible a total of about once per year for the HCCP alone. For Unit No. 1 emissions alone, haze would be perceptible a total of about five times per year. During the simultaneous operation of the HCCP and Unit No. 1, haze is predicted a total of six times per year. Thus, as with the 30% conversion results, adding HCCP emissions (even at the permitted level) to those from Unit No. 1 increased the estimate by only one event per year.

Table 4.3.8. Sensitivity analysis of the number of events per year that homogeneous oxidation of SO_2 is predicted to cause a sulfate concentration greater than or equal to the threshold for visual effects

		HCCP (permitted case)				Unit No. 1				HCCP and Unit No. 1[a]			
Modeled area	Height agl	DOE case[b]	10% change in b_{ext}[c]	Higher oxidation rates[d]	Both	DOE case[b]	10% change in b_{ext}[c]	Higher oxidation rates[d]	Both	DOE case[b]	10% change in b_{ext}[c]	Higher oxidation rates[d]	Both
South	Surface	0	0	0	0	0	2	5	30	0	2	5	29
South	500 ft	0	0	0	0	2	3	14	38	2	7	20	44
Northeast	Surface	0	0	0	0	1	7	10	32	2	8	13	36
Northeast	500 ft	0	0	0	6	2	7	19	33	8	14	27	41

[a]Based on modeling the SO_2 emissions from both sources rather than summing the results from the previous columns.

[b]Assumes that a 20% change in b_{ext} (the light extinction coefficient) would be required to perceive regional haze; assumes homogeneous oxidation rates of SO_2 to sulfate of 0.1%/hr from December through February, 0.2%/hr in March and November, 0.5%/hr in April and October, and 1%/hr during the remainder of the year.

[c]Assumes that a 10% change in b_{ext} (the light extinction coefficient) would be sufficient to perceive regional haze.

[d]Assumes homogeneous oxidation rates of SO_2 to sulfate of 1.4%/hr from October through March and 1.9%/hr from April through September.

Table 4.3.9. Sensitivity analysis of the number of events per year that heterogeneous oxidation of SO_2 is predicted to cause a sulfate concentration greater than or equal to the threshold for visual effects

Modeled area	Height agl	HCCP (permitted case)		Unit No. 1		HCCP and Unit No. 1[a]	
		50%[b]	30%[b]	50%[b]	30%[b]	50%[b]	30%[b]
South	Surface	0	0	3	2	4	2
South	500 ft	<1[c]	<1[c]	3	2	4	2
Northeast	Surface	0	0	2	1	2	1
Northeast	500 ft	<1[c]	<1[c]	2	1	2	2

[a]Based on modeling the SO_2 emissions from both sources rather than summing the results from the previous columns.
[b]The assumed percentage of SO_2 that is oxidized to sulfate within clouds and then exposed to view when the clouds evaporate.
[c]Indicates an event would occur occasionally, but on a frequency of less than once per year.

NPS and EPA Views. *[This section was provided by NPS in consultation with EPA.] The NPS and EPA concur with the air dispersion model selected to conduct the screening analysis to estimate the combined HCCP and Unit No. 1 contribution to regional haze; it should provide a reasonable first-order approximation. However, as with plume modeling, an investigator can excercise considerable latitude regarding modeling assumptions and interpretation that can lead to widely differing results. For these reasons the NPS and EPA asked that representative literature values of input parameters be used to provide a range of values for the possible impacts of this project. The preceding discussion provides modeling results for a range of perceptibility thresholds and homogenous oxidation rates using the currently accepted 10% extinction perceptibility threshold. Also, no analysis is provided for other accepted values for the level of the solubility of the background aerosol (a critical factor for determining the relative impact of HCCP). These additional analyses, if conducted, would indicate a greater number of hours for which perceptible impacts would be possible.*

Similarly, as with the plume modeling analysis, the NPS and EPA assert that the geographical domain for which the regional haze analysis is presented is too small. Tabulations should have included all 15-km sight paths in the park that exceeded the perception threshold. Proximity of the source to the park boundary does not prevent high rates of sulfate formation due to aqueous phase chemistry that can rapidly occur in clouds even in a distance as short as 4 km, or long transport times due to meandering plumes. Also, the area that separates the northeast portion of DNPP from the southern portion should not have been omitted from the analysis. Observers located in either of these portions of DNPP could have their view affected by pollutants in the intervening area.

Conclusion. *After extensive coordination and consultation with NPS, DOE believes that the regional haze analysis presented herein is both reasonable and conservative for the reasons previously*

described. Regional haze has been detected at DNPP, but that haze has not been attributed to any particular source, due to the limitations of the monitoring data. All analyses of regional haze indicate that the frequency of occurrence from the combined emissions of the proposed HCCP and the existing Unit No. 1 would only be slightly greater than that from Unit No. 1 alone. However, any conclusion must recognize the practical limitations of modeling for regional haze at the HCCP site. For this reason, the Memorandum of Agreement for mitigating the effects of Unit No. 1 (see Sect. 2.1.3.2) provides for the further reduction of emissions if haze conditions result.

4.3.3 Surface Water Resources

Negligible impacts to surface water resources in DNPP are expected as a consequence of HCCP construction and operation. As discussed in Sect. 4.1.3.2, a small increase in acidic deposition resulting from HCCP SO_2 and NO_x emissions should not cause a measurable change in the pH of regional surface waters because their natural pH levels are generally 7.0 or higher and their buffering capacities are high.

4.3.4 Groundwater Resources

No impacts to groundwater resources in DNPP are expected as a consequence of HCCP construction and operation.

4.3.5 Ecological Resources

Effects of pollutant gases from the HCCP on vegetation in DNPP would be minimal because predicted maximum SO_2 and NO_2 concentrations in DNPP are much lower than predicted maximum ambient concentrations and well below levels that are known to be toxic to plants. Similarly, major effects are not expected from deposition of emitted particles and acid deposition as a result of SO_2 and NO_x emissions (see Sect. 4.1.5.1 and Sect. 4.3.2.2). The USGS/NPS study of element concentrations in lichens, mosses, and surface soil found that elemental concentrations dropped to effective background levels about 6 km from Unit No. 1 and other sources in the Healy area (Crock et al. 1992). This result suggests that the DNPP has not been greatly exposed to emissions from Unit No. 1. This result includes sulfur, which suggests that DNPP has not been exposed to substantial amounts of SO_2 or acid deposition from Unit No. 1. Because sulfur tends to be retained by terrestrial ecosystems, sulfur concentrations in vegetation and the upper layer of the soil have proved to be sensitive indicators of exposure to atmospheric sulfur in other studies (Sigal and Suter 1987). Measurements of wet deposition in DNPP indicate that, even with the existing Healy Unit No. 1 in operation, acid deposition is not a problem. Monthly mean pH values fluctuate between 5 and 6.5, which is typical of relatively clean areas in the western United States (NADP/NTN Coordination Office 1989). However, some precipitation events have pH levels as low as 3.9 (NADP/NTN Coordination Office 1990). These precipitation pH levels are typical of background sites (Sisterson et al. 1990). The acidity in low-pH precipitation at background sites is attributed to organic acids and naturally derived sulfate (Sisterson et al. 1990). Therefore, emissions from Unit No. 1 are not necessarily the cause or even a major contributor to low-pH precipitation events in DNPP. ***Studies of stream water chemistry in DNPP have found alkaline pH values and high ionic concentrations resulting in well-buffered headwaters, contrary to other alpine areas (Stottlemyer 1992; Stottlemyer and McLoone 1990). These results indicate that streams in DNPP are not currently affected by acidic deposition and are not susceptible to effects of acid or heavy metal deposition (Stottlemyer and McLoone 1990).*** No other impacts to ecological resources in DNPP are expected as a consequence of HCCP construction and operation.

4.3.6 Floodplains and Wetlands

No impacts to floodplains and wetlands in DNPP are expected as a consequence of HCCP construction and operation.

4.3.7 Prehistoric and Historic Resources

No impacts to prehistoric and historic resources in DNPP are expected as a consequence of HCCP construction and operation.

4.3.8 Socioeconomics

No impacts to socioeconomic resources (beyond impacts discussed in Sect. 4.1.8) are expected as a consequence of HCCP construction and operation.

4.3.9 Noise

No noise from HCCP construction and operation would be heard within DNPP.

4.3.10 Waste Management

No impacts to resources in DNPP are expected as a consequence of waste disposal at the community landfill during HCCP construction and at the UCM Poker Flats mine during HCCP operation.

4.3.11 Electromagnetic Fields

Because the HCCP would use existing transmission lines that do not cross into DNPP, no electromagnetic effects would occur.

4.3.12 Worker Health and Safety

Worker health and safety issues in DNPP would not be affected by HCCP construction and operation.

4.3.13 Concerns of the National Park Service

The U.S. Department of the Interior's (DOI's) NPS, a cooperating agency by virtue of its role as an FLM for DNPP, expressed a number of concerns about potential impacts ***on DNPP resources resulting from HCCP emissions that would be generated*** only 4 miles from the border of DNPP. These concerns ***were*** related to: (1) ambient air quality, (2) acidic deposition, (3) visibility, (4) surface water resources, (5) ecological resources, (6) aquatic resources, (7) ice fog, ***(8) regional haze, and (9) global climate change. Letter No. 76 in Volume II of the EIS contains a complete discussion of NPS concerns. As a result of negotiations by DOI/NPS, DOE, AIDEA, and GVEA, a Memorandum of Agreement (Appendix I) was signed by all four parties on November 9, 1993; consequently, DOI/NPS has agreed to support release of the final EIS and withdraw its objections to the project (see Sect. 5.4.6 for a discussion of the agreement).***

4.4 MITIGATION MEASURES

In addition to the retrofit of Healy Unit No. 1 agreed to under the Memorandum of Agreement discussed in Sect. 5.4.6, mitigation measures have been developed by AIDEA for the proposed HCCP to minimize potential environmental impacts associated with the construction and operation of the facilities. Many of the mitigation measures are related to socioeconomic issues. AIDEA has agreed to alleviate socioeconomic impacts, primarily by providing a camp for construction workers. In addition, AIDEA would provide medical services for construction workers and trained fire-fighting personnel during the construction period, with sufficient equipment and supplies to protect the HCCP site and the work force in the construction camp. These measures are expected to minimize related short-term socioeconomic impacts to the Healy area. Subsequently, the Healy area would have time to plan for and integrate most long-term effects into the community.

Another major mitigation measure is the installation of a cross connection between the HCCP and Healy Unit No. 1 circulating-water discharges. This measure would allow part of the HCCP circulating water to discharge to the Unit No. 1 outfall during times when Unit No. 1 is shut down in the winter, thus keeping the intake pond free of ice. The cross connection would minimize cold shock to fish by allowing discharge to both outfalls when one of the units is shut down. In addition, the cross connection would provide the flexibility to route the Healy Unit No. 1 circulating water through the HCCP outfall, if necessary, during the summer to ensure that temperatures in the Nenana River would not exceed the ADEC regulation of 55.4°F for maximum water temperature at the mixing zone.

Table 4.4.1 lists the mitigation measures that AIDEA ***would*** provide during the construction and operation of the HCCP (with a cross-reference to their citation in the text).

Table 4.4.1. Mitigation measures to be provided during construction and operation of the Healy Clean Coal Project (HCCP)

Section	Page	Measure
4.1.2.1 4.2.2	4-3 4-65	Use sprinkler trucks, as needed, during construction to spray roads and construction areas to minimize fugitive dust.
4.1.3.1	4-13	Implement standard erosion control measures, such as straw barriers, diversion trenches, and riprap to minimize sediment transport during construction.
4.1.3.2	4-14	Install a cross connection between the HCCP and Healy Unit No. 1 circulating-water discharges to regulate temperature in the mixing zone of the Nenana River and minimize cold shock to fish.
4.1.8	4-40	Provide a construction camp to minimize socioeconomic impacts associated with construction workers.
4.1.8.5	4-51	Provide trained fire-fighting personnel during the construction period with adequate equipment and supplies to protect the HCCP site and the work force in the construction camp.
4.1.8.5	4-51	Provide medical services for workers during the construction of the HCCP. Specifically, a trained emergency medical technician would be on staff during the major construction period. Arrangements for helicopter medivac services out of Fairbanks would be made for life-threatening cases.
4.1.9.2	4-59	Install a silencer for the intake of the forced-draft fan to lower noise levels.

5. IMPACTS OF COMMERCIAL OPERATION

Following the completion of the 1-year HCCP demonstration in *1997*, commercial operation of the HCCP is anticipated in *1998*. Three scenarios are reasonably foreseeable outcomes of the demonstration: (1) a successful demonstration followed by continuation of the project at approximately the same power level using the same technologies (the demonstration case discussed in Sect. 4); (2) a demonstration that fails to meet project objectives for air emissions, but attains permitted levels for air emissions, is otherwise successful, and continues in operation at permitted levels (the permitted case); and (3) an unsuccessful demonstration followed by conversion of the *HCCP* facility to a coal-fired power plant using best available control technology, including low-NO_x burners to burn pulverized coal and dry scrubbers utilizing lime for flue gas desulfurization (the *HCCP* retrofit case). Several site-specific comparisons of scenarios are given using the proposed site. Similar comparisons for the alternative site are not included because the comparisons would add little to the discussion.

Except for Sect. 5.4, the analyses in this section that include Healy Unit No. 1 characterize the unmitigated impacts of Unit No. 1 prior to its planned retrofit discussed in Sect. 2.1.3.2. The analyses that include the retrofitted Unit No. 1 are presented in Sect. 5.4.6. Those analyses indicate that impacts associated with air quality, visibility, and regional haze would decrease following the Unit No. 1 retrofit, while changes in impacts to other resources would be minimal. Therefore, the analyses presented prior to Sect. 5.4 would overstate the impacts on air quality and visibility during the simultaneous operation of the HCCP and the retrofitted Unit No. 1.

5.1 DEMONSTRATION CASE

If the demonstration is successful, the HCCP would continue in commercial operation using the same technologies. ***The expected operating life of the HCCP is in excess of 40 years.*** The HCCP is planned as a baseload power plant operating 24 h/d; therefore, the level of short-term impacts would not change from those described for the demonstration in Sect. 4. The HCCP operation at the 50-MW level would progressively increase from 65% of the time during the demonstration to 80% during the first year of commercial operation (year 2) to 85% for years 3 through at least 25. Therefore, the level of long-term (annual) impacts would increase slightly because the HCCP would be on-line for a greater percentage of the year. However, because potential effects of the HCCP demonstration were conservatively based on operation of the HCCP at an 85% capacity factor (and a 100% capacity factor for air quality impacts), actual impacts during commercial operation should remain less than predicted in Sect. 4. ***CO_2 emissions per year would remain the same as estimated in Table 4.1.3. It is likely that the HCCP would receive coal from several open-pit mines at the UCM. No matter which UCM pit is used, there*** is no risk of exceeding the ash disposal capacity ***of any UCM mine pit*** over the operating life of the HCCP. The combined annual disposal rate of ash from Healy Unit No. 1 and the HCCP would be less than 1% of the annual coal and overburden combined production rate at the UCM mine. ***Although the HCCP could receive coal from other mines in the area during commercial operation, the amount of fly ash disposed of would still be a small fraction of coal production at Poker Flats. Therefore, there is no danger of exceeding the fly ash disposal capacity of the mine. A little more than 100 tons of limestone would be transported to HCCP per week (assuming an annual consumption rate of 5600 tons). This would require between 10 and 20 truckloads per week. About 224,000 tons of limestone would be required during the 40-year operating life of HCCP. Because the actual site that would be used to obtain limestone is unknown, potential impacts resulting from limestone mining operations are not specifically evaluated but are expected to be minor.*** Socioeconomic impacts would be smaller than those projected for demonstration in *1997*, because the number of workers required to operate the HCCP would gradually be reduced from 32 to 22 (proposed site), or from 45 to 40 (alternative site), as experience is gained in operating the facility.

5.2 PERMITTED CASE

The second scenario describes a demonstration that fails to meet project objectives for air emissions, but attains permitted levels and is otherwise successful. For this scenario, it is expected that the HCCP would continue in operation (with no change in equipment) with air emissions at permitted levels. Expected emissions would increase as follows (based on an 85% capacity factor): SO_2, from 103 to 207 tons/year; NO_x, from 480 to 840 tons/year; and PM_{10}, from 36 to 48 tons/year. SO_2 emissions are based on an 80% SO_2 removal rate (resulting in emissions of 0.086 lb/*M*MBtu of heat input to the combustion process) using the same blended coal as in the demonstration case; NO_x and PM_{10} emissions are based on 0.35 and 0.02 lb, respectively, per *M*MBtu. The emission rates analyzed for this scenario are similar to the rates requested in the PSD permit application prepared by AIDEA and approved by the ADEC. Limestone usage would decrease from 5609 to 4711 tons/year because less limestone would be required in the chemical reactions to meet permitted SO_2 levels. Correspondingly, ***limestone-based*** scrubber waste would be reduced from 5545 to 4706 tons/year. Other parameters would remain at almost identical levels. Material flow diagrams that depict the resource requirements and discharges are displayed in Fig. 5.2.1 for the short-term maximum rate during the permitted case and in Fig. 5.2.2 for the long-term rate based on an 85% capacity factor. With the exception of CO_2 emissions, impacts to atmospheric resources would be greater for the permitted case than for the demonstration case. ***CO_2 emissions for the permitted case would remain the same as the demonstration case because there would be no change in the equipment, and the same amount of coal would be used. Impacts*** to other resources

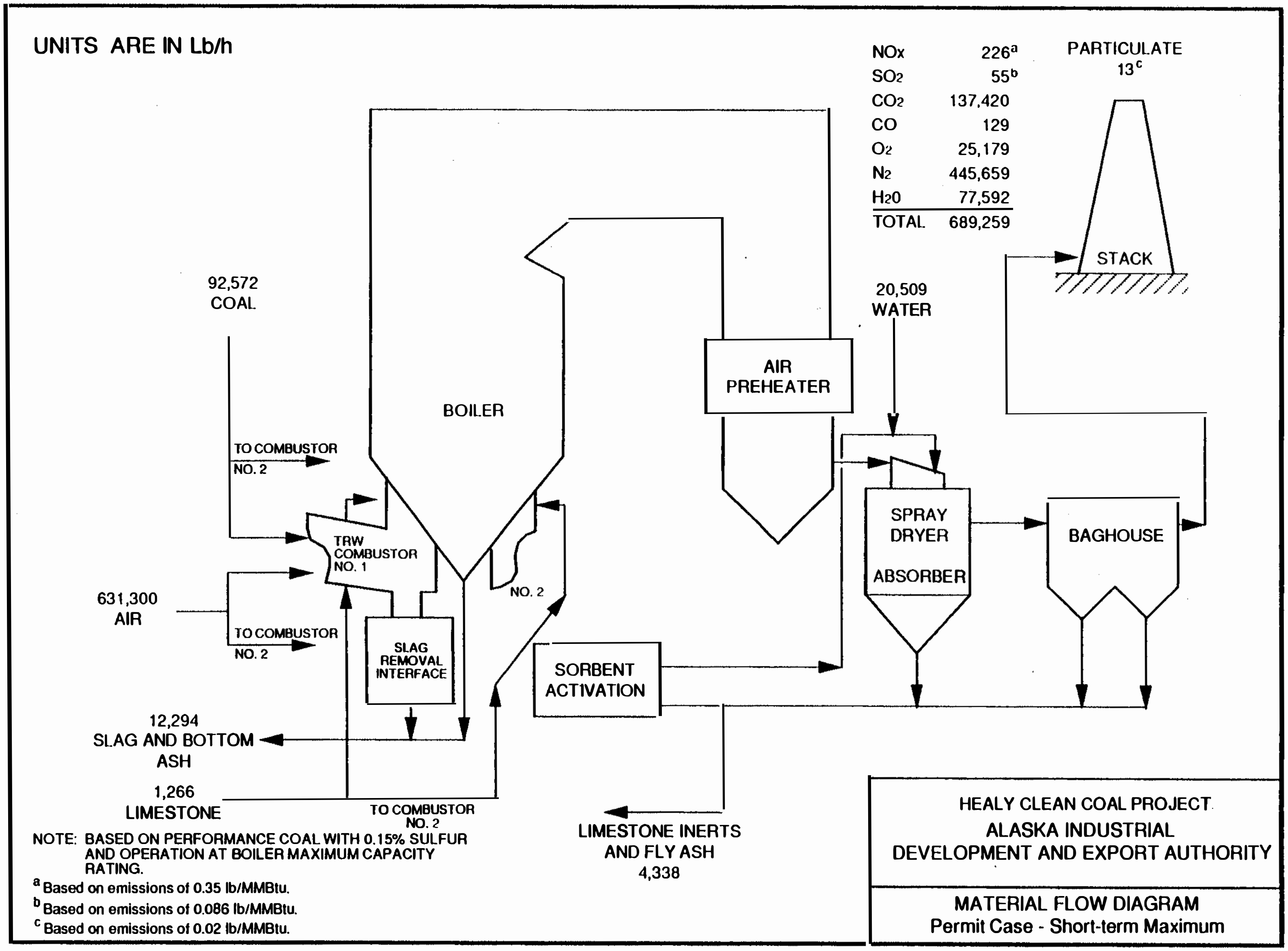


Fig. 5.2.1. Material flow diagram for the short-term maximum rate during the permitted case.

92M-8039

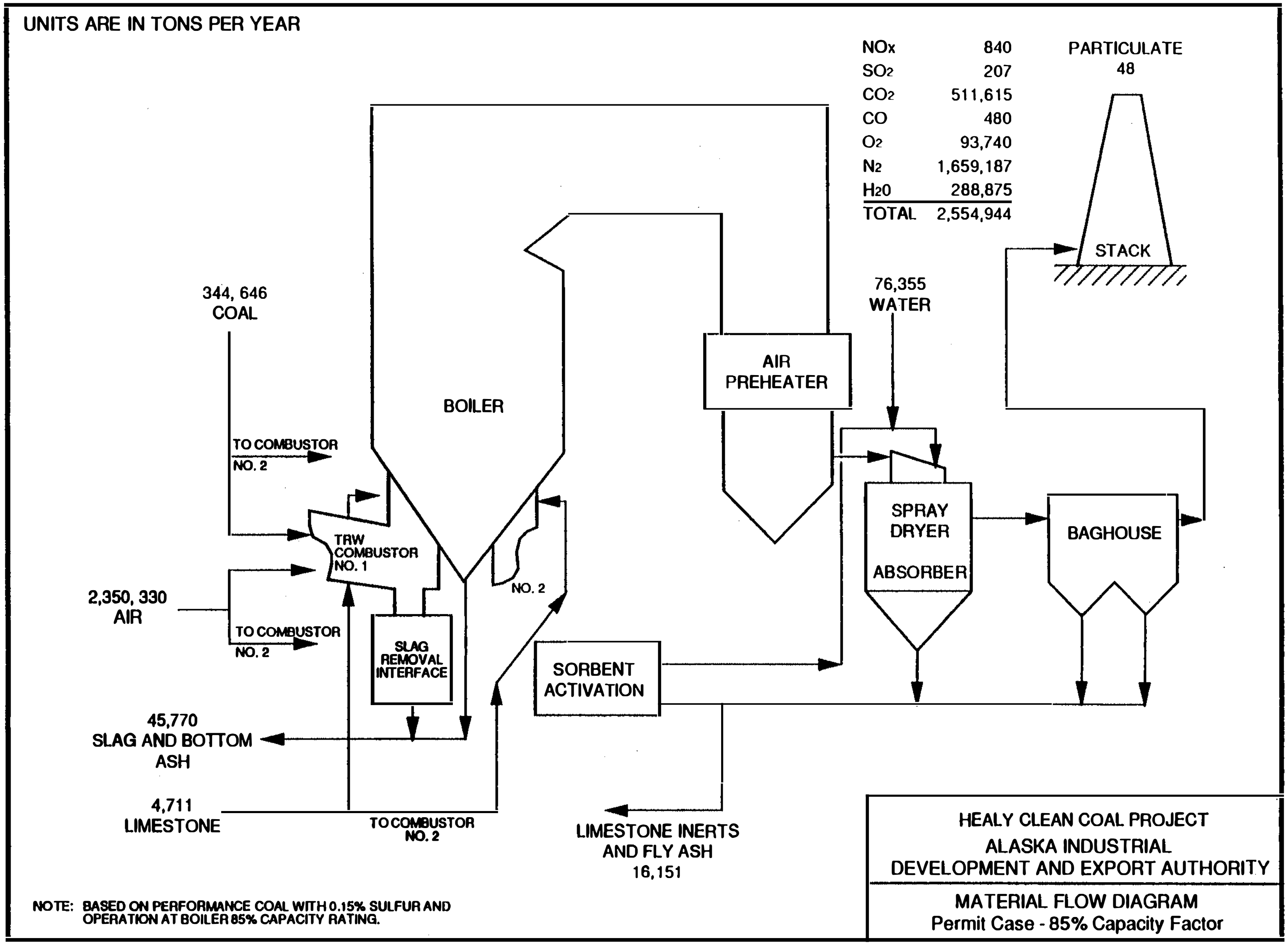


Fig. 5.2.2. Material flow diagram for the permitted case with an 85% capacity factor.

would be almost identical to a successful demonstration. As with a successful demonstration, socioeconomic impacts would be smaller than those projected for demonstration in *1997*, because the number of workers required to operate the HCCP would gradually be reduced from 32 to 22 (proposed site), or from 45 to 40 (alternative site), as experience is gained in operating the facility.

Analyses were performed to estimate the increased level of impacts to atmospheric resources associated with the permitted case compared with the demonstration case. Table 5.2.1 displays the predicted maximum concentrations resulting from SO_2, NO_x, and ***particulate*** emissions from the HCCP for the PSD Class I and II areas. ***For most pollutants and averaging periods,*** maximum concentrations would be substantially higher for the permitted case. Maximum concentrations for the permitted case ***are predicted to consume up to 96%*** of the PSD increments. ***The highest percentages are predicted for 24-h and 3-h SO_2 concentrations within DNPP (96% and 88%, respectively) and for 24-h particulate matter outside DNPP (93%). Other predicted concentrations consume less than 30% of the increments.*** Table 5.2.2 shows the cumulative air quality impacts resulting from the simultaneous operation of Healy Unit No. 1 and the HCCP. Because almost all of the modeled concentrations resulted from downwash (downward movement) of the Unit No. 1 stack plume caused by the new HCCP boiler building, total impacts ***for*** the HCCP permitted case were ***identical to*** the demonstration case.

Table 5.2.3 presents the cumulative air quality impacts to DNPP resulting from the simultaneous operation of the HCCP and Healy Unit No. 1. Except for a slight increase in 3-h and 24-h SO_2 concentrations, total impacts for the HCCP permitted case were the same as for the demonstration case. Therefore, Healy Unit No. 1 is predicted to contribute much more than the HCCP to the maximum modeled concentrations. As with the demonstration case, all total impacts for the permitted case are expected to be less than 25% of the NAAQS, and most are expected to be less than 20% of the NAAQS. Except for the 3-h and 24-h SO_2 concentrations, the ambient background concentrations are the largest component of the total impacts.

Using the same approach as discussed in Sect. ***4.3.2.3***, potential visibility degradation was also evaluated for the HCCP permitted case. Table ***5.2.4*** summarizes results from the PLUVUE I ***model*** of the number of ***daytime*** hours per year that the plume is ***predicted*** to be perceptible from the DNPP Visitor Access Center for views to the north and south ***and the total number of hours.*** The predicted number of hours is low (but slightly higher than the demonstration case): ***4 h for the north sight path, 9 h for the south sight path, and a total of 9 h.*** The percentage of hours affected is ***much*** less than 1% of the approximately 4380 h/year of ***daytime***.

Cumulative visibility impacts of air emissions resulting from the simultaneous operation of the HCCP (permitted case) and Healy Unit No. 1 also were evaluated ***and summarized in Table 5.2.4.***

Table 5.2.1. Prevention of Significant Deterioration (PSD) impact analysis for the Healy Clean Coal Project (HCCP) for the demonstration and permitted cases

				Demonstration case		Permitted case	
Class	Pollutant	Averaging period	PSD increment[a] (μg/m³)	Maximum modeled concentration[b] (μg/m³)	Percent of PSD increment	Maximum modeled concentration[b] (μg/m³)	Percent of PSD increment
I[c]	SO_2	3-h	25	9.4	38	22	88
		24-h	5	2.0	40	4.8	96
		Annual	2	0.2	9	0.4	20
	NO_2	Annual	2.5	0.8	32	1.3	56
	TSP[d]	24-h	10	0.7	7	0.9	9
		Annual	5	0.1	2	0.1	2
II[e]	SO_2	3-h	512	57	11	133	26
		24-h	91	11	12	26	29
		Annual	20	0.8	4	1.7	8
	NO_2	Annual	25	3.4	14	6.0	24
	TSP[d]	24-h	37	17	46	34	93
		Annual	19	2.4	13	3.0	16

[a] PSD increments are standards established in accordance with existing Clean Air Act provisions to limit the degradation of ambient air quality in areas in attainment with the National Ambient Air Quality Standards.

[b] Maximum concentrations predicted by *computer models resulting from HCCP emissions alone.*

[c] Stringent PSD Class I increments apply to areas such as Denali National Park and Preserve (DNPP) where almost any deterioration of air quality is undesirable and little or no major industrial development would be allowed.

[d] *Total suspended particulate matter (TSP) rather than PM_{10} is used in this comparison because the air dispersion modeling for the permitted case used TSP emissions (that are greater than PM_{10} emissions) for sources such as the fly ash storage silo.*

[e] The area surrounding the HCCP site outside DNPP is designated a PSD Class II area where moderate, well-controlled industrial growth is allowed.

Table 5.2.2. National Ambient Air Quality Standards (NAAQS) impact analysis for the combined effects of Healy Unit No. 1 and the Healy Clean Coal Project (HCCP) (demonstration and permitted cases)[a]

				Demonstration case			Permitted case		
Pollutant	Averaging period	NAAQS[b] (μg/m³)	Ambient background concentration[c] (μg/m³)	Modeled concentration[d] (μg/m³)	Total impact[e] (μg/m³)	Percent of NAAQS	Modeled concentration[d] (μg/m³)	Total impact[e] (μg/m³)	Percent of NAAQS
SO_2	3-h	1300	45	*1100*	*1145*	*88*	*1100*	*1145*	*88*
	24-h	365	26	*326*	*352*	96	*326*	*352*	96
	Annual	80	5	*64*	*69*	*86*	*64*	*69*	*86*
NO_2	Annual	100	6	*61*	*67*	*67*	*61*	*67*	*67*
PM_{10}	24-h	150	31	*89*	*120*	*80*	*89*	*120*	*80*
	Annual	50	5	*20*	*25*	*50*	*20*	*25*	*50*

[a]*Values presented do not reflect the Mitigation Agreement discussed in Sect. 2.1.3.2.*
[b]*The NAAQS are absolute limits established in accordance with existing Clean Air Act provisions to protect public health and welfare with an adequate margin of safety.*
[c]*Background concentrations are based on Park Monitoring Station data from the 12-month monitoring period from September 1990 through August 1991.*
[d]*Maximum concentrations predicted by computer models resulting from HCCP and Healy Unit No. 1 emissions.*
[e]*Total impact is calculated as the sum of the ambient background concentration and the modeled concentration.*

Table 5.2.3. National Ambient Air Quality Standards (NAAQS) impact analysis for the combined effects of Healy Unit No. 1 and the Healy Clean Coal Project (HCCP) (demonstration and permitted cases) within Denali National Park and Preserve (DNPP)[a]

				Demonstration case			Permitted case		
Pollutant	Averaging period	NAAQS[b] (μg/m³)	Ambient background concentration[c] (μg/m³)	Modeled concentration[d] (μg/m³)	Total impact[e] (μg/m³)	Percent of NAAQS	Modeled concentration[d] (μg/m³)	Total impact[e] (μg/m³)	Percent of NAAQS
SO_2	3-h	1300	45	188	233	18	194	239	18
	24-h	365	26	28	54	15	29	55	15
	Annual	80	5	2	7	9	2	7	9
NO_2	Annual	100	6	2	8	8	2	8	8
PM_{10}	24-h	150	31	2	33	22	2	33	22
	Annual	50	5	0.1	5	10	0.1	5	10

[a]Values presented do not reflect the Mitigation Agreement discussed in Sect. 2.1.3.2.
[b]The NAAQS are absolute limits established in accordance with existing Clean Air Act provisions to protect public health and welfare with an adequate margin of safety.
[c]Background concentrations are based on Park Monitoring Station data from the 12-month monitoring period from September 1990 through August 1991.
[d]Maximum concentrations predicted by computer models resulting from HCCP and Healy Unit No. 1 emissions.
[e]Total impact is calculated as the sum of the ambient background concentration and the modeled concentration.

Table 5.2.4. Number of daytime hours during the year calculated by the PLUVUE I model that the NO_2 plume burden from Unit No. 1 and the Healy Clean Coal Project (HCCP) (permitted case) exceeded a visual threshold of 150 ppbv·km in the sight paths from the Denali National Park and Preserve (DNPP) Visitor Access Center

Emission source	*North sight path*	*South sight path*	*Total* [a]
HCCP (permitted case)	*4*	*9*	*9*
Unit No. 1	*5*	*5*	*6*
Unit No. 1 plus HCCP [b]	*15*	*23*	*26*

[a]*The total is less than the sum of the north and south sight paths because of some hours in which the threshold was simultaneously exceeded in both sight paths.*

[b]*Based on modeling the NO_2 emissions from both sources rather than summing the previous two lines (the columns do not add up because the modeling was performed separately for each emission source and the combination of the two emission sources).*

Although the estimates are greater than for the HCCP alone, the number of hours is still small: ***15 h for the north sight path, 23 h for the south sight path, and a total of 26 h.*** The predicted number of hours is slightly greater than for the corresponding cumulative plume associated with the demonstration case. The percentage of hours affected is less than 1% of ***daytime*** hours during the year.

Model predictions indicated no hours in which a plume might be perceptible at the DNPP Northeast Unit. For cumulative emissions from the simultaneous operation of the HCCP (permitted case) and Unit No. 1, the maximum NO_2 burden was predicted by PLUVUE I to be 137 ppbv·km which is less than the threshold for perception of 150 ppbv·km.

Using the same approach as discussed in Sect. 4.3.2.3, a comparison was made of the results from the PLUVUE I and PLUVUE II models for the HCCP permitted case (Table 5.2.5). PLUVUE II results are very similar to those of PLUVUE I in showing that the predicted number of hours in which an HCCP plume is expected to be perceptible is very low: 2 h for the north sight path and 6 h for the south sight path. The percentage of hours affected is much less than 1% of the approximately 4380 h per year of daytime. Cumulative visibility impacts of air emissions resulting from the simultaneous operation of the HCCP permitted case and Healy Unit No. 1 also were evaluated using PLUVUE II and are summarized in Table 5.2.5. Although the estimates are greater than for the HCCP alone, the number of hours is still small: 5 h for the north sight path and 7 h for the south sight path. Again, the percentage of hours affected is much less than 1% of daytime hours during the year. The results obtained using PLUVUE II, while slightly less than PLUVUE I, are very similar overall, and the same conclusions can be inferred from either model.

Table 5.2.5. Number of daytime hours during the year, calculated by the PLUVUE I and PLUVUE II models, that a plume from Unit No. 1 and the Healy Clean Coal Project (HCCP) (permitted case) would be perceptible in the sight paths from the Denali National Park and Preserve (DNPP) Visitor Access Center

	North sight path		South sight path	
Emission source	*PLUVUE I*	*PLUVUE II*	*PLUVUE I*	*PLUVUE II*
HCCP (permitted case)	4	2	9	6
Unit No. 1	5	3	5	1
Unit No. 1 plus HCCP[a]	15	5	23	7

[a]*Based on modeling the NO_2 emissions from both sources rather than summing the previous two lines (the columns do not add up because the modeling was performed separately for each emission source and the combination of the two emission sources).*

For the same reasons and using the same approach as discussed in Sect. 4.3.2.3, an analysis was performed for the HCCP permitted case to evaluate the sensitivity of visibility modeling to (1) the value used for the perceptibility threshold and (2) the extension of the sight paths beyond the DNPP boundary (Sonoma Technology, Inc., 1993c). Table 5.2.6 presents the results of the sensitivity analysis. The first column for each sight path and for the total, denoted as the "DOE case," gives the results as presented in this final EIS (Table 5.2.4). The second column indicates how the results change by extending the sight path, while the third column shows how the results change by using 69 ppbv·km rather than 150 ppbv·km for the perceptibility threshold. Finally, the fourth column indicates the results of using both the extended sight path and the 69 ppbv·km threshold.

The modeling is more sensitive to changing the perceptibility threshold than extending the sight paths, as indicated by a greater increase from the DOE case in the number of hours in the third column than in the second column. The modeling is extremely sensitive to changing both parameters simultaneously, as indicated by the greatest increase in the number of hours in the fourth column. The north sight path is more sensitive than the south sight path. As discussed in Sect. 4.3.2.3, DOE believes that the "DOE case" is most appropriate because the predicted Unit No. 1 results most nearly match the actual experience from human observers and the evidence of time-lapse cameras, which have not detected any plumes from Unit No. 1.

5.3 *HCCP* RETROFIT CASE

The third scenario consists of an unsuccessful demonstration; subsequently, the HCCP would be converted to a coal-fired power plant that uses best available control technology, including low-NO_x

Table 5.2.6. Sensitivity analysis of the number of daytime hours during the year that a plume from Unit No. 1 and the Healy Clean Coal Project (HCCP) (permitted case) is predicted to be perceptible

Emission source	North sight path				South sight path				Total[a]			
	DOE case	Extended sight path	Threshold of 69 ppbv·km	Change in both parameters	DOE case	Extended sight path	Threshold of 69 ppbv·km	Change in both parameters	DOE case	Extended sight path	Threshold of 69 ppbv·km	Change in both parameters
HCCP (permitted case)	4	15	54	237	9	13	46	58	9	24	55	240
Unit No. 1	5	13	42	143	5	9	29	46	6	17	42	145
Unit No. 1 plus HCCP[b]	15	78	125	317	23	28	71	123	26	85	129	329

[a]The total is less than the sum of the north and south sight paths because of some hours in which the threshold was simultaneously exceeded in both sight paths.

[b]Based on modeling the NO_2 emissions from both sources rather than summing the previous two lines (the columns do not add up because the modeling was performed separately for each emission source and the combination of the two emission sources).

burners to burn pulverized coal and dry scrubbers utilizing lime for flue gas desulfurization. The baghouse would continue to be used to remove PM from the flue gas. The dry scrubbers would generate solid waste that, along with the PM from the baghouse, would be returned to the UCM Poker Flats mine for disposal.

For most resource areas, the level of impacts for this scenario would be almost identical to those discussed in Sect. 4 for the HCCP demonstration because the resource requirements and discharges are nearly identical. Surface water, groundwater, ecological, and socioeconomic impacts are not expected to change substantially; expected changes in impacts are discussed in the following paragraphs.

Minor effects would be expected during the dismantling and removal of HCCP components and during the delivery and installation of components for the retrofit case. The type of impacts would be similar to those described for construction impacts in Sect. 4. The level of impacts would generally be less than in Sect. 4 because much of the HCCP facility would not require modification during the retrofitting process. In addition, the HCCP would not be operating during the process so that dismantling and installation impacts would be offset by the lack of operational impacts during the period.

Coal requirements for the retrofit case would be similar but not identical to the HCCP demonstration case. It is expected that run-of-mine coal from the UCM mine would be used without blending waste coal. Consequently, because the heating value of run-of-mine coal is greater than blended coal (7815 vs 6960 Btu/lb) (Table 2.1.1), the amount of run-of-mine coal required for the retrofit case would be about 90% of the blended coal required for the HCCP. Because the ash content of run-of-mine coal is considerably less than that of blended coal (8 vs 17%) (Table 2.1.1), the retrofit case would be expected to generate about 50% less ash following combustion. Fewer trips, involving less ash, would be required to return the ash to the UCM mine.

The amount of mining required would be greater for the retrofit case than for the HCCP demonstration case because about 50% of the coal used by the HCCP would be waste coal uncovered during mining for run-of-mine coal. It is estimated that the retrofit case would require about a 10% increase in total mining operations at the UCM mine as compared with the HCCP. Therefore, it is expected that PM emissions from fugitive dust during mining would be about 10% greater for the retrofit case. However, because fugitive dust consists primarily of large particles that settle quickly to the ground and because other sources (e.g., forest fires, wind-blown glacial silt) contribute to ambient ground-level PM concentrations, increases in ambient concentrations from mining for the retrofit case are expected to be less than 10% (compared with the HCCP).

Operational air emissions would be greater for the retrofit case than for the HCCP demonstration case because the retrofit case, like the permitted case, would only meet permitted levels rather than emit less than permitted levels. In addition to the same level of emissions, it is assumed that the retrofit case would have the same source parameters as the permitted case (e.g., stack height, flue

gas exit velocity and temperature). Therefore, the retrofit case would result in impacts to atmospheric resources, including visibility, that would be at the same level as the permitted case (the previously discussed second scenario). CO_2 emissions for the retrofit case would be approximately the same as the demonstration case and permitted case because of the compensating effects of using a smaller amount of coal vs a higher Btu content of the coal (run-of-mine coal would be used without blending waste coal).

The scenario for the retrofit case is almost identical to the scenario described as a no-action alternative in which a conventional coal-fired power plant equivalent in capacity to the HCCP with conventional flue gas desulfurization would be built at Healy by the project participants without DOE's financial assistance (Sect. 2.2.1). The impacts for this no-action scenario are expected to be almost identical to those previously described for the retrofit case.

