MESABA ENERGY PROJECT

ENVIRONMENTAL SUPPLEMENT:

SECTION ONE

Prepared by

EXCELSIOR ENERGY

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1.1 Introduction

The Mesaba Energy Project is a 1,212 megawatt electrical power generating station being developed on Minnesota's Iron Range by Excelsior Energy Inc. The station will be built in two phases of 606 megawatts each. The station will utilize an innovative coal gasification process in which coal is converted to a synthetic gas and the gas is combusted to generate electricity. The Mesaba Energy Project will provide a clean source of energy with a superior environmental performance than conventional coal-burning plants.

In recognition of the strong public interest in promoting coal gasification, the development of the Mesaba Energy Project is supported in part by financial assistance in the form of loans from the United States Department of Energy and the State of Minnesota. The construction and operation of the generating station will require a variety of federal and state permits. As a condition to final governmental approvals, federal and state law require the preparation of an environmental impact statement, which is being jointly prepared by the United States Department of Energy and the Minnesota Department of Commerce.

This Environmental Supplement is submitted by Excelsior Energy as required by state and federal regulations and is designed to assist the federal and state agencies in the preparation of the environmental impact statement. The Environmental Supplement describes the proposed Phase I and Phase II developments, evaluates their reasonable alternatives, provides a detailed description of the affected environment at the preferred and alternate sites, identifies potential environmental impacts, and identifies how such impacts could be mitigated.

The Environmental Supplement is organized into five principal sections as follows:

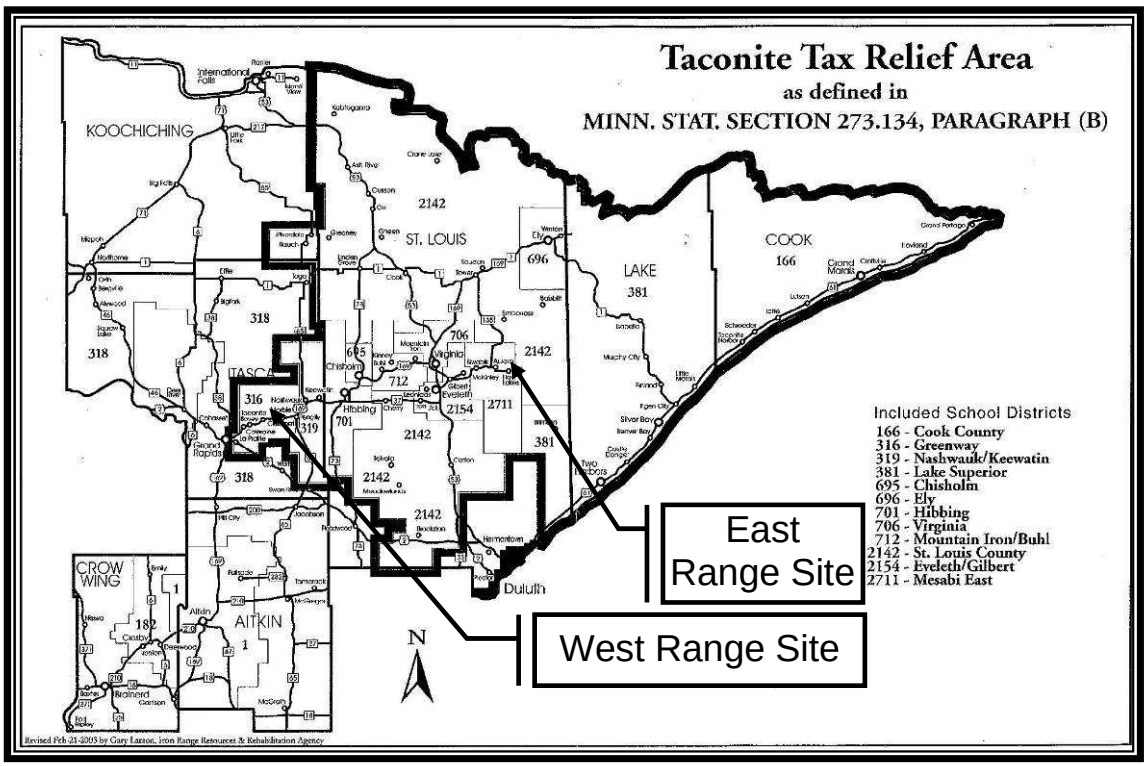
- Section 1: Detailed description of the Mesaba Energy Project, the facilities and technologies proposed as part of the Phase I and Phase II developments, their associated infrastructure requirements and alternatives, and the process and criteria utilized by Excelsior Energy to select the preferred West Range Site in the vicinity of Taconite, Minnesota and the alternate East Range Site in the vicinity of Hoyt Lakes, Minnesota.
- Section 2: Detailed description of the affected environment for the preferred and alternate sites and their local/regional surroundings.
- Section 3: Detailed discussion of the potential environmental impacts associated with constructing the Phase I and Phase II developments at the preferred or alternate sites, including, impacts to air quality, ecosystems, wetlands, water resources, local/regional communities, and historical and cultural resources.
- Sections 4 and 5: Lists of agencies and individuals contacted in the course of developing this Environmental Supplement and references cited.