5.4 MITIGATION MEASURES

No NAAQS or PSD standards would be violated if the HCCP continued to operate under the demonstration or permitted/retrofit cases. However, the consequences of operation of the HCCP in conjunction with Healy Unit No. 1 could potentially result in minor visibility degradation. *This section describes potential mitigation options to reduce overall air emissions from the Healy site, and discusses the technical, environmental, and economic feasibility of implementing those mitigation measures. It also describes the steps which DOE, DOI, AIDEA, and GVEA have agreed to take to implement certain of these mitigation measures.*

5.4.1 Background

Visibility analyses performed using computer models suggest that potential visibility impairment within DNPP from a coherent plume would be largely a function of NO_x emissions, and contributions to regional haze would be largely related to SO_2 emissions. The evaluations presented in this section have thus focused upon reduction of NO_x and SO_2 emissions that could be accomplished through installation of control technology and/or operational/administrative constraints for Unit No. 1.

Figure 5.4.1 uses a bar chart to characterize NO_x and SO_2 emissions for several combinations of Unit No. 1 and HCCP operating conditions. All combinations conservatively assume a 100% capacity factor for both facilities. Because of scheduled and unscheduled outages, virtually no electrical generating facility would be capable of operating at a 100% capacity factor (an 85% capacity factor is typical); therefore, actual emissions are expected to be lower. The first bar presents Unit No. 1 emissions allowed under the existing permit. The second bar gives estimates of actual emissions from Unit No. 1, which are considerably less than permitted emissions, especially for NO_x emissions. Actual Unit No. 1 emissions are somewhat variable, but these estimates are within the range of variability and

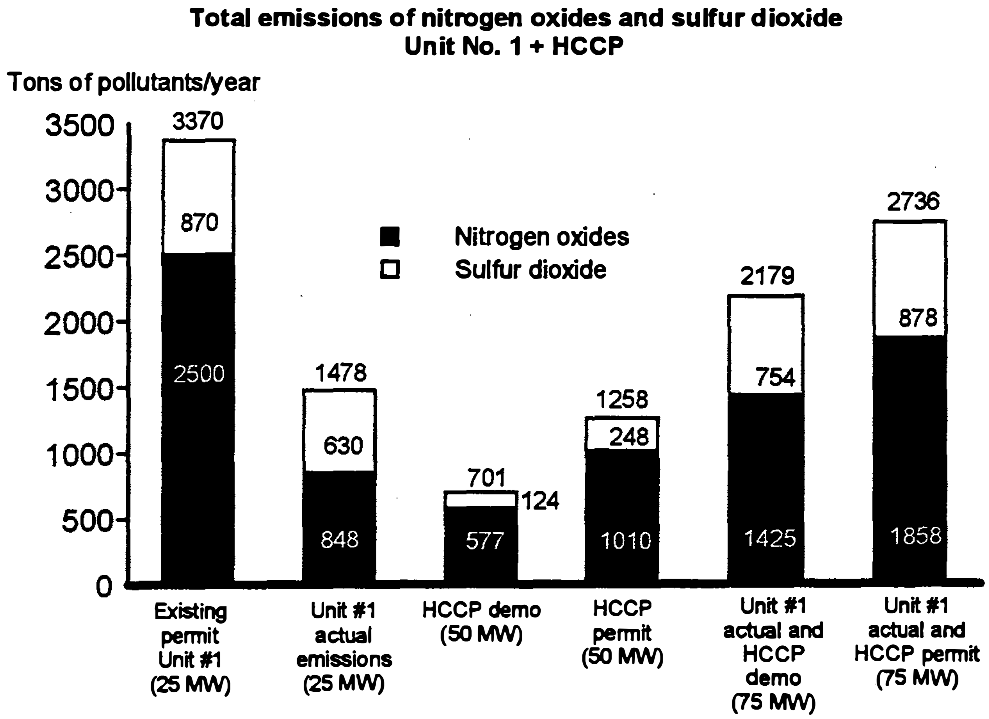


Fig. 5.4.1. Total site NO_x and SO_2 emissions for the Healy Unit No. 1 and Healy Clean Coal Project facilities. Emission levels are for a 100% capacity factor.

are considered reasonable values. The third bar presents the very low emissions that are the target objectives for the HCCP demonstration case. Whether these objectives are achievable for the HCCP remains to be demonstrated. The fourth bar gives the HCCP permitted case, which is the upper bound for emissions that could occur if the HCCP does not achieve its target emissions. Even for the permitted case, HCCP emissions per MW of electricity generated are lower than actual Unit No. 1 emissions. The fifth and sixth bars display Unit No. 1 actual emissions combined with HCCP emissions for the demonstration case and permitted case, respectively.

A range of representative options was evaluated to mitigate the increase in site emissions resulting from demonstration and commercial operation of the HCCP. Unit No. 1 has historically operated and currently operates well within its permit requirements and has no requirement to reduce its emissions. However, Unit No. 1 does offer an opportunity to partially offset incremental HCCP emissions of NO_x and/or SO_2 through installation of retrofit emission control systems and operational-administrative constraints. Therefore, the following descriptions of control technologies for NO_x and SO_2 evaluate the technical, environmental, and economic feasibility of installing and operating each technology on Unit No. 1.

Cost estimates prepared for the economic analyses are preliminary and were based on the typical cost of retrofitting that technology to a similar source; the estimates did, wherever possible, take into consideration the physical constraints and location of Unit No. 1 in Alaska. Annualized cost estimates were based on a 20-year remaining plant life for Unit No. 1.

Stand-alone technologies for controlling NO_x emissions are addressed in Sect. 5.4.2, and those for controlling SO_2 emissions are addressed in Sect. 5.4.3. Two additional processes or strategies that were also considered for combined NO_x and SO_2 control, the SNOX process and operational-administrative controls, are addressed in Sect. 5.4.4.

5.4.2 Description of Healy Unit No. 1 Retrofit Control Technologies for NO_X

The ability to retrofit is an important characteristic to be considered in the identification of potential control alternatives for Healy Unit No. 1. To identify NO_x control processes for retrofit to Unit No. 1, a representative range of available NO_x control techniques was reviewed. From this review, the representative NO_x control technologies selected were (1) selective catalytic reduction/selective noncatalytic reduction and (2) low-NO_x burners. The feasibility of retrofitting each of these technologies to Unit No. 1 is discussed in the following paragraphs.

5.4.2.1 Selective Catalytic Reduction (SCR)/Selective Noncatalytic Reduction (SNCR)

SCR systems utilize ammonia as a reducing agent in a gas-phase reaction with NO_x to form nitrogen and water. The reactions are facilitated by a proprietary metal catalyst (usually a vanadium-titanium formulation). The catalytic reactor is generally placed after the economizer and upstream of the air heater to obtain the desired reaction temperature. Gaseous ammonia is injected immediately upstream of the reactor at a rate that is determined by continuous measurements of the exhaust flue gas NO_x concentration.

Ammonia-based SCR systems have been used extensively for NO_x reduction on gas turbine installations and a few natural gas boilers. SCR has not been demonstrated commercially, however, on any coal-fired units in the United States. Substantial technical and environmental problems arise with the process when installed on a coal-fired facility. These problems are being addressed by several organizations [e.g., DOE, EPA, and the Electric Power Research Institute (EPRI)] using a variety of research and demonstration programs. To date, however, SCR has not been shown to be commercially feasible on any U.S. boilers burning coal. The technology, if successful, may be capable of relatively high levels of NO_x reduction (i.e., 50% to 80%). A 60% NO_x reduction is assumed in the following analyses.

SNCR of NO_x with ammonia or urea as the reagent is similar to SCR in that NO_x is chemically reduced to molecular nitrogen and water vapor by reaction with a reagent compound. The major difference between the two general processes is that in the SNCR techniques, the NO_x reduction *reactions take place homogeneously in the gas phase within a specific thermal window (approximately 1600 to 2000°F). In the SCR technique, similar reactions take place at lower temperatures (approximately 600 to 750°F), but on the surface of a catalyst. Many of the advantages and potential problems associated with SCR are also common to SNCR, with the additional consideration that NO_x removal levels available from application of SNCR are typically only about half of those possible with SCR. Consequently, while not specifically addressed here as a separate mitigation option, the applicability of SNCR for retrofit to Unit No. 1 for NO_x control is effectively treated within the discussion and analyses conducted for SCR.*

SCR has major environmental drawbacks, particularly involving the use of ammonia. Operation of SCR requires that excess ammonia be injected in the flue gas to maintain the desired NO_x reduction efficiency. The excess ammonia that does not react with NO_x passes through the unit and is emitted to the atmosphere. A typical design basis for a coal-fired application places the level of ammonia slip at about 5 ppm. This level can rapidly increase, however, as the catalyst degrades. However, even the 5 ppm level can be significant because ammonia is considered by EPA to be a hazardous substance under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) (40 CFR Part 302) and an extremely hazardous substance under the Superfund Amendments and Reauthorization Act (SARA) (40 CFR Part 355).

In addition, there is a danger of ammonia spills during transportation, transfer, storage, and on-site use. These events could have potentially major environmental, health, and safety consequences.

The content of ammonium compounds in the fly ash can also have an adverse impact on waste disposal and marketing practices because these compounds decompose and release ammonia at elevated pH levels. If SO_2 controls involving injection of lime or limestone byproducts were also implemented on Unit No. 1, the ash would be high in alkaline content. Under these conditions, even slight wetting (e.g., condensation of atmospheric moisture on the ash material, rain or snow, or wetting for dust suppression during ash transport) could result in an ammonia odor problem. In addition, the chemistry of the ash could change (e.g., it could contain toxic compounds) such that is could not be disposed of at the UCM mine. Disposal of ash at another location would substantially increase the cost of ash disposal.

Another detrimental environmental effect of SCR results from disposal of the spent catalyst. Most SCR catalysts contain around 5% vanadium pentoxide (V_20_5). In its pure commercial-grade form, V_20_5 is considered a hazardous material by EPA (40 CFR Part 302).

The use of SCR for retrofit to the Unit No. 1 steam generator would also have energy penalties in terms of electricity needed to operate the SCR unit and a decrease in the efficiency of the unit. Additional energy is required because of the electricity consumption of the SCR and the efficiency loss due to pressure drop across the catalyst reactor.

A conservative but realistic NO_x removal efficiency of 60% was assumed for an SCR retrofit on Unit No. 1. The annualized cost of installation and operation of the SCR technology on Unit No. 1 is estimated at $2,700,000 or $5,305/ton of NO_x removed.

5.4.2.2 Low-NO_x Burners

Low-NO_x burners are a combustion control technology that is specific to pulverized-coal furnaces. Concurrent with a replacement of the existing burners at Healy Unit No. 1 with low-NO_x burners, the mills that pulverize the coal would also need to be replaced.

Low-NO_x burner controls are proven reliable and are commercially available. Low-NO_x burners do not create waste products that require disposal, and do not use catalyst materials that deteriorate over time and eventually require disposal themselves. Operation of low-NO_x burners may cause a slight reduction in efficiency and may cause an increase in unburned carbon in the fly ash.

Up to a 50% reduction in NO_x emissions could be anticipated following a low-NO_x burner retrofit of Unit No. 1. The annualized cost of installation and operation is estimated to be $644,000 or $1,519/ton of NO_x removed.

5.4.3 Description of Healy Unit No. 1 Retrofit Control Technologies for SO_2

The SO_2 control technologies considered as representative for potential retrofit to Healy Unit No. 1 are limestone scrubbing with forced oxidation (LSFO), lime spray dryers, and flash-calcinated material (FCM) duct injection. The feasibility of retrofitting each of these representative SO_2 control technologies to Unit No. 1 are discussed below.

5.4.3.1 Limestone Scrubbing with Forced Oxidation

LSFO is a wet-process technology that is located downstream of the particulate collector and induced draft fans. Flue gas enters a vertical spray tower where the flue gas is contacted with a slurry containing approximately 10% solids. The slurry contains calcium carbonate, calcium sulfite, and calcium sulfate. The flue gas is cooled when it contacts the slurry. SO_2 is absorbed into the slurry droplets where it reacts with the calcium carbonate to form calcium sulfite and calcium sulfate. In these reactions, carbon dioxide (CO_2) is given off in the reaction and exits the scrubber with the flue gas. Limestone is added to make up for the calcium carbonate consumed in the reaction with SO_2. The filter cake waste product containing 80% suspended solids is conveyed to a storage facility where it is loaded onto trucks and transported to a disposal site.

Wet LSFO processes have seen increased application in commercial utility operations. The number of full-scale LSFO operating facilities has increased from three in 1978 to over 20 in 1993.

The technology is proven for utility-sized pulverized-coal boilers. However, the high levels of SO_2 removal (greater than 95%) have generally been demonstrated on high-sulfur applications. Technical disadvantages of the LSFO process include the large amount of space required and the increased maintenance costs due to scale formation in the scrubber and outlet ductwork.

A major environmental disadvantage of the LSFO process is that the amount of waste generated by the LSFO is greater than that for the other FGD processes. This is because the waste material, calcium sulfate, has a higher molecular weight than wastes from the other processes and 20% of the waste, by weight, is water. Since the waste contains water from the scrubbing process and this water is usually high in total dissolved solids (TDS), there is a greater potential for leaching of TDS into ground and surface waters. Also, because of the high water content of the wastes, handling of the waste material becomes more difficult and transport back to the UCM mine may not be possible without specialized transport equipment.

An additional environmental disadvantage of the LSFO process is that the plume would be completely saturated and not reheated. This would result in less plume rise than would occur for other processes. Furthermore, in subarctic climatic conditions, ice crystals in a fully saturated plume have an increased probability of surviving transport to the nearest boundary of DNPP.

An LSFO system would use about 2% of the unit's net generation, which is equivalent to 0.5 MW of the 25 MW generated by Unit No. 1.

It is reasonable to assume that the SO_2 removal efficiency for an LSFO retrofit on Unit No. 1 would be about 90%. The annualized cost of installation and operation is estimated at $2,670,000 or $4,715/ton of SO_2 removed.

5.4.3.2 Lime Spray Dryer FGD

A lime spray dryer FGD system is essentially the same as the Activated Recycle SDA process proposed for the HCCP. The principal difference between the two processes is the type of alkali used and the point at which it is introduced into the process.

Pebble lime (CaO) is used in the lime spray dryer FGD system. Pebble lime is not currently manufactured in Alaska, and the nearest source is in the Tacoma, Washington, area. Pebble lime could be transported to the Healy site and stored in a silo. From the silo it would be conveyed into a feeder and then into a slaker for conversion into a milk of lime slurry. The milk of lime slurry, along with slurried recycle solids, would be fed into a spray dryer atomizer, where it reacts with the SO_2 in the flue gas to form calcium sulfate and calcium sulfite.

Lime spray dryers have been shown to be capable of removing 90% of the SO_2 from medium- or high-sulfur coals. As with the wet LSFO process, applying lime spray drying to flue gas following combustion of the low-sulfur coal used by Unit No. 1 may increase the difficulty of attaining a high percentage of SO_2 removal and may substantially increase costs of applying the technology. A removal efficiency of 70% is considered reasonable for a retrofit of a lime spray dryer on Unit No. 1.

The major advantages of the lime spray dryer system over the wet LSFO system are that a dry waste product is formed; waste products would be transported by the existing ash handling system, so a separate waste handling system would not be required; a flue gas reheat system would not be required since the flue gas is not fully saturated; and because the flue gas is not fully saturated, carbon steel construction could be utilized and exotic alloys and linings would not be required.

Environmental effects from the lime spray dryer process would be less than that for the wet LSFO process. The flue gas from the lime spray dryer process is not completely saturated with moisture and would be discharged into the atmosphere at a higher temperature and velocity and attain a higher plume rise which aids in the dispersion of the plume and reduces ground-level concentrations of pollutants. The dry waste product would not have moisture available for contaminating ground or surface waters and would be more easily transported to the UCM mine for disposal.

The annual power requirement for the lime spray dryer FGD system would be 0.7% of Unit No. 1 net generation (0.2 MW).

Assuming an SO_2 removal efficiency of 70% for a lime spray dryer retrofit on Unit No. 1, the annualized cost of installation and operation is estimated at \$940,000 or \$2,132/ton of SO_2 removed.

5.4.3.3 Duct Injection of Flash-Calcined Material (FCM)

A potential option for capture of SO_2 from the Healy Unit No. 1 system is the injection of FCM generated by the HCCP into the ductwork of Unit No. 1 upstream of the fabric filter. FCM would be conveyed from the HCCP sorbent activation system to Unit No. 1, where it would be sprayed by nozzles under pressure into the flue gas ductwork. Controlled humidification might also be added, if necessary, to enhance the reaction of the FCM with the SO_2 in the flue gas. SO_2 would be captured through reaction with FCM in the flue gas stream as well as on the surface of the fabric filter media in the baghouse. The FCM material would be collected with the fly ash and disposed of with the fly ash at the UCM mine.

Numerous studies and tests have been performed on duct injection of lime and limestone, but duct injection of FCM has not been tested. However, because FCM has been shown to have reactivity rates comparable to lime, it is expected that the FCM would offer adequate reactivity for use in a duct injection system. An SO_2 capture rate of up to 25% is a reasonable possibility with this technology on *the low-sulfur coal used by Unit No. 1. The FCM is a byproduct of the HCCP process, and only a portion of the FCM is actually recycled in the HCCP while the remainder is sent to disposal. Additional limestone might be needed to maintain the required levels of FCM for use in both the HCCP and Unit No. 1.*

This technology has the potential advantages of utilizing FCM that would otherwise be disposed of and requiring relatively minor equipment modifications. These equipment modifications would include an extension of the HCCP injection system piping to the Unit No. 1 flue gas duct upstream of the existing baghouse, increasing the HCCP injection blower discharge pressure, and the addition of FCM injection nozzles to be installed in the Unit No. 1 ductwork.

Assuming an SO_2 removal efficiency of 25% for a duct injection FCM system retrofit on Unit No. 1, the annualized cost of installation and operation is estimated at $17,000 or $106/ton of SO_2 removed.

5.4.4 Description of Healy Unit No. 1 Combined Control Technologies and Strategies for NO_x and SO_2

This section discusses two means of simultaneously reducing emissions of NO_x and SO_2: (1) the SNOX technology, and (2) operational procedures and administrative control strategies.

5.4.4.1 SNOX

The SNOX process catalytically removes NO_x and SO_2 without the use of sorbents, with only salable sulfuric acid as a "waste" product (other than ash). The SNOX process is currently under demonstration at Unit No. 2 of the Niles Station power plant, operated by the Ohio Edison Company in Niles, Ohio. Objectives of the demonstration include removal efficiencies of 95% for both NO_x and SO_2.

The SNOX technology consists of five key process areas: particulate collection, NO_x reduction, SO_2 oxidation, sulfuric acid condensation, and acid conditioning. The Ohio SNOX project has demonstrated short-term removal efficiencies of over 90% for NO_x and SO_2 using 2.8% sulfur coal. The SNOX process is designed to operate most efficiently using high-sulfur coals, and efficiencies decrease with decreasing coal sulfur content.

At this time the technology has not been sufficiently tested for use in the United States and is not commercially available. However, the method is discussed here for comparative purposes. In Alaska, there is probably no market for the quantities of sulfuric acid that would be produced; therefore, the acid would have to be shipped out of state. Sulfuric acid is a hazardous and corrosive material, and its shipment would pose additional environmental risks.

Assuming a conservative but reasonable 80% removal efficiency of both NO_x and SO_2 for a SNOX retrofit on Unit No. 1, the annualized cost of installation and operation of the SNOX technology is estimated at $5,090,000 or $4,308/ton of both SO_2 and NO_x removed.

5.4.4.2 Operational-Administrative Controls of Healy Unit No. 1

Operational Controls. *Adjustments to the operating parameters of Unit No. 1 could take the form of combustion tuning to further reduce NO_x emissions. This approach, if applicable to Unit No. 1, could reduce NO_x emissions by about 15% but would not affect SO_2 emissions. The technique would be implemented by conducting a test program on the unit to ascertain the extent to which air-fuel mixtures may be minimized or modified to reduce NO_x emissions. While capital costs associated with these techniques are generally quite low (consisting mainly of the costs to perform the test program), implementation may result in reduced power plant efficiency. Installation and operation of a continuous emission monitoring system to monitor changes in short-term emission levels would also be required.*

It may also be possible to reduce SO_2 emissions by arranging for UCM to provide coal that has lower sulfur levels. However, this would require stockpiling of lower sulfur coal by UCM or the saving of lower sulfur coal seams for specific use by Unit No. 1. Both of these options would severely hinder UCM mining operations, and would be impractical over the long term. Due to the already ultra-low sulfur content of UCM coal, reductions in sulfur content of coal delivered to Unit No. 1 would be small, even if it were technically feasible for UCM to mine a consistently lower sulfur content coal for Unit No. 1. Mining of a separate run-of mine product for Unit No. 1 would likely increase the quantity of waste coal generated by UCM, thereby reducing the efficiency of the HCCP with respect to waste coal utilization.

Because the specific form of adjustments to operating parameters to reduce emissions and the viability of stockpiling lower sulfur coal could not be determined in the absence of engineering investigations, capital and operating cost estimates for these options could not be prepared.

Administrative Controls. *Administrative controls of Healy Unit No. 1 operations could include: (1) short-term reductions in operating load in response to a visibility-impairing event attributable to the combined site emissions, (2) reductions in plant capacity factor through long-term load reduction, or (3) reductions in plant capacity factor by operating Unit No. 1 at full capacity only during a portion of the year and shutting down the unit during the remainder of the year.*

Short-Term Load Reductions. *If a visibility impairing event were to be reported and documented as occurring, the load on Unit No. 1 could be reduced to decrease total site emissions. This administrative action would reduce the SO_2 emissions in direct proportion to the reduction in the coal feed rate and, therefore, in proportion to load. This would also result in reduced NO_x emissions, though not in direct proportion to load because NO_x emissions are dependent upon a number of factors in addition to fuel feed rate.*

Reduction in Capacity Factor Through Long-Term Load Reduction. *Reduction in plant capacity factor through long-term load reduction would be accomplished by reducing the Healy*

Unit No. 1 load to a level below its maximum of 25 MW. To achieve a complete offset of HCCP permitted SO_2 emissions, Unit No. 1 load would need to be reduced by 40% from 25 MW to 15 MW. However, continuous operation of Unit No. 1 at only 60% load could result in increased operating costs and potential damage to the unit. Operating experience with Unit No. 1 suggests that fuel oil might need to be burned in addition to coal to maintain proper combustion temperatures at 60% load. Combined fuel firing would increase the complexity of operating Unit No. 1 and might have an appreciable impact on unit availability. In addition, this administrative control option principally addresses only reductions to SO_2 emissions.

Reduction in Capacity Factor Through Seasonal Operation. *Another administrative emissions control option is reduction in plant capacity factor by operating the Unit No. 1 facility at full capacity only during a portion of the year and shutting down the unit during the remainder of the year. To achieve an offset of HCCP permitted SO_2 emissions, the Unit No. 1 capacity factor would need to be reduced by 40%. This would be accomplished by shutting down Unit No. 1 during 40% of the year. From a visibility standpoint and based upon current modeling results, the effects of a visible plume would be addressed most effectively through a reduction in NO_x emissions during the winter, whereas the effects of regional haze would be addressed most effectively through a reduction in SO_2 emissions during the summer. From the standpoint of electrical load demand and maintenance activities, operating Unit No. 1 during the cold winter months and shutting it down during the warmer months would be most beneficial.*

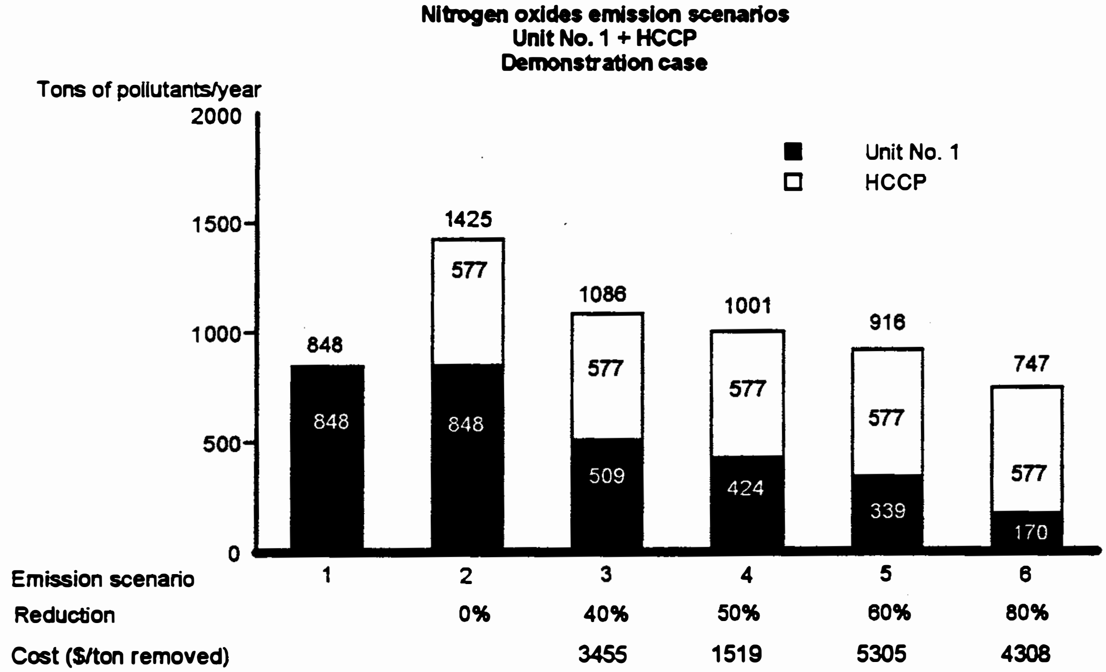
The annualized cost of shutting down Unit No. 1 for 40% of the year is estimated at $2,040,000 or $3,455/ton of both SO_2 and NO_x removed. This cost includes the replacement of lost generating capacity through the purchase of power from other electrical generating facilities in the state and the increased per unit costs of generating the remaining power production.

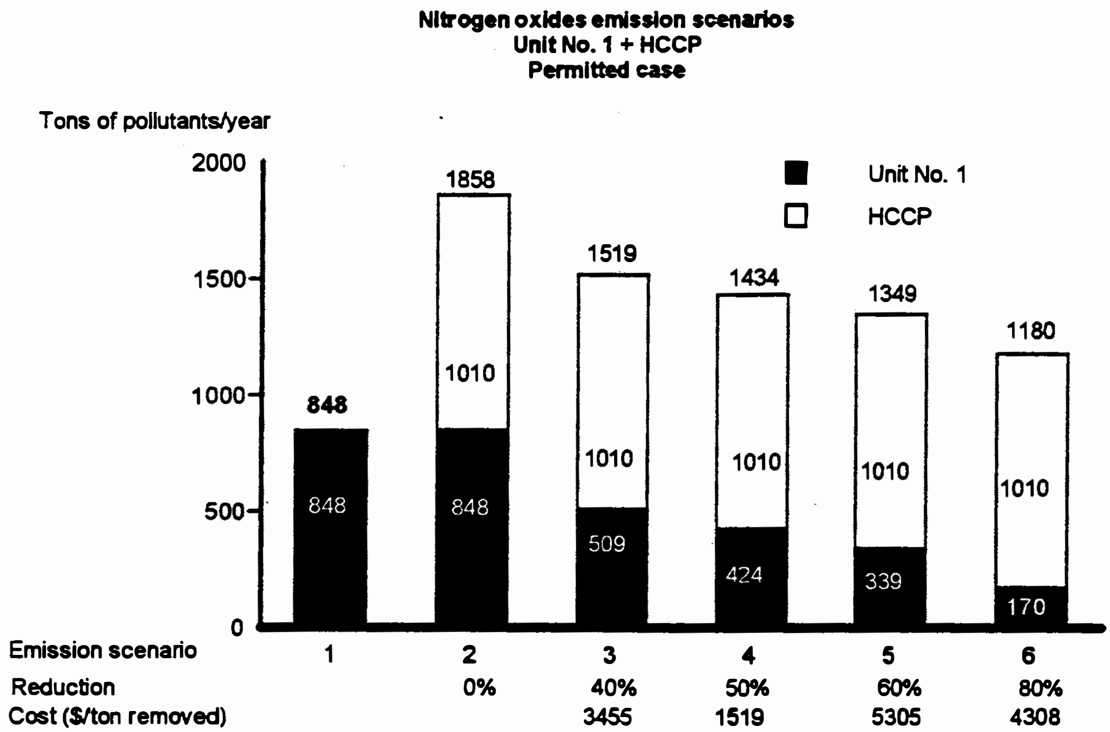
5.4.5 Comparison of Mitigation Measures

This section compares the technical, environmental, and economic viability of the mitigation measures discussed above. In particular, a comparison is made of the effectiveness of each mitigation measure at reducing sitewide NO_x and SO_2 emissions; measures are presented in order of increasing effectiveness at decreasing emissions. Actual Unit No. 1 emissions alone (without mitigation) are used as a baseline for comparison.

5.4.5.1 NO_x

Figure 5.4.2 displays actual NO_x emissions for Healy Unit No. 1 alone (Scenario 1) and in combination with the HCCP for the demonstration case and permitted case (Scenario 2). The figure





Emission scenario:

1 Unit No. 1 actual emissions
2 Unit No. 1 actual plus HCCP emissions
3 Unit No. 1 with administrative controls (40% reduction) plus HCCP emissions
4 Unit No. 1 with low nitrogen oxide burners retrofit (50% reduction) plus HCCP emissions
5 Unit No. 1 with SCR retrofit (60% reduction) plus HCCP emissions.
6 Unit No. 1 with SNOX retrofit (80% reduction) plus HCCP emissions

Fig. 5.4.2. NO_x emission reduction scenarios for Healy Unit No. 1 plus the Healy Clean Coal Project for the demonstration case and permitted case. Emission levels are for a 100% capacity factor.

also depicts Unit No. 1 with administrative controls (Scenario 3) and three retrofit NO_x emission scenarios corresponding to Unit No. 1 with low-NO_x burners, SCR, and SNOX (Scenarios 4, 5, and 6, respectively). For each of these four NO_x reduction scenarios, the reduced Unit No. 1 emissions are also combined with the HCCP for the demonstration case and permitted case.

Of the four NO_x reduction scenarios, administrative controls on Unit No. 1 operations (Scenario 3) would have the least effect on NO_x emissions. For the demonstration case, annual sitewide NO_x emissions would be 1086 tons compared with the baseline of 848 tons for actual Unit No. 1 emissions alone. For the permitted case, annual sitewide NO_x emissions would be 1519 tons. Costs would be less than for SCR and SNOX retrofit (Scenarios 5 and 6, respectively) but substantially greater than for low-NO_x burners (Scenario 4). In addition, administrative controls on Unit No. 1 would require purchase of replacement power, which could shift the source of air emissions to another locale. Air emission increases associated with generating facilities in the Anchorage or Fairbanks areas might exacerbate the nonattainment status for carbon monoxide (CO) of those airsheds, particularly during winter.

Retrofitting Unit No. 1 with low-NO_x burners (Scenario 4) would offer an option for NO_x reduction that is technically, economically, and environmentally viable. For the demonstration case, annual sitewide NO_x emissions would be 1001 tons compared with the baseline of 848 tons for Unit No. 1 emissions. For the permitted case, annual sitewide NO_x emissions would be 1434 tons. Environmental effects of low-NO_x burners are appreciably less than from either an SCR or SNOX retrofit (Scenarios 5 and 6, respectively). Low-NO_x burners are also more cost effective than SCR or SNOX technologies or administrative controls.

Using the SCR technology (Scenario 5) would nearly result in a no-net change in annual sitewide NO_x emissions for the demonstration case: 916 tons compared with the baseline of 848 tons. For the permitted case, emissions would be 1349 tons. However, because SCR has never been applied to a commercial-scale unit firing U.S. coal and has never been applied to a commercial pulverized-coal unit in either Japan or Europe using a fabric filter for particulate control, it is not considered to be a technically or economically viable option for retrofit to Unit No. 1. SNCR is also not considered to be fully demonstrated on any coal-fired source other than circulating fluidized bed boilers. Since problems comparable to those encountered in European SCR applications are expected for U.S. applications, pilot-scale studies to validate this technology on U.S. coals are still in their early stages. Both SCR and SNCR retrofit control systems are substantially less cost effective than low-NO_x burners and have major environmental disadvantages. The annualized cost of SCR technology, at \$5305/ton of NO_x removed, is the highest of the NO_x mitigation measures that have been evaluated.

Using the SNOX technology (Scenario 6) would more than offset the incremental increase in emissions for the HCCP demonstration case and result in annual sitewide NO_x emissions of 747 tons *compared with the baseline of 848 tons. For the permitted case, emissions would be 1180 tons. Although removal efficiencies might be high with the SNOX technology, it is not presently considered technically viable or commercially available, especially for the low-sulfur coal used by Unit No. 1. In addition, the high costs of the technology and environmental constraints of shipping sulfuric acid out of Alaska are substantial drawbacks to its use as a retrofit to Unit No. 1.*

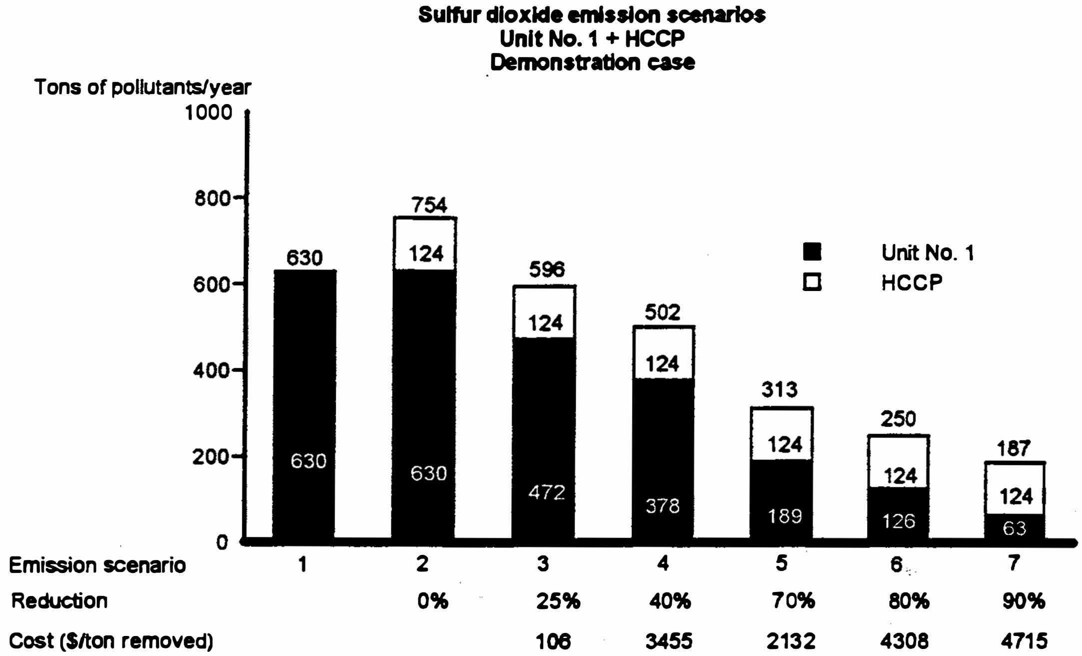
5.4.5.2 SO_2

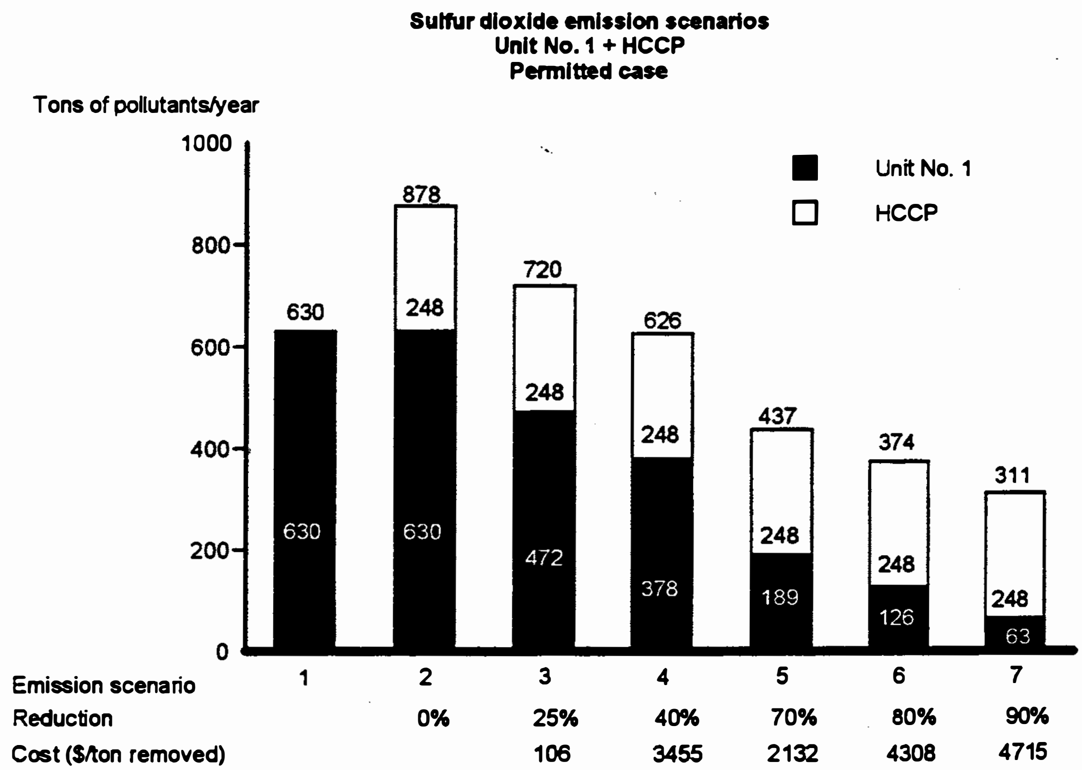
Figure 5.4.3 displays actual SO_2 emissions for Healy Unit No. 1 alone (Scenario 1) and in combination with the HCCP for the demonstration case and permitted case (Scenario 2). The figure also depicts Unit No. 1 with administrative controls (Scenario 4) and four retrofit SO_2 emission scenarios corresponding to Unit No. 1 with FCM duct injection, lime spray dryer FGD, SNOX, and LSFO (Scenarios 3, 5, 6, and 7, respectively). For each of these five SO_2 reduction scenarios, the reduced Unit No. 1 emissions are also combined with the HCCP for the demonstration case and permitted case.

FCM duct injection technology (Scenario 3) would have the least effect on SO_2 emissions of the five SO_2 reduction scenarios, but it would still more than offset the addition of the HCCP emissions for the demonstration case: annual sitewide SO_2 emissions would be 596 tons compared with the baseline of 630 tons for actual Unit No. 1 emissions alone. Even for the permitted case, sitewide emissions would increase only slightly, from 630 tons to 720 tons. FCM duct injection technology offers the practical advantages of utilizing an otherwise waste product for the SO_2 capture reagent, minimal additional production of waste, and minimal additional consumption of limestone.

Administrative controls of Unit No. 1 SO_2 emissions (Scenario 4) would have higher costs than FCM duct injection but would be more effective in decreasing emissions. For both the demonstration and permitted cases, annual sitewide SO_2 emissions would be less than the baseline of 630 tons: 502 tons for the demonstration case and 626 tons for the permitted case. Administrative controls on Unit No. 1 would require purchase of replacement power, which shift would the source of air emissions to another locale, as described in Sect. 5.4.5.1.

The lime spray dryer FGD system (Scenario 5) would be an effective retrofit option for Unit No. 1. For both the demonstration and permitted cases, annual sitewide SO_2 emissions would be much less than the baseline of 630 tons: 313 tons for the demonstration case and 437 tons for the permitted case. The cost of installing and operating the lime spray dryer would, however, be appreciably higher than for duct injection of FCM.





Emission scenario:

1 Unit No. 1 actual emissions
2 Unit No. 1 actual plus HCCP emissions
3 Unit No. 1 with FCM duct injection retrofit (25% reduction) plus HCCP emissions
4 Unit No. 1 with administrative controls (40% reduction) plus HCCP emissions
5 Unit No. 1 with lime spray dryer FGD retrofit (70% reduction) plus HCCP emissions
6 Unit No. 1 with SNOX retrofit (80% reduction) plus HCCP emissions
7 Unit No. 1 with LSFO retrofit (90% reduction) plus HCCP emissions

Fig. 5.4.3. SO_2 emission reduction scenarios for Healy Unit No. 1 plus the Healy Clean Coal Project for the demonstration case and permitted case. Emission levels are for a 100% capacity factor.

Using the SNOX technology (Scenario 6) would more than offset the incremental increase in emissions for the HCCP demonstration and permitted cases and result in annual sitewide SO_2 emissions of 250 and 374 tons, respectively, compared with the baseline of 630 tons. However, for reasons discussed in Sect. 5.4.5.1, the SNOX technology is not considered a viable retrofit technology for either NO_x or SO_2 control on Unit No. 1.

Using the wet LSFO technology (Scenario 7) would greatly reduce annual sitewide SO_2 emissions. There would be 187 tons for the demonstration case and 311 tons for the permitted case compared with the baseline of 630 tons. However, as discussed in Sect. 5.4.3.1, the disadvantages of the wet LSFO process include the increased amount of waste produced, waste handling and disposal requirements, space requirements, high costs, and a visible moisture plume during operation. Therefore, the LSFO process is not considered a viable retrofit option for Unit No. 1.

5.4.6 Mitigation Agreement

Using the above-described mitigation scenarios that would reduce emissions from the existing Healy Unit No. 1 as a basis for discussion, DOE facilitated negotiations between the project participant team (AIDEA and GVEA) and the U.S. Department of the Interior (DOI) regarding the latter's concerns that increased emissions from the combined operation of Unit No. 1 and the HCCP would adversely affect DNPP. These negotiations were successfully concluded and a Memorandum of Agreement was signed on November 9, 1993 (Appendix I), to ensure the protection of DNPP's resources from potential adverse air pollution impacts attributable to the HCCP and Unit No. 1.

The cornerstone of the Memorandum of Agreement is the planned retrofit of Unit No. 1 to reduce emissions of NO_x and SO_2. For NO_x control, the Agreement calls for Unit No. 1 to be retrofitted with low-NO_x burners with overfire air (if technologically feasible) after the start-up of the HCCP. GVEA has agreed to reduce Unit No. 1 NO_x emissions by approximately 50%, from 848 tons per year to 429 tons per year. This NO_x control is very similar to Scenario 4, described in Sect. 5.4.5.1. The Agreement also requires that SO_2 emissions from Unit No. 1 be reduced by 25%, from 630 tons per year to 472 tons per year, using duct injection of a sorbent (e.g., FCM or lime). This SO_2 control is very similar to Scenario 3, described in Sect. 5.4.5.2. Under the Agreement, these emissions limits will be monitored with continuous emission monitoring equipment.

The Agreement requires that the permit to operate issued by the ADEC reflect the new reductions in emissions from Unit No. 1. Also, GVEA has agreed to implement administrative controls (reduce Unit No. 1 output) if DNPP experiences any visibility impacts. In addition, Section IV of the procedures for implementing the Agreement provides for the renegotiation of the Agreement if visibility impacts occur more than 10 times during any six-month period. In addition, two years after start-up of the HCCP and as otherwise agreed, GVEA and the DNPP superintendent would meet to evaluate these *procedures and discuss additional reasonable measures, if necessary, to protect air quality related values of DNPP, including measures applicable to ice and/or steam plumes. Furthermore, the Agreement establishes that if the HCCP successfully attains the low level of emissions expected for the demonstration case, then GVEA would request that ADEC reduce SO_2 and NO_x emission limits in the HCCP's operating permit to match achieved emission levels. The Agreement also states that DOI shall withdraw its request to the ADEC to reconsider the issuance of the operating permit, and that the mitigation terms and conditions of the Agreement shall be incorporated into and become enforceable requirements in the permit which allows the HCCP and Unit No. 1 to operate.*

Table 5.4.1 compares the operating characteristics for the existing and retrofitted Unit No. 1 alone and in combination with the HCCP demonstration case. This table is based on a 90% capacity factor for Unit No. 1 and an 85% capacity factor for the HCCP, except that the SO_2 and NO_x emissions for the retrofitted Unit No. 1 are based on the permitted emission limits given in the Memorandum of Agreement (Appendix I). The table indicates that most of the characteristics for the unmitigated vs retrofitted Unit No. 1 (i.e., Column 1 vs Column 2, and Column 3 vs Column 4) are identical except for the reduction in SO_2 and NO_x emissions for the mitigated Unit No. 1. Many of the characteristics are unchanged from those described and analyzed in the draft EIS because the waste FCM from the HCCP is expected to be used again in the duct injection for the retrofitted Unit No. 1. The changes in the retrofitted Unit No. 1 coal consumption and air emissions of CO and CO_2 reflect a 1% increase in coal consumption to offset an anticipated 1% decrease in overall efficiency due to the use of low-NO_x burners in the retrofitted Unit No. 1. The increase in process water consumption is for the retrofitted Unit No. 1 FCM injection system. Overall, potential impacts associated with air quality, visibility, and regional haze would be expected to decrease following the Unit No. 1 retrofit, while changes in impacts to other resources would be minimal.

Figure 5.4.4 illustrates the terms of the Memorandum of Agreement by comparing NO_x and SO_2 emissions for the existing Unit No. 1 alone with NO_x and SO_2 emissions for the simultaneous operation of the retrofitted Unit No. 1 and the HCCP for the demonstration and permitted cases. Emissions for the combined operation of the existing Unit No. 1 and the HCCP (permitted case) are also shown for comparison. All scenarios assume a 100% capacity factor for both units. If the HCCP demonstration technology operates as expected, combined NO_x and SO_2 emissions from the Healy site with the Unit No. 1 retrofit would increase by only about 8%, from 1478 tons per year to 1602 tons per year, even though electrical generation would increase from the existing 25 MW to 75 MW for the two units. If the HCCP demonstration fails to meet project objectives for air emissions but attains permitted levels, then the combined emissions from the Healy site with the Unit No. 1 retrofit would be capped at 2160 tons per year under the Agreement. This is a reduction of 576 tons per year from the permitted case for the original project, as described and analyzed in the draft EIS.

Table 5.4.1. Operating characteristics for the existing and retrofitted Healy Unit No. 1 alone and combined with the proposed Healy Clean Coal Project (HCCP) (demonstration case)

Operating characteristics	Existing Healy Unit No. 1[a]	Retrofitted Healy Unit No. 1[b]	Existing Unit No. 1 Plus HCCP[c]	Retrofitted Unit No. 1 Plus HCCP[c]
Capacity, MW	25	25	75	75
Capacity factor, %[d]	90	90	-	-
Power production, MWh/year	196,300	196,300	582,100	582,100
Size of site, acres	65	65	65	65
Coal consumption, tons/year	174,300	176,000	518,900	520,600
Limestone consumption, tons/year	0	0[e]	5,600	5,600
Water consumption				
Cooling water, 10^6 gal/year	6,150	6,150	18,650	18,650
Wastewater, 10^6 gal/year	0	0	40	40
Process water, 10^6 gal/year[f]	154	165	281	292
Air emissions				
Sulfur dioxide, tons/year	567[g]	472[h]	670	575
Nitrogen oxides, tons/year	763[i]	429[h]	1,243	909
Particulate matter, tons/year	22[j]	22[e]	58	58
Carbon monoxide, tons/year	51[k]	52[hk]	531	532
Carbon dioxide, tons/year	288,300[k]	291,200[k]	799,900	802,800
Effluents				
Wastewater discharges, 10^6 gal/year	0	0	87	87
Cooling water, 10^6 gal/year	6,150	6,150	18,650	18,650
Winter temperature rise above ambient (30 ft downstream from HCCP outfall), °F	5	5	14.3	14.3
Solid waste				
Slag/Bottom ash, tons/year	1,550	1,550	47,300	47,300
Fly ash, tons/year	13,950	13,950	25,400	25,400
Scrubber waste[l], tons/year	0	5,550[m]	5,550	5,550

[a]Based on a 90% capacity factor, which approximates historical operating conditions for Healy Unit No. 1.

[b]Modifications made to Healy Unit No. 1 after construction of proposed HCCP based on Memorandum of Agreement in Appendix I.

[c]HCCP based on the demonstration case with an 85% capacity factor.

[d]Capacity factor is the ratio of the energy output during a period of time to the energy that would have been produced if the equipment had operated at its maximum power during that period.

[e]Since Unit No. 1 retrofit technology for SO_2 control utilizes FCM scrubber waste from HCCP, limestone consumption by either unit will not increase above HCCP levels.

[f]Process water consumption includes water consumed by the HCCP process and water discharged as vapor.

[g]Based on 90% of actual emissions of 630 tons/year.

[h]Reduced Unit No. 1 emissions based on Memorandum of Agreement in Appendix I. New permit emission limits will take effect following construction of proposed HCCP.

[i]Based on 90% of actual emissions of 848 tons/year.

[j]Based on 90% of actual emissions of 24 tons/year. Permitted emissions are 161 tons/year.

[k]Based on actual emissions. Emissions are not subject to permit limitations.

[l]Scrubber waste is limestone-based particulate emissions.

[m]The scrubber waste from the HCCP will be utilized in the Unit No. 1 FCM injection system. Total scrubber waste generated by both units will be equal to the scrubber waste generated by the HCCP.

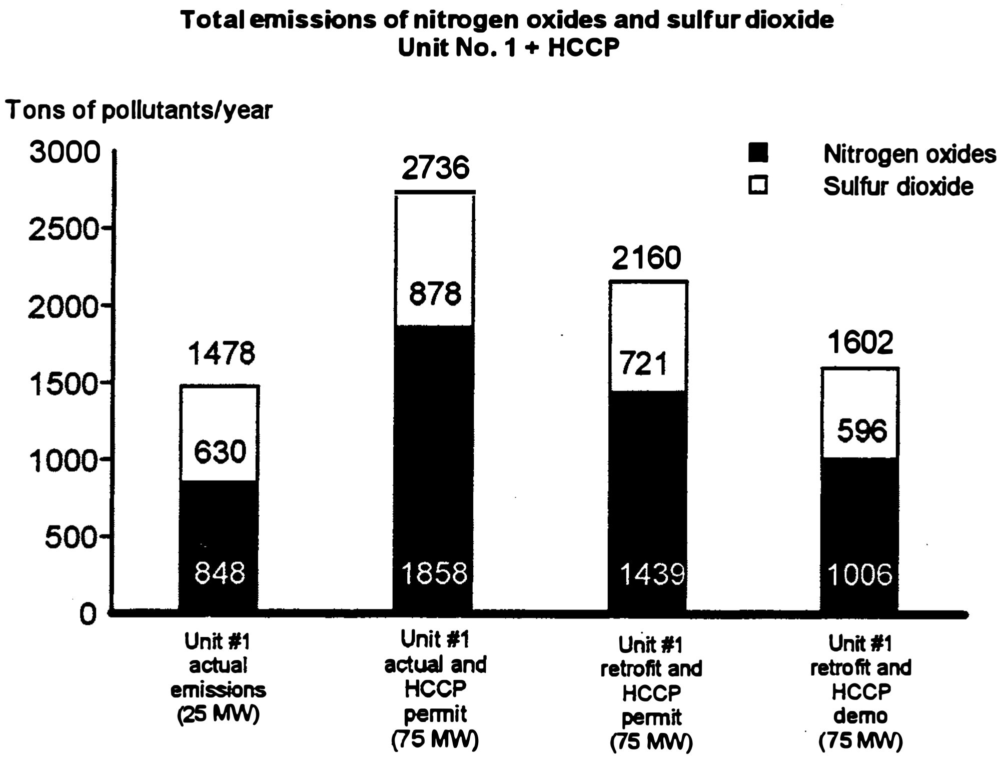


Fig. 5.4.4. Total site NO_x and SO_2 emissions for the Healy Unit No. 1 (actual and retrofit) and Healy Clean Coal Project facilities. Emission levels are for a 100% capacity factor.

Analyses were performed to estimate the reduced level of impacts to atmospheric resources associated with the simultaneous operation of the retrofitted Unit No. 1 and the HCCP demonstration and permitted cases. Modeling for the retrofit Unit No. 1 case utilized the same air dispersion models described in Sect. 4.1.2.2. The modeling also employed reductions in SO_2 and NO_x emissions equivalent to total annual emissions of 472 tons per year and 429 tons per year, respectively. These emission values are prorated rates based upon the annual emission limitations expressed in the Memorandum of Agreement. The Permittee for the PSD Permit (GVEA) has not yet determined the mix of emission rates and administrative controls which would be utilized in the permit amendment pending before the state PSD permitting authority (ADEC). The retrofit modeling was conducted with Unit No. 1 flue gas exit temperature reduced by 100°F and flue gas exit velocity reduced by 4.4 m/sec to approximate the retrofit of low-NO_x burners and duct injection of FCM to Unit No. 1. No changes were made to the emissions or stack parameters of the HCCP demonstration and permitted cases.

A comparison of the modeling results presented in Table 5.4.2 with those in Table 5.2.2 shows that the total impact for the 24-h SO_2 concentration decreased from 96% to 81% of the NAAQS for the retrofitted Unit No. 1 in combination with the HCCP demonstration and permitted cases. Similarly, the total impact for the annual NO_2 concentration decreased from 67% to 29% of the NAAQS for the

Table 5.4.2. National Ambient Air Quality Standards (NAAQS) impact analysis for the combined effects of the retrofitted Healy Unit No. 1 and the Healy Clean Coal Project (HCCP) (demonstration and permitted cases)

				Demonstration case			Permitted case		
Pollutant	Averaging period	NAAQS[a] (μg/m^3)	Ambient background concentration[b] (μg/m^3)	Modeled concentration[c] (μg/m^3)	Total impact[d] (μg/m^3)	Percent of NAAQS	Modeled concentration[c] (μg/m^3)	Total impact[d] (μg/m^3)	Percent of NAAQS
SO_2	3-h	1300	45	966	1011	78	966	1011	78
	24-h	365	26	271	297	81	271	297	81
	Annual	80	5	54	59	74	54	59	74
NO_2	Annual	100	6	23	29	29	23	29	29
PM_{10}	24-h	150	31	89	120	80	89	120	80
	Annual	50	5	20	25	50	20	25	50

[a]The NAAQS are absolute limits established in accordance with existing Clean Air Act provisions to protect public health and welfare with an adequate margin of safety.
[b]Background concentrations are based on Park Monitoring Station data from the 12-month monitoring period from September 1990 through August 1991.
[c]Maximum concentrations predicted by computer models resulting from HCCP and retrofitted Healy Unit No. 1 emissions.
[d]Total impact is calculated as the sum of the ambient background concentration and the modeled concentration.

retrofitted Unit No. 1 in combination with the HCCP demonstration and permitted cases. As previously described for the modeling performed for the existing Unit No. 1 emissions in combination with the HCCP demonstration and permitted cases (Table 5.2.2), because close-in impacts are almost entirely the result of Unit No. 1 emissions, modeled concentrations for the HCCP demonstration and permitted cases are identical.

For effects within DNPP, a comparison of the modeling results displayed in Table 5.4.3 with those in Table 5.2.3 shows that the total impact for the 24-h SO_2 concentration decreased from 15% to 14% of the NAAQS for the retrofitted Unit No. 1 in combination with both the HCCP demonstration and permitted cases, as compared to the existing Unit No. 1 in combination with the HCCP cases. Similar small improvements are predicted for some of the other pollutants and averaging times. No change is predicted to the already low percentages for other pollutants and averaging times. Modeled concentrations within DNPP for the retrofitted Unit No. 1 in combination with the HCCP demonstration and permitted cases are very similar but not identical, indicating that the HCCP is contributing a small percentage of the concentrations. This conclusion is supported by Table 5.2.1, which shows the modeled concentrations for the HCCP alone.

The modified PLUVUE I computer model discussed in Sect. 4.3.2.3 was used as a tool to evaluate the effect of the planned retrofit of Unit No. 1 on potential visibility impacts at DNPP. Table 5.4.4 presents the number of daytime hours per year that a plume (or plumes) from the simultaneous operation of the HCCP and the retrofitted Unit No. 1 is predicted to be perceptible from the DNPP Visitor Access Center for views to the north and south and the total number of hours. The predicted number of hours for the existing Unit No. 1 alone and for the combined operation of the existing Unit No. 1 with the HCCP (permitted case) are also given as a basis for comparison. The predicted number of hours is very low. For the simultaneous operation of the retrofitted Unit No. 1 and the HCCP (demonstration case), the predictions are 3 h for the north sight path, 9 h for the south sight path, and a total of 9 h. The total is less than the sum of the north and south sight paths because the threshold was also exceeded in the south sight path during the same 3 h in which it was exceeded in the north sight path. For the simultaneous operation of the retrofitted Unit No. 1 and the HCCP (permitted case), the predictions are 9 h for the north sight path, 19 h for the south sight path, and a total of 20 h. For comparison, the predicted number of hours for the existing Unit No. 1 alone is 5 h for the north sight path, 5 h for the south sight path, and a total of 6 h (these results for Unit No. 1 are also presented in Table 4.3.4). Also for comparison, the predicted number of hours for the combined operation of the existing Unit No. 1 with the HCCP (permitted case) is 15 h for the north sight path, 23 h for the south sight path, and a total of 26 h (these results are also presented in Table 5.2.4). The predicted total number of hours increases very slightly from 6 h for the existing Unit No. 1 to 9 h and 20 h for the retrofitted Unit No. 1 operating simultaneously with the HCCP for the demonstration case and

Table 5.4.3. National Ambient Air Quality Standards (NAAQS) impact analysis for the combined effects of the retrofitted Healy Unit No. 1 and the Healy Clean Coal Project (HCCP) (demonstration and permitted cases) within Denali National Park and Preserve (DNPP)

				Demonstration case			Permitted case		
Pollutant	Averaging period	NAAQS[a] (μg/m³)	Ambient background concentration[b] (μg/m³)	Modeled concentration[c] (μg/m³)	Total impact[d] (μg/m³)	Percent of NAAQS	Modeled concentration[c] (μg/m³)	Total impact[d] (μg/m³)	Percent of NAAQS
SO_2	3-h	1300	45	155	200	15	160	205	16
	24-h	365	26	25	51	14	25	51	14
	Annual	80	5	1	6	8	2	7	9
NO_2	Annual	100	6	1	7	7	2	8	8
PM_{10}	24-h	150	31	2	33	22	2	33	22
	Annual	50	5	0.1	5	10	0.1	5	10

[a] The NAAQS are absolute limits established in accordance with existing Clean Air Act provisions to protect public health and welfare with an adequate margin of safety.
[b] Background concentrations are based on Park Monitoring Station data from the 12-month monitoring period from September 1990 through August 1991.
[c] Maximum concentrations predicted by computer models resulting from HCCP and retrofitted Healy Unit No. 1 emissions.
[d] Total impact is calculated as the sum of the ambient background concentration and the modeled concentration.

Table 5.4.4. Number of daytime hours during the year that a plume from the existing and retrofitted Unit No. 1 and the Healy Clean Coal Project (HCCP) is predicted to be perceptible in the sight paths from the Denali National Park and Preserve (DNPP) Visitor Access Center

Emission source	North sight path	South sight path	Total[a]
Unit No. 1 (existing)	5	5	6
Unit No. 1 (existing) plus HCCP (permitted case)	15	23	26
Unit No. 1 (retrofit) plus HCCP (demonstration case)	3	9	9
Unit No. 1 (retrofit) plus HCCP (permitted case)	9	19	20

[a]The total is less than the sum of the north and south sight paths because of some hours in which the threshold was simultaneously exceeded in both sight paths.

permitted case, respectively. Since no hours of visual impact wer predicted for the DNPP Northeast Unit for existing emissions from Unit No. 1 alone and in combination with the HCCP demonstration and permit emissions, there were also no hours of impact with retrofitted Unit No. 1 emissions. The results of the visibility modeling indicate that, after the planned retrofit of Unit No. 1 and implementation of the Memorandum of Agreement, there would be very little change from the baseline results predicted for the existing Unit No. 1. As discussed previously, if DNPP experiences any visibility impacts, GVEA has also agreed to implement administrative controls.

In response to a request made at the workshop held in Washington, D.C., on September 22, 1993 (see Sect. 4.3.2.3), an analysis was performed to evaluate the sensitivity of the visibility modeling to differing assumptions associated with the predictions for the retrofitted Unit No. 1. Table 5.4.5 presents the results of the analysis, which examined the sensitivity of changing the value used for the perceptibility threshold and the sensitivity of extending the sight paths beyond the DNPP boundary. The first column for each sight path and for the total, denoted as the "DOE case," repeats the results presented in Table 5.4.4. The second column indicates how the results change by extending the sight path, while the third column shows how the results change by using 69 ppbv·km rather than 150 ppbv·km for the perceptibility threshold (see Sect. 4.3.2.3). Finally, the fourth column indicates the results of using both the extended sight path and the 69 ppbv·km threshold. The modeling is more sensitive to changing the perceptibility threshold than extending the sight paths, as indicated by a

Table 5.4.5. Sensitivity analysis of the number of daytime hours during the year that a plume from the existing and retrofitted Unit No. 1 and the Healy Clean Coal Project (HCCP) is predicted to be perceptible

Emission source	North sight path				South sight path				Total[a]			
	DOE case	Extended sight path	Threshold of 69 ppbv·km	Change in both parameters	DOE case	Extended sight path	Threshold of 69 ppbv·km	Change in both parameters	DOE case	Extended sight path	Threshold of 69 ppbv·km	Change in both parameters
Unit No. 1 (existing)	5	13	42	143	5	9	29	46	6	17	42	145
Unit No. 1 (existing) plus HCCP (permitted case)	15	78	125	317	23	28	71	123	26	85	129	329
Unit No. 1 (retrofitted) plus HCCP (demonstration case)	3	14	36	198	9	12	31	41	9	23	37	205
Unit No. 1 (retrofitted) plus HCCP (permitted case)	9	46	71	288	19	22	55	70	20	57	74	294

[a]The total is less than the sum of the north and south sight paths because of some hours in which the threshold was simultaneously exceeded in both sight paths.

greater increase from the DOE case in the number of hours in the third column than in the second column. The modeling is extremely sensitive to changing both parameters simultaneously, as indicated by the greatest increase in the number of hours in the fourth column. The north sight path is more sensitive than the south sight path.

The results show that the number of daytime hours during the year in which a plume is predicted to be perceptible from the simultaneous operation of the retrofitted Unit No. 1 and the HCCP is usually greater than the number of hours for the existing Unit No. 1 alone, but less than the number of hours for the combined operation of the existing Unit No. 1 with the HCCP (permitted case). For example, for the case of changing both parameters (the fourth column), the predicted total number of hours increases from 145 h for the existing Unit No. 1 to 205 h and 294 h for the retrofitted Unit No. 1 operating simultaneously with the HCCP for the demonstration case and permitted case, respectively. For comparison, the predicted total number of hours for the combined operation of the existing Unit No. 1 with the HCCP (permitted case) is 329 h. Therefore, the mitigation serves to reduce the potential number of hours with a perceptible plume compared to the analogous case without mitigation.

The effect of the planned retrofit of Unit No. 1 on potential regional haze at DNPP was evaluated using the supplemental analysis discussed in Sect. 4.3.2.4. Table 5.4.6 presents the results of a sensitivity analysis performed for differing assumptions associated with the predictions of regional haze. The first column gives the "DOE case" as evaluated in the supplemental regional haze analysis for the existing Unit No. 1 alone, for the existing Unit No. 1 operating simultaneously with the HCCP (permitted case), and for the retrofitted Unit No. 1 operating simultaneously with the HCCP for the demonstration case and permitted case. The second column indicates how the results change by considering a 10% change in b_{ext} as the threshold for perception, and the third column shows how the results change by using higher oxidation rates (see Sect. 4.3.2.4). The fourth column indicates the results of changing both assumptions simultaneously.

The results show that the annual number of events of regional haze predicted is sensitive to the assumptions. Overall, the results are more sensitive to the oxidation rates than the percentage change in b_{ext}. In comparing the existing Unit No. 1 alone with the retrofitted Unit No. 1 operating simultaneously with the HCCP, the results show very little change in the annual number of events for a given set of assumptions. For example, for the case of changing both assumptions (the fourth column) for the northeast area at the surface (the third line), the annual number of events is 32 for the existing Unit No. 1, 30 for the retrofitted Unit No. 1 combined with the HCCP demonstration case, and 31 for the retrofitted Unit No. 1 combined with the HCCP permitted case. By comparison, the annual number of events for the combined operation of the existing Unit No. 1 with the HCCP (permitted case) is usually larger than for the other scenarios (36 in the above example). Thus, the analysis indicates that

Table 5.4.6. Sensitivity analysis of the number of events per year that homogeneous oxidation of SO_2 is predicted to cause a sulfate concentration greater than or equal to the threshold for visual effects following the retrofit of Unit No. 1

		Unit No. 1 (existing)				Unit No. 1 (existing) plus HCCP (permitted case)				Unit No. 1 (retrofit) plus HCCP (demonstration case)				Unit No. 1 (retrofit) plus HCCP (permitted case)			
Modeled area	Height agl	DOE case[a]	10% change in b_{ext}[b]	Higher oxidation rates[c]	Both	DOE case[a]	10% change in b_{ext}[b]	Higher oxidation rates[c]	Both	DOE case[a]	10% change in b_{ext}[b]	Higher oxidation rates[c]	Both	DOE case[a]	10% change in b_{ext}[b]	Higher oxidation rates[c]	Both
South	Surface	0	2	5	30	0	2	5	29	0	1	1	13	0	1	3	18
South	500 ft	2	3	14	38	2	7	20	44	0	3	11	31	1	3	15	34
Northeast	Surface	1	7	10	32	2	8	13	36	0	5	3	30	0	6	7	31
Northeast	500 ft	2	7	19	33	8	14	27	41	1	6	18	31	2	9	18	35

[a]Assumes that a 20% change in b_{ext} (the light extinction coefficient) would be required to perceive regional haze; assumes homogeneous oxidation rates of SO_2 to sulfate of 0.1%/hr from December through February, 0.2%/hr in March and November, 0.5%/hr in April and October, and 1%/hr during the remainder of the year.
[b]Assumes that a 10% change in b_{ext} (the light extinction coefficient) would be sufficient to perceive regional haze.
[c]Assumes homogeneous oxidation rates of SO_2 to sulfate of 1.4%/hr from October through March and 1.9%/hr from April through September.

the planned retrofit of Unit No. 1 would be effective in preventing an increase in regional haze attributed to the Healy site. Not withstanding results of modeling, conducted over a wide range of assumptions, it should be noted that there have been no published reports of regional haze attributable to the existing Unit No. 1.

In summary, DOE believes that the Memorandum of Agreement adequately ensures that the DNPP would be protected from plume or haze impacts from the Healy site. GVEA must reduce combined emissions from the site to the existing Unit No. 1 emissions, immediately upon notification by either NPS or ADEC that a NO_x or other pollutant plume, or a sulfate or other pollutant haze, is visible inside DNPP. Furthermore, if sightings persist, the NPS may reopen the Agreement so that additional measures can be taken.

6. CUMULATIVE IMPACTS

This section discusses potential impacts resulting from other facilities, operations, and activities that in combination with potential impacts from the HCCP may contribute to cumulative impacts. Because the proposed site is so remote, the adjacent Healy Unit No. 1 is the only other existing facility that has been identified as contributing to cumulative impacts. The cumulative effects of Unit No. 1 are discussed in Sect. 4, because the effects are so intertwined with the HCCP that discussion is more appropriate in that section. For example, solid ash generated by the HCCP is compared with existing ash generation at Unit No.1 and the capacity for disposal at the UCM ***Poker Flats*** mine.

Several major development projects have been identified that ***might be*** constructed in the Healy region. Some of these projects have the potential to contribute to cumulative environmental impacts. These projects include

- a new 25-MW, coal-fired power plant proposed by Healy Power, Inc. (HPI), an independent power producer, for the Healy area,
- UCM mine expansion,
- Alaska Lime Company (Cantwell, Alaska) expansion,
- new gold mines to be established,
- new ***electrical transmission*** intertie systems,
- Trans-Alaska Gas System (TAGS) pipeline from Prudhoe Bay to Cook Inlet,
- natural gas pipeline from Anchorage to Fairbanks,
- products pipeline from the Mapco Refinery in North Pole to Anchorage,
- expansion of the Alaska Railroad north of Nenana, and
- ***a railroad within DNPP for visitors.***

One project for which much design work has been conducted is the development of the Fort Knox open-pit gold mine proposed by Fairbanks Gold Mining, Inc., located about 15 miles northeast of Fairbanks, Alaska. The applicant initiated the environmental permitting process for this project, thus triggering a NEPA review by the COE in the form of an environmental assessment (CH2M Hill 1992). The project design is based on a deposit of 200 million tons of ore, which would be mined at a rate of 35,000 to 50,000 tons per day. Project facilities, including new service roads, would cover about 4500 acres. The project would have a duration of at least 16 years, possibly longer if additional ore were found. The project would employ from 200 to 275 workers in three shifts, 24 h/d throughout the year. Power requirements of about 35 MW would be supplied via a new 28-mile, 138-kV transmission line that would be connected to the existing Fairbanks grid.

Because of the distance (nearly 100 miles) between the proposed HCCP and the proposed Fort Knox Mine, no cumulative environmental impacts are expected. Furthermore, neither of the projects is dependent on the other for its operation. GVEA currently possesses more than ample excess power generating capacity, even without including the 70-MW intertie from Anchorage. The Fort Knox Mine's power requirements would be only about 40% of GVEA's present excess generating capacity during peak demand. The oil-fired North Pole plant (consisting of two 60-MW units) accounts for most of the surplus in generating capacity. The units usually operate only during peak periods of electrical demand because their operating costs are very high. The HCCP would operate a much greater percentage of the time because its costs would be lower. GVEA plans to operate the HCCP with or without the Fort Knox Mine. In the absence of the HCCP, operation of the mine would require GVEA to either burn additional fuel oil at its North Pole plant or purchase additional electricity via the Anchorage intertie.

In May 1993, the Alaska legislature and governor approved the construction of two electrical transmission interties by committing $90 million from the Railbelt Energy Fund (part of $250 million remaining from the fund established for the since-abandoned Susitna Dam project). The northern intertie would be built between Healy and Fairbanks, while the southern intertie would be located from Anchorage south to the Kenai Peninsula. The participating utilities (GVEA for the Healy-Fairbanks intertie) have executed an agreement which will transfer the funds to AIDEA and commit the utilities to paying for the design and construction costs in excess of the funding amount.

The 138-kV Healy-Fairbanks intertie would generally follow the route of the existing 138-kV transmission line. The new line would be constructed in a separate corridor that parallels the existing corridor; therefore, a clearing of at least 100 ft in width would be required for the length of the corridor. The new line would carry about 80 MW of electricity, which, when added to the 95 MW carried by the existing line, would increase capacity to 175 MW. The line would carry electricity from Healy Unit No. 1 and the HCCP to Fairbanks and also would allow for the purchase of up to 100 MW of power from Anchorage. The line is expected to reduce losses and increase the reliability of Anchorage-purchased power transfers to Fairbanks.

Environmental impact assessment by the Rural Electrification Administration and design of the intertie are scheduled for 1994. The intertie is not expected to contribute major cumulative impacts in conjunction with the proposed HCCP. Construction of the intertie would occur in 1995 and 1996; the line is expected to be operational by early 1997.

With the exception of the *Fort Knox Mine, the Healy-Fairbanks intertie, and the* TAGS pipeline, none of these projects has reached the stage where feasibility has been determined and schedules fixed. The TAGS pipeline would be constructed at a distance far enough from the Healy area as to preclude major cumulative impacts. In addition, because the HCCP would meet GVEA's energy needs, it is highly unlikely that the HPI plant would ever be required or built. If the HCCP is not built, the HPI facility is not expected to come on-line before 2007. It is impossible to analyze cumulative impacts in the unlikely event that the HPI facility would be built, because the site, fuel, and technology have not yet been selected. Therefore, the cumulative impacts of these projects are not assessed.

7. REGULATORY COMPLIANCE AND PERMIT REQUIREMENTS

This section discusses federal and state regulatory compliance and permit requirements for the HCCP. A tentative schedule for obtaining permits is given in Appendix G.

7.1 RELATIONSHIP TO FEDERAL AND STATE ENVIRONMENTAL REQUIREMENTS

NEPA requires that a detailed statement be written for every recommendation or report on proposals for legislation and other major federal actions significantly affecting the quality of the human environment. NEPA is not a permitting process, but a process to examine perceived or potential environmental impacts in as broad but reasonable scope as possible. Conversely, environmental laws such as CAA, CWA, and RCRA require proponents of proposed actions to make application to appropriate permitting agencies, such as EPA, COE, and state regulatory agencies for approval to carry out a particular proposed action—whether the federal government is involved or not.

Permits require specific project or process conditions to be included in applications. Conditions are often negotiable as long as the permitting agency believes that environmental impacts resulting from the final permit approval will not adversely affect the environment.

The permitted case in Sect. 5.2 describes the process conditions that are expected to exist for the HCCP, and the environmental impacts (a NEPA responsibility) resulting from those conditions are discussed. Due to the dynamic nature of permitting activities, modifications to the conditions could arise. Thus, the permitted case described in Sect. 5.2 could be slightly different from the final negotiated conditions that would be required if a particular permit were granted. DOE has investigated and written Sect. 5.2 with the explicit intention of ensuring, to the best of its ability, that environmental impacts associated with the HCCP would not substantially change due to future permit conditions that may arise from permit negotiations.

7.1.1 Clean Air Act

Many standards and regulations promulgated under the CAA (CAA, Pub. L. 95-95, as amended) are germane to the HCCP. The CAA, administered jointly by EPA and the State of Alaska, is intended, in part, to ensure that air quality is maintained. Alaska has set its standards to be equivalent to federal standards. The HCCP would conform *to* Alaska's State Implementation Plan during construction and operation of the project. In the Healy area, where ambient air quality is better than national standards, PSD permitting requirements (40 CFR *Part* 51.24) apply. The HCCP would require a PSD permit.

NAAQS have been established by EPA (40 CFR *Part* 50) for ambient concentrations of SO_2, NO_2, CO, PM, O_3, and lead *(Table 7.1.1)*. Under NAAQS, both primary and secondary standards must be met. Primary standards set ambient concentration levels above which public health is believed to be threatened.

Table 7.1.1 National Ambient Air Quality Standards for air pollutants

Pollutant/averaging period	Primary standard ($\mu g/m^3$)	Primary standard (ppm)	Secondary standard ($\mu g/m^3$)	Secondary standard (ppm)
Sulfur dioxide				
Annual arithmetic mean	80	0.03		
24-h	365	0.14		
3-h			1,300	0.5
Particulate matter (as PM_{10})[a]				
Annual arithmetic mean	50		50	
24-h	150		150	
Carbon monoxide				
8-h	10,000	9		
1-h	40,000	35		
Ozone				
1-h	235	0.12	235	0.12
Nitrogen dioxide				
Annual arithmetic mean	100	0.05	100	0.05
Lead				
Maximum quarterly average	1.5		1.5	

[a] PM_{10} is particulate matter with an aerodynamic diameter $\leq 10 \mu m$.

Secondary standards set concentration levels above which public welfare (e.g., crops, livestock, building materials) is believed to be negatively affected. Effective July 31, 1987, the concentration limit and basis for measurement of PM were changed. Attainment of primary and secondary NAAQS for PM must now be determined by measuring particles termed PM_{10}. The major reason for this change was to establish standards that reflect the greater potential effects to human health associated with the smaller respirable particles.

New Source Performance Standards (NSPS) emission limitations (40 CFR ***Part*** 60) are applicable to the HCCP because the facility has the potential to emit more than the specified amount of pollutants annually. During the 1970s and 1980s, EPA promulgated several different "sets" of NSPS applicable to fossil-fuel steam generators. The boiler capacity along with the date when construction, reconstruction, or modification begins will determine which NSPS the HCCP must meet.

Significant amendments to the CAA were enacted in November 1990. The precise impact of these amendments upon the HCCP cannot be stated with certainty at this time because regulations as yet unpromulgated by the EPA will eventually define the impact. However, Title V of the amendments establishes a new permitting structure that requires all major sources of air pollution to obtain a permit pursuant to the new requirements of the title. Title V provides that EPA is required to promulgate regulations that define the requirements for state programs to implement the title. Each state will then have 3 years to develop and submit to EPA a new operating permit program for compliance, which EPA will then approve or disapprove. Title V provides that a single permit may be issued for a facility with multiple sources.

Titles I, III, and IV of the CAA Amendments of 1990 may also affect electric generating facilities. Title I addresses the attainment and maintenance of NAAQS, especially for geographic areas that are not presently in attainment. ***The Healy area is in attainment for all of the criteria pollutants.*** Title III, which addresses hazardous air pollutants, mandates specific studies to establish whether public health criteria warrant further control of utility emissions of hazardous air pollutants. Title IV imposes additional constraints on utility emissions of SO_2 and NO_x to alleviate acid deposition. Nationwide SO_2 emissions will be reduced in two phases by a total of 10 million tons below 1980 levels: 5 million tons by 1995, and another 5 million tons by 2000. A 4-year extension of the second-phase deadline will be granted to power plants that elect to use clean coal technologies to decrease their emissions. NO_x emissions in the year 2000 are required to be 2 million tons less than 1980 levels. ***However, Title IV only applies to the contiguous 48 states.***

7.1.2 Clean Water Act

The CWA (CWA; Pub. L. 92-500, as amended) is intended to restore and maintain the chemical, physical, and biological integrity of the nation's waters. As with the CAA, this statute is based on federal-state cooperation. Title III of the CWA directs EPA to set discharge standards and gives the state agency enforcement powers. Standards that act as a "floor," below which water quality at the HCCP should not drop, and effluent discharge limits "at the end of the pipe" are intended to ensure that these standards are met. Title IV establishes a permit program system, the NPDES (NPDES; 40 CFR *Part* 122), that regulates discharges to surface waters. The HCCP would not be allowed to discharge into ***waters*** of ***the United States*** without an NPDES permit.

EPA has established effluent limitations for existing and new steam electric power plants (40 CFR *Part* 423). Table 7.1.2 shows NSPS ***for the steam electric generating category*** applicable to the HCCP.

Table 7.1.2. New source performance standards for steam electric power generation

Source[a]	Pollutant/property	Concentration 1-d maximum (mg/L)	Concentration 30-d average (mg/L)
Low-volume wastes	Total suspended solids (TSS)	100	30
	Oil/grease	20	15
Metal cleaning wastes	TSS	100	30
	Oil/grease	20	15
	Copper	1	1
	Iron	1	1
Bottom ash transport water	TSS	100	30
	Oil/grease	20	15
Cooling water[b] >25 MW	Chlorine (residual)	0.2[c]	
Cooling water <25MW	Chlorine (residual)	0.5[c]	0.2d
Cooling water (blowdown)	Chlorine (free available)	0.5[c]	0.2[d]
	126 priority pollutants	Not detectable	Not detectable
	Chromium (total)	0.2	0.2
	Zinc (total)	1	1
All sources	Polychlorinated biphenyls	0	0
All sources except once-through[b]	pH	6–9	6–9

[a]The quantity of pollutants discharged from the following sources shall not exceed the quantity determined by multiplying the flow of the waste source times the concentration listed.
[b]Once-through cooling water.
[c]Maximum concentration.
[d]Average concentration.

In addition, ***an Oil Spill Prevention, Containment, and Countermeasure Plan (SPCCP)*** is required for the HCCP in accordance with CWA requirements [Sect. 311(j)], as amended by the Oil Pollution Act of 1990. The existing SPCCP for Healy Unit No. 1 is being revised to incorporate contingency measures for spills of diesel fuels as well as other nonpetroleum chemicals that would be stored and utilized in the HCCP.

7.1.3 Resource Conservation and Recovery Act and Amendments

The RCRA Pub. L. 94-580, as amended and a major amendment to it known as the 1984 Hazardous and Solid Waste Amendments (HSWA; Pub. L. 98-616) are intended to ensure that all solid waste, including suspensions, other liquids, and especially hazardous waste, is handled so as to minimize risks to the environment and the public.

Solid coal combustion wastes from the HCCP are currently exempt from regulation under Sect. 3001 of RCRA. However, Sect. 8002 of RCRA required EPA to study alternatives for disposal of coal combustion wastes and present the results to Congress. The study (EPA 1988) found that fly ash, bottom ash, boiler slag, and flue gas desulfurization wastes generally do not exhibit hazardous characteristics under current RCRA regulations. EPA intends to regulate these wastes under Subtitle D of RCRA (for nonhazardous wastes).

EPA found that some maintenance and water purification wastes do, however, exhibit RCRA hazardous characteristics (EPA 1988). EPA is considering removing the Sect. 3001 exemption for these wastes, making them subject to the requirements of Subtitle C. If catalysts, filter cakes, slag, ash, or by-products contain sufficient amounts of heavy metals or extractable/leachable organics and are disposed of off-site or without mixing with other solid wastes, they could also be classified as hazardous.

If any of these wastes or by-products are eventually regulated as hazardous under Subtitle C of RCRA, the HCCP would need to comply with the regulations.

7.1.4 Endangered Species Act

Under Sect. 7 of the Endangered Species Act of 1973 (Pub. L. 93-205, as amended), DOE must consult with FWS to ensure that proposed actions are not likely to jeopardize the continued existence of any endangered species or threatened species or result in the destruction or adverse modification of the critical habitat of such species. Appendix C documents the findings of the FWS from such consultation.

7.1.5 Floodplains and Wetlands Requirements

Federal agencies must consider the effects of their proposed actions on floodplains and wetlands under Executive Orders (EOs) 11988 ("Floodplain Management") and 11990 ("Protection of Wetlands"). These EOs require federal agencies to avoid to "the extent practicable" adverse impacts associated with the occupancy and modification of floodplains and the destruction and modification of wetlands. Agencies are also directed to avoid direct or indirect support of development in floodplains and wetlands where there is a practicable alternative. DOE has established Part 1022 of Chapter X of Title 10 of the Code of Federal Regulations to comply with EOs 11988 and 11990. DOE must determine whether a floodplain or wetland is present at the HCCP site (Sect. 4.1.6), assess the impacts on such floodplains and wetlands, and consider alternatives that would minimize impacts to these resources. If DOE finds that the only practicable alternative consistent with the law and with EO 11988 requires siting in a floodplain, DOE must, before taking action, design or modify the action in order to minimize potential harm to or within the floodplain and must publish a notice containing an explanation of why the action is proposed to be located in the floodplain.

The federal agency responsible for enforcing these EOs is EPA. The Federal Water Pollution Control Act (FWPCA) Amendments of 1972, Pub. L. 92-500, 86 Stat. 931 (1972) replaced the previous language of the FWPCA entirely. CWA of 1977, Pub. L. 95-217, 91 Stat. 1566 (1977), then substantially amended this new text. The act is now commonly referred to as the Clean Water Act. The U.S. Congress authorized the Secretary of the Army acting through the Chief of Engineers to regulate the discharge of dredged or fill material into navigable waters pursuant to the Sect. 404 of (33 U.S.C. 1344). Subsection (b) of Sect. 404 directed that each disposal site shall be specified for each permit by the Corps of Engineers through the application of guidelines developed by the administrator of the EPA; hence, EPA's "veto authority" states that the administrator is authorized to prohibit the specification (including the withdrawal of specification) of any defined area as a disposal site, and he is authorized to deny or restrict the use of any defined area for specification (including the withdrawal of specification) as a disposal site. Subsection (q) provided for establishment of memoranda of agreement with other agencies. Several memoranda of agreement have been signed between EPA and the Corps concerning regulation of discharges of solid waste, geographic jurisdiction, mitigation, and enforcement.