1.2 Mesaba Energy Project and Regulatory Review

1.2.1 Mesaba Energy Project Proponent

Excelsior Energy Inc. ("Excelsior"), an energy development company based in Minnetonka, Minnesota has created two wholly-owned project companies, MEP-I LLC and MEP-II LLC (MEP-I LLC and MEP-II LLC, together, the "Proponent" or "Company") to construct, own and operate at a site in Northeastern Minnesota a 1,212 megawatt$_{(net)}$ integrated gasification combined cycle ("IGCC") electric power generating station (hereafter, the "IGCC Power Station") fueled by coal and other solid, petroleum-based feedstocks. The IGCC Power Station consists of Phase I and Phase II of the Mesaba Energy Project (hereafter, "Mesaba One and Mesaba Two," respectively) each phase of which is nominally rated at peak to deliver 606 megawatts ("MW") of electricity to the bus bar of the high voltage switchyard located within the IGCC Power Station's fenced boundary. Mesaba One and Mesaba Two will be located at a site in the Taconite Tax Relief Area ("TTRA") of Northeastern Minnesota in conformance with Minn. Stat. § 216B.1694, such site to be determined in accordance with procedures established under the Minnesota Power Plant Siting Act (Minn. Stat. §§ 116C.51-.69, hereafter, the "Act") and Minn. R. ch. 4400 (the "Applicable Rules"). Figure 1.2-1 shows the boundary of the TTRA and the two locations Excelsior is proposing as part of its responsibilities for permitting Mesaba One and Mesaba Two under the Act and Applicable Rules (see Section 1.2.6.1).

Figure 1.2-1. Minnesota Taconite Tax Relief Area



In reference to their geographical relationship and location on the Iron Range, the Proponent has designated the western-most location as its West Range Site and the eastern-most location as its East Range Site. The Proponent has selected the West Range Site as its preferred location on which to construct Mesaba One and Mesaba Two.

Excelsior's corporate vision is to bring power generation, economic development, and reduced levels of pollution inside and outside Minnesota via the widespread application of innovative and advanced clean energy technologies. The Proponent believes that IGCC technology is a critical component of comprehensive national energy security and environmental protection strategies and has selected IGCC as the vehicle to pursue and transform its vision to reality.

1.2.2 Mesaba One and Mesaba Two

At the West Range Site, Mesaba One and Mesaba Two are expected to deliver a total of 1,206 MW to the point of interconnection ("POI") with the high voltage transmission grid. Power delivered to the POI for the East Range Site is expected to be about 1,197 MW. The difference between the amount of power delivered to the West Range and East Range POIs is due to the East Range generating station's added auxiliary power demands (see Section 1.6.6.3.2) and higher power losses associated with transmitting the station's electric output over longer distances required to reach its POI.