7.1.6 Other Federal and State Regulatory Requirements

The regulatory requirements discussed above are those most likely to be encountered for the HCCP. In addition, under Sect. 106 of the National Historic Preservation Act (Pub. L. 89-665, as amended), DOE must consult with the Alaska SHPO to ensure compliance with the act. Appendix D documents the findings of the SHPO from such consultation.

7.2 STATE AND FEDERAL PERMITS AND DOCUMENTS

The federal permits, NEPA compliance documents, other support and compliance documents, and state permits that would be prepared and obtained for the HCCP are listed in Tables 7.2.1, 7.2.2, 7.2.3, and 7.2.4, respectively. Where state and federal requirements are given on a single issue, the state generally has primacy with federal oversight. If the state regulation is found to be less effective than the federal regulation, the federal agency can require compliance with its regulation in addition to the state regulation.

Table 7.2.1. Federal permits and documents to be obtained or prepared for the Healy Clean Coal Project

Anticipated permitting agency	Permit description
U.S. Environmental Protection Agency	Permit to discharge into water, National Pollutant Discharge Elimination System: ***(1) storm water discharges from construction activities;*** *(2)* wastewater discharge from construction camp sewage plant; *(3)* wastewater discharge from batch plant and general construction area; *(4)* wastewater discharge for once-through cooling during plant operation (5-year renewable); *(5)* wastewater discharge for treated plant service water during plant operation (5-year renewable); *(6)* coal pile runoff discharge; ***(7) storm water discharges associated with industrial activity***
	Oil ***Spill Prevention Control and Countermeasure Plan*** for oil storage facilities
	Generation, transportation, storage, treatment, or disposal of hazardous waste
Corps of Engineers	Discharge of dredged or fill material into U.S. waters–Department of the Army permit (Section 404 Permit): (1) construction of intake and discharge facilities in the Nenana River; (2) lands classified as wetlands by the Corps of Engineers
U.S. Department of Transportation, Federal Aviation Administration	Notice of proposed construction or alteration of structures that may interfere with airplane flight paths

Table 7.2.2. National Environmental Policy Act (NEPA) support and compliance documents

Document	Prepared by	Description of action taken
Environmental Information Volume	Participant	Forms the basis *for* U.S. Department of Energy's (DOE's) preparation of an environmental impact statement (EIS) and related NEPA documents
EIS	DOE	The key environmental document that serves as the basis for the Record of Decision and further federal action

Table 7.2.3. Other support and compliance documents

Document	Prepared by	Description of action taken
Environmental Monitoring Plan	Participant	Prepared subsequent to the Environmental Impact Statement and within 60 days after construction begins

Table 7.2.4. State permits and documents to be obtained or prepared for the Healy Clean Coal Project

Permitting agency	Permit description
Alaska Department of Natural Resources, Division of Land and Waste Management	Temporary permits to appropriate water: (1) concrete batch plant; (2) dust control; (3) construction camp and potable water supply
	Permit to appropriate water (permanent water rights permit): (1) once-through cooling; (2) boiler feed water; (3) potable water; (4) dust control
	Temporary land use permits: national park air quality monitoring site
	Right-of-way (easement) permit: (1) access roads; (2) water pipelines; (3) transmission lines
	Material sale contract: gravel extraction
	Land use lease: (1) national park air quality monitoring site; (2) long-term lease of state of Alaska, Lots 7 and 8 under lease to Golden Valley Electric Association, Inc.
Alaska Department of Environmental Conservation	Air quality program: prevention of significant deterioration
	Air quality control: permit to operate
	Wastewater disposal permit: (1) wastewater discharge from the construction camp sewage plant; (2) wastewater discharge from the batch plant and general construction area; (3) wastewater discharge for once-through cooling during plant operation; (4) wastewater discharge for treated plant service water during plant operation; (5) coal pile runoff discharge
	Plan review for sewage systems, water, and wastewater treatment works during construction
	Certificate of reasonable assurance (401 Water Quality Certification)
	Solid waste disposal permit
	Fuel storage, transfer, and handling
Alaska Railroad Corporation	Land use lease

8. REFERENCES

ADCRA (Alaska Department of Community and Regional Affairs) 1992. Telephone communication between Scott Ruby, Local Government Specialist, ADCRA, Anchorage, Alaska, and James Saulsbury, ORNL, August 13, 1992.

AIDEA (Alaska Industrial Development and Export Authority) 1990. *Ambient Sound Level Survey, Healy Clean Coal Project, Healy, Alaska*, prepared by Stone & Webster Engineering Corp., Denver, December.

AIDEA (Alaska Industrial Development and Export Authority) 1991a. *Second Draft Environmental Information Volume, Healy Clean Coal Project, Healy, Alaska*, prepared by Stone & Webster Engineering Corp., Denver, September.

AIDEA (Alaska Industrial Development and Export Authority) 1991b. *Application for NPDES Permit for Power Plant Operation: Healy Clean Coal Project, Healy, Alaska*, prepared by Stone & Webster Engineering Corp., Denver, October.

AIDEA (Alaska Industrial Development and Export Authority) 1992. *Permit Application for Air Quality Program—Prevention of Significant Deterioration (PSD) and Air Quality Control—Permit to Operate, State of Alaska Department of Environmental Conservation*, Vol. I, Healy Clean Coal Project, Healy, Alaska, prepared by Stone and Webster Engineering Corp., *Denver*, April.

AIDEA (Alaska Industrial Development and Export Authority) 1993. Final Thermal Discharge Impact Analysis, Elements of Technical Analysis, Healy Clean Coal Project, Healy, Alaska, prepared by Stone and Webster Engineering Corp., Denver, January.

Alaska Department of Natural Resources 1985. *Tanana Basin Area Plan for State Lands*, June.

Alaska Department of Natural Resources 1990. *Tanana Basin Area Plan Resource Assessment Summary Nenana River Corridor*, May.

Alaska Department of Transportation and Facilities 1990. "Annual Average Daily Traffic Counts: The George Parks Highway."

Alaska Heritage Research Group, Inc. 1987. *Cultural Resources Management Plan for the Lignite (Hoseanna) Creek Drainage*, prepared for Usibelli Coal Mine, Inc., January.

Algermissen, S. T., et al. 1990. "Probabilistic Earthquake Acceleration and Velocity Maps for the United States and Puerto Rico," Miscellaneous Field Studies Map MF-2120, U.S. Geological Survey, Denver.

APA (Alaska Power Authority) 1985. Susitna Hydroelectric Project, Definition and Costs of Thermal Power Alternatives to Susitna, Harza-Ebasco, Susitna Joint Venture, Anchorage, Alaska, November.

APA (Alaska Power Authority) 1988. Estimated Costs and Environmental Impacts of Coal-Fired Power Plants in the Alaska Railbelt Region, prepared by Stone and Webster Engineering Corp., Denver, November.

Applied Technology Council 1978. Tentative Provisions for the Development of Seismic Regulations for Buildings, National Bureau of Standards Special Publication 510, U.S. Department of Commerce, Washington, D.C.

Baker, J. P., et al. 1990. *Biological Effects of Changes in Surface Water Acid-Base Chemistry*, NAPAP Report 13, National Acid Precipitation Assessment Program, Washington, D.C.

Benson, C. S. 1965. *Ice Fog: Low Temperature Air Pollution*, Geophysical Institute Report, UAG R-173 (DDC No. 631553).

BLM (U.S. Bureau of Land Management) 1980. *Visual Resource Management Program.*

Bittner, J. January 1991. Alaska State Historic Preservation Office, letter to W. D. Steigers, Stone and Webster Engineering Corp., Denver.

Bodhaine, B. A., and Dulton, E. G. 1993. "A Long-term Decrease in Arctic Haze at Barrow, Alaska," Geophys. Res. Lett. 20(10): 947–950.

Bowers, J. F., Bjorklund, J. R., and Cheney, C. S. 1979. *Industrial Source Complex (SC) Dispersion Model User's Guide*, EPA-450/4-79-030, prepared for the U.S. Environmental Protection Agency by H. E. Cramer Company, Inc., Salt Lake City, Utah.

Bradley, W. E. 1985. *Estimating Exterior Noise from Power Plants*, pp. 343–47 in proceedings of NOISE.CON85, Columbus, Ohio, Noise Control Foundation, Poughkeepsie, New York, June 3–5.

Brewer, R. S. January 4, 1993. Mayor, Denali Borough, letter to Dr. E. W. Evans, U.S. Department of Energy, Pittsburgh Energy Technology Center.

Canter, L. W. 1977. *Environmental Impact Assessment*, McGraw-Hill, New York.

CH2M Hill. 1992. Fort Knox Mine Draft Environmental Assessment, Anchorage, Alaska, December.

Crock, J. G., *et al.* 1992. *Element Concentrations and Trends for Moss, Lichen, and Surface Soils in and near Denali National Park and Preserve* . Open File Report 92-323. U.S. Geological Survey, Denver, Colo.

Dames and Moore 1975. *Influence of Golden Valley Electric Association, Inc., Thermal Discharge on Biota of the Nenana River near Healy, Alaska: A Physical-Chemical Evaluation,* Final Report No. 9057-005-22.

Davis, D. D., and Wilhour, R. G. 1976. *Susceptibility of Woody Plants to Sulfur Dioxide and Photochemical Oxidants*, EPA-600/3-76-102, Corvallis Environmental Research Laboratory, Oreg.

DeHayes, D. H. 1992. "Winter Injury and Development of Cold Tolerance of Red Spruce," Ch. 9 in *The Ecology and Decline of Red Spruce in the Eastern United States*, ed., C. Eagar and M. B. Adams, Springer-Verlag, New York.

DeHayes, D. H., Ingle, M. A., and Waite, C. E. 1989. "Nitrogen Fertilization Enhances Cold Tolerance of Red Spruce Seedlings," *Can. J. For. Res.* **19**, 1037–1043.

DOE (U.S. Department of Energy) 1989. *Clean Coal Technology Demonstration Program, Final Programmatic Environmental Impact Statement*, Doc. No. DOE/EIS-0146, U.S. Department of Energy, Washington, D.C., November.

DOE (U.S. Department of Energy) 1991. *Implementation Plan for the Preparation of an Environmental Impact Statement for the Proposed Healy Clean Coal Project*, U.S. Department of Energy, Washington, D.C., August.

Durfor, C. N., and Becker, E., 1964. "Public Water Supplies of the 100 Target Cities in the United States, 1962," U.S. Geological Survey Water Supply Paper No. 1812, Denver.

Dvorak, A. J., et al. 1977. *The Environmental Effects of Using Coal for Generating Electricity*, NUREG-0252, U.S. Nuclear Regulatory Commission, Washington, D.C.

Dvorak, A. J., et al. 1978. *Impacts of Coal-Fired Power Plants on Fish, Wildlife, and Their Habitats*, FWS/OBS-78/029, U.S. Fish and Wildlife Service, Washington, D.C.

Elliott, C. L. 1984. "Wildlife Food Habits and Habitat Use on Revegetated Stripmine Land in Alaska," Ph.D. thesis, University of Alaska, Fairbanks.

ENSR (formerly ERT) 1987. *User's Guide to the Rough Terrain Diffusion Model (RTDM).*

ENSR Consulting and Engineering 1992. Healy Clean Coal Project Air Quality Monitoring Program–Annual Data Report September 1990 through August 1991, Fort Collins, Colo.

EPA (U.S. Environmental Protection Agency) 1972. Workbook of Thermal Plume Prediction, Volume I, Submerged Discharge, August.

EPA (U.S. Environmental Protection Agency) 1976. *Development Document for Best Technology Available for the Location, Design, Construction and Capacity of Cooling Water Intake Structures for Minimizing Adverse Environmental Impact*, EPA 440/1-76/015a, Washington, D.C.

EPA (U.S. Environmental Protection Agency) 1982. *Air Quality Criteria for Particulate Matter and Sulfur Oxides*, EPA-600/8-82-029C, Research Triangle Park, N.C.

EPA (U.S. Environmental Protection Agency) 1988. *Report to Congress–Wastes from the Combustion of Coal by Electric Utility Power Plants*, EPA/530-SW-88-002, Office of Solid Waste and Emergency Response, Washington, D.C., February.

EPA (U.S. Environmental Protection Agency) 1990a. *Evaluation of the Potential Carcinogenicity of Electromagnetic Fields, Review Draft*, EPA/600/6-90/005A, June.

EPA (U.S. Environmental Protection Agency) 1990b. *(Proposed) Supplement B - Guideline on Air Quality Models (Revised)*, Office of Air Quality Planning and Standards, U.S. Environmental Protection Agency, Research Triangle Park, N.C.

EPA (U.S. Environmental Protection Agency) 1991. Final Environmental Impact Statement, Florida Power & Light Company, Martin Coal Gasification/Combined Cycle Project, EPA 904/-9-91-001 (a), May.

ESSA (U.S. Department of Commerce, Environmental Science Services Administration) 1968. *Weather Atlas of the United States*, June.

FWS (U.S. Fish and Wildlife Service) 1989. "Endangered and Threatened Wildlife and Plants; Animal Notice of Review," *Fed. Regist.* 54, 554–579.

FWS (U.S. Fish and Wildlife Service) 1990. "Endangered and Threatened Wildlife and Plants; Review of Plant Taxa for Listing as Endangered or Threatened Species," *Fed. Regist.* 55, 6184–6229.

Geophysical Research Letters 1993. A Long-Term Decrease in Arctic Haze at Barrow, Alaska. American Geophysical Union, 20 (10) pp. 947-950, May.

Glenn, J. 1990. "The State of Garbage in America," *Biocycle*, March.

Golden, J. et al. 1979. *Environmental Impact Data Book*, Ann Arbor Science, Ann Arbor, Mich.

Gough, L. P., Shacklette, H. T., and Case, A. A. 1979. "Element Concentrations Toxic to Plants, Animals, and Man," *U.S. Geological Survey Bulletin* 1466, U.S. Government Printing Office, Washington, D.C.

Greiser, T. W., et al. 1986. "Sample Survey and Predictive Module Refinement for Cultural Resources Located Along the Susitna Hydroelectric Project Inner Features," in *Cultural Resource Management Plan for the Lignite (Hoseanna) Creek Drainage*, prepared by Alaska Heritage Research Group, Inc., for Usibelli Coal Mine, Inc., 1987.

Grey, E., and Lehner, D. 1983. *Flood Plain Management Study (Low Intensity), Lower Tanana River and Tributaries, Interior, Alaska*, U.S. Department of Agriculture, Soil Conservation Service.

GVEA (Golden Valley Electric Association, Inc.) 1978. Application for Approval to Construct/Modify a Source Pursuant to Prevention of Significant Deterioration—Unit No. 2, Healy Alaska, prepared by Stanley Consultants, Inc., November.

GVEA (Golden Valley Electric Association, Inc.) 1991a. Power Requirements Study, prepared by CH2M Hill, Bellevue, Washington, December.

GVEA (Golden Valley Electric Association Inc.) 1991b. Integrated Resource Planning Study, prepared by CH2M Hill, Bellevue, Washington, December.

Helm, D. 1985. *Pre-mining Vegetation Inventory, Poker Flats Permit Area, Usibelli Coal Mine*, Usibelli Coal Mine, Inc., Healy, Alaska.

Huffman, P. J., and Ohtake, T. 1971. "Formation and Growth of Ice Fog Particles at Fairbanks, Alaska," *Journal of Geophysical Research* 70, 657–65.

ICBO (International Conference of Building Officials) 1988. "Uniform Building Code," International Conference of Building Officials, Whittier, Calif.

Institute of Social and Economic Research, University of Alaska, Anchorage 1988. *Economic and Demographic Projections for the Alaska Railbelt: 1988–2010*, prepared for the Alaska Power Authority, August.

Keller, T. 1985. "SO_2 Effects on Tree Growth," pp. 250–263 in *Sulfur Dioxide and Vegetation*, eds. W. E. Winner, H. A. Mooney, and R. A. Goldstein, Stanford University Press, Stanford, Calif.

Klein, R. M., Perkins, T. D., and Meyers, H. L. 1989. "Nutrient Status and Winter Hardiness of Red Spruce Foliage," *Can. J. For. Res.* **19**, 754–758.

Kumai, M. A. 1969. *Formation and Reduction of Ice Fog: Part II: Ice Fog Formation from a Cooling Pond*, CRREL, Research Report 235.

Langford, T. E. 1983. *Electricity Generation and the Ecology of Natural Waters*, Liverpool University Press, Liverpool, England.

Latimer, D. A., et al. 1985. *Modeling Regional Haze in the Southwest: A Preliminary Assessment of Source Contributions*, SYSAPP/85-038, Systems Applications, Inc., San Rafael, Calif.

Latimer, D. A., and Ireson, R. G. 1988. *Workbook for Plume Visual Impact Screening and Analysis*, EPA-450/4-88-015, U.S. Environmental Protection Agency, Office of Air Quality Planning and Standards, Research Triangle Park, N.C., September.

LeBlanc, F., and Rao, D. N. 1975. "Effects of Air Pollutants on Lichens and Bryophytes," pp. 231–272, in *Responses of Plants to Air Pollution*, eds. B. H. Mudd and T. T. Kozlowski, Academic Press, New York.

Leistritz, L., and Murdock, S. 1986. "Socioeconomic Impacts of Large Scale Development Projects in the Western United States: Implications for Synthetic Fuels Commercialization," in *Contributions in Political Science No. 179*, eds. E. Yanarella and W. Green, Greenwood Press, Westport, Conn.

Lusis, M. A., Anlauf, K. G., Barrie, L. A., and Wiebe, H. A., 1978. "Plume Chemistry Studies at a Northern Alberta Power Plant," Atmos. Environ. 12, 2429-2437.

McLaughlin, S. B., Jr., and Taylor, G. E. Jr. 1985. "SO_2 Effects on Dicot Crops: Some Issues, Mechanisms, and Indicators," pp. 227–249 in *Sulfur Dioxide and Vegetation*, eds. W. E. Winner, H. A. Mooney, and R. A. Goldstein, Stanford University Press, Stanford, Calif.

Mitchell, J. F. B. 1989. "The 'Greenhouse' Effect and Climatic Change," *Reviews of Geophysics* **27**, 115–139.

NADP/NTN Coordination Office 1989. *NADP/NTN Annual Data Summary: Precipitation Chemistry in the United States 1988*, Colorado State University, Fort Collins, Colo.

NADP/NTN Coordination Office 1990. *NADP/NTN Annual Data Summary: Precipitation Chemistry in the United States 1989*, Colorado State University, Fort Collins, Colo.

NAS (National Academy of Sciences) 1993. "Protecting Visibility in National Parks and Wilderness Areas," National Research Council, National Academy Press, Washington, DC.

Nash, T. H., III 1973. "Sensitivity of Lichens to Sulfur Dioxide," *Bryologist* **76**, 333–339.

National Radiological Protection Board 1992. "Electromagnetic Fields and the Risk of Cancer," Report of an Advisory Group on Non-ionizing Radiation, Vol. 3, No. 1, 1992, National Radiological Protection Board, Chilton, Didcot Oxon OX11 ORQ.

Nenana 1987a. Nenana Coal-Fired Electrical Generating Plant Project Assessment, City of Nenana, March.

Nenana 1987b. Nenana Coal-Fired, Electric Generation Facility Feasibility Study, Preliminary Phase 1 Work Program (Financial Feasibility), City of Nenana, December.

Niemi, G. J., et al. 1990. "Overview of Case Studies on Recovery of Aquatic Systems from Disturbance," *Environmental Management* **14**, 571–587.

NOAA (National Oceanic and Atmospheric Administration) 1988. *Local Climatological Data, Annual Summary with Comparative Data*, Fairbanks, Alaska.

Novak, J. December 14, 1992. Superintendent, Denali Borough School District, letter to Dr. E. W. Evans, U.S. Department of Energy, Pittsburgh Energy Technology Center.

NPS (National Park Service) 1982. *Environmental Assessment for Development Concept Plant, Park Road Corridor, Denali National Park and Preserve.*

NPS (National Park Service) 1990. *Final Environmental Impact Statement, Cumulative Effects of Mining, Denali National Park and Preserve, Alaska,* Anchorage, Alaska.

NRC (National Research Council) 1980. *Trace-Element Geochemistry of Coal Resource Development Related to Environmental Quality and Health*, National Academy Press, Washington, D.C.

Price, B. January 8, 1993. Program Director, Railbelt Mental Health and Addictions Program, letter to Dr. E. W. Evans, U.S. Department of Energy, Pittsburgh Energy Technology Center.

Richards, L. W., Blanchard, C. L., and Blumenthal, D. L., eds. 1991. "Navajo Generating Station Visibility Study," Final report prepared for Salt River Project by Sonoma Technology, Inc., Santa Rosa, CA., STI-90200-1124-FR, November.

Roseneau, D. G., and Springer, A. M. 1991. *Raptor Surveys in the Vicinity of the Healy Clean Coal Project near Healy, Alaska, 30-31 May 1991*, draft interim report (Task 1), Biosystems Alaska, Fairbanks.

Sagan, L. A., M.D. 1988. "Research Priorities in Electric and Magnetic Fields," *Forum for Applied Research and Public Policy*, Winter.

Seed, H. B., and Idriss, I. M. 1971. "Simplified Procedure for Evaluating Soil Liquefaction Potential," *Journal of the Soil Mechanics and Foundations Division*, Proceedings of the American Society of Civil Engineers **97**:9, 1249–1274.

Shaw, G. E. March 20, 1991. Letter communication from G. E. Shaw, University of Alaska, Fairbanks Geophysical Institute, to W. D. Steigers, Stone & Webster Engineering Corporation.

Shriner, D. S., et al. 1990. *Response of Vegetation to Atmospheric Deposition and Air Pollution*, NAPAP Report 18, National Acid Precipitation Assessment Program, Washington, D.C.

Sigal, L. L. and Suter, G. W., II 1987. "Evaluation of Methods for Determining Adverse Impacts of Air Pollution on Terrestrial Ecosystems," *Environ. Manage.* 11, 675–694.

Sisterson, D. L., et al. 1990. *NAPAP State of Science Report 6: Deposition Monitoring: Methods and Results*, National Acid Precipitation Assessment Program, Washington, D.C.

Smith, A. E., and J. B. Levenson 1980. A Screening Procedure for the Impacts of Air Pollution Sources on Plants, Soils, and Animals, EPA 450/2-81-078, U.S. Environmental Protection Agency, Research Triangle Park, N.C.

Sonoma Technology, Inc. 1992a. Visual Impact Analysis of the Plume from the Healy Clean Coal Project on Denali National Park and Preserve, STI-91170-1205-DFR, prepared for Alaska Industrial Development and Export Authority, Santa Rosa, Calif., April.

Sonoma Technology, Inc. 1992b. Addendum to the Visual Impact Analysis of the Plume from the Healy Clean Coal Project on Denali National Park and Preserve, STI-91170-1205-ADD, prepared for Alaska Industrial Development and Export Authority, Santa Rosa, Calif., September.

Sonoma Technology, Inc. 1993a. Addendum No. 2 to the Visual Impact Analysis of the Plume from the Healy Clean Coal Project on Denali National Park and Preserve, STI-91170-1205-ADD2, prepared for Alaska Industrial Development and Export Authority, Anchorage, Alaska, Santa Rosa, Calif., June.

Sonoma Technology, Inc. 1993b. Supplemental Regional Haze Analysis for the Healy Clean Coal Project, STIi-91170-1366-RHA, prepared for Alaska Industrial Development and Export Authority, Santa Rosa, Calif., July.

Sonoma Technology, Inc. 1993c. Addendum No. 3 to the Visual Impact Analysis of the Plume from the Healy Clean Coal Project on Denali National Park and Preserve, STI-91170-1205-ADD3, prepared for Alaska Industrial Development and Export Authority, Santa Rosa, Calif., October.

Soroos, M. S. 1992. "The Odyssey of Arctic Haze, Toward a Global Atmospheric Regime," Environment 34, No. 10.

Stanley Engineering Company 1967. Operator Training Manual Part 2—Unit No. 1 Characteristics, prepared for Golden Valley Electric Association, Inc.

Stottlemeyer, R. 1992. Nitrogen mineralization and streamwater chemistry, Rock Creek Watershed, Denali National Park, Alaska, U.S.A. Arctic and Alpine Research 24:291-303.

Stottlemeyer, R. and K. McLoone, 1990. Natural regulation of headwater stream chemistry by geological substrata, soils, and vegetation, Denali National Park and Preserve. Draft Final Report, GLARSU Research Rept. 43, Michigan Technological University, Houghton, MI.

Suter, G. W., II, and Sharples, F. S. 1984. "Examination of a Proposed Test for Effects of Toxicants on Soil Microbial Processes," pp. 327–344 in *Toxicity Screening Procedures Using Bacterial Systems*, eds. D. Liu and B. J. Dutka, Marcel Decker, Inc., New York.

Tarbox, K. E., et al. 1979. *Biological Studies of a Proposed Power Plant Site Near Healy, Alaska*, Woodward-Clyde Consultants, Anchorage, Alaska.

Thorson, R. M. 1978. "Recurrent Late Quaternary Faulting near Healy, Alaska," Alaska Division of Geologic and Geophysical Surveys Geologic Report 61, 10–14.

UCM (Usibelli Coal Mine, Inc.) 1983. Poker Flat Mine Permit Application, Healy, Alaska.

UCM (Usibelli Coal Mine, Inc.) 1989. "Mine Water Must Be 25 Times Cleaner Than Natural," *Usibelli Coal Miner* 9, 2.

U.S. Bureau of the Census 1988. *County and City Data Book, 1988*, U.S. Department of Commerce, Bureau of the Census.

USFS (U.S. Forest Service) 1974. *National Forest Landscape Management*, Agricultural Handbook No. 462, Vol. 2, April.

USGS (U.S. Geological Survey) 1990. *National Water Summary 1987, Hydrologic Events and Water Supply and Use*, USGS Water-Supply Paper 2350, U.S. Government Printing Office, Denver.

USGS (U.S. Geological Survey) 1991. Computer database information on flow of the Nenana River at Healy, Alaska, January 23.

van der Wildt, and Waarts, R. G. 1983. "Contrast Detection and its Dependence on the Presence of Edges and Lines in the Stimulus Field," Vision Res. 23, 821–830.

Van Hook, R. I., and Shults, W. D. 1977. *Effects of Trace Contaminants from Coal Combustion*, ERDA 77-64, Energy Research and Development Administration, Washington, D.C.

Wackter, D. J., and Foster, J. A. 1987. *Industrial Source Complex (ISC) Dispersion Model User's Guide*, 2nd ed. (rev.), EPA-450/4-88-002a, prepared for the U.S. Environmental Protection Agency by TRC Environmental Consultants, East Hartford, Conn.

Westman, W. E., Preston, K. P., and Weeks, L. B. 1985. "SO_2 Effects on the Growth of Native Plants," pp. 264–280 in *Sulfur Dioxide and Vegetation*, eds. W. E. Winner, H. A. Mooney, and R. A. Goldstein, Stanford University Press, Stanford, Calif.

White, W. H., Seigneur, C., Heinold, D. W., Eltgroth, M. W., Richards, L. W., Roberts, P. T., Bhardwaja, P. S., Conner, W. D., and Wilson, W. E., Jr., 1985. "Predicting the Visibility of Chimney Plumes: An Intercomparison of Four Models with Observations at a Well-Controlled Power Plant," Atmos. Environ. 19, 515–528.

Whitmore, M. E. 1985. "Effects of SO_2 and NO_x on Plant Growth," pp. 281–295 in *Sulfur Dioxide and Vegetation*, eds. W. E. Winner, H. A. Mooney, and R. A. Goldstein, Stanford University Press, Stanford, Calif.

Winklmann, J. December 18, 1992. Physicians Assistant, Healy Clinic, letter to Dr. E. W. Evans, U.S. Department of Energy, Pittsburgh Energy Technology Center.

Wolfe, R. 1988. Unpublished report to the Alaska Joint Boards of Fish and Game.

Woodward-Clyde Consultants 1978. *Winter Biological Observations of Two Proposed Power Plant Sites Near Nenana and Healy, Alaska,* Anchorage, Alaska.

RELATED DOCUMENTS

Alaska Industrial Development and Export Authority 1989. *Proposal, Healy Cogeneration Project Demonstrating TRW's Entrained Combustion System with Limestone Injection and Joy Technologies' Activated Recycle SDA System,* (submitted in response to Program Opportunity Notice for Clean Coal Technology Demonstration Projects, DE-PS01-89FE61825), August.

Alaska Industrial Development and Export Authority 1990. *Air Quality and Related Monitoring Programs, Healy Clean Coal Project, Healy, Alaska,* prepared by Stone & Webster Engineering Corp., Denver, August.

Alaska Industrial Development and Export Authority 1990. *Permit and Environmental Plan, Healy Power Project, Healy, Alaska,* prepared by Stone & Webster Engineering Corp., Denver, April.

Alaska Power Authority 1982. *Environmental Assessment Report, Anchorage-Fairbanks Transmission Intertie,* R-2422, prepared by Commonwealth Associates Inc., March.

Golden Valley Electric Association 1978. *Application for Approval to Construct/Modify a Source Pursuant to Prevention of Significant Deterioration — Unit No. 2, Healy, Alaska,* prepared by Stanley Consultants, Inc., August.

U.S. Department of Agriculture 1983. *Flood Plain Management Study (Low Intensity), Lower Tanana River and Tributaries, Interior, Alaska,* Soil Conservation Service, May.

U.S. Department of Energy 1990. *Environmental Assessment, Utility Retrofit Demonstration Using TRW Slagging Combustor Technology,* DOE/EA-0396, Washington, D.C., February.

U.S. Department of the Interior 1982. *Environmental Assessment, Development Concept Plan for Park Road Corridor, Denali National Park and Preserve, Alaska,* National Park Service, Denver, March.

U.S. Department of the Interior 1987. *Draft Environmental Impact Statement, Trans-Alaska Gas System,* Bureau of Land Management, Anchorage, Alaska, September.

U.S. Environmental Protection Agency 1980. *Interim Guidance for Visibility Monitoring,* EPA-450/2-80-082, EPA Office of Air Quality Planning and Standards, Research Triangle Park, N.C., November.

U.S. Environmental Protection Agency 1984. *User's Manual for the Plume Visibility Model (PLUVUE II)*, EPA-600/8-84-005, EPA Office of Research and Development, Research Triangle Park, N.C., February.

U.S. Environmental Protection Agency 1988. *Workbook for Plume Visual Impact Screening and Analysis*, EPA-450/4-88-015, EPA Office of Air Quality Planning and Standards, Research Triangle Park, N.C., September.

U.S. Environmental Protection Agency 1990. *IMPROVE Progress Report*, EPA-450/4-90-008, EPA Office of Air Quality Planning and Standards, Research Triangle Park, N.C., May.

U.S. Federal Energy Regulatory Commission 1984. *Draft Environmental Impact Statement, Susitna Hydroelectric Project, FERC No. 7114 - Alaska*, FERC/DEIS-0038, Washington, D.C., May.

U.S. Federal Energy Regulatory Commission 1985. *Final Supplemental Environmental Impact Statement, Bradley Lake Project, FERC No. 8221 - Alaska*, FERC/EIS-0039, Washington, D.C., September.

9. LIST OF PREPARERS

U.S. Department of Energy

Steven J. Heintz, Project Manager
Office of Clean Coal Technology, Pittsburgh Energy Technology Center

Thomas C. Ruppel, Environmental Coordinator
Office of Clean Coal Technology, Pittsburgh Energy Technology Center

Earl W. Evans, Senior Environmental Coordinator
Office of Clean Coal Technology, Pittsburgh Energy Technology Center

Ellen Bjerklie, Post-Graduate Environmental Researcher
Oak Ridge Associated Universities

Oak Ridge National Laboratory

Robert L. Miller, Program Leader, Energy Division
Technical Responsibility: Project Leader, Meteorology and Air Quality Analysis
Education: B.S., 1975, Meteorology, Pennsylvania State University
M.S., 1977, Meteorology, Pennsylvania State University
Years of Experience: 14
Total Publications: 30

Andrea W. Campbell, Research Staff, Energy Division
Technical Responsibility: Surface Water Resources and Noise
Education: B.S., 1970, Biology, Wilkes University
M.S., 1978, Biology, Wilkes University
Years of Experience: 19
Total Publications: 30

Robert O. Johnson, Development Staff, Energy Division

Technical Responsibility: Thermal Discharge Analysis

Education: B.S., 1972, Mechanical Engineering, University of Evansville
M.S., 1975, Mechanical Engineering, Purdue University
Ph.D., 1984, Engineering Science & Mechanics, University of Tennessee

Years of Experience: 16

Total Publications: 38

James W. Saulsbury, Research Staff, Energy Division

Technical Responsibility: Prehistoric and Historic Resources, Socioeconomics, and Aesthetic Analyses

Education: B.A., 1986, History, University of Tennessee
M.S., 1989, Planning, University of Tennessee

Years of Experience: 4

Total Publications: 5

William P. Staub, Research Staff, Energy Division

Technical Responsibility: Geology, Geohydrology, and Solid Waste Management

Education: B.S., 1956, Geological Engineering, Washington University of St. Louis
M.S., 1961, Geology, Washington University of St. Louis
Ph.D., 1968, Geotechnical Engineering, Iowa State University

Years of Experience: 29

Total Publications: 50

Glenn W. Suter II, Research Staff, Environmental Sciences Division

Technical Responsibility: Terrestrial and Aquatic Ecology

Education: B.S., 1970, Biology, Virginia Polytechnic Institute
Ph.D., 1976, Ecology, University of California, Davis

Years of Experience: 15

Total Publications: 77

10. GLOSSARY

acidic deposition	Wet (rain, snow, fog) or dry (particle, gas) deposition of acidic substances on the earth's surface following the chemical transformation and transport of SO_2 and NO_x
alluvial terrace	An ancient floodplain
amine	Ammonia-based compound used to control corrosion in the boiler system
anadromous	Ascending rivers from the sea for breeding
arctic zone	Climatic region characterized by low precipitation and a temperature range from the 40s (°F) to 20 below zero; located as the Arctic Drainage division on maps
atmospheric dispersion model	Computer program that simulates the effect or spread of pollutants into the atmosphere from a source such as a power plant
baghouse	Structure containing fabric filter bags that remove particulate matter from the flue gas before emissions leave the stack
baseline conditions	Existing conditions used to establish a baseline from which to evaluate potential impacts
baseload power plant	A plant intended to normally operate at near maximum capacity
benthic	Of, relating to, or occurring at the bottom of a body of water
biocide	A substance (e.g., chlorine) that is destructive to many different organisms and is used to treat water
blended coal	Equal amounts of run-of-mine coal and waste coal
boiler	Equipment (vessel) in which water is converted to steam
boiler blowdown stream	Removes impurities that have settled to the bottom of the boiler
boiler hoppers	Used to collect the heavy fallout from the flue gas that occurs with a change in velocity due to a turn in the ductwork
bottom ash	Heavy combustion particles that drop out of the flue gas in the boiler area or comprise the fouling deposit residual cleaned off the boiler tubes
capacity factor	The percentage of electricity actually generated by a power plant during a year compared with the plant's maximum capacity
coal fines	Small particles and dust from coal

cold shock	Depression of an animal's vital processes caused by a sudden drop in temperature (e.g., decrease in water temperature by 5°F or more can kill some fish species)
combustor	Equipment in which coal is burned at high temperatures
cones of depression	Depression of the potentiometric water surface due to pumping of a well
continental zone	Climatic region characterized by an average of 12 in./year precipitation and temperatures ranging from the 70's (°F) to 20 below zero; includes the Interior Basin area, central to northern Copper River area, and the West-Central area
conventional coal-fired power plant	Plant using currently commercially existing coal burning technologies such as pulverized coal, stoker-fired coal, or atmospheric fluidized bed combustion
conventional fuel	Traditionally used fuel such as coal, oil, and gas
cooling water	Water that is heated as a result of being used to cool the boiler
cross connection	Point where two separate cooling water discharge pipes are joined together and allow part of the flow from either pipe to be diverted to the other pipe
demineralizer reagents	Compounds (sulfuric acid and sodium hydroxide) used to reactivate the ion exchange demineralizers
downwash	Downward movement of air on the downwind side of a structure
dry scrubber	The equipment used to remove sulfur dioxide (SO_2) and particulate matter from the flue gas stream through a dry removal process
electric substation	Transformation and distribution center for electricity produced by the power plant
entrainment mortality	Death of organisms pulled through a water intake structure and through a water use facility
eyries	Sites high on mountains or cliffs where birds of prey will lay eggs and raise young
flash calcine	The formation of lime (CaO) by rapidly heating limestone ($CaCO_3$)
flocculation	Adsorption of chemicals by small particles to form larger stable aggregates or granules which can be removed from water by filtration or sedimentation

fly ash	Fine combustion particles (ash, soot, dust) that are carried in the flue gas
forced draft fans	Fans used to provide combustion air into the boiler
Gaussian dispersion model	Atmospheric dispersion model in which the spread of pollutants is defined by a Gaussian (normal) distribution
glacial outwash deposits	Material moved by glaciers and subsequently sorted and deposited by streams flowing from the melted glacial ice
global warming	Concept of a worldwide increase in climatic temperatures due to various man- or environment-induced occurrences that increase greenhouse gases (e.g., CO_2) in the atmosphere
hazardous	Continuous risk of harm or failure caused by or related to a substance or situation
heat load	Volume of heated water discharged after being used by a facility to cool steam
heat shock	Depression of an animal's vital processes or sudden stimulation of the nerves and contraction of the muscles caused by a sudden increase in temperature
hydration	Water gained via chemical reaction; the rigid attachment of water molecules to a chemical compound
hydrologic cycle	The endless circulation of water between ocean, atmosphere, and land
ichthyoplankton	Fish eggs and larvae
impingement mortality	Death of organisms that collect on the screens of a water intake structure
induced draft fans	Fans used to remove the combustion air from the outlet of the boiler and/or air pollution control equipment
intake pond	Natural or dredged pond used as the cooling water supply
intertie	Interconnection between two or more electric utility systems for passage of current
inversion layer	Layer of air having increased temperature with height
laydown area	Material and equipment storage area for the construction phase
leachate	Solution or product obtained by leaching
light extinction theory	A theory that describes how light intensity is decreased, thus diminishing visibility

limestone injection	The addition of limestone at or near the fuel combustors for flash calcination
maritime zone	Climatic region characterized by high (60–200 in./year) precipitation, temperatures ranging from 60°F to 20°F, and strong winds (50–100 mph) associated with storms; includes southeastern Alaska, the South Coast, and southwestern islands
mitigation	Minimizing or eliminating
mixing height	The height within the lower atmosphere within which relatively vigorous mixing of pollutant emissions occurs
monostatic acoustic radar unit	An instrument used to determine mixing height in the atmosphere
moraine	Accumulation of earth and stones carried and deposited by a glacier
NAAQS	National Ambient Air Quality Standards are concentration levels set for six air pollutants to protect public health and welfare
no-action alternative	Alternative whereby the HCCP would not be funded under the Clean Coal Technology Program and the clean coal technologies would not be demonstrated
outfall	The outlet point for discharged or runoff water to a body of water or land area
overburden	Material overlying a deposit of useful geologic materials or bedrock
palustrine	Wetlands classification that includes nontidal wetlands characterized by the presence of trees and shrubs, rooted plants, or aquatic beds, or nonvegetated wetlands
plume	***A volume of air or water containing a mixture of a gaseous, liquid, or solid discharge and the surrounding ambient environment.***
precombustors	Equipment that burns coal with excess air in order to supply higher temperature air to the combustor
productivity (vegetation)	Capacity of an environment for producing a specific plant or sequence of plants under a specified system of management, generally expressed in terms of vegetative or seed yields
proof-of-concept	Demonstrating that a proposed process will operate successfully

PSD increments	The maximum increases to ambient pollution levels that may be incurred as a result of increased emissions from new or modified sources; applied to three different types of areas
raptor	A bird of prey
repower	The process of installing major new equipment at an existing power plant site or industrial facility; repowering often involves installing an entirely different technology and will increase the electricity generated by a plant
retrofit	The process of installing new equipment at an existing power plant or industrial facility to improve efficiency or pollution control without replacing the basic unit
riparian	Relating to, living, or located along the bank of a river or lake
reagent	A substance used because of its chemical or biological activity (e.g., limestone used in the scrubbing process)
receptor	A spatial point used in computer models at which pollutant effects are predicted
run-of-mine coal	Coal with sufficiently favorable characteristics that it is conventionally used in combustion processes
secondary particulate species	Compounds such as sulfate or nitrate formed in the atmosphere from gases such as SO_2 or NO_x emitted from a source such as a power plant
significant emission rates	Threshold values for ambient air quality monitoring requirements
slag	The molten by-product of firing coal at high temperature (3000°F)
spray dryer absorber	Structure in which SO_2 is removed from the flue gas by using lime to capture the SO_2
stability class	A category within a classification scheme designed to measure the ability of the atmosphere to mix air pollutants (e.g., A stability is most unstable and results in vigorous mixing, while F stability is very stable and results in extremely limited mixing).
stratosphere	The layer of the earth's atmosphere above the troposphere and extending to about 31 miles above the earth's surface; temperature varies little and clouds are rare
sump	Concrete-lined pit at the lowest point of the drainage system
taiga	Coniferous woodlands and forests

thermal plume	Area of a water body with elevated temperature due to discharged heated water
tipple	Structure used to store coal before loading into coal cars
toxic	Of, relating to, or caused by a poison or toxin
train load-out facility	Structures and equipment necessary to load coal onto train cars
transition zone	Climatic region characterized by moderate precipitation, temperatures ranging between the 60's (°F) to 10 below zero, and strong winds (50–100 mph) associated with storms; includes the southern Copper River area, the Chugach Mountains to Bristol Bay area, and the coastal region of the West-Central area
transmission corridor	Area used to provide separation between the transmission lines and the general public and provides access to the transmission link for construction and maintenance
transmission line	Support structures, insulators, and conductors that transmit electrical power at 69 kV or higher
troposphere	The lowest layer of the earth's atmosphere extending 7–10 miles from the earth's surface; temperature generally decreases with altitude and clouds form
turbine-generator	The equipment that converts steam energy to mechanical energy (turbine) and to electrical energy (generator)
waste coal	Low-grade coal or overburden-contaminated coal
watershed	The surface drainage area and subsurface soils and geologic formations that drain to a particular body of water
wind rose	Diagram that shows the relative frequency or frequency and strength of winds from different directions
1Q10	Lowest average one day flow in any 10-year period
7Q10	Lowest average daily flow during any 7 consecutive days in any 10-year period

APPENDIX A

WATER QUALITY PARAMETERS MONITORED IN THE NENANA RIVER AND HEALY CREEK

Table A.1. Parameters measured monthly in water samples from the Nenana River and Healy Creek

pH[a]	Solids, residue at 108°C
Temperature[a]	Solids, residue at 180°C
Specific conductance[a]	Nitrate, total and dissolved
Dissolved oxygen[a]	Nitrate, total and dissolved
Streamflow[a]	Barium, total and dissolved
Alkalinity	Copper, total and dissolved
Bicarbonate	Iron, total and dissolved
Carbonate	Manganese, total and dissolved
Calcium, total and dissolved	Strontium, total and dissolved
Chloride, dissolved	Zinc, total and dissolved
Hardness	5-day BOD
Magnesium, total and dissolved	Chemical oxygen demand
Potassium, total and dissolved	Organic carbon; total, suspended, and dissolved
Silica, dissolved	Color
Sodium, total and dissolved	Silt density index
Sulfate, dissolved	Turbidity
	Suspended sediment

[a]Field measurements.

Source: Alaska Industrial Development and Export Authority, *1991a. Second Draft Environmental Information Volume, Healy Clean Coal Project, Healy, Alaska*, prepared by Stone and Webster Engineering Corp., Denver, *September*.

Table A.2. Parameters measured quarterly in water samples

Fecal coliform bacteria	Cadmium, total and dissolved
Bromide, dissolved	Chromium, total and dissolved
Fluoride, dissolved	Cobalt, total and dissolved
Iodide, dissolved	Cyanide, total
Ammonia as NH, total and dissolved	Lithium, total and dissolved
Phosphorus, total and dissolved	Lead, total and dissolved
Phosphate, total and dissolved	Mercury, total and dissolved
Oil and grease	Nickel, total and dissolved
Aluminum, total and dissolved	Selenium, total and dissolved
Antimony, total	Silver, total and dissolved
Arsenic, total and dissolved	Sulfide, total
Beryllium, total and dissolved	Zinc, total

Table A.3. Environmental Protection Agency priority pollutants measured once in water samples from the Nenana River and Healy Creek

Semi-volatile organics	
Chloro-methylphenol, total	Di-N-butyl phthalate, total
2-Chlorophenol, total	1,2-Dichlorobenzene, total
2,4-Dichlorophenol, total	1,3-Dichlorobenzene, total
2,4,6-Trichlorophenol, total	1,4-Dichlorobenzenine, total
2,4-Dimethylphenol, total	3,3-Dichlorobenzidine, total
Dinitromethylphenol, total	Diethyl phthalate, total
2,4-Dinitrophenol, total	Dimethyl phthalate, total
2-Nitrophenol, total	2,4-Dinitrotoluene, total
4-Nitrophenol, total	2,6-Dinitrotoluene, total
Pentachlorophenol, total	Di-N-octylphthalate, total
Phenol, total	2-Ethylhexyl phthalate, total
Acenaphthene, total	Fluorene, total
Acenaphthylene, total	Fluoranthene, total

Table A.3 (continued)

Anthracene, total	Hexachlorobenzene, total
Benzidine, total	Hexachlorobutadienre, total
Benzo(A) anthracene, total	Hexachlorocyclopentadiene, total
Benzo(B) fluoranthene, total	Hexachloroethane, total
(Benzo(K) fluoranthene, total	Indeno (1,2,3) pyrene, total
Benzo (Ghi) perylene, total	Naphthalene, total
Butyl benzyl phthalate, total	Nitrobenzene, total
2-Chloroethoxy methane, total	Nitrosodimethylamine, total
2-Chloroethyl ether, total	N-nitrosodiphenylamine, total
2-Chloroisopropyl ether, total	N-nitrosodi-N-propylamine, total
4-Bromophenyl phenylether, total	Phenanthrene, total
2-Chloronaphthalene, total	Pyrene, total
4-Chlorophenyl phenyl ether, total	2,3,7,8-Tetrachlorodibenzo-p-dioxin, total
Chrysene, total	1,2,4,-Trichlorobenzene, total
Dibenzoanthracene, total	
Purgeable organics	
Benzene, total	Methylene chloride, total
Bromoform, total	1,1,2,2-Tetrachloroethene, total
Carbon tetrachloride, total	Tetrachloroethylene, total
Chlorobenzene, total	Toluene, total
Chlorodibromo, total	1,1,1-Trichloroethane, total
Chloroethane, total	1,1,2-Trichloroethane, total
2-ol-Ethylvinylether	Trichloroethylene, total
Chloroform, total	Trichlorofluoromethane, total
Dichlorobromomethane, total	Vinyl chloride, total
Dichlorodifluoromethane, total	Chloromethane
1,1-Dichloroethane, total	1,2-Dibromoethane, total
1,2-Dichloroethane, total	1,2-Dichlorobenzene, total
1,1-Dichloroethylene, total	1,3-Dichlorobenzene, total

Table A.3 (continued)

1,2-transdiol-Ethylene	1,4-Dichlorobenzene, total
1,2-Dichloropropane, total	Cis-2,3-dichloropropene
1,3-Dichloropropene, total	Trans 1,3-dichloropropene
Ethylbenzene, total	Styrene
Methylbromide, total	Xylene, total
Organochloride insecticides	
Perthane, total	Heptachlor epoxide, total (water)
Endosulfan I, total	Lindane, total (water)
Aldrin, total (water)	Toxaphene, total (water)
Chlordane, total (water)	Gross PCBs, total (water)
DDD, total (water)	Gross PCNs, total (water)
DDE, total (water)	Methoxychlor, total (water)
DDT, total (water)	Mirex, total
Dieldrin, total (water)	Alpha-BHC, total
Endrin, total (water)	Beta-BHC, total
Heptachlor, total (water)	Delta-BHC, total
Arochlors	
Arochlor 1016, total	Arochlor 1242, total
Arochlor 1221, total	Arochlor 1248, total
Arochlor 1232, total	Arochlor 1254, total

Source: Alaska Industrial Development and Export Authority, *1991a. Second Draft Environmental Information Volume, Healy Clean Coal Project, Healy, Alaska*, prepared by Stone and Webster Engineering Corp., Denver, *September*.

Table A.4. Results of water quality analysis of samples from three locations in the Nenana River and one location at Healy Creek, August 1990 through July 1991

		Site 1[a]		Site 2[a]		Site 3[a]		Site 4[a]	
Parameter	*Units*	*Range of values*	*Number of tests*	*Range of values*	*Number of tests*	*Range of values*	*Number of tests*	*Range of values*	*Number of tests*
Dissolved[b] oxygen	mg/L	10.0–13.6	>19	10.9–15.0	>21	11.2–13.6	>37	9.8–15.0	15
Specific conductance	µs/cm	202–466	>19	182–398	>21	196–382	>37	460–633	>14
pH[b]	units	7.18–8.54	>19	7.2–8.34	>20	7.77–8.5	>37	7.92–8.46	>14
Chemical oxygen demand (COD)	mg/L	<10–21	12	<10–33	12	<10–19	12	<10–38	12
Total organic carbon (TOC)	mg/L	0.6–3.1	12	0.9–2.8	12	0.7–3.2	12	0.4–11.0	12
Temperature[b]	°C	0–12.8	19	0–11.8	N/A	0–9.4	37	0–13.5	14
Turbidity[b]	NTUs	0.5–86	12	0.4–160	12	0.5–140	12	0.5–250	12
Color[b]		<1–80	12	<1–40	12	1–25	12	<1–30	12
Alkalinity (as $CaCO_3$)	mg/L	59–120	12	54–125	12	48–121	12	113–193	12
Hardness (as $CaCO_3$)	mg/L	150–200	12	100–200	12	100–200	12	230–370	12
Calcium[c]	mg/L	31–51	12	30–52	12	27–53	12	41–74	12
Magnesium[c]	mg/L	8.9–17	12	8.7–16	12	7.6–17	12	30–48	12
Potassium[c]	mg/L	1.0–1.7	12	1.0–1.7	12	1.0–1.8	12	1.0–1.3	12
Sodium[c]	mg/L	2.4–5.5	12	2.4–5.6	12	2.4–5.5	12	3.1–5.9	12
Chlorides[b,c]	mg/L	1.3–4.3	12	0.8–4.8	11	0.2–4.6	12	1.1–6.0	12
Sulfates[b,c]	mg/L	50–82	12	57–81	12	52–79	12	120–180	12
NH_3N[c] (as N)	mg/L	<0.01–0.04	9	<0.010–0.040	9	<0.01–0.04	8	<0.01–0.04	8
$NO_3N + NO_2N$ (as N)	mg/L	<0.05–0.22	12	<0.10–0.31	12	<0.05–0.90	12	<0.05–0.40	12
NO_2N[c] (as N)	mg/L	<0.010–0.01	12	<0.01–0.01	12	<0.01–0.01	12	<0.01–0.02	12
Phosphorous[c], total	mg/L	<0.01	1	<0.01	1	<0.01	1	<0.01	1
Silica[c]	mg/L	4.2–7.9	11	4.1–7.7	11	6.5–7.6	11	3.1–11.0	12

Table A.4 (continued)

Parameter	Units	Site 1[a]		Site 2[a]		Site 3[a]		Site 4[a]	
		Range of values	*Number of tests*	*Range of values*	*Number of tests*	*Range of values*	*Number of tests*	*Range of values*	*Number of tests*
Iodide[c]	mg/L	0.001	1	0.001	1	<0.001	1	0.001	1
Bromide[c]	mg/L	<0.010	1	<0.010	1	<0.010	1	0.010	1
Fluoride[c]	mg/L	0.10–0.20	5	<0.10–0.20	5	0.10–0.20	5	<0.10–0.20	5
Cyanide	mg/L	<0.010	1	<0.010	1	<0.010	1	<0.010	1
Sulfide	mg/L	<0.5	1	<0.5	1	0.5	1	<0.5	1
Arsenic[c]	µg/L	<1	1	<1	1	<1	1	<1	1
Barium[c]	µg/L	34–200	12	31–61	12	29–200	12	26–56	12
Beryllium[c]	µg/L	<0.5	8	<0.5	8	<0.5	8	<10	6
Cadmium[c]	µg/L	<1.0–2.0	8	<1.0–4.0	8	1.0–2.0	8	<1.0–1.0	6
Chromium[c]	µg/L	<1	8	1	8	<1	8	1	6
Cobalt[c]	µg/L	<1	8	<1	8	<1	8	<1–<3	6
Copper[c]	µg/L	<10	12	2–3	12	2	12	1	12
Iron[c]	µg/L	6–74	12	6–56	12	6–73	12	<3–1400	12
Lead[c]	µg/L	<1	8	<1–1	8	<1	8	<1	6
Manganese[c]	µg/L	4–20	12	4–20	12	3–20	12	7–64	12
Molybdenum[c]	µg/L	1	8	<1	8	<1	8	<1	6
Nickel[c]	µg/L	2–3	8	1–3	8	2–3	8	1	0
Antimony	µg/L	<1	1	<1	1	<1	1	<1	1
Aluminum[c]	µg/L	<10	1	10	1	<10	1	20	1
Selenium[c]	µg/L	<1	1	<1	1	1	1	<1	1
Mercury[c]	µg/L	0.1	1	<0.10	1	<0.1	1	<0.10	1
Silver[c]	µg/L	<1.0–2.0	8	<1.0	8	<1.0	8	<1.0–1.0	6
Strontium[c]	µg/L	170–340	12	170–310	12	170–300	12	210–360	12
Zinc[c]	µg/L	4–9	12	5–12	12	<3–26	12	<3–11	12

Table A.4 (continued)

Parameter	*Units*	Site 1[a] *Range of values*	Site 1[a] *Number of tests*	Site 2[a] *Range of values*	Site 2[a] *Number of tests*	Site 3[a] *Range of values*	Site 3[a] *Number of tests*	Site 4[a] *Range of values*	Site 4[a] *Number of tests*
Lithium[c]	µg/L	7–11	8	7–11	8	7–8	8	9–14	6
Vanadium[c]	µg/L	<6	7	<1	7	3	7	<1	6
Dichloro-bromomethane	µg/L	<3.0	2	<3.0	1	<3.0	1	<3.0	1
Carbon tetra-chloride	µg/L	<3.0	2	<3.0	1	<3.0	1	<3.0	1
1,2-Di-chloroethane	µg/L	<3.0	2	<3.0	1	<3.0	1	<3.0	1
Bromoform	µg/L	<3.0	2	<3.0	1	<3.0	1	<3.0	1
Chlorobromo-methane	µg/L	<3.0	2	<3.0	1	<3.0	1	<3.0	1
Chloroform	µg/L	<3.0	2	<3.0	1	<3.0	1	<3.0	1
Toluene	µg/L	<3.0	2	<3.0	1	<3.0	1	<3.0	1
Benzene	µg/L	<3.0	2	<3.0	1	<3.0	1	<3.0	1
Chlorobenzene	µg/L	<3.0	2	<3.0	1	<3.0	1	<3.0	1
Chloroethane	µg/L	<3.0	2	<3.0	1	<3.0	1	<3.0	1
Ethylbenzene	µg/L	<3.0	2	<3.0	1	<3.0	1	<3.0	1
Methylbromide	µg/L	<3.0	2	<3.0	1	<3.0	1	<3.0	1
Methylchloride	µg/L	<3.0	2	<3.0	1	<3.0	1	<3.0	1
Methylene chloride	µg/L	<3.0	2	<3.0	1	<3.0	1	<3.0	1
Tetrachloro-ethylene	µg/L	<3.0	2	<3.0	1	<3.0	1	<3.0	1
Trichloro-fluoromethane	µg/L	<3.0	2	<3.0	1	<3.0	1	<3.0	1
1,1-Dichloro-ethane	µg/L	<3.0	2	<3.0	1	<3.0	1	<3.0	1
1,1-Dichloro-ethylene	µg/L	<3.0	2	<3.0	1	<3.0	1	<3.0	1

Table A.4 (continued)

		Site 1[a]		Site 2[a]		Site 3[a]		Site 4[a]	
Parameter	*Units*	*Range of values*	*Number of tests*	*Range of values*	*Number of tests*	*Range of values*	*Number of tests*	*Range of values*	*Number of tests*
1,1,1-Trichloroethane	µg/L	<3.0	2	<3.0	1	<3.0	1	<3.0	1
1,1,2-Trichloroethane	µg/L	<3.0	2	<3.0	1	<3.0	1	<3.0	1
1,1,2,2-Tetrachloroethane	µg/L	<3.0	2	<3.0	1	<3.0	1	<3.0	1
1,2-Dichlorobenzene	µg/L	<3.0	2	<3.0	1	<3.0	1	<3.0	1
1,2-Dichloropropane	µg/L	<3.0	2	<3.0	1	<3.0	1	<3.0	1
1,2-Transdichloroethene	µg/L	<3.0	2	<3.0	1	<3.0	1	<3.0	1
1,3-Dichloropropene	µg/L	<3.0	2	<3.0	1	<3.0	1	<3.0	1
1,3-Dichlorobenzene	µg/L	<3.0	2	<3.0	1	<3.0	1	<3.0	1
1,4-Dichlorobenzene	µg/L	<3.0	2	<3.0	1	<3.0	1	<3.0	1
2-Chloroethylvinylether	µg/L	<3.0	2	<3.0	1	<3.0	1	<3.0	1
Dichlorodifluoromethane	µg/L	<3.0	2	<3.0	1	<3.0	1	<3.0	1
Trans-1,3-chloropropene	µg/L	<3.0	2	<3.0	1	<3.0	1	<3.0	1
Cis-1,3–Dichloropropene	µg/L	<3.0	2	<3.0	1	<3.0	1	<3.0	1
Vinyl chloride	µg/L	<1.0	2	<1.0	1	<1.0	1	<1.0	1
Trichloroethylene	µg/L	<3.0	2	<3.0	1	<3.0	1	<3.0	1
Styrene	µg/L	<3.0	2	<3.0	1	<3.0	1	<3.0	1
1,2-Dibromoethane water, whole	µg/L	<3.0	2	<3.0	1	<3.0	1	<3.0	1

Table A.4 (continued)

		Site 1[a]		Site 2[a]		Site 3[a]		Site 4[a]	
Parameter	*Units*	*Range of values*	*Number of tests*	*Range of values*	*Number of tests*	*Range of values*	*Number of tests*	*Range of values*	*Number of tests*
Xylene-total water, whole	µg/L	<3.0	2	<3.0	1	<3.0	1	<3.0	1
Oil and grease[b]	mg/L	<1	2	<1	1	<1	1	<1	1
Phenols	µg/L	6	2	11	1	6	1	1	1

[a]Sampling sites are indicated on Fig. 3.3.2.

[b]Alaska Water Quality Standards for these parameters are given in Table 3.3.1.

[c]Dissolved.

Source: AIDEA (Alaska Industrial Development and Export Authority) 1991a. Second Draft Environmental Information Volume, Healy Clean Coal Project, Healy, Alaska, prepared by Stone & Webster Engineering Corp., Denver, September.

APPENDIX B

ANALYSIS OF THE EXTENT OF OPEN WATER DOWNSTREAM FROM THE PROPOSED HEALY CLEAN COAL PROJECT

APPENDIX B

ANALYSIS OF THE EXTENT OF OPEN WATER DOWNSTREAM FROM THE PROPOSED HEALY CLEAN COAL PROJECT

The purpose of this analysis is to estimate the extent of open (ice-free) water downstream from the proposed HCCP during winter. An example of the extent of open water that has been observed downstream from Healy Unit No. 1 during the winter is shown in Fig. B.1 (Dames & Moore 1975). The area of open water gradually spreads from the east bank on which the thermal discharge occurs to almost the entire Nenana River just past the first bend in the river below the outfall. The width of open water stays approximately constant at about 225 ft beyond the bend. Dames & Moore (1975) did not report the furthest downstream extent of open water in the observations shown in Fig. B.1. The open water caused by Healy Unit No. 1 extends downstream to Poker Creek, approximately 3 miles from the discharge point (W. D. Steigers, personal communication to R. L. Miller, Energy Division, Oak Ridge National Laboratory, Dec. 6, 1991). An additional transitional area extends downstream for about 1 mile beyond Poker Creek in which pockets of open water occur that are interspaced with areas of thin ice.

Figure B.2 displays the geometry of the open water (Dames & Moore 1975) (W. D. Steigers, personal communication to R. L. Miller, Energy Division, Oak Ridge National Laboratory, Dec. 6, 1991). The area of open water is proportional to the magnitude of the thermal discharge, and the transport of thermal energy within the dispersing plume initially follows, at least approximately, a power law. Hence, in the first 0.5 mile where the extent of open water gradually spreads from the bank, the width can be written as

$$w = x^a \ , \qquad (1)$$

where w is the plume width (feet), x is the downstream distance (feet), and a is an empirical constant whose value must be determined. Using the downstream distance of 2640 ft (0.5 mile) and the width of 225 ft, a is calculated as

$$a = ln(225)/ln(2640) = 0.69 \ . \qquad (2)$$

The area A_1, of open water in the first 0.5 mile is

$$A_1 = \int_0^{2640} x^a \, dx = \left[\frac{x^{a+1}}{a+1} \right]_0^{2640} \ , \qquad (3a)$$

$$= 360{,}000 \text{ ft}^2 \ . \qquad (3b)$$

ORNL-DWG 91M-4966

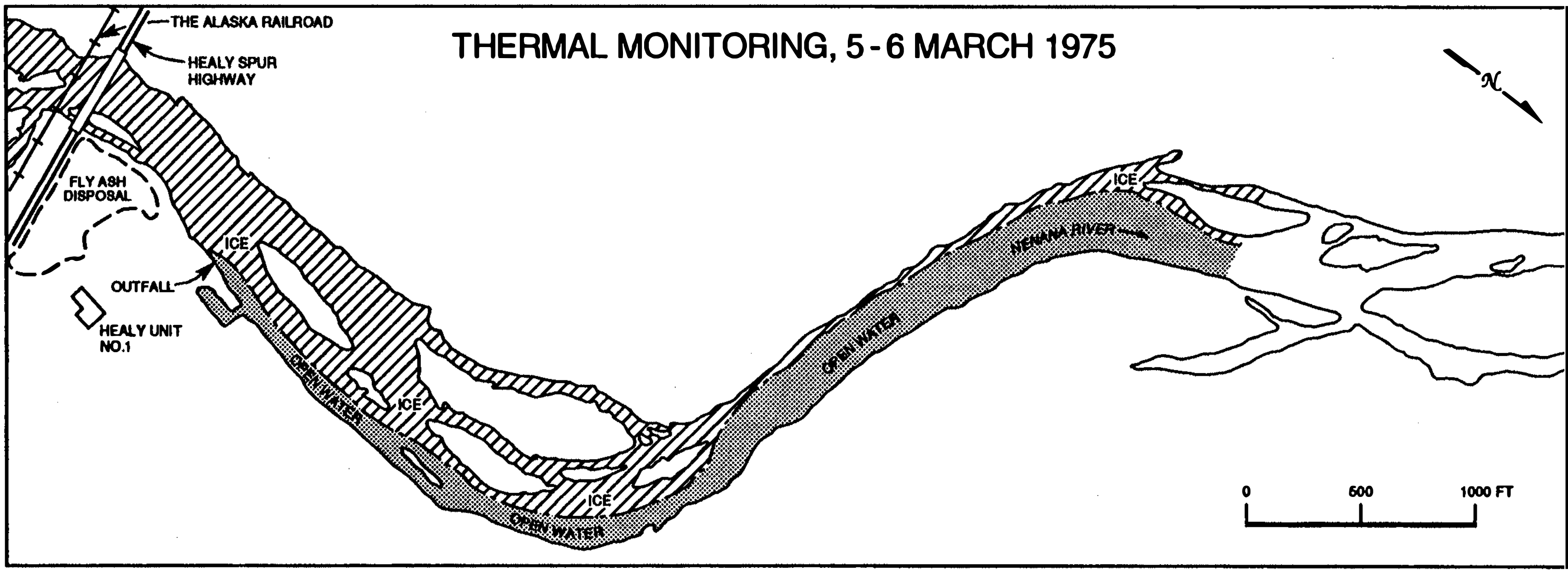


Fig. B.1. Extent of open water observed downstream from Healy Unit No. 1 (Dames & Moore 1975).

ORNL-DWG 91M-4967

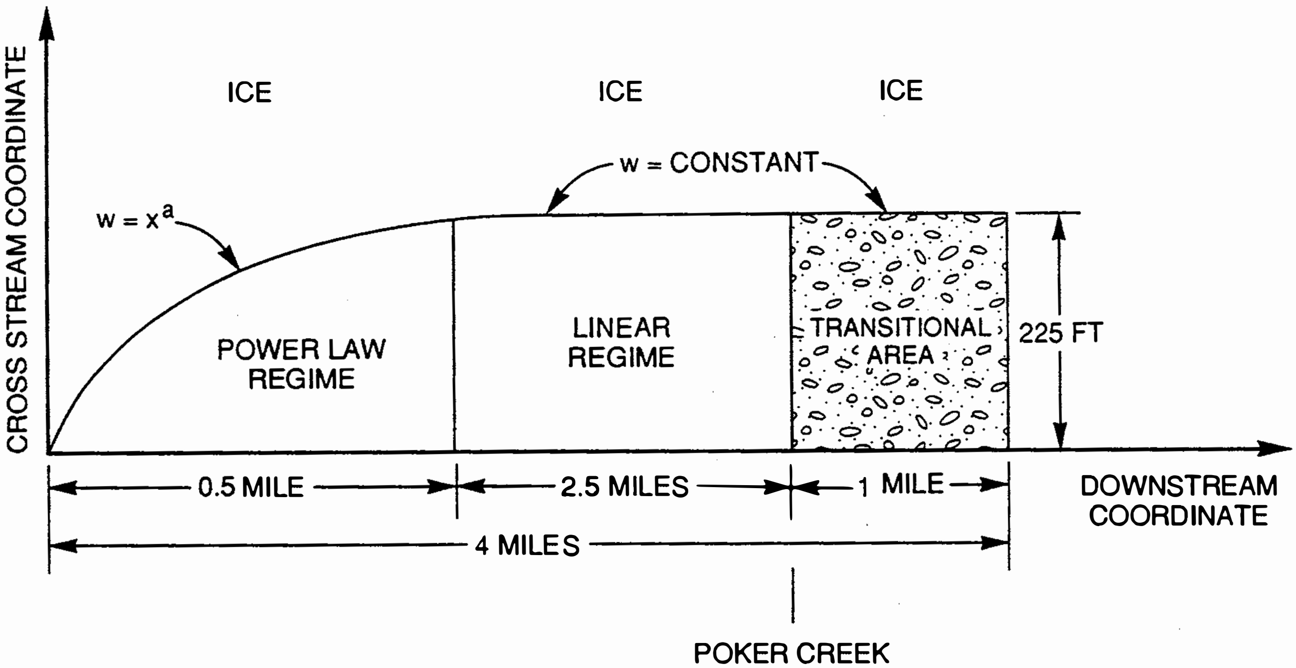


Fig. B.2. Healy Unit No. 1 open water area (not drawn to scale).

Once the width of open water becomes constant, the area computation is simplified considerably. In the linear regime (see Fig. B.2), the area A_2 is

$$A_2 = \text{length} \times \text{width} = 225 \text{ ft} \times 13{,}200 \text{ ft} \ , \tag{4a}$$

$$= 2{,}970{,}000 \, ft^2 \ . \tag{4b}$$

The total area of open water resulting from the thermal discharge of Healy Unit No. 1 is $A_1 + A_2$, or 3,330,000 ft^2. This area calculation does not include the transitional area consisting of thin ice and pockets of open water. A transitional area would be present at the end of the thermal plume, regardless of the magnitude of the thermal discharge. The plume must be cooled to this minimum level before freezing occurs.

The combined thermal discharges from Healy Unit No. 1 and the proposed HCCP would increase the downstream extent of open water during the winter. The magnitude of the HCCP thermal discharge would be twice that of Healy Unit No. 1. The heat load discharged into the Nenana River by both units would be three times that of Unit No. 1 alone. The geometry of the combined thermal plume would be similar, although larger in area, to the plume observed from Healy Unit No. 1 because both thermal discharges would occur along the bank of the Nenana River. The 500-ft distance between the Healy Unit No. 1 and proposed HCCP discharge points can be neglected in an analysis of open water with a downstream extent that is measured in miles. The two thermal discharges can be merged for the analysis. The increased cooling efficiency attributable to the submerged nozzle proposed for the HCCP would be minimal during the winter because the depth of the Nenana River averages 2 ft.

This analysis estimates the downstream extent of open water, which is considered to be in the far field (Fischer et al. 1979). The thermal structure in the far field is insensitive to the effects of initial momentum and buoyancy at the discharge point, as well as the mixing processes by which heat is transported across the channel by turbulence. In the far field, the heat has been transported completely across the channel, and a spatially-averaged temperature can be defined over the channel cross-section which varies only with the downstream coordinate. The far field also is insensitive to distance between the Healy Unit No. 1 outfall and the proposed HCCP outfall.

Because the area of open water is proportional to the magnitude of the thermal discharge, the additional area of open water attributable to the HCCP would be twice that of Healy Unit No. 1 or 6,660,000 ft^2. The additional distance in the linear regime can be obtained by dividing the area by the

225-ft width. The incremental increase is 29,600 ft or 5.6 miles. The geometry of the open water area that would result from the combined thermal discharge from Healy Unit No. 1 and the HCCP is displayed in Fig. B.3. The total extent of open water in the Nenana River during the winter would be approximately 10 miles.

ORNL-DWG 91M-4968

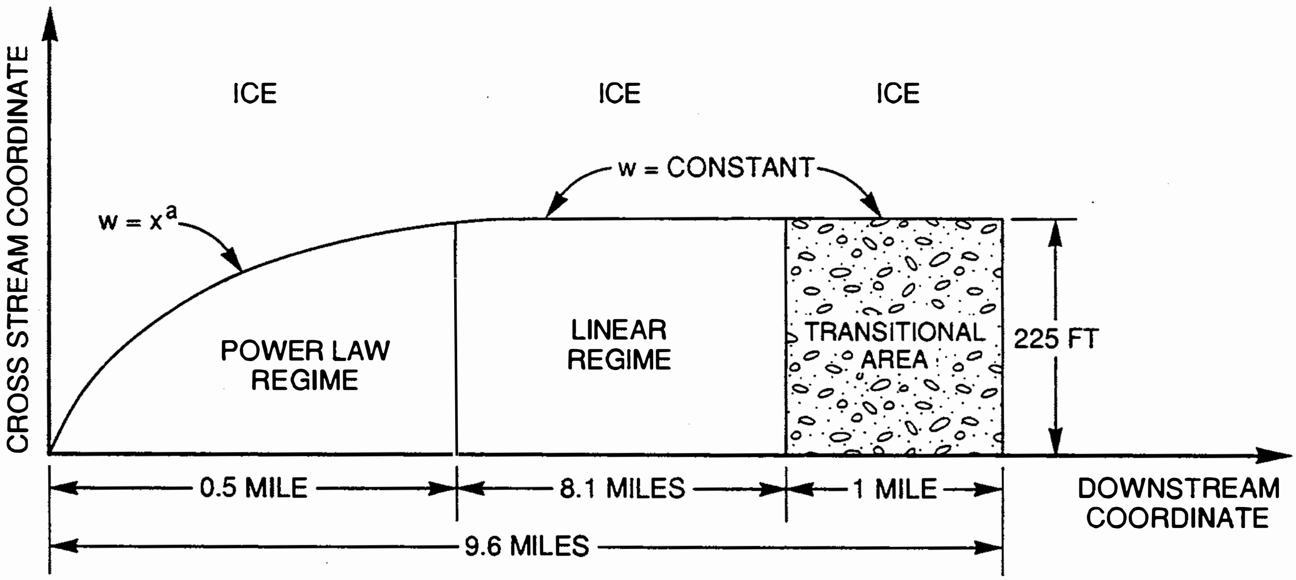


Fig. B.3. Open water area attributable to the combined thermal discharge from Healy Unit No. 1 and the proposed HCCP (not shown to scale).

REFERENCES

Dames & Moore, 1975. *Influence of Golden Valley Electric Association, Inc., Discharge on Biota of the Nenana River Near Healy, Alaska: A Physical–Chemical Evaluation (Final Report)*, No. 9057-005-22, Chicago.

Fischer, H. B., et al. 1979. *Mixing in Inland and Coastal Waters*, Academic Press, Inc., New York.

APPENDIX C

CONSULTATION LETTER UNDER SECTION 7 OF THE ENDANGERED SPECIES ACT

IN REPLY REFER TO:

United States Department of the Interior

FISH AND WILDLIFE SERVICE

NORTHERN ALASKA ECOLOGICAL SERVICES
101 12th Ave., Box 20, Room 232
Fairbanks, AK 99701
May 29, 1991

Mr. Earl W. Evans
Office of Clean Coal Technology
Department of Energy
Pittsburgh Energy Technology Center
P.O. Box 10940
Pittsburgh, Pennsylvania 15236-0940

Dear Mr. Evans:

The Fish and Wildlife Service reviewed the threatened and endangered species that may occur in the area of the proposed Healy Clean Coal Project as per your request dated April 30, 1991.

Two listed subspecies occur in the area of the proposed project. The endangered American Peregrine Falcon (*Falco peregrinus anatum*) nests in interior Alaska and also migrates through the area during spring and fall migration. There are no known nest sites within 15 miles of the project area, but suitable habitat exists along the Healy River immediately adjacent to the proposed project sites. The threatened Arctic Peregrine Falcon (*Falco peregrinus tundrius*) nests in northern Alaska, but some individuals likely migrate through the area. No candidate plant species are known to occur in the area.

Based upon the above information, the fact that the peregrine population is expanding, and that no recent survey has been made in the vicinity of the proposed project, the Service recommends that a survey be conducted for nesting peregrine falcons prior to construction. The Service has developed guidelines for conducting peregrine surveys and will be pleased to provide assistance in planning such surveys.

We appreciate your interest and cooperation. Should you have need for further information or assistance please call Ervin McIntosh at (907) 456-0444 or Skip Ambrose at (907) 456-0239.

Sincerely,

Patrick Sousa

Patrick J. Sousa
Field Supervisor

APPENDIX D

CONSULTATION LETTER UNDER SECTION 106 OF THE NATIONAL HISTORIC PRESERVATION ACT

STATE OF ALASKA

DEPARTMENT OF NATURAL RESOURCES

DIVISION OF PARKS AND OUTDOOR RECREATION
Office of History and Archaeology

WALTER J. HICKEL, GOVERNOR

3601 C STREET, Suite 1278
ANCHORAGE, ALASKA 99503
PHONE: (907) 762-2622

MAILING ADDRESS:
P.O. Box 107001
ANCHORAGE, ALASKA 99510-7001

July 11, 1991

File No.: 3130-1R Dept. of Energy

Subject: Clean Coal Technology Program

Mr. Thomas C. Ruppel
Office of Clean Coal Technology
Department of Energy
Pittsburgh Energy Technology Center
P.O. Box 10940
Pittsburgh, PA 15236-0940

Dear Mr. Ruppel:

Thank you for your letter of June 10th concerning potential impacts to historic properties with respect to the Healy Clean Coal Program.

The present power plant and immediately adjacent area have been thoroughly disturbed by previous construction. There is no possibility that any National Register-eligible historic properties exist there.

The alternative facility location approximately 3.5 miles to the north/northwest contains no known historic properties. Further, the area is a relatively recent flood plain of the Nenana River and would therefore have a very low potential to contain any presently undiscovered sites.

We have no objections to the implementation of this project. Thank you for the opportunity to comment. Please call Tim Smith at 762-2625 if there are any questions or if we can be of further assistance.

Sincerely,

Judith E. Bittner
State Historic Preservation Officer

JEB:tas

APPENDIX E

DESCRIPTION OF PLANT OPERATIONAL WASTEWATER SYSTEMS

APPENDIX E

DESCRIPTION OF PLANT OPERATIONAL WASTEWATER SYSTEMS

The design philosophy for the proposed HCCP operation is to allow for maximum water reuse and minimal wastewater discharge. Wastewater streams (with the exclusion of metal cleaning fluids and sanitary wastewater, water not lost to the atmosphere by evaporation, or water used for flue gas desulfurization, fly ash wetdown, and slag/bottom ash quenching and conveying) would be sent to the wastewater treatment system and eventually discharged into the Nenana River. Wastewater absorbed by the slag/bottom ash and fly ash wastes would be carried with the ash to the UCM mine for disposal in the mine operation.

The systems for treatment of the wastewater streams generated from plant operation would process each stream according to its individual characteristics, anticipated utilization, and eventual disposition.

The overall wastewater treatment system would provide for separate treatment or nontreatment of the individual effluent streams before collection into a common sump (or sumps), followed by reuse in appropriate plant systems. Excess wastewater would be combined to a waste stream. The stream would flow through an equalization and final pH adjustment system. This system would consist of supply tanks equipped with metering pumps to input appropriate neutralizing reagents. After passing through this system, the effluent would be routed to a sump for suspended impurity precipitation. The neutralized and treated effluent would be pumped to the circulating cooling water system for transport to the Nenana River.

Instrumentation would be installed in the waste stream downstream of the precipitation sump. These instruments would continuously monitor flow and pH of the effluent. Samples would be metered out of the waste stream and analyzed for established potential effluent contaminants to maintain effluent accountability.

The treatment for each of the waste stream subsystems is described in the following sections.

E.1 BOILER BLOWDOWN WASTEWATER TREATMENT SUBSYSTEM

E.1.1 System Foundation

The boiler blowdown would be a scheduled release of set quantities of water from the boiler to control the natural buildup of impurities in the boiler system. The impurities would originate from the soluble constituents in the boiler feedwater and the additions of water treatment chemicals. The frequency of the blowdown would be determined by the quantity of total dissolved solids (TDS) and the ratio of major cations in the boiler feedwater.

Chemicals that would be added to the boiler include an oxygen scavenger and an amine that would both scavenge oxygen and control pH. In addition, coordinated phosphate treatment may be used for fluidizing solids in the boiler drum.

The blowdown stream would be used in the spray dryer absorber section of the FGD system for reactivating the recycled flash calcined material. Any excess blowdown water would be routed to the wastewater treatment system, where it would be utilized elsewhere in the plant operation or mixed with other waste streams, treated, neutralized, or released as part of the plant effluent.

E.1.2 System Description

Blowdown from the boiler would be discharged through pipelines into a flash receiving tank from which blowoff steam would be recycled back to the boiler system. The blowdown liquid phase would be transferred from the flash tank to a blowoff tank. A pump at the blowoff tank would be used to transfer the blowdown liquid stream to the FGD system.

The waste disposal plant would be to utilize all, or at least a significant portion of, the boiler blowdown stream in the FGD. The liquid phase of that system would be evaporated and discharged to the atmosphere through the flue gas stack. Any surplus blowdown, resulting during peak flow conditions (such as startups) would be pumped to a final pH equalization circuit and commingled with other wastewater streams.

The system would be equipped with sampling valves and flow indicators for proportioning the blowdown flow to the flue gas desulfurization system and the final pH equalization circuit. Sampling of the blowdown stream would be performed periodically to determine pH, specific conductance, phosphate, sodium, and silica.

The maximum blowdown flow rate for the boiler has been calculated to be about 3.5% of the stream generator flow rate, i.e., approximately, 40 gal/min.

E.2 DEMINERALIZER REGENERATION WASTEWATER TREATMENT SUBSYSTEM

E.2.1 System Function

The wastewater stream resulting from regeneration of the demineralizers used to purify the makeup water would contain a high salt content and residual acidity. The stream would be used in the spray dryer absorber section of the FGD system. Salts would be retained in the solid waste by-product of the FGD process while the moisture would be released to the atmosphere through the flue gas stack.

E.2.2 System Description

Regeneration of each demineralizer would produce an estimated 150 gal/day of waste regenerant solution. This solution would be collected in two agitation tanks, sized to accept the total wastes produced from two full regenerations of the demineralizer train. Sodium hydroxide (NaOH) would be metered into the agitation tanks containing the regenerant waste solutions for neutralization. The neutralized stream would be piped to the spray dryer absorber. Any surplus neutralized regenerant wastewater, resulting from peak flow conditions, would be pumped to the equalization and final pH adjustment system.

E.3 FLOOR AND EQUIPMENT DRAIN WASTEWATER TREATMENT SUBSYSTEM

E.3.1 System Function

Normally the plant drains would only receive washdown water; however, on occasion, they would receive overflows, spills, leaks, chemicals, and solvents. There are two general types of plant drains: equipment drains and plant floor drains. Equipment drains would provide a release for pump seal water, while the plant floor drains would drain wastewater containing varying amounts of dirt, debris, oils, grease, and salts. Because of the expected content of contaminants in the waste stream from the floor drain, the drains would be fitted with equipment necessary to remove the contaminants.

E.3.2 System Description

The plant floor drains and the equipment seal water drains would be routed to flow into collection sumps, strategically located in the plant to collect all drainage from the operation. Solid wastes would be allowed to settle out in the sump *area* and would be removed periodically. The wastewater would be transferred to an oil/water separator by a sump pump. The oil and grease would be handled as a petroleum waste and removed from the site with the metal cleaning fluids wastes discussed in Sect. E.5.

The oil- and grease-free wastewater would be transferred to the final pH equalization circuit and commingled with the other wastewaters. The combined wastewater would be recycled to the slag quenching or FGD system for use or discharged into the final wastewater sump for clarification before discharge to the circulating cooling water outfall stream.

E.4 COAL PILE RUNOFF SYSTEM

E.4.1 System Function

The coal pile runoff of the proposed HCCP would contain a varying amount of inorganic and organic constituents. The amount of each constituent would vary according to the location within the mine from which the coal was taken, how long the coal is subjected to weathering, the surface area of the coal lump, temperature, and the amount of precipitation received on the pile.

Coal pile runoff is anticipated to contain minor soluble constituents in the leachate and entrained fine solid particulates as it flows from the surface and through the coal. Because of the low sulfur content of the UCM coal, the runoff water would probably be neutral to slightly acidic.

For waste management purposes, coal, slag, and fly ash samples from a test on the performance coal were collected for toxicity/leachability tests. The Toxicity Characteristics Leaching Procedure (TCLP) was utilized. The procedure was limited to the following metals: arsenic, barium, cadmium, chromium, lead, selenium, silver, mercury, copper, nickel, zinc, beryllium, iron, manganese, vanadium, rubidium, strontium, and zirconium. The results are given in Table 4.1.6 of this EIS. All results were found to be well below any given TCLP regulatory limit. There should be no problems with storing or disposing of the coal, slag, or fly ash in a landfill.