Mesaba One and Mesaba Two will be feedstock-flexible IGCC plants sized at a commercial scale and using a technology that is efficient, economical, reliable, and environmentally superior to conventional coal-fueled steam electric generating stations.

Construction of Mesaba One is scheduled to begin in the 1st quarter of 2008 with a commercial in-service date scheduled for the fourth quarter of 2011. The commercial in-service date for Mesaba Two is scheduled for 2013.

1.2.3 Terminology

In the following sections of this report, the terms "Project" or "Mesaba One" will be used synonymously with the phrases "Phase I IGCC Power Station" and "Phase I Development." The term "Mesaba Two" will be used synonymously with the phrases "Phase II IGCC Power Station" and "Phase II Development." The combined Phase I and Phase II Developments will be used synonymously with the term "Mesaba One and Two" and the phrase "Phase I and II IGCC Power Station." The phrases "IGCC Power Station", "Power Station", or "Station" will be used where the context with respect to Mesaba One, Mesaba Two, or both is obvious, and/or where the context regarding the site being discussed is obvious. The term "IGCC Power Station Footprint" or "Station Footprint" means the specific area within which the IGCC Power Station is located. "Buffer Land" means the land area contiguous with or adjacent to the IGCC Power Station Footprint, extending to the boundary of the property controlled by the Proponent, and upon which limited Station-related activity occurs. The term "Associated Facilities" means the buildings, equipment, and other physical structures that are necessary to operate the Station and includes, without limitation: the equipment identified in Sections 1.6.5, 1.6.6, and 1.6.7; fuel tanks; roads; rail track; process water supply and wastewater discharge pipelines, pumps, pump houses, metering equipment, valves, and force mains; water intake structures (floating or permanent); wastewater discharge structures; flood control systems; and security systems. "Water Resources" means potable water supplies and source/receiving waterbodies required to

support construction and operation of the IGCC Power Station. Finally, the term "Site" means the land area which includes the IGCC Power Station Footprint, Buffer Land, any other land needed or acquired for the Associated Facilities, and "Additional Land" (land needed to interconnect Mesaba One and Mesaba Two with existing transportation [railroad and highway] infrastructure and to provide for use of Water Resources and other essential utilities).

1.2.4 Enabling Legislation and Funding

Minnesota Law provides special regulatory incentives to "innovative energy projects" and "clean energy technologies" under Minn. Stat. § 216B.1694 and Minn. Stat. § 216B.1693, respectively (together, the "Enabling Legislation").

1.2.4.1 Innovative Energy Projects and Their Exemption from Certificate of Need Procedures

Mesaba One and Two are innovative energy projects because they meet the requirements of the Enabling Legislation, are located in the TTRA, and have received an appropriate designation by the Commissioner of Iron Range Resources ("IRR"), an agency of the State (see Minn. Stat. § 216B.1694 subd. 1(3)). As innovative energy projects, Mesaba One and Mesaba Two are exempt from the requirements for a Certificate of Need (see Minn. Stat. § 216B.1694, subd. 2(a)(1)) that would otherwise require analysis and consideration of issues relating to their size, type, and timing, among other things.

1.2.4.2 Mesaba One and Two Located In TTRA

The TTRA is a geographic area in Northeastern Minnesota that encompasses approximately 13,000 square miles and stretches from Crosby, Minnesota, across the state's Cuyuna, Mesabi and Vermilion iron ore ranges, to the North Shore of Lake Superior. This area was the site of some of the largest iron mines in the world, but is now economically depressed. Pursuant to the Enabling Legislation, the Proponent's Project siting efforts were focused within the TTRA to take advantage of the existing infrastructure system developed in response to heavy industrial mining activities. Figure 1.2-2 is a general location map that shows the Mesabi iron formation in the broad, geographical context of the Lake Superior region. Figures 1.2-3 and 1.2-4 show specific regions of the Mesabi Iron Range known as the Central and Western Mesabi Iron Range and the Eastern Mesabi Iron Range, respectively.