E.4.2 System Description

The contour of the land area used for coal pile storage would direct the water that runs off or leaks through the coal piles to ***an unlined*** catchment basin. The catchment basin would be sized to handle the inflow of water that would result from a historical maximum 10-year, 24-h rainstorm event ***(approximately 2 in.). In addition, Healy Unit No. 1 bottom ash would be sluiced to the pond when the HCCP is not operating. Overflow from this basin is not expected. However, if overflow should occur, such water would be caught in an unlined emergency overflow pond between the Healy Spur Highway and the Alaska Railroad Suntrana Spur. No discharge of coal pile runoff to the Nenana River would occur.***

E.5 METAL CLEANING FLUIDS WASTE TREATMENT SYSTEM

E.5.1 System Function

The metal cleaning fluids waste treatment system of the proposed HCCP would remove chemical cleaning fluids and their resulting wastes along with metal cleaning fluids that would be used to clean the boiler and associated equipment during planned shutdown periods.

E.5.2 System Description

Metal cleaning fluids that would be used to clean the boiler and associated equipment would be collected into containers appropriate to the containment of the cleaning wastes. The cleaning wastes would only be held at the plant site for a short-term storage period. Wastes would be properly transported offsite by an appropriate carrier to the chemical supplier or to a qualified waste disposal facility.

E.6 FIRE PROTECTION RUNOFF TREATMENT SYSTEM

E.6.1 System Function

The function of the system would be to dispose of wastewater during fire protection testing and actual fires, if any, at the proposed plant.

E.6.2 System Description

Fire protection water discharged within the plant buildings during system testing and drills would be treated for disposal in the same manner as floor drain and equipment drain waters. Fire protection water used for actual fire fighting, in volumes that would exceed the carrying capacity of the floor drains and sumps, would be discharged to the Nenana River in the same manner as storm water runoff.

E.7 PLANT SITE SANITARY WASTEWATER TREATMENT SYSTEM

E.7.1 System Function

The plant site sanitary wastewater treatment system would treat and dispose of plant lavatory wastewater in accordance with accepted practices established for the Healy area.

E.7.2 System Description

Sanitary water from personnel lavatory facilities of the proposed HCCP would be discharged into subsurface drainage piping where it would flow by gravity into a subsurface septic tank system. The septic tank would be sized to retain the wastewater solids for a sufficient length of time for effective digestion. Water effluent from the septic tank would overflow by gravity into a subsurface drainage (leach) field. Accumulated sludge in the septic tank would be removed as needed (approximately every 2 to 3 years) by a commercial operator authorized to deliver the wastes to a waste treatment plant for disposal.

Wastewater from the plant sanitary waste treatment system would not discharge a waste stream into surface or ground waters of the area. The septic system would be sized to meet the needs for all personnel of both the proposed HCCP and Healy Unit No. 1, replacing the existing Healy Unit No. 1 system.

APPENDIX F

HEALY CLEAN COAL PROJECT (HCCP) TECHNOLOGY DESCRIPTION

APPENDIX F

HEALY CLEAN COAL PROJECT (HCCP) TECHNOLOGY DESCRIPTION

The proposed HCCP would consist of two pulverized coal-fired combustion systems, a boiler, a Spray Dryer Absorber with activation and recycle equipment, a fabric filter system (baghouse), a turbine-generator, coal and limestone pulverizing and handling equipment, and associated auxiliary equipment. The HCCP would pulverize and burn coal from the UCM Poker Flats mine to generate high-pressure steam that would be used by the steam turbine generator to produce electricity.

The air pollution control system that would be demonstrated by the proposed project incorporates the following major components:

- TRW Coal Combustion System
- Foster Wheeler boiler
- Joy Spray Dryer Absorber
- Fabric Filter System (baghouse).

The integrated air pollution control process that would result from the HCCP configuration of these components has been designed to minimize emissions of SO_2, NO_x, and PM from the facility while firing a broad range of coals.

NO_x emissions would be reduced in the coal combustion process by use of the fuel and air-staged combustor system and a boiler that controls fuel and thermal-related conditions which inhibit NO_x formation. The slagging combustor/boiler system would also function as a limestone calciner and first stage SO_2 removal device in addition to its heat recovery function. Secondary and tertiary SO_2 capture would be accomplished by a single Spray Dryer Absorber vessel and a baghouse, respectively. Ash collection in the process would be first achieved by the removal of molten slag in the coal combustors followed by particulate removal in the baghouse downstream of the spray dry absorber vessel.

The TRW Combustion System would be designed to be installed on the boiler furnace to provide efficient combustion, maintain effective limestone calcination, and minimize the formation of NO_x emissions. The main system components would include a precombustor, main combustor, slag recovery section, tertiary air windbox, pulverized coal and limestone feed system, and a combustion air system. The coal-fired precombustor would be used to increase the air inlet temperature to the main combustor for optimum slagging performance. It would burn approximately 25–40% of the total coal input to the combustor. Combustion would occur in several stages to minimize NO_x formation.

The main slagging combustor would consist of a water-cooled cylinder which would be sloped toward a slag opening. The remaining coal would be injected axially into the combustor, rapidly entrained by the swirling precombustor gases and additional air flow, and burned under substoichiometric (fuel-rich) conditions for NO_x control. The ash contained in the burning coal would form drops of molten slag and accumulate on the water-cooled walls as a result of the centrifugal force caused by the swirling gas flow. The molten slag would be driven by aerodynamic and gravity forces through a slot into the bottom of the slag recovery section where it would fall into a water-filled tank and would be removed by the slag removal system. Approximately 80% of the ash in the coal would be removed as molten slag.

The hot gas, containing carbon monoxide and hydrogen, would then be ducted to the furnace from the slag recovery section through the hot gas exhaust duct. To ensure complete combustion in the furnace, additional air would be supplied from the tertiary air windbox from NO_x control ports, and from final overfire air ports located in the furnace.

For SO_2 control, pulverized limestone would be fed into the combustor. While passing into the boiler, most of the limestone would be decomposed to flash calcined lime by the following reaction:

$$CaCO_3 + \text{heat} \rightarrow CaO + CO_2 \quad . \qquad (1)$$

The mixture of this lime and the ash not removed by the combustors is called flash calcined material (FCM). Some sulfur capture by the entrained calcium oxide (CaO) would also occur at this time, but the primary SO_2 removal mechanism would be through a multiple step process of spray drying the slurried and activated FCM solids.

FCM that would be produced in the furnace via equation (1) would be removed in the baghouse. A portion of the material would be transported to disposal. Most of the material, however, would be conveyed to a mixing tank, where would be mixed with water to form a 45% FCM solids slurry. The lime rich FCM material would be slaked by agitation of the suspension. A portion of the slurry from the mixing tank passes directly through a screen to the feed tank, where the slurry would be continuously agitated. The remainder of the slurry leaving the mixing tank would be pumped to a grinding mill, where the suspension would be further mechanically activated by abrasive grinding.

By grinding the slurry in a mill, the FCM would be activated by a mechanical process whereby the overall surface area of available lime would be increased, and coarse lime particle formation would be avoided. Thus, the mill would enhance the slaking conditions of the FCM, and increase the surface area for optimal SO_2 absorption. FCM slurry leaving the tower mill would be transported through the screen to the feed tank.

Feed slurry would be pumped from the feed tank to the Spray Dryer Absorber, where it would be atomized via rotary atomization using Joy/Niro dry scrubbing technology. Sulfur dioxide in the flue gas would react with the FCM slurry as water would be simultaneously evaporated. The dry reaction product would be removed via the Spray Dryer Absorber hopper or the baghouse. Sulfur dioxide would be further removed from the flue gas by reacting with the dry FCM on the baghouse filter bags.

The HCCP would be an integrated system for the combustion of coal and control of all emissions. The slagging combustor, furnace, and enhanced recycle Spray Dryer Absorber system would all play a part in reducing emissions from the plant. The slagging combustor would inhibit NO_x production, generate the FCM for capture of SO_2, and reduce the potential amount of PM by up to 80%. The furnace would further contribute to the NO_x reduction process and begin the SO_2 removal process. The recycle/reactivation Spray Dryer Absorber system and the pulse-jet baghouse would complete the collection of PM and SO_2.

Removal of any single component in the integrated system would result in ramifications on other components. For example, removal of the slagging combustor and replacement with low NO_x burners would increase the ash loading out of the furnace by nearly 400%; eliminate the production of FCM, would which require the conversion of the recycle/reactivation Spray Dryer Absorber system to a conventional lime spray dryer system; and possibly increases NO_x emissions. Replacement of the spray dryer with a wet scrubber would eliminate the need to generate FCM because all of the PM would be collected upstream of the wet scrubber in a baghouse or electrostatic precipitator where there would be no way of separating PM from FCM.

Emissions of SO_2 and NO_x are expected to be demonstrated at levels significantly below EPA New Source Performance Standards (NSPS). Tests were performed at the TRW facility in Cleveland and Joy-Niro's facilities in Copenhagen to confirm design conditions for the HCCP. Coal and limestone that are to be used by the HCCP were used for the tests.

The tests at the TRW facility in Cleveland were designed to provide data that will form the basis of the scale-up and design of the combustors and other systems for the HCCP. Specific objectives of the test burns were to evaluate combustion system operation and performance using Alaskan performance coal (50% waste coal blend) and collect a 5-ton sample of FCM produced by injection of Alaskan limestone. During the test program, over 350 tons of Alaskan coal were handled and burned by the TRW combustion system at the Cleveland test facility. The HCCP coal test burn program demonstrated that the performance coal can be effectively burned in the TRW combustion system. The performance coal was handled, pulverized, and fed safely and reliably in the Cleveland test facility coal preparation and feed systems. Both combustion performance and slag capture met expectations. Low NO_x emissions were also demonstrated (as low as 0.2 lb/MMBtu) by the TRW combustion system alone without the benefit of additional NO_x reduction techniques such as boiler NO_x and overfire air ports which will be incorporated into the HCCP design. Finally, the tests demonstrated that FCM for the Joy dry scrubber can be produced by the TRW combustion system using Alaskan coal and limestone.

Preliminary results from the Niro tests show that 70% SO_2 removal is attainable at a calcium/sulfur ratio of 1.7:1, with 90% removal attainable at slightly higher stoichiometries. These tests were accomplished by heating the FCM slurry. Testing ***will also*** be performed to determine the effect of mechanical activation (grinding) of the FCM.

APPENDIX G

TENTATIVE SCHEDULE FOR OBTAINING PERMITS

APPENDIX G
TENTATIVE SCHEDULE FOR OBTAINING PERMITS

The permit schedule outlined in this appendix is based on the construction schedule used in this environmental impact statement. In the event that the construction schedule changes, the dates for submitting permit applications will be adjusted accordingly.

Table G.1. Schedule of permit application submitted

Agency/permit type	Date application submitted to agency	Scheduled date for final permit	Date permit received
	Federal		
	Environmental Protection Agency		
National Pollutant Discharge Elimination System			
Wastewater Discharge for Operational Wastewater	9 Oct 91	31 Mar 94	
Once-through Cooling Wastewater	9 Oct 91	31 Mar 94	
Storm Water Runoff for HCCP Construction Activities	30 Jun 93		13 Aug 93
	U.S. Army Corps of Engineers		
Section 404 Permit			
Construction of Intake and Discharge Facilities	7 Jan 92	31 Mar 94	
Lands Classified as Wetlands Laydown/Storage	7 Jan 92	31 Mar 94	
Construction Camp Wastewater Discharge	15 May 92	31 Mar 94	
	Federal Aviation Administration		
Hazards to Air Traffic from Construction of Structures			
Air Monitoring Site, Permit #90-AAL-65-OE	4 June 90		22 Aug 90
Construction Camp, Permit #92-AAL-058-OE	1 May 92		3 June 92
HCCP Stack, Permit #92-AAL-057-OE	1 May 92		18 Aug 92

Table G.1 (continued)

Agency/permit type	Date application submitted to agency	Scheduled date for final permit	Date permit received
State of Alaska			
Department of Natural Resources			
Temporary Permits to Appropriate Water			
Construction Camp and Potable Water Supply, Permit #LAS 13723	15 May 92		1 July 92
Permanent Permits to Appropriate Water			
Once-through Cooling, Permit #13551	24 Jan 92	3 Mar 94	
Boiler Feed Water, Potable Water, and Dust Control, Permit #13550	24 Jan 92	31 Mar 94	
Temporary Land Use Permit or Leases for Air Monitoring Sites			
Air Monitoring Site, Permit #LAS 12874	5 June 90		2 July 90
Air Monitoring Site, Permit #ADL 414438	4 June 90		12 Sept 91
Department of Environmental Conservation			
Wastewater Disposal Permits			
Construction Excavation Wastewater	6 Aug 92	31 Jan 94	
Construction Camp Sewage Plant	15 May 92	1 Apr 94	
401 Water Quality Certification	15 Feb 94	28 Feb 94	
Prevention of Significant Deterioration	24 Apr 92		10 Mar 93
Air Quality Control—Permit to Operate	24 Apr 92		10 Mar 93
Alaska Railroad Corporation			
Land Use Leases			
Air Monitoring Site, ARRC# 6337	5 June 90		1 July 90
Air Monitoring Site, ARRC# 6337 Sup #1	12 June 91		1 July 91
Garner Hill Visibility Camera Site, ARRC Contract #6483	23 Jan 92		10 Feb 92
Construction Camp Site, ARRC Contract #6490	1 Feb 92	*1 Mar 94*	
Laydown/Storage Area, ARRC Contract #6491	1 Feb 92	*1 Mar 94*	

APPENDIX H

CORPS OF ENGINEERS
PUBLIC NOTICE OF CONSTRUCTION

Regulatory Branch (1145b)
Post Office Box 898
Anchorage, Alaska 99506-0898

PUBLIC NOTICE DATE: The 30-day comment period for this Public Notice runs concurrent with the Final Environmental Impact Statement review period.

EXPIRATION DATE: See above.

REFERENCE NUMBER: 4-900217

WATERWAY NUMBER: Nenana River 21

Interested parties are hereby notified that an application has been received for a Department of the Army permit for certain work in waters of the United States, as described below and shown on the attached plan.

APPLICANT: The Alaska Industrial Development and Export Authority, 480 West Tudor, Anchorage, Alaska 99503-6690.

LOCATION: The proposed project is located in the center and SE corner of section 20 and the SW corner of section 20, T. 12 S., R. 7 W., Fairbanks Merdian, Healy, Alaska,

WORK: The applicant proposes to place a total of 4,687 cubic yards (cy) of dredged or fill material into waters of the United States adjacent to the Nenana River and Healy Creek for the construction and operation of a coal fired generator near Healy, Alaska. Approximately 1,000 cy of gravel fill material would be placed into approximately 6.9 acres of wetlands for a level work surface in the construction of a temporary laydown and storage area with a berm along the north side of Healy Creek. This portion of the project would be removed following completion of construction. Also approximately 50 cy of gravel fill material would be used to construct a berm partially surrounding a wastewater discharge basin in wetlands west of the Nenana River. The balance of the fill material (3,637 cy) would be placed below the ordinary high water mark of the Nenana River for construction of the intake and outfall structures.

PURPOSE: The applicant's purpose is to construct and operate a demonstration project for the Clean Coal Technology Program.

ADDITIONAL INFORMATION: This proposed project is jointly funded by the U.S. Department of Energy and AIDEA. It is being conducted under the Clean Coal Technology Program (Public Law No. 100-446) and is proposed to be located next to the present Golden Valley Electric Association Power Plant at Healy, Alaska. Mr. John B. Olson may be contacted for additional information at telephone number (907) 561-8050.

The U.S. Department of Energy has prepared a Final Environmental Impact Statement (EIS) for the proposed project. The United States Department of Agriculture, Rural Electrification Administration, the United States Department of the Army, Corps of Engineers Alaska District, the United States Department of the Interior, National Park Service, and United States Environmental Protection Agency are cooperating agencies in the EIS process. Additional information about the proposed project is contained in the EIS. To receive a copy of the EIS, send a written request to the Corps of Engineers at the address above or to, Attn: Dr. Earl N. Evans, NEPA Compliance Officer, U.S. Department of Energy, Pittsburgh Energy Technology Center, Post Office Box 10940, Pittsburgh, PA 15236.

Since an Environmental Impact Statement has been prepared to evaluate the impacts of the entire project, that portion of the project i.e., the intake and outfall structures, which would have otherwise been authorized by nationwide permit, have also been considered during the EIS process. Aproximately 3,637 cubic yards of fill material would be placed below the ordinary high water mark of the Nenana River for both the intake and outfall structures.

WATER QUALITY CERTIFICATION: A permit for the described work will not be issued until a certification or waiver of certification as required under Section 401 of the Clean Water Act (Public Law 95-217), has been received from the Alaska Department of Environmental Conservation.

PUBLIC HEARING: Any person may request, in writing, within the comment period specified in this notice, that a public hearing be held to consider this application. Requests for public hearings shall state, with particularity, the reasons for holding a public hearing.

CULTURAL RESOURCES: The latest published version of the Alaska Heritage Resources Survey (AHRS) has been consulted for the presence or absence of historic properties, including those listed in or eligible for inclusion in the National Register of Historic Places. These worksites are not a registered or eligible property. Consultation of the AHRS constitutes the extent of cultural resource investigations by the District Engineer at this time, and he is otherwise unaware of the presence of such resources. This application is being coordinated with the State Historic Preservation Office (SHPO). Any comments SHPO may have concerning presently unknown archeological or historic data that may be lost or destroyed by work under the requested permit will be considered in our final assessment of the described work.

ENDANGERED SPECIES: The project area is within the known or historic range of the American Peregrine Falcon. Preliminarily, the described activity will not affect endangered species, or their critical habitat designated as endangered or threatened, under the Endangered Species Act of 1973 (87 Stat. 844). This application is being coordinated with the U.S. Fish and Wildlife Service and the National Marine Fisheries Service. Any comments they may have concerning endangered or threatened wildlife or plants or their critical habitat will be considered in our final assessment of the described work.

FEDERAL SPECIES OF CONCERN: The following Federal species of concern may use the project area: Chinook Salmon, Coho Salmon, White-fronted Goose, Bald Eagle, Trumpeter Swan, Mallard, Canvasback Duck, Lesser Sandhill Crane, and American Peregrine Falcon.

FLOODPLAIN MANAGEMENT: Evaluation of the described activity will include conformance with appropriate State or local flood plain standards; consideration of alternative sites and methods of accomplishment; and weighing of the positive, concentrated and dispersed, and short and long-term impacts on the floodplain.

SPECIAL AREA DESIGNATION: The project is located four miles north of the northern boundary of the Denali National Park.

EVALUATION: The decision whether to issue a permit will be based on an evaluation of the probable impacts including cumulative impacts of the proposed activity and its intended use on the public interest. Evaluation of the probable impacts which the proposed activity may have on the public interest requires a careful weighing of all those factors which become relevant in each particular case. The benefits which reasonably may be expected to accrue from the proposal must be balanced against its reasonably foreseeable detriments. The decision whether to authorize a proposal, and if so the conditions under which it will be allowed to occur, are therefore determined by the outcome of the general balancing process. That decision should reflect the national concern for both protection and utilization of important resources. All factors which may be relevant to the proposal must be considered including the cumulative effects thereof. Among those are conservation, economics, aesthetics, general environmental concerns, wetlands, cultural values, fish and wildlife values, flood hazards, floodplain values, land use, navigation, shore erosion and accretion, recreation, water supply and conservation, water quality, energy needs, safety, food and fiber production, mineral needs, considerations of property ownership, and, in general, the needs and welfare of the people. For activities involving 404 discharges, a permit will be denied if the discharge that would be authorized by such permit would not comply with the Environmental Protection Agency's 404(b)(1) guidelines. Subject to the preceding sentence and any other applicable guidelines or criteria (see Sections 320.2 and 320.3), a permit will be granted unless the District Engineer determines that it would be contrary to the public interest.

The Corps of Engineers is soliciting comments from the public; Federal, State, and local agencies and officials; Indian Tribes; and other interested parties in order to consider and evaluate the impacts of this proposed activity. Any comments received will be considered by the Corps of Engineers to determine whether to issue, modify, condition or deny a permit for this proposal. To make this decision, comments are used to assess impacts on endangered species, historic properties, water quality, general environmental effects, and the other public interest factors listed above. Comments are used in the preparation of an Environmental Assessment and/or an Environmental Impact Statement pursuant to the National Environmental Policy Act. Comments are also used to determine the need for a public hearing and to determine the overall public interest of the proposed activity.

Comments on the described work, with the reference number, should reach this office no later than the expiration date of this Public Notice to become part of the record and be considered in the decision. If further information is desired concerning this notice, contact Don P. Kuhle at (907) 753-2712.

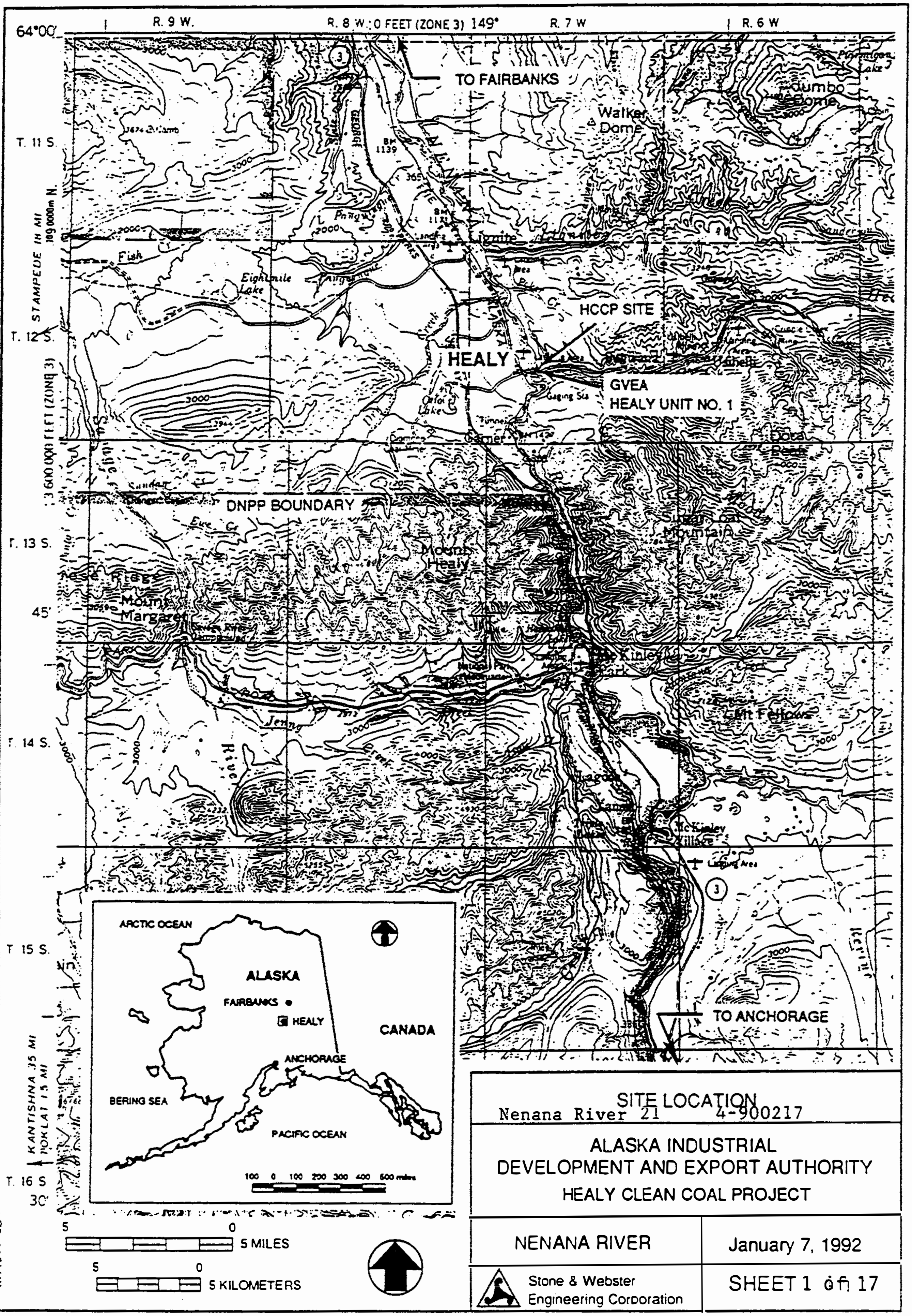
AUTHORITY: This permit will be issued or denied under the following authorities:

(X) Discharge dredged or fill material into waters of the United States - Section 404 Clean Water Act (33 U.S.C. 1344). Therefore, our public interest review will consider the guidelines set forth under Section 404(b) of the Clean Water Act (40 CFR 230).

A plan, and Notice of Application for State Water Quality Certification are attached to this Public Notice.

District Engineer
U.S. Army, Corps of Engineers

Attachments



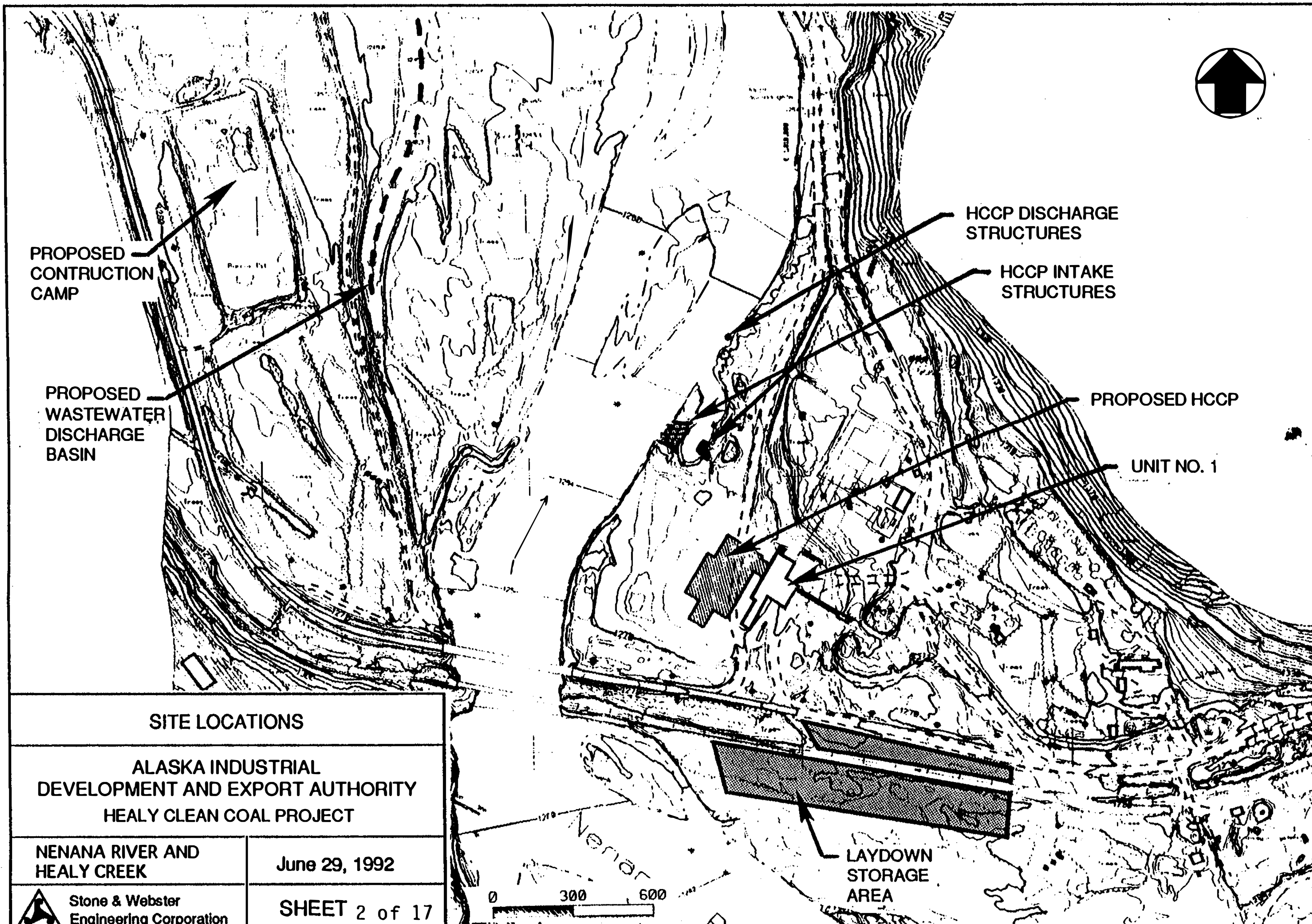
SITE LOCATION

Nenana River 21 4-900217

ALASKA INDUSTRIAL DEVELOPMENT AND EXPORT AUTHORITY

HEALY CLEAN COAL PROJECT

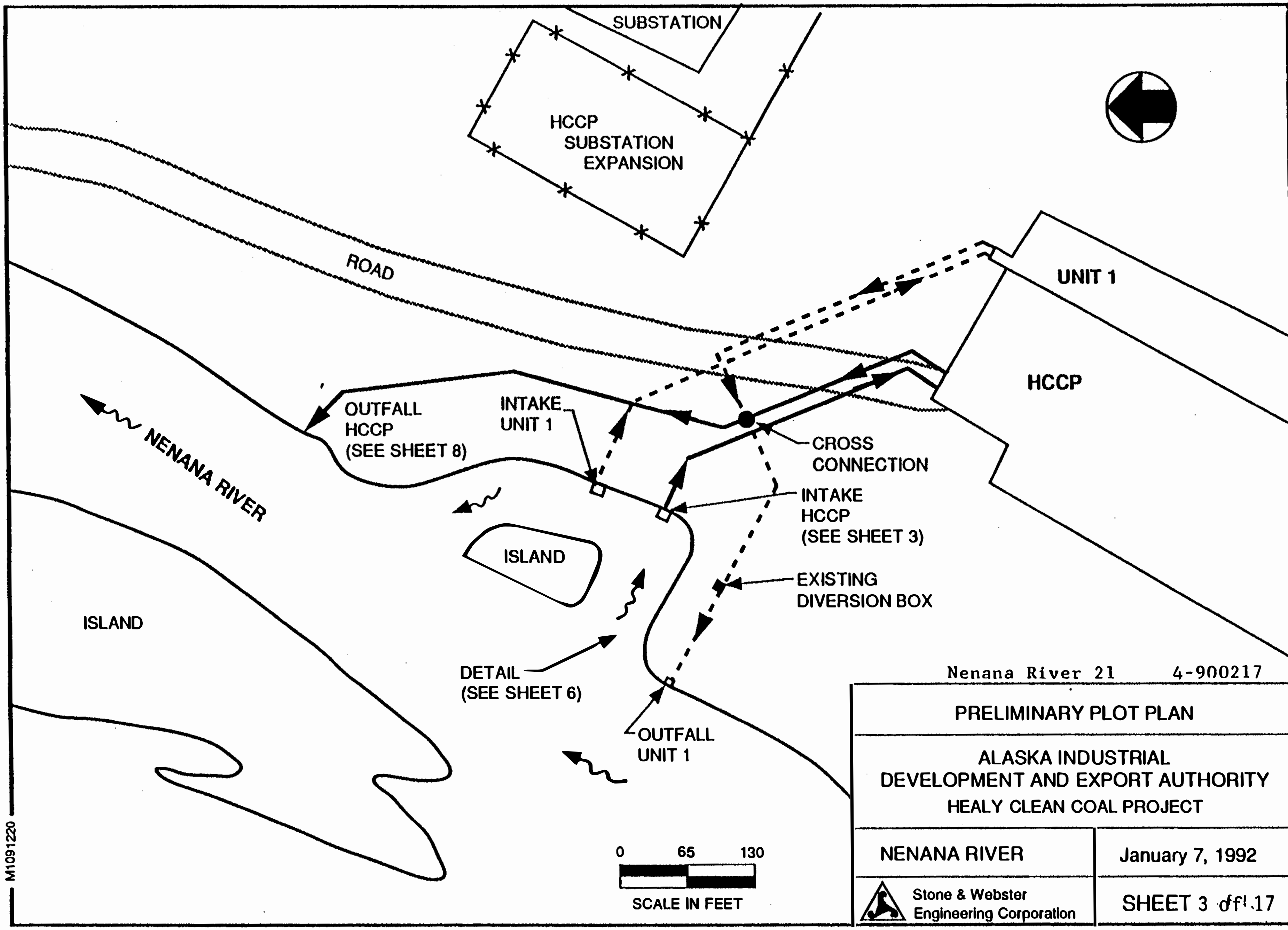
NENANA RIVER	January 7, 1992
Stone & Webster Engineering Corporation	SHEET 1 of 17



SITE LOCATIONS

ALASKA INDUSTRIAL DEVELOPMENT AND EXPORT AUTHORITY
HEALY CLEAN COAL PROJECT

NENANA RIVER AND HEALY CREEK	June 29, 1992
Stone & Webster Engineering Corporation	SHEET 2 of 17



Nenana River 21 4-900217

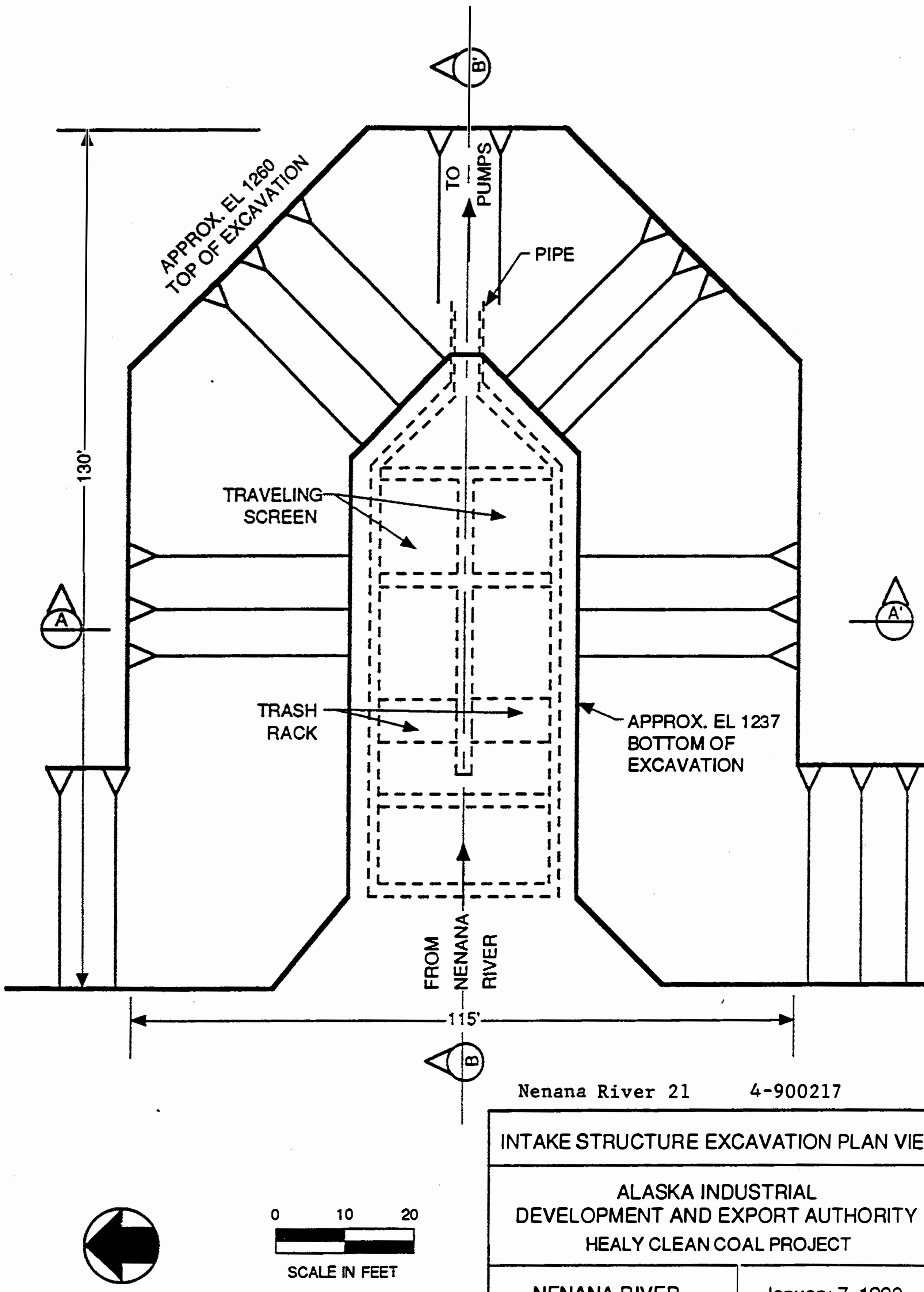
PRELIMINARY PLOT PLAN

ALASKA INDUSTRIAL
DEVELOPMENT AND EXPORT AUTHORITY
HEALY CLEAN COAL PROJECT

NENANA RIVER	January 7, 1992
Stone & Webster Engineering Corporation	SHEET 3 of 17

M1091220

H-7



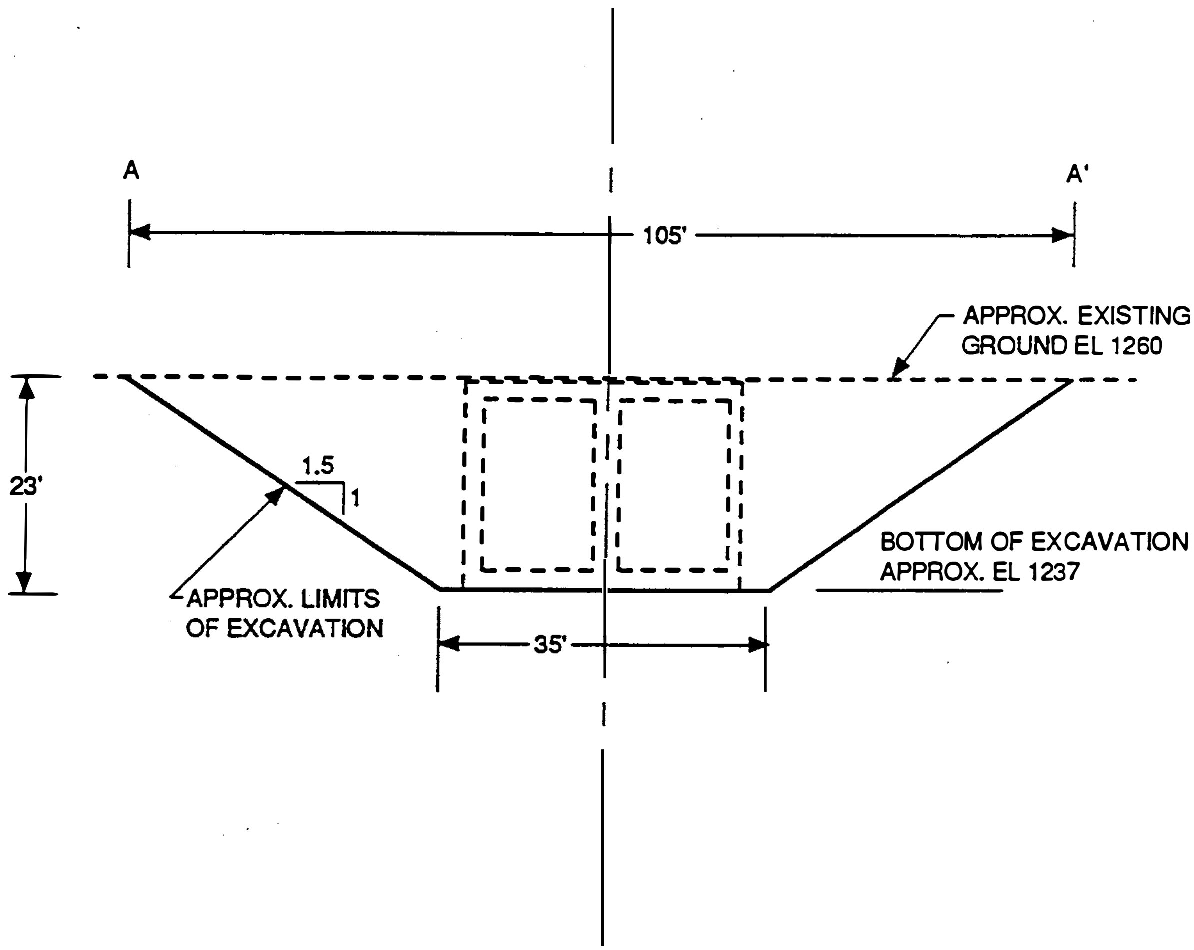
Nenana River 21 4-900217

INTAKE STRUCTURE EXCAVATION PLAN VIEW

ALASKA INDUSTRIAL
DEVELOPMENT AND EXPORT AUTHORITY
HEALY CLEAN COAL PROJECT

NENANA RIVER	January 7, 1992
Stone & Webster Engineering Corporation	SHEET 4 of 17

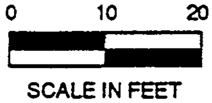
M1091222



SEE SHEET 3 FOR SECTION LOCATION

APPROXIMATE QUANTITY
OF EXCAVATION = 5700 CY

APPROXIMATE QUANTITY
OF BACKFILL = 3300 CY



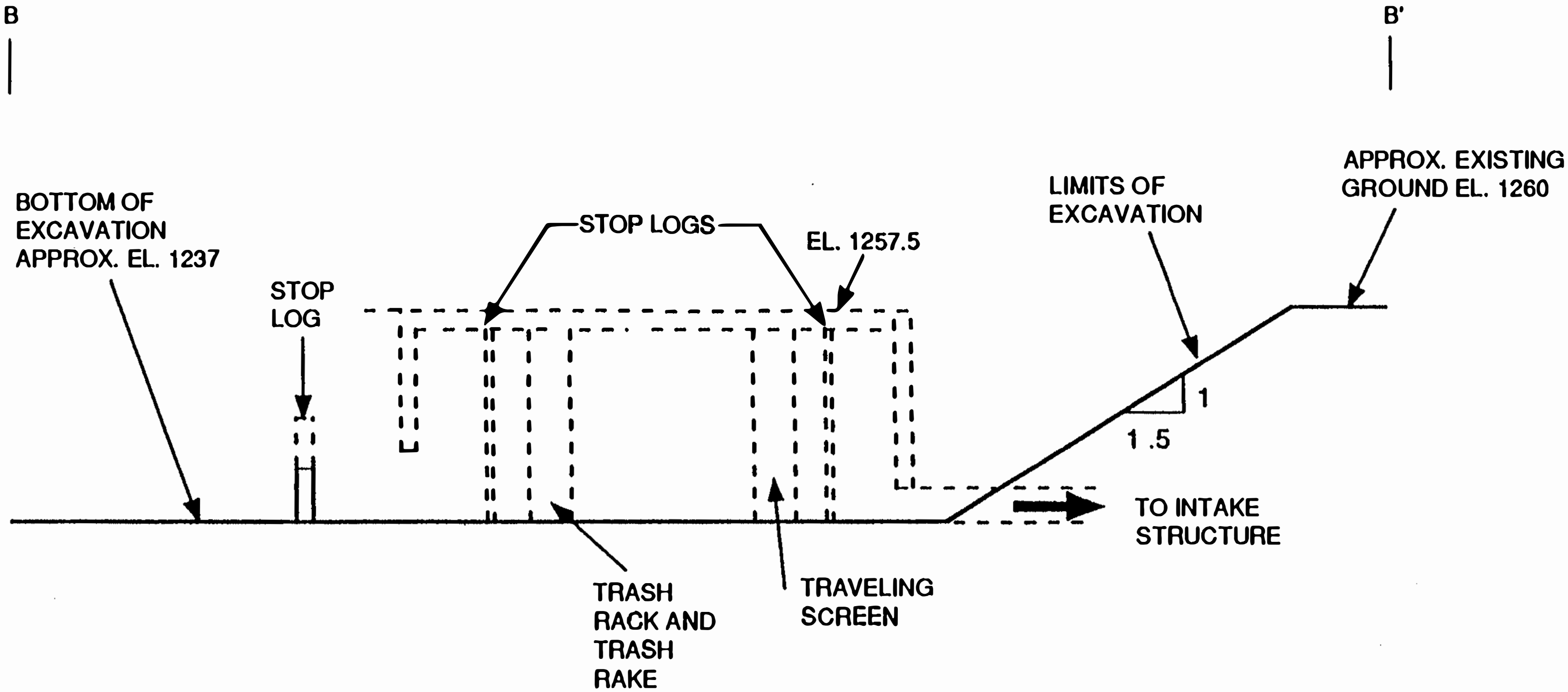
Nenana River 21 4-900217

INTAKE STRUCTURE EXCAVATION
SECTION A-A'

ALASKA INDUSTRIAL
DEVELOPMENT AND EXPORT AUTHORITY
HEALY CLEAN COAL PROJECT

NENANA RIVER	January 7, 1992
Stone & Webster Engineering Corporation	SHEET 5 of 17

M1091223



Nenana River 21 4-900217

SEE SHEET 3 FOR SECTION LOCATION

0 10 20

SCALE IN FEET

INTAKE STRUCTURE EXCAVATION
SECTION B-B'

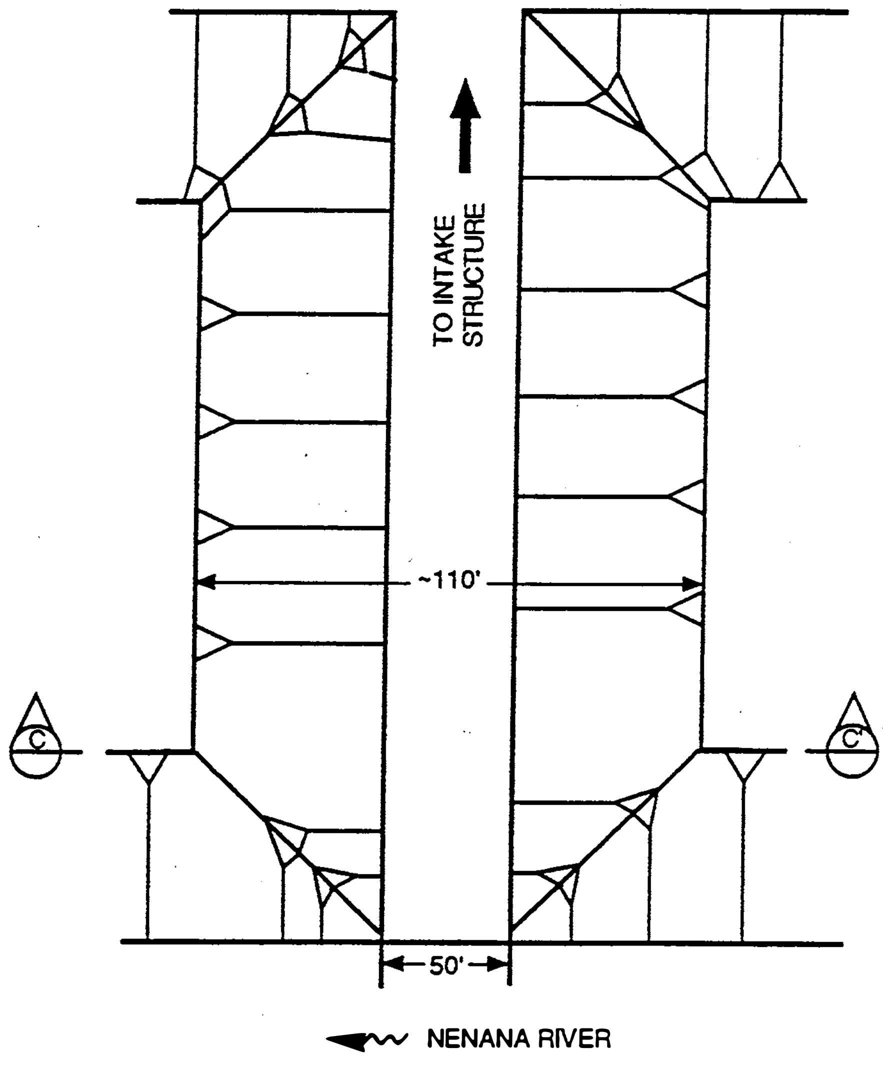
ALASKA INDUSTRIAL
DEVELOPMENT AND EXPORT AUTHORITY
HEALY CLEAN COAL PROJECT

NENANA RIVER

January 7, 1992

Stone & Webster Engineering Corporation

SHEET 6 of 17



Nenana River 21 4-900217

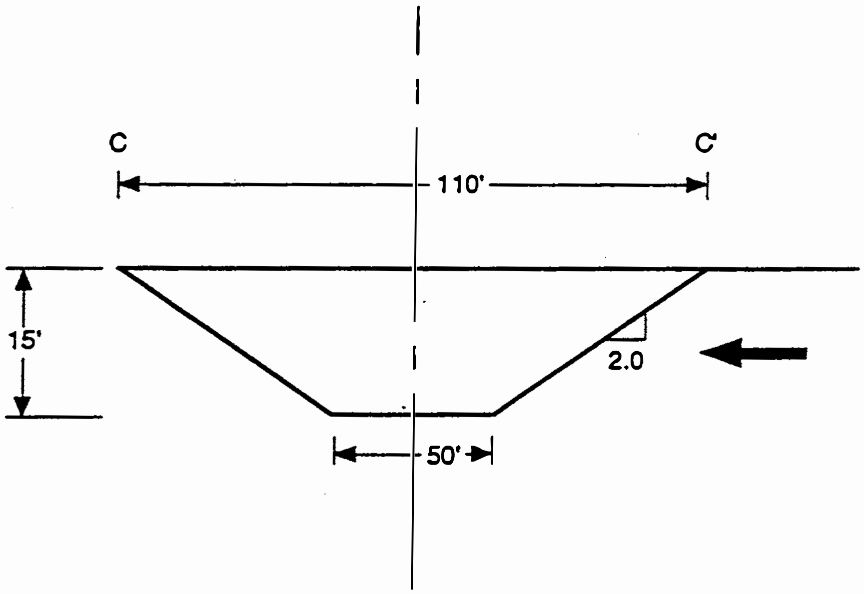
INTAKE CHANNEL EXCAVATION PLAN VIEW

ALASKA INDUSTRIAL
DEVELOPMENT AND EXPORT AUTHORITY
HEALY CLEAN COAL PROJECT

NOT TO SCALE

NENANA RIVER	January 7, 1992
Stone & Webster Engineering Corporation	SHEET 7 of 17

M1091225A



SEE SHEET 6 FOR SECTION LOCATION

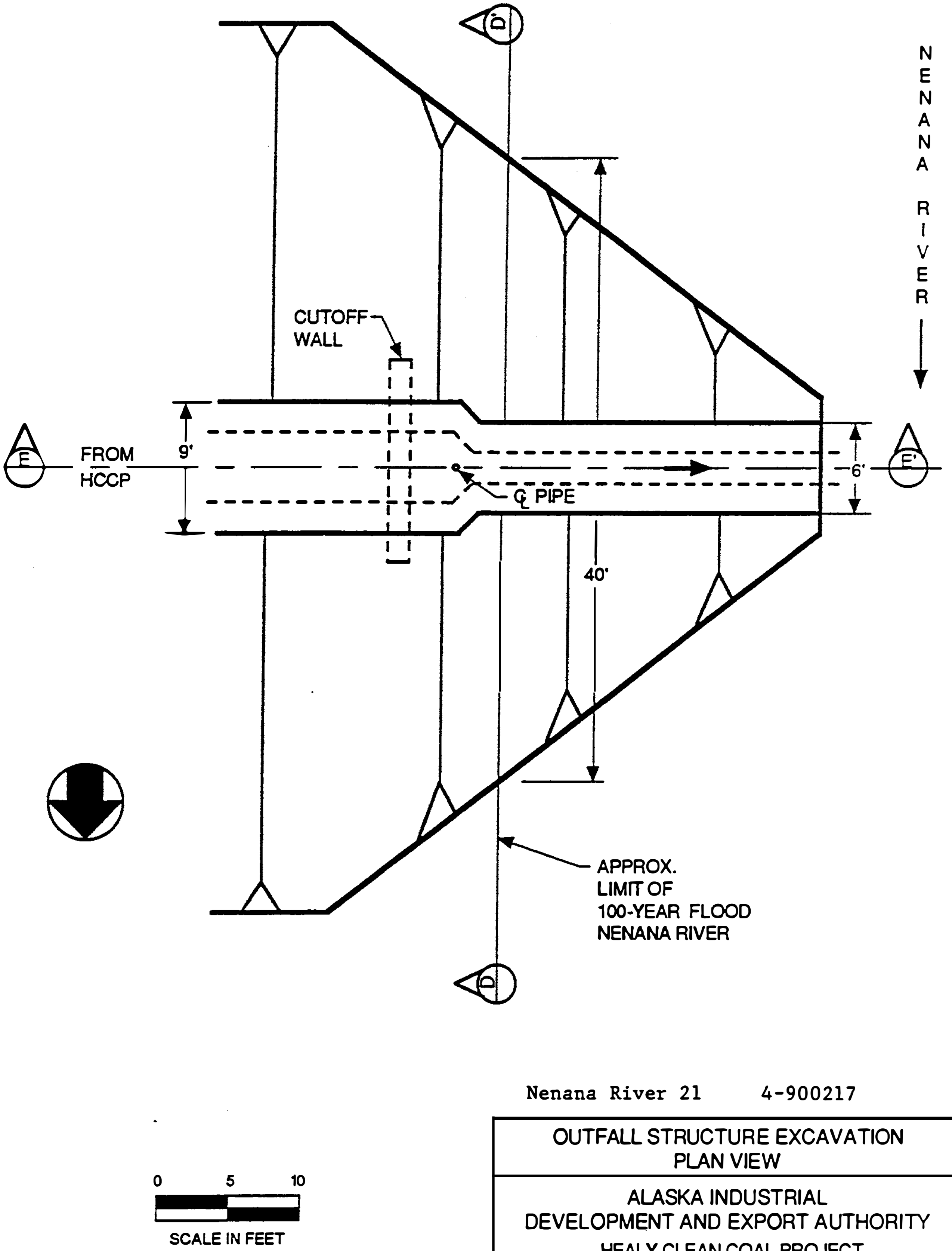
APPROXIMATE QUANTITY
OF EXCAVATION = 3600 CY

NOT TO SCALE

Nenana River 21 4-900217

INTAKE CHANNEL EXCAVATION SECTION C-C'	
ALASKA INDUSTRIAL DEVELOPMENT AND EXPORT AUTHORITY HEALY CLEAN COAL PROJECT	
NENANA RIVER	January 7, 1992
Stone & Webster Engineering Corporation	SHEET 8 of 17

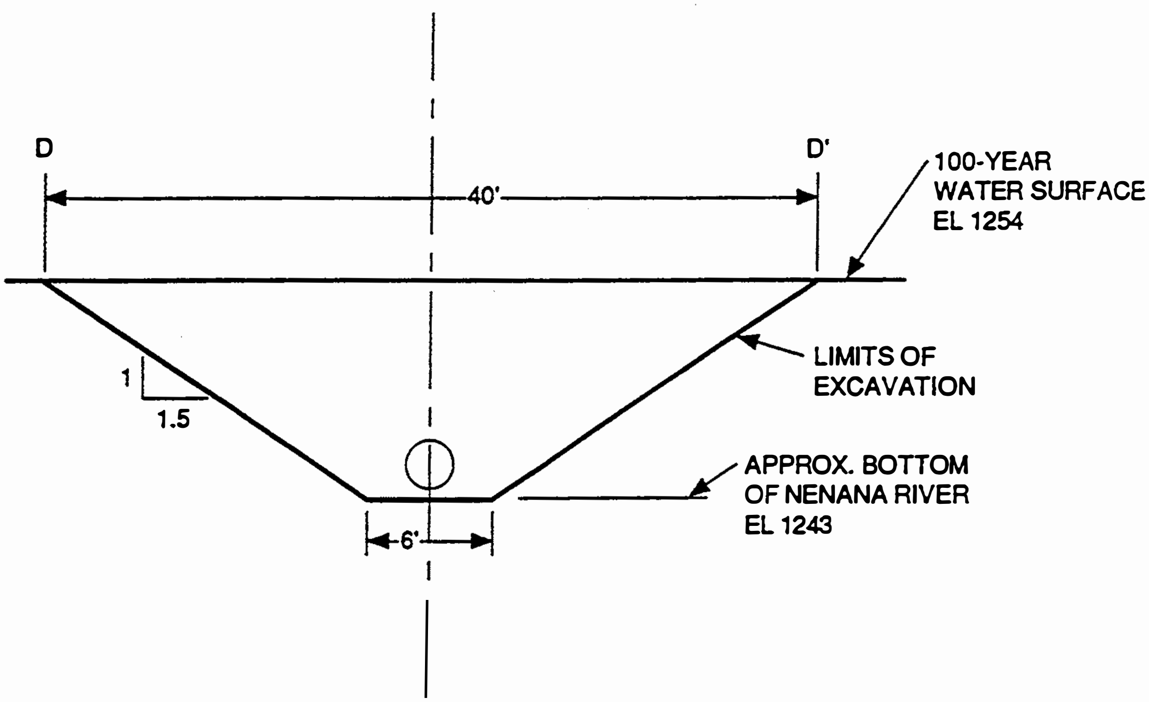
M1091226



Nenana River 21 4-900217

OUTFALL STRUCTURE EXCAVATION PLAN VIEW	
ALASKA INDUSTRIAL DEVELOPMENT AND EXPORT AUTHORITY HEALY CLEAN COAL PROJECT	
NENANA RIVER	January 7, 1992
Stone & Webster Engineering Corporation	SHEET 9 of 17

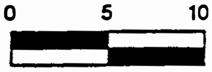
M1091227



APPROXIMATE QUANITY OF EXCAVATION = 250 CY

APPROXIMATE QUANITY OF BACKFILL = 240 CY

SEE SHEET 8 FOR SECTION LOCATION



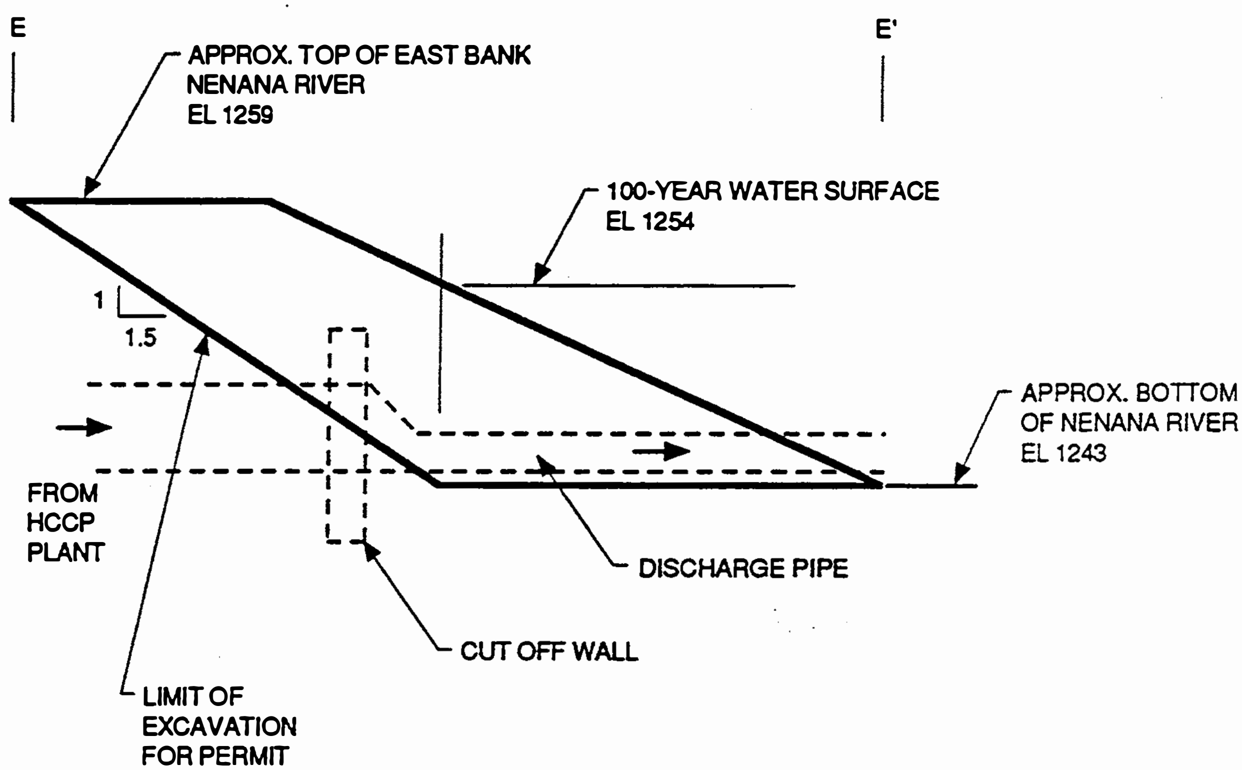
Nenana River 21 4-900217

OUTFALL STRUCTURE EXCAVATION
SECTION D-D'

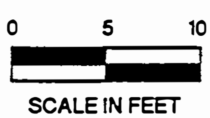
ALASKA INDUSTRIAL
DEVELOPMENT AND EXPORT AUTHORITY
HEALY CLEAN COAL PROJECT

NENANA RIVER	January 7, 1992
Stone & Webster Engineering Corporation	SHEET 10 of 17

M1091227A



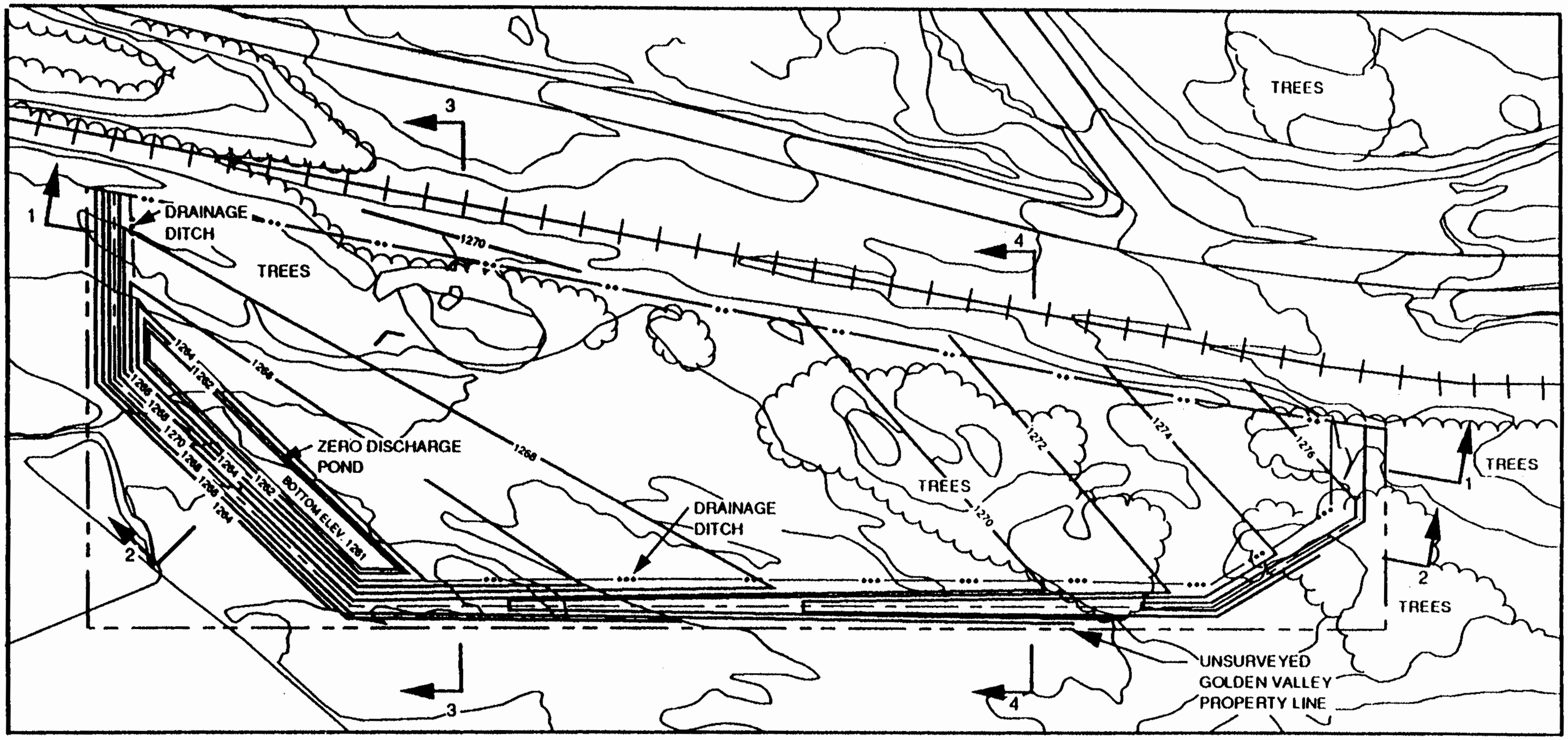
SEE SHEET 8 FOR SECTION LOCATION



Nenana River 21 4-900217

OUTFALL STRUCTURE EXCAVATION SECTION E-E'	
ALASKA INDUSTRIAL DEVELOPMENT AND EXPORT AUTHORITY HEALY CLEAN COAL PROJECT	
NENANA RIVER	January 7, 1992
Stone & Webster Engineering Corporation	SHEET 11 of 17

M1091232



LEGEND

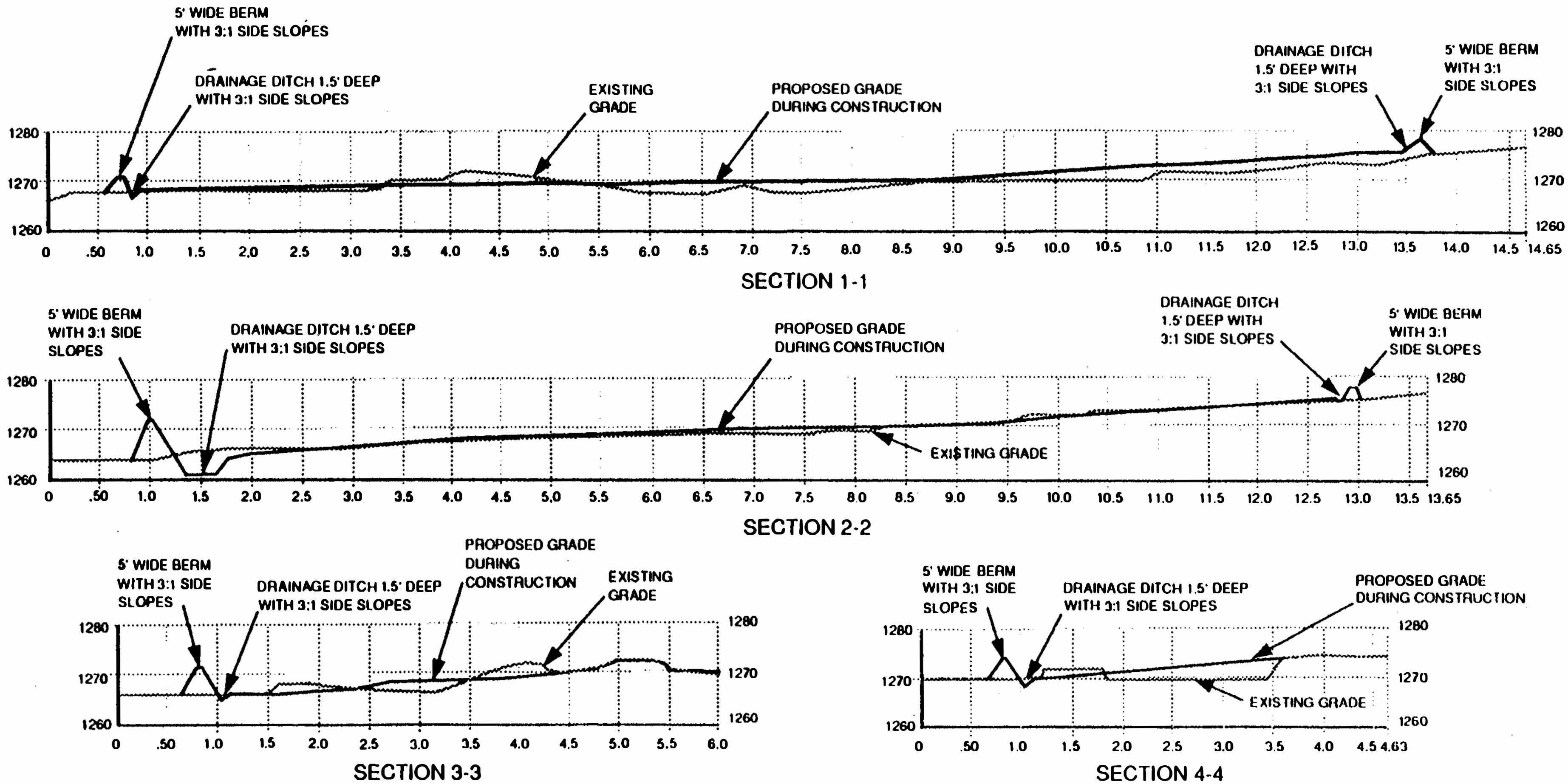
EXISTING CONTOURS

PROPOSED CONTOURS

0 150 300

SCALE IN FEET

LAYDOWN/STORAGE AREA REGRADING PLAN VIEW	
ALASKA INDUSTRIAL DEVELOPMENT AND EXPORT AUTHORITY HEALY CLEAN COAL PROJECT	
NENANA RIVER AND HEALY CREEK	January 7, 1992
Stone & Webster Engineering Corporation	SHEET 12 of 17

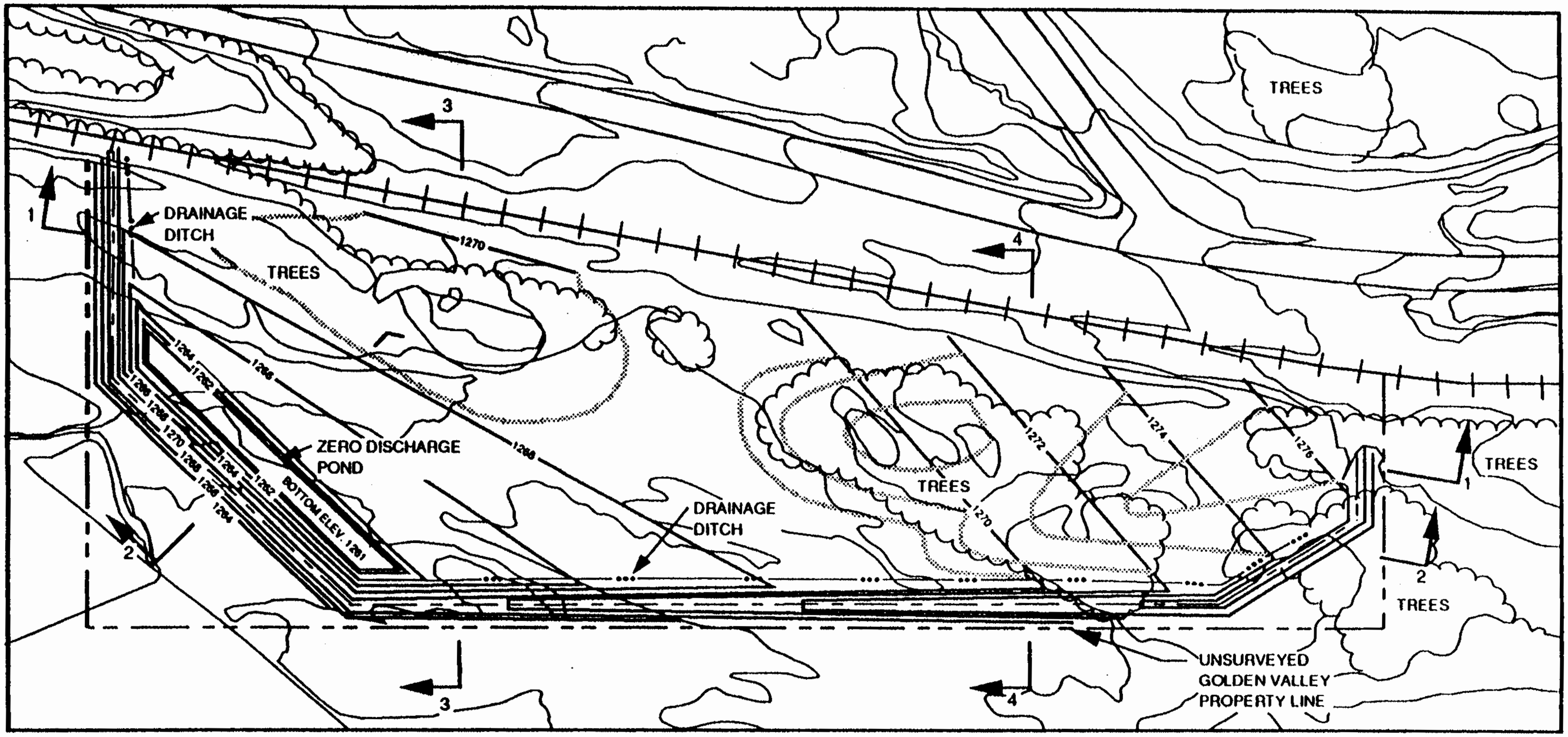


SEE SHEET 12 FOR SECTION LOCATION

0 150 300
SCALE IN FEET

LAYDOWN/STORAGE AREA SECTIONS	
ALASKA INDUSTRIAL DEVELOPMENT AND EXPORT AUTHORITY HEALY CLEAN COAL PROJECT	
NENANA RIVER AND HEALY CREEK	January 7, 1992
Stone & Webster Engineering Corporation	SHEET 13 of 17

H-18



LEGEND

EXISTING CONTOURS

PROPOSED CONTOURS

REGRADED CONTOURS

0 150 300

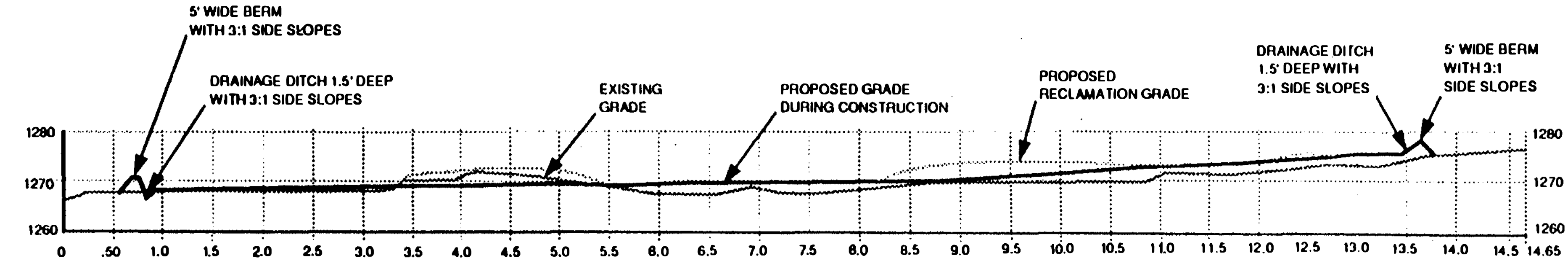
SCALE IN FEET

LAYDOWN/STORAGE AREA
REGRADING PLAN VIEW

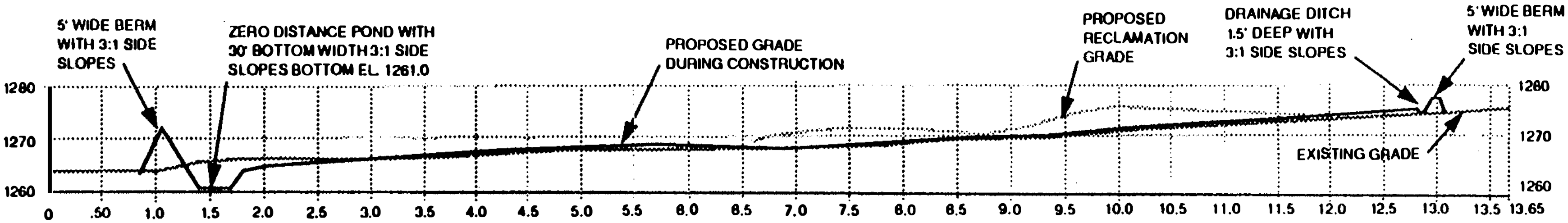
ALASKA INDUSTRIAL
DEVELOPMENT AND EXPORT AUTHORITY
HEALY CLEAN COAL PROJECT

NENANA RIVER AND HEALY CREEK	January 7, 1992
Stone & Webster Engineering Corporation	SHEET 14 of 17

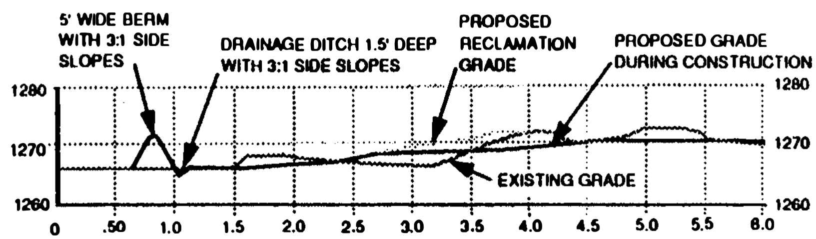
M119:014



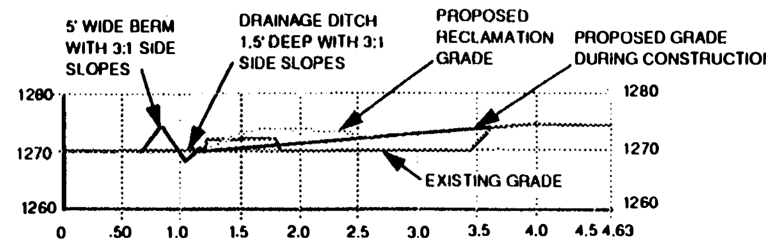
SECTION 1-1



SECTION 2-2



SECTION 3-3



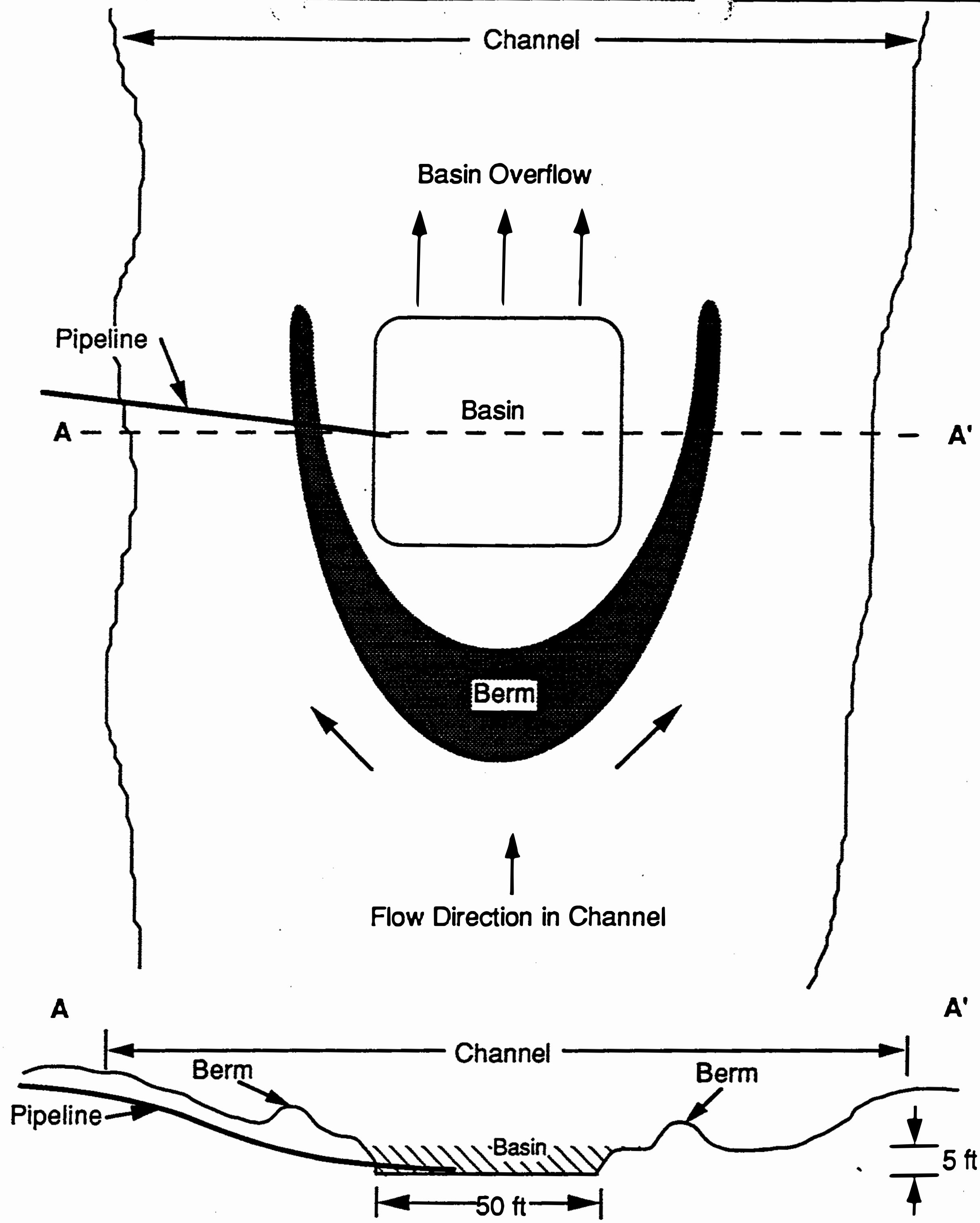
SECTION 4-4

SEE SHEET 14 FOR SECTION LOCATIONS

0 150 300

SCALE IN FEET

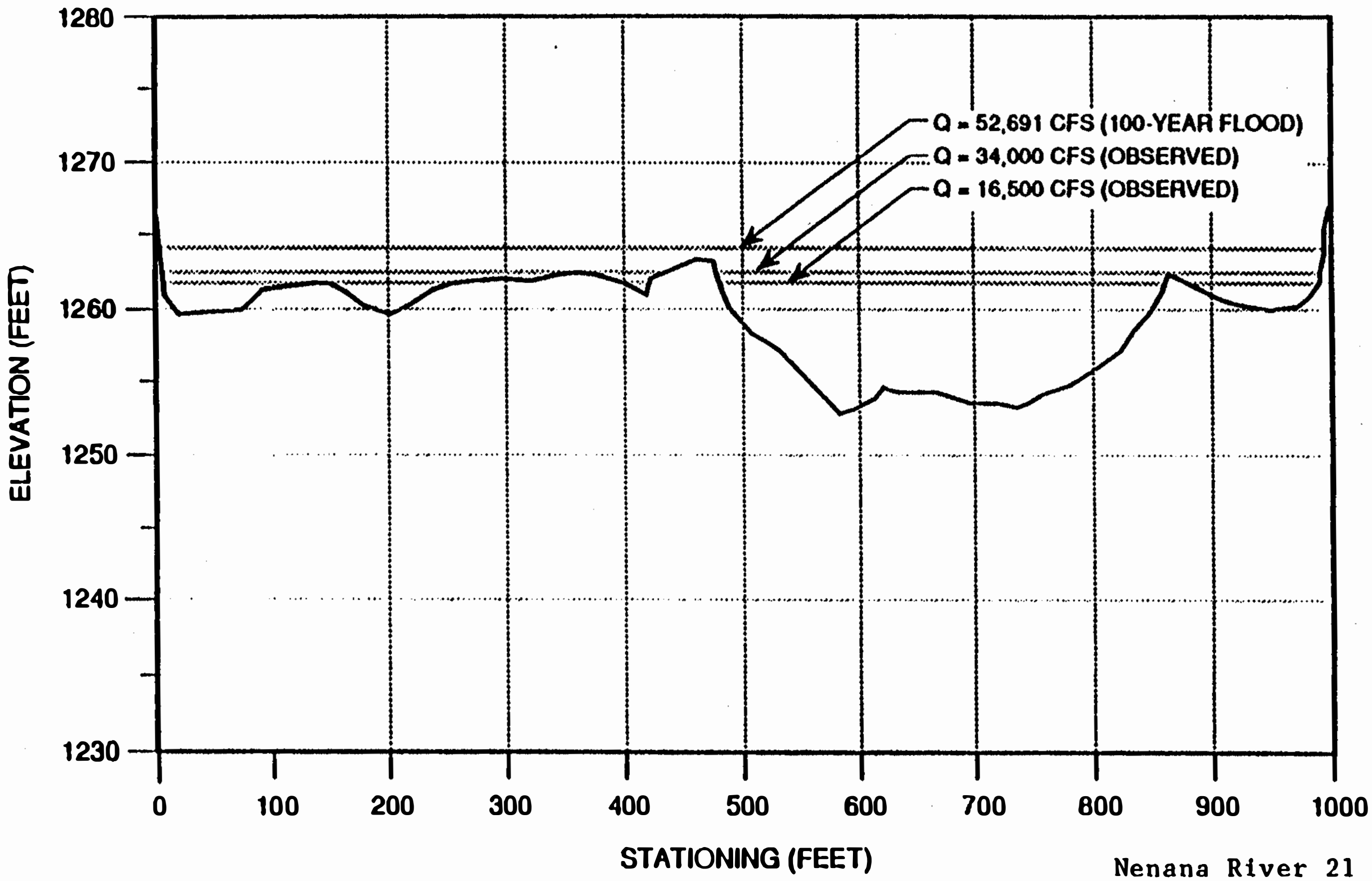
LAYDOWN/STORAGE AREA REGRADING SECTIONS	
ALASKA INDUSTRIAL DEVELOPMENT AND EXPORT AUTHORITY HEALY CLEAN COAL PROJECT	
NENANA RIVER AND HEALY CREEK	January 7, 1992
Stone & Webster Engineering Corporation	SHEET 15 of 17



NOT TO SCALE

SANITARY WASTEWATER DISCHARGE BASIN	
ALASKA INDUSTRIAL DEVELOPMENT AND EXPORT AUTHORITY HEALY CLEAN COAL PROJECT	
NENANA RIVER	May 1, 1992
Stone & Webster Engineering Corporation	SHEET 17 of 17

M1091181



Nenana River 21 4-900217

NENANA RIVER CROSS SECTION STA. 6070	
ALASKA INDUSTRIAL DEVELOPMENT AND EXPORT AUTHORITY HEALY CLEAN COAL PROJECT	
NENANA RIVER AND HEALY CREEK	January 7, 1992
Stone & Webster Engineering Corporation	SHEET 16 of 17

NOTE: CROSS SECTION IS SHOWN LOOKING DOWNSTREAM

STATE OF ALASKA

WALTER J. HICKEL, GOVERNOR

DEPT. OF ENVIRONMENTAL CONSERVATION

Telephone: (907) 465-2600
Address:

P.O. Box 0
Juneau, AK 99811-1800

NOTICE OF APPLICATION
FOR
STATE WATER QUALITY CERTIFICATION

Any applicant for a Federal license or permit to conduct any activity which may result in any discharge into the navigable waters must first apply for and obtain certification from the Alaska Department of Environmental Conservation that any such discharge will comply with the Clean Water Act of 1977 (PL 95-217), the Alaska Water Quality Standards and other applicable State laws. By agreement between the U.S. Army Corps of Engineers and the Alaska Department of Environmental Conservation application for a Department of the Army Permit may also serve as application for State Water Quality Certification when such certification is necessary.

Notice is hereby given that the application for a Department of the Army Permit described in the Corps of Engineers Public Notice No. 4-900217 also serves as application for State Water Quality Certification from the Alaska Department of Environmental Conservation, as provided in Section 401 of the Clean Water Act of 1977 (PL 95-217).

The Department will review the proposed activity to insure that any discharge to waters of the United States resulting from the referenced project will comply with the Clean Water Act of 1977 (PL 95-217) the Alaska Water Quality Standards and other applicable State laws.

Any person desiring to comment on the water quality impacts of the proposed project may do so by writing to:

Alaska Department of Environmental Conservation
Southeastern Regional Office
P.O. Box 2420
Juneau, Alaska 99803
Telephone: 789-3151

within 30 days of publication of this notice.

APPENDIX I

MEMORANDUM OF AGREEMENT
HEALY CLEAN COAL PROJECT
HEALY, ALASKA

MEMORANDUM OF AGREEMENT

HEALY CLEAN COAL PROJECT

HEALY, ALASKA

The parties to this Agreement are the United States Department of Energy (DOE), the United States Department of the Interior (DOI)/National Park Service (NPS), the Alaska Industrial Development and Export Authority (AIDEA), an agency of the State of Alaska, and Golden Valley Electric Association, Inc. (Golden Valley).

Now, therefore, the parties agree as follows:

I. SPECIFIC AGREEMENTS BY U.S. DEPARTMENT OF ENERGY

A. The DOE shall incorporate a discussion of the provisions set forth in Section III below pertaining to Environmental Mitigation Measures into the final Environmental Impact Statement (EIS) for the Healy Clean Coal Project (HCCP), and shall release the final EIS not later than December 15, 1993.

B. The DOE shall immediately approve a federal assistance award that allows funding for the HCCP as proposed in AIDEA's continuation application for budget period No. 3, subject only to the conditions that no authorizations for funding of construction or equipment purchases (other than items of equipment that DOE determines are long-lead time items) may be given, and no construction will be initiated on site until the later of DOE's issuance of its Record of Decision that provides for full funding for HCCP or the incorporation of this Memorandum of Agreement into the permit to operate pursuant to paragraph IV. Nothing in this agreement alters the requirements for DOE to conduct reviews required under the National Environmental Policy Act of 1969 and the rules thereunder. AIDEA reserves the right, subject to DOE approval, to amend the continuation application to adapt it to delays to the project. AIDEA accepts the risks of incurring project costs prior to the issuance of the Record of Decision in the event that DOE determines not to fund HCCP.

C. Following completion of the EIS and if DOE determines to fund HCCP, the DOE shall fund the purchase and installation of continuous emission monitoring equipment for SO_2 and NO_x and overfire air for Healy Unit #1, in an amount not to exceed $500,000.00. Funding provided under the preceding sentence for the purchase and installation of continuous emission monitoring equipment will be available no later than February 1, 1994. Subject to the release of construction funds, funding for the installation of overfire air will be available no later than the date for the installation of that equipment as provided in Section III. A. 1.

II. SPECIFIC AGREEMENTS BY THE DEPARTMENT OF THE INTERIOR/NATIONAL PARK SERVICE

A. The DOI/National Park Service (NPS) shall support immediate release of the final EIS upon incorporation therein by DOE of the matters referenced in Section I. A. The DOI/NPS shall, in writing, inform other cooperating federal agencies of its support of the release of the final EIS.

B. The DOI/NPS shall withdraw its request for an adjudicatory hearing to reconsider the issuance of Permit to Operate No. 9231-AA007 by the Alaska Department of Environmental Conservation (ADEC) by entering into a stipulation for dismissal of said action with prejudice. The stipulation for dismissal shall be in substantially the same form as is set forth in Attachment "A".

C. The DOI/NPS shall encourage appellants, Trustees for Alaska, et al., to dismiss their challenge to Permit to Operate No. 9231-AA007.

III. SPECIFIC AGREEMENTS BY GOLDEN VALLEY ELECTRIC ASSOCIATION, INC.

A. Golden Valley will commit to the following mitigation measures (Environmental Mitigation Measures) to be implemented as specified herein:

1. Retrofit Healy Unit #1 to low-NO_x burners. If technologically feasible, overfire air will be added to Healy Unit #1. In any event, Golden Valley will achieve annual NO_x emissions for Healy Unit #1 not to exceed 429 tons per year (tpy) no later than the end of the first construction season (April 1 - September 30) after the start-up of HCCP. This represents a reduction of approximately 50% from Healy Unit #1's actual NO_x emissions of 848 tpy. NO_x control technology will be added to Healy Unit #1 during the first construction season beginning after the start-up of HCCP. If Golden Valley fails to install NO_x control technology by the end of such first construction season, Golden Valley will not exceed the NO_x emission limitation for Healy Unit #1 of 429 tpy thereafter.

2. Inject sorbent (e.g., Flash Calcined Material (FCM) or lime) into Healy Unit #1 gas stream for SO_2 control to achieve annual SO_2 emissions for Healy Unit #1 not to exceed 472 tpy no later than the end of the second construction season after the start-up of HCCP. This

represents a reduction of 25% from Healy Unit #1's current actual SO_2 emissions of 630 tpy. If feasible, SO_2 control technology will be added to Healy Unit #1 during the first construction season (April 1 - September 30) beginning after the start-up of HCCP. If addition of SO_2 control technology is not feasible during the first construction season after the start-up of HCCP, the control technology will be added during the second construction season after start-up. If Golden Valley fails to install SO_2 control technology by the end of such second construction season, Golden Valley will not exceed the SO_2 emission limitation for Healy Unit #1 of 472 tpy thereafter.

3. Authorize and accept new emission limitations in the ADEC permit to operate (a) for NO_x (1439 tpy) for Healy Unit #1 and HCCP combined, effective after the first construction season following the start-up of HCCP, and (b) for SO_2 (721 tpy) for Healy Unit #1 and HCCP combined, effective no later than the end of the second construction season following the start-up of HCCP. During the period between HCCP start-up and the installation of NO_x and SO_2 control technologies respectively, Golden Valley agrees to a cap of NO_x (1858 tpy) and SO_2 (878 tpy) for Healy Unit #1 and HCCP combined emissions.

4. In no event will Golden Valley seek ADEC permit emission levels which exceed 1439 tpy for NO_x or 721 tpy for SO_2 for the combined Healy Unit #1 and HCCP. If HCCP demonstration technology successfully reduces emissions as expected, Golden Valley will request that ADEC reduce SO_2 and NO_x emission limitations in its permit to operate immediately upon the completion of the demonstration phase to reflect achieved emission levels allowing for reasonable operational variability. In addition, Golden Valley will, in applications for renewed permits to operate, continue to seek lower emission limitations representative of achieved emission levels allowing for reasonable operational variability.

5. Beginning with the start-up of HCCP, Golden Valley agrees that if Healy Unit #1 and/or HCCP are operating and generating a NO_x or other pollutant plume (exclusive of steam and ice crystal plumes) or a sulfate or other pollutant haze visible inside Denali National Park and Preserve (DNPP), Golden Valley will, upon notification by NPS or an order by ADEC, immediately reduce combined emissions to existing Healy Unit #1 emissions (approximately 200 pounds/hour NO_x and 150 pounds/hour SO_2) for twelve (12) hours. This

period of time may be extended for additional twelve (12) hour periods. The procedures for implementing these provisions, including procedures for limiting and/or extending these time limits, are attached as Addendum No. 1.

6. As soon as funds are made available by DOE, Golden Valley will install and operate a continuous emission monitoring (CEM) system for NO_x and SO_2 on Healy Unit #1.

7. Golden Valley will, beginning immediately, provide reasonable technical and administrative support for any related ongoing studies which DOE and DOI agree to pursue.

8. At the Park's request, Golden Valley will, beginning immediately, provide NPS with fly ash and slag ash, as available, FOB Healy, at no charge.

9. Golden Valley will make available to NPS (by donation account or other mechanism specified by the NPS) $25,000 per year for three years beginning one year before HCCP start-up to fund NPS-selected air pollution projects (e.g., research, monitoring, mitigation) in the Park and/or Healy area. These funds shall not reduce funding or otherwise affect the obligations of Golden Valley under the permit to operate (condition #25) to perform visibility monitoring pursuant to a plan developed in consultation with NPS.

10. Consistent with prudent utility practices, Golden Valley will, beginning in 1994, schedule one of its two routine Healy Unit #1 maintenance shutdowns (typically 2 to 8 weeks) and its major maintenance shut-downs, during the June, July, August time period.

11. Golden Valley will immediately apply to ADEC for all necessary permit modifications to make these agreements enforceable as part of the permit to operate.

12. For the purposes of this Agreement, the "start-up of HCCP" shall mean the date upon which HCCP begins its demonstration phase.

IV. CONDITION PRECEDENT

It is a condition of this Agreement becoming final and binding that the Environmental Mitigation Measures set forth above in Section III shall be incorporated as enforceable permit conditions into Permit to Operate No. 9231-AA007 in substantially

the same form as set forth above, pursuant to a stipulation (described in Attachment "A") by the ADEC to do so.

V. AUTHORITY/BINDING EFFECT

Each of the signatories hereto represent that they have full authority to execute this Memorandum of Agreement on behalf of their respective party. The parties agree that the terms hereof shall be binding upon their representatives and successors in interest. This Agreement shall be executed in several counterparts, each of which shall be deemed an original, but all of which shall constitute one and the same instrument.

VI. NO ADMISSION OF LIABILITY

The parties acknowledge that this Memorandum of Agreement is entered into, in part, as a compromise and settlement of disputed claims and to avoid the expense and inconvenience of continued or potential litigation. As such, this Agreement shall not be construed in any manner as an admission of fault or liability on behalf of any of the parties hereto and it shall not be admissible into evidence in any proceeding involving the parties, except for the purpose of enforcing this Agreement.

U.S. DEPARTMENT OF ENERGY

By ______________________

Its ______________________

Date ______________________

U.S. DEPARTMENT OF THE INTERIOR/NATIONAL PARK SERVICE

By George T Frampton Jr.

Its Assistant Secretary for Fish and Wildlife and Parks

Date Nov. 9, 1993

ALASKA INDUSTRIAL DEVELOPMENT AND EXPORT AUTHORITY

By ______________________

Its ______________________

Date ______________________

GOLDEN VALLEY ELECTRIC ASSOCIATION, INC.

By ______________________

Its ______________________

Date ______________________

the same form as set forth above, pursuant to a stipulation (described in Attachment "A") by the ADEC to do so.

V. AUTHORITY/BINDING EFFECT

Each of the signatories hereto represent that they have full authority to execute this Memorandum of Agreement on behalf of their respective party. The parties agree that the terms hereof shall be binding upon their representatives and successors in interest. This Agreement shall be executed in several counterparts, each of which shall be deemed an original, but all of which shall constitute one and the same instrument.

VI. NO ADMISSION OF LIABILITY

The parties acknowledge that this Memorandum of Agreement is entered into, in part, as a compromise and settlement of disputed claims and to avoid the expense and inconvenience of continued or potential litigation. As such, this Agreement shall not be construed in any manner as an admission of fault or liability on behalf of any of the parties hereto and it shall not be admissible into evidence in any proceeding involving the parties, except for the purpose of enforcing this Agreement.

U.S. DEPARTMENT OF ENERGY

By ______________________

Its ______________________

Date ______________________

U.S. DEPARTMENT OF THE INTERIOR/NATIONAL PARK SERVICE

By ______________________

Its ______________________

Date ______________________

ALASKA INDUSTRIAL DEVELOPMENT AND EXPORT AUTHORITY

By ______________________

Its ______________________

Date ______________________

GOLDEN VALLEY ELECTRIC ASSOCIATION, INC.

By Mike Kelly

Its General Manager

Date 11/09/93

the same form as set forth above, pursuant to a stipulation (described in Attachment "A") by the ADEC to do so.

V. AUTHORITY/BINDING EFFECT

Each of the signatories hereto represent that they have full authority to execute this Memorandum of Agreement on behalf of their respective party. The parties agree that the terms hereof shall be binding upon their representatives and successors in interest. This Agreement shall be executed in several counterparts, each of which shall be deemed an original, but all of which shall constitute one and the same instrument.

VI. NO ADMISSION OF LIABILITY

The parties acknowledge that this Memorandum of Agreement is entered into, in part, as a compromise and settlement of disputed claims and to avoid the expense and inconvenience of continued or potential litigation. As such, this Agreement shall not be construed in any manner as an admission of fault or liability on behalf of any of the parties hereto and it shall not be admissible into evidence in any proceeding involving the parties, except for the purpose of enforcing this Agreement.

U.S. DEPARTMENT OF ENERGY

By ______________________

Its ______________________

Date ______________________

U.S. DEPARTMENT OF THE INTERIOR/NATIONAL PARK SERVICE

By ______________________

Its ______________________

Date ______________________

ALASKA INDUSTRIAL DEVELOPMENT AND EXPORT AUTHORITY

By William R. Snell

Its Executive Director

Date November 9, 1993

GOLDEN VALLEY ELECTRIC ASSOCIATION, INC.

By ______________________

Its ______________________

Date ______________________

the same form as set forth above, pursuant to a stipulation (described in Attachment "A") by the ADEC to do so.

V. AUTHORITY/BINDING EFFECT

Each of the signatories hereto represent that they have full authority to execute this Memorandum of Agreement on behalf of their respective party. The parties agree that the terms hereof shall be binding upon their representatives and successors in interest. This Agreement shall be executed in several counterparts, each of which shall be deemed an original, but all of which shall constitute one and the same instrument.

VI. NO ADMISSION OF LIABILITY

The parties acknowledge that this Memorandum of Agreement is entered into, in part, as a compromise and settlement of disputed claims and to avoid the expense and inconvenience of continued or potential litigation. As such, this Agreement shall not be construed in any manner as an admission of fault or liability on behalf of any of the parties hereto and it shall not be admissible into evidence in any proceeding involving the parties, except for the purpose of enforcing this Agreement.

U.S. DEPARTMENT OF ENERGY	U.S. DEPARTMENT OF THE INTERIOR/NATIONAL PARK SERVICE
By [signature]	By ______
Its Secretary of Energy	Its ______
Date 11/09/93	Date ______
ALASKA INDUSTRIAL DEVELOPMENT AND EXPORT AUTHORITY	GOLDEN VALLEY ELECTRIC ASSOCIATION, INC.
By ______	By ______
Its ______	Its ______
Date ______	Date ______

ADDENDUM NO. 1

PROCEDURE FOR IMPLEMENTING
MITIGATION MEASURE NUMBER III. A. 5.

I. NPS will, in consultation with ADEC, insure that designated DNPP personnel are trained in pollutant plume and haze identification.

II. If a NO_x or other pollutant plume (exclusive of steam and ice crystal plumes) or sulfate or other pollutant haze which impairs visibility and which is reasonably attributable to the operation of HCCP and/or Healy Unit #1 is observed or otherwise detected within the Park boundaries, the following procedures shall apply:

A. All notifications of plume or haze observation or detection reasonably attributable to the operation of HCCP and/or Healy Unit #1 shall be relayed to Golden Valley by the Park Superintendent or his or her designated representative.

B. The Park Superintendent or his or her designated representative shall notify Golden Valley's Healy Plant Superintendent by telephone of plume or haze observation or detection which is reasonably attributable to the operation of HCCP and/or Healy Unit #1 if the Park Superintendent determines that the report of such plume or haze observation or detection is credible.

C. Upon receipt of a notification of plume or haze observation or detection, Golden Valley will investigate the situation and proceed within 90 minutes of notification as follows:

1. If Golden Valley concurs in the NPS determination in paragraph II. B. above, Golden Valley will reduce the combined emissions from HCCP and Healy Unit #1 to existing Healy Unit #1 emissions (approximately 200 pounds/hour NO_x and 150 pounds/hour SO_2) for a minimum of twelve (12) hours. This period of time will be extended for additional twelve (12) hour periods by mutual agreement of the parties, as defined in this paragraph, if the plume and/or haze persist, or conditions conducive to plume and/or haze formation persist. At any time during this period of reduced emissions, Golden Valley may resume full operations upon a determination, by the mutual agreement of the parties, as defined in

this paragraph, that the plume and/or haze is no longer detectable and conditions conducive to plume and/or haze formation no longer exist. The phrase "by mutual agreement of the parties," as used in this paragraph, means that Golden Valley's Healy Plant Superintendent and the Park Superintendent, or their designated representatives, will discuss the issue requiring decision and undertake to reach agreement on the decision; provided that if such decision cannot be agreed upon, Golden Valley may proceed to resume operations, and both parties will keep a record of the disagreement.

2. If Golden Valley does not concur with the Park Superintendent's determination in paragraph II. B. above within 90 minutes or if the Park Superintendent does not concur with Golden Valley's decision to resume operations in paragraph II. C. 1. above, the Park Superintendent or his or her designated representative may notify air quality control personnel in the Northern Regional Office of ADEC in Fairbanks, Alaska. ADEC may then order Golden Valley to reduce the combined emissions as set forth in paragraph 1 above if, after an opportunity for consultation with Golden Valley and the Park Superintendent, ADEC concurs with the NPS determination based on an observation or detection made or confirmed by a person or persons trained pursuant to the procedures established in paragraph I., above. Because this process depends on prompt decision-making and communication, telephone transactions are contemplated.

3. For purposes of any order issued under paragraph II. C. 2. above, Golden Valley hereby waives rights to advance notice and opportunity for hearing provided by AS 46.03.850 (Compliance Orders) and stipulates to the imposition of any emergency order under AS 46.03.820.

D. In emergency conditions (defined as the loss of a significant portion of Golden Valley's generating resources and/or the Alaska Intertie), Golden Valley will undertake the reductions in Section C.1 when the emergency conditions end.

III. A. Two years after the start-up of HCCP, Golden Valley will meet with the Park Superintendent to evaluate whether the procedures set forth herein (1) are adequate to protect Denali National Park and Preserve

(DNPP) air quality related values and (2) are compatible with Golden Valley's obligation to meet its legal responsibilities for energy supply. At this time, if necessary, the parties may also discuss reasonable mitigation measures applicable to ice and/or steam plumes reasonably attributable to the operation of HCCP and/or Healy Unit #1, which have been observed or detected within the DNPP boundary. By mutual agreement, the parties may meet at other times.

B. Based on the evaluation set forth in paragraph A, either Golden Valley or the Park Superintendent may propose revision of the abatement procedures (Mitigation Measure Number III. A. 5.), including any additional or alternative requirements necessary to assure that (1) NPS can adequately protect DNPP air quality related values (including mitigation of steam and/or ice plumes) and (2) Golden Valley can meet its legal responsibilities for energy supply.

C. 1. If the Park Superintendent and Golden Valley are unable in good faith to reach agreement under paragraph B, above, either party may submit the matter to arbitration in accordance with 5 USC sections 571-583 (the Administrative Dispute Resolutions Act). DOI has considered factors enumerated in 5 USC section 572(b)(1)-(6) and has determined that utilization of the Administrative Dispute Resolution Act is appropriate for controversies under this paragraph B.

2. All proceedings and awards under paragraph 1 shall be in accordance with 5 USC sections 571-583. The Park Superintendent and Golden Valley shall each designate an arbitrator, and the two arbitrators shall agree on a neutral third arbitrator pursuant to 5 USC sections 573 and 577. If the two arbitrators cannot agree on a neutral third arbitrator within fifteen (15) days of their appointment, then either party may apply to a federal judge of the United States District Court for the District of Alaska for appointment of a neutral third arbitrator. The subject matter to be submitted to the arbitration panel shall be the resolution of the specific dispute which the parties are unable to resolve under paragraph B, above. In addition to the enforceability of any awards under 5 USC section 580, if the requirements of the award are appropriate matters for incorporation into a revised ADEC permit to operate, Golden Valley shall, forthwith, request ADEC to revise its permit to operate to

incorporate the requirements of the award and the parties agree that they shall all join in that request.

D. Golden Valley or the Park Superintendent may request a meeting every two years thereafter to implement the provisions of paragraphs A and B, above.

IV. A. If conditions attributable to the operation of HCCP and/or Healy Unit #1 require the implementation of Mitigation Measure Number III. A. 5. more than 10 times during any six month period (as substantiated by the use of the Mitigation Measure Number III. A. 5. abatement procedure), then the Park Superintendent and Golden Valley will undertake to agree on emission limitations or other actions sufficient to prevent formation of a plume or haze to which Mitigation Measure Number III. A. 5. would apply, including action to reduce the SO_2 and NO_x emission limitations to the existing Healy Unit #1 emissions (approximately 200 pounds/hour of NO_x and 150 pounds/hour of SO_2).

B. If the Park Superintendent and Golden Valley are unable in good faith to reach agreement under paragraph A, above, the matter shall be arbitrated in accordance with 5 USC sections 571-583 (the Administrative Dispute Resolution Act). All proceedings and awards shall be in accordance with those sections. The Park Superintendent and Golden Valley shall each designate an arbitrator and the two arbitrators shall agree on a neutral third arbitrator pursuant to 5 USC sections 573 and 577. If the two arbitrators cannot agree on a neutral third arbitrator within fifteen (15) days of their appointment, then either party may apply to a federal judge of the United States District Court for the District of Alaska for the appointment of a neutral third arbitrator. Each of the arbitrators chosen by the Park Superintendent and Golden Valley shall be recognized experts in visibility science.

C. DOI has considered factors enumerated in 5 USC section 572(b)(1)-(6) and has determined that utilization of the Administrative Dispute Resolution Act is appropriate for controversies under this section IV.

D. The subject matter to be submitted to the arbitration panel is the formulation of a permit amendment which establishes emission limitations or requires other actions sufficient to prevent or further limit the frequency of formation of plumes or a haze to which Mitigation Measure Number III. A. 5. would apply. In addition to the enforceability of any awards under 5

USC section 580, Golden Valley shall, forthwith, request ADEC to revise its permit to operate to incorporate the requirements of the award and the parties agree that they shall all join in that request.

V. Any concerns related to the operation of Healy Unit #1 and/or HCCP may be raised by NPS when Golden Valley submits its application for renewal of the permit to operate. This agreement will be incorporated in, and made enforceable by, each permit to operate for Healy Unit #1 and/or HCCP.

VI. As used in this Addendum, references to the "Park Superintendent or his or her designated representative" are intended neither to confer any additional authority on the Park Superintendent beyond his or her existing organizational authority nor to preclude involvement by other appropriate personnel. Rather, such references are used in order to encourage a close working relationship between the parties at the local level.

ATTACHMENT "A"

BEFORE THE COMMISSIONER OF THE

DEPARTMENT OF ENVIRONMENTAL CONSERVATION

STATE OF ALASKA

IN THE MATTER OF THE HEALY CLEAN
COAL PROJECT, AIR QUALITY CONTROL PERMIT TO OPERATE
NO. 9231-AA007

STIPULATION FOR DISMISSAL

The Department of the Interior, by and through the National Park Service, a petitioner herein, and respondents, State of Alaska Department of Environmental Conservation, the Alaska Industrial Development and Export Authority and Golden Valley Electric Association, Inc., by and through their respective counsel of record, hereby stipulate and agree to the following:

1. The parties have settled and compromised the claims between them asserted herein.

2. The parties agree that the terms and conditions, which are set forth and attached hereto as Attachment 1, shall be incorporated into and become enforceable requirements of Permit No. 9231-AA007.

3. The parties agree that this appeal and all claims therein between them shall be dismissed with prejudice, with each party bearing its own costs and legal fees.

4. This stipulation and order does not, in any manner, affect the adjudication between Trustees for Alaska and the parties named herein.

DATED this ___________ day of ______________, 1993.

UNITED STATES DEPARTMENT OF THE INTERIOR

By ________________________________
F. Christopher Bockmon

ALASKA INDUSTRIAL DEVELOPMENT AND EXPORT AUTHORITY

By ________________________________
Douglas Kemp Mertz

ALASKA DEPARTMENT OF ENVIRONMENTAL CONSERVATION

By ________________________________
Robert K. Reges, Jr.

GOLDEN VALLEY ELECTRIC ASSOCIATION, INC.

By ________________________________
Peter H. Haller

ORDER OF DISMISSAL

THIS MATTER having come before the Commissioner upon the stipulation of all the parties and their counsel of record and the Commissioner having been generally advised, now, therefore,

IT IS HEREBY ORDERED that:

1. This matter is dismissed with prejudice as to the signatories to the stipulation.

2. That the terms and conditions contained in Attachment "1" hereto shall be incorporated into Permit No. 9231-AA007 as operating conditions thereof.

3. This appeal and all claims therein raised by the signatories to the stipulation are hereby dismissed with prejudice.

4. All parties shall bear their own costs and legal fees associated with this proceeding.

DATED: ______________________________

____
Commissioner
State of Alaska, ADEC

ATTACHMENT "1"

Golden Valley will commit to the following mitigation measures (Environmental Mitigation Measures) to be implemented as specified herein:

1. Retrofit Healy Unit #1 to low-NO_X burners. If technologically feasible, overfire air will be added to Healy Unit #1. In any event, Golden Valley will achieve annual NO_X emissions for Healy Unit #1 not to exceed 429 tons per year (tpy) no later than the end of the first construction season (April 1 - September 30) after the start-up of HCCP. This represents a reduction of approximately 50% from Healy Unit #1's actual NO_X emissions of 848 tpy. NO_X control technology will be added to Healy Unit #1 during the first construction season beginning after the start-up of HCCP. If Golden Valley fails to install NO_X control technology by the end of such first construction season, Golden Valley will not exceed the NO_X emission limitation for Healy Unit #1 of 429 tpy thereafter.

2. Inject sorbent (e.g., Flash Calcined Material (FCM) or lime) into Healy Unit #1 gas stream for SO_2 control to achieve annual SO_2 emissions for Healy Unit #1 not to exceed 472 tpy no later than the end of the second construction season after the start-up of HCCP. This represents a reduction of 25% from Healy Unit #1's current actual SO_2 emissions of 630 tpy. If feasible, SO_2 control technology will be added to Healy Unit #1 during the first construction season (April 1 - September 30) beginning after the start-up of HCCP. If addition of SO_2 control technology is not feasible during the first construction season after the start-up of HCCP, the control technology will be added during the second construction season after start-up. If Golden Valley fails to install SO_2 control technology by the end of such second construction season, Golden Valley will not exceed the SO_2 emission limitation for Healy Unit #1 of 472 tpy thereafter.

3. Authorize and accept new emission limitations in the ADEC permit to operate (a) for NO_X (1439 tpy) for Healy Unit #1 and HCCP combined, effective after the first construction season following the start-up of HCCP, and (b) for SO_2 (721 tpy) for Healy Unit #1 and HCCP combined, effective no later than the end of the second construction season following the start-up of HCCP. During the period between HCCP start-up and the installation of NO_X and SO_2 control technologies respectively, Golden Valley agrees to a cap of NO_X (1858 tpy) and SO_2 (878 tpy) for Healy Unit #1 and HCCP combined emissions.

4. In no event will Golden Valley seek ADEC permit emission levels which exceed 1439 tpy for NO_X or 721 tpy for SO_2 for the combined Healy Unit #1 and HCCP. If HCCP demonstration technology successfully reduces emissions as expected, Golden Valley will request that ADEC reduce SO_2 and NO_X emission limitations in its permit to operate immediately upon the completion of the demonstration phase to reflect

achieved emission levels allowing for reasonable operational variability. In addition, Golden Valley will, in applications for renewed permits to operate, continue to seek lower emission limitations representative of achieved emission levels allowing for reasonable operational variability.

5. Beginning with the start-up of HCCP, Golden Valley agrees that if Healy Unit #1 and/or HCCP are operating and generating a NO_x or other pollutant plume (exclusive of steam and ice crystal plumes) or a sulfate or other pollutant haze visible inside Denali National Park and Preserve (DNPP), Golden Valley will, upon notification by NPS or an order by ADEC, immediately reduce combined emissions to existing Healy Unit #1 emissions (approximately 200 pounds/hour NO_x and 150 pounds/hour SO_2) for twelve (12) hours. This period of time may be extended for additional twelve (12) hour periods. The procedures for implementing these provisions, including procedures for limiting and/or extending these time limits, are attached as Addendum No. 1.

6. As soon as funds are made available by DOE, Golden Valley will install and operate a continuous emission monitoring (CEM) system for NO_x and SO_2 on Healy Unit #1.

7. Golden Valley will, beginning immediately, provide reasonable technical and administrative support for any related ongoing studies which DOE and DOI agree to pursue.

8. At the Park's request, Golden Valley will, beginning immediately, provide NPS with fly ash and slag ash, as available, FOB Healy, at no charge.

9. Golden Valley will make available to NPS (by donation account or other mechanism specified by the NPS) $25,000 per year for three years beginning one year before HCCP start-up to fund NPS-selected air pollution projects (e.g., research, monitoring, mitigation) in the Park and/or Healy area. These funds shall not reduce funding or otherwise affect the obligations of Golden Valley under the permit to operate (condition #25) to perform visibility monitoring pursuant to a plan developed in consultation with NPS.

10. Consistent with prudent utility practices, Golden Valley will, beginning in 1994, schedule one of its two routine Healy Unit #1 maintenance shutdowns (typically 2 to 8 weeks) and its major maintenance shut-downs, during the June, July, August time period.

11. Golden Valley will immediately apply to ADEC for all necessary permit modifications to make these agreements enforceable as part of the permit to operate.

12. For the purposes of this Agreement, the "start-up of HCCP" shall mean the date upon which HCCP begins its demonstration phase.

ADDENDUM NO. 1

PROCEDURE FOR IMPLEMENTING
MITIGATION MEASURE NUMBER III. A. 5.

I. NPS will, in consultation with ADEC, insure that designated DNPP personnel are trained in pollutant plume and haze identification.

II. If a NO_x or other pollutant plume (exclusive of steam and ice crystal plumes) or sulfate or other pollutant haze which impairs visibility and which is reasonably attributable to the operation of HCCP and/or Healy Unit #1 is observed or otherwise detected within the Park boundaries, the following procedures shall apply:

A. All notifications of plume or haze observation or detection reasonably attributable to the operation of HCCP and/or Healy Unit #1 shall be relayed to Golden Valley by the Park Superintendent or his or her designated representative.

B. The Park Superintendent or his or her designated representative shall notify Golden Valley's Healy Plant Superintendent by telephone of plume or haze observation or detection which is reasonably attributable to the operation of HCCP and/or Healy Unit #1 if the Park Superintendent determines that the report of such plume or haze observation or detection is credible.

C. Upon receipt of a notification of plume or haze observation or detection, Golden Valley will investigate the situation and proceed within 90 minutes of notification as follows:

1. If Golden Valley concurs in the NPS determination in paragraph II. B. above, Golden Valley will reduce the combined emissions from HCCP and Healy Unit #1 to existing Healy Unit #1 emissions (approximately 200 pounds/hour NO_x and 150 pounds/hour SO_2) for a minimum of twelve (12) hours. This period of time will be extended for additional twelve (12) hour periods by mutual agreement of the parties, as defined in this paragraph, if the plume and/or haze persist, or conditions conducive to plume and/or haze formation persist. At any time during this period of reduced emissions, Golden Valley may resume full operations upon a determination, by the mutual agreement of the parties, as defined in this paragraph, that the plume and/or haze is no longer detectable and conditions conducive to plume and/or haze formation no longer exist. The phrase "by mutual agreement of the parties," as

used in this paragraph, means that Golden Valley's Healy Plant Superintendent and the Park Superintendent, or their designated representatives, will discuss the issue requiring decision and undertake to reach agreement on the decision; provided that if such decision cannot be agreed upon, Golden Valley may proceed to resume operations, and both parties will keep a record of the disagreement.

2. If Golden Valley does not concur with the Park Superintendent's determination in paragraph II. B. above within 90 minutes or if the Park Superintendent does not concur with Golden Valley's decision to resume operations in paragraph II. C. 1. above, the Park Superintendent or his or her designated representative may notify air quality control personnel in the Northern Regional Office of ADEC in Fairbanks, Alaska. ADEC may then order Golden Valley to reduce the combined emissions as set forth in paragraph 1 above if, after an opportunity for consultation with Golden Valley and the Park Superintendent, ADEC concurs with the NPS determination based on an observation or detection made or confirmed by a person or persons trained pursuant to the procedures established in paragraph I., above. Because this process depends on prompt decision-making and communication, telephone transactions are contemplated.

3. For purposes of any order issued under paragraph II. C. 2. above, Golden Valley hereby waives rights to advance notice and opportunity for hearing provided by AS 46.03.850 (Compliance Orders) and stipulates to the imposition of any emergency order under AS 46.03.820.

D. In emergency conditions (defined as the loss of a significant portion of Golden Valley's generating resources and/or the Alaska Intertie), Golden Valley will undertake the reductions in Section C.1 when the emergency conditions end.

III. A. Two years after the start-up of HCCP, Golden Valley will meet with the Park Superintendent to evaluate whether the procedures set forth herein (1) are adequate to protect Denali National Park and Preserve (DNPP) air quality related values and (2) are compatible with Golden Valley's obligation to meet its legal responsibilities for energy supply. At this time, if necessary, the parties may also discuss reasonable mitigation measures applicable to ice and/or steam plumes reasonably attributable to the operation of HCCP and/or Healy Unit #1, which have been observed or detected within the DNPP boundary. By mutual agreement, the parties may meet at other times.

B. Based on the evaluation set forth in paragraph A, either Golden Valley or the Park Superintendent may propose revision of the abatement procedures (Mitigation Measure Number III. A. 5.), including any additional or alternative requirements necessary to assure that (1) NPS can adequately protect DNPP air quality related values (including mitigation of steam and/or ice plumes) and (2) Golden Valley can meet its legal responsibilities for energy supply.

C. 1. If the Park Superintendent and Golden Valley are unable in good faith to reach agreement under paragraph B, above, either party may submit the matter to arbitration in accordance with 5 USC sections 571-583 (the Administrative Dispute Resolutions Act). DOI has considered factors enumerated in 5 USC section 572(b)(1)-(6) and has determined that utilization of the Administrative Dispute Resolution Act is appropriate for controversies under this paragraph B.

2. All proceedings and awards under paragraph 1 shall be in accordance with 5 USC sections 571-583. The Park Superintendent and Golden Valley shall each designate an arbitrator, and the two arbitrators shall agree on a neutral third arbitrator pursuant to 5 USC sections 573 and 577. If the two arbitrators cannot agree on a neutral third arbitrator within fifteen (15) days of their appointment, then either party may apply to a federal judge of the United States District Court for the District of Alaska for appointment of a neutral third arbitrator. The subject matter to be submitted to the arbitration panel shall be the resolution of the specific dispute which the parties are unable to resolve under paragraph B, above. In addition to the enforceability of any awards under 5 USC section 580, if the requirements of the award are appropriate matters for incorporation into a revised ADEC permit to operate, Golden Valley shall, forthwith, request ADEC to revise its permit to operate to incorporate the requirements of the award and the parties agree that they shall all join in that request.

D. Golden Valley or the Park Superintendent may request a meeting every two years thereafter to implement the provisions of paragraphs A and B, above.

IV. A. If conditions attributable to the operation of HCCP and/or Healy Unit #1 require the implementation of Mitigation Measure Number III. A. 5. more than 10 times during any six month period (as substantiated by the use of the Mitigation Measure Number III. A. 5. abatement procedure), then the Park Superintendent and Golden Valley will undertake to agree on emission limitations or other actions sufficient to prevent formation of a plume or haze to which Mitigation Measure Number III. A. 5. would apply, including action to reduce the SO_2 and NO_x emission limitations to the existing Healy Unit #1 emissions (approximately 200 pounds/hour of NO_x and 150 pounds/hour of SO_2).

B. If the Park Superintendent and Golden Valley are unable in good faith to reach agreement under paragraph A, above, the matter shall be arbitrated in accordance with 5 USC sections 571-583 (the Administrative Dispute Resolution Act). All proceedings and awards shall be in accordance with those sections. The Park Superintendent and Golden Valley shall each designate an arbitrator and the two arbitrators shall agree on a neutral third arbitrator pursuant to 5 USC sections 573 and 577. If the two arbitrators cannot agree on a neutral third arbitrator within fifteen (15) days of their appointment, then either party may apply to a federal judge of the United States District Court for the District of Alaska for the appointment of a neutral third arbitrator. Each of the arbitrators chosen by the Park Superintendent and Golden Valley shall be recognized experts in visibility science.

C. DOI has considered factors enumerated in 5 USC section 572(b)(1)-(6) and has determined that utilization of the Administrative Dispute Resolution Act is appropriate for controversies under this section IV.

D. The subject matter to be submitted to the arbitration panel is the formulation of a permit amendment which establishes emission limitations or requires other actions sufficient to prevent or further limit the frequency of formation of plumes or a haze to which Mitigation Measure Number III. A. 5. would apply. In addition to the enforceability of any awards under 5 USC section 580, Golden Valley shall, forthwith, request ADEC to revise its permit to operate to incorporate the requirements of the award and the parties agree that they shall all join in that request.

V. Any concerns related to the operation of Healy Unit #1 and/or HCCP may be raised by NPS when Golden Valley submits its application for renewal of the permit to operate. This agreement will be incorporated in, and made enforceable by, each permit to operate for Healy Unit #1 and/or HCCP.

VI. As used in this Addendum, references to the "Park Superintendent or his or her designated representative" are intended neither to confer any additional authority on the Park Superintendent beyond his or her existing organizational authority nor to preclude involvement by other appropriate personnel. Rather, such references are used in order to encourage a close working relationship between the parties at the local level.