1.2.4.3 Other Incentives Provided to Innovative Energy Projects

The Enabling Legislation entitles an innovative energy project, subject to the approval of the Minnesota Public Utilities Commission ("MPUC"), to enter into a long-term power purchase agreement with a public utility that owns a nuclear generating facility in the State of Minnesota for the bulk of the Project's output. The Enabling Legislation also requires that an innovative energy project be considered for all future fossil-fuel capacity additions required to meet the State's projected growth in baseload power demand, and that the public utility that owns a nuclear facility also supply "at least two percent of the electric energy provided to retail customers from clean energy technology" if the MPUC finds that "it is or is likely to be a least cost resource." The Enabling Legislation represents a commitment by the state to facilitate the development of a fleet of highly efficient, environmentally superior, economically competitive, and extremely flexible sources of power, if approved by the MPUC.

1.2.4.4 Funding Awarded to the Project

1.2.4.4.1 Iron Range Resources

The State of Minnesota has provided assistance for the Project in the form of loans totaling $9.5 million from IRR, a state agency formed to strengthen and diversify the economy of northeastern Minnesota.

1.2.4.4.2 Renewable Development Fund

In February 2005, the MPUC approved a grant in the amount of $10,000,000, payable in the amount of $2,000,000 each year for five years, to Excelsior pursuant to the statutory authorization contained in Minn. Stat.§ 216B.1694, subd. 2(a)(8).

1.2.4.4.3 Clean Coal Power Initiative

Mesaba One has been awarded a $36 million Clean Coal Power Initiative ("CCPI") interest-free cost sharing loan from the U.S. Department of Energy ("DOE"). The DOE selected Excelsior Energy under the DOE's CCPI Round II competitive solicitation process. The CCPI is an innovative technology demonstration program designed to foster more efficient clean coal technologies[1] for use in new and existing U.S. electric power generating facilities.

The Energy Policy Act of 2005 also authorizes a federal loan guarantee for the Project and allows the Project proponents to also make use of the CCPI funding to support such loan guarantees.

1.2.5 Environmental Impact Statement Requirements for the Project

DOE's National Energy Technology Laboratory ("NETL") is required by the National Environmental Policy Act ("NEPA") of 1969, as amended (42 U.S.C. 4321, *et seq.*), the Council on Environmental Quality NEPA regulations (40 Code of Federal Regulations ["C.F.R."] Parts 1500-1508), and the DOE NEPA regulations (10 C.F.R. Part 1021) to prepare an environmental impact statement ("EIS") as part of its participation in the Mesaba Energy Project. Figure 1.2-1 illustrates the process to be undertaken by DOE in fulfillment of its NEPA responsibilities.

Because the proposed Project is considered a Large Electric Power Generating Plant ("LEPGP"), the Project is also subject to the requirements of the Minnesota Power Plant Siting Act (Minn. Stat. §§ 116C.51-.697), which requires the preparation of a state-equivalent EIS. Figure 1.2-6 illustrates the process to be undertaken by the state in producing its EIS.

The EIS requirements under NEPA and the Minnesota Power Plant Siting Act are substantially similar, and it is DOE's intent to prepare, in cooperation with the Minnesota Department of Commerce ("DOC") and the MPUC, a joint EIS that will fulfill the requirements of both state and federal law. The Proponent is required to prepare this Environmental Supplement ("ES") to support preparation of the joint EIS. A schedule showing the coordination between DOE and the MPUC's schedule for preparing the EIS is provided in Figure 1.2-7.

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[1] "Clean coal technology" describes a new generation of coal-based electricity producing processes that sharply reduce air emissions and other pollutants compared to conventional coal-burning systems.

Figure 1.2-2 Iron Formations in the Lake Superior Region Relative to West and East Range Sites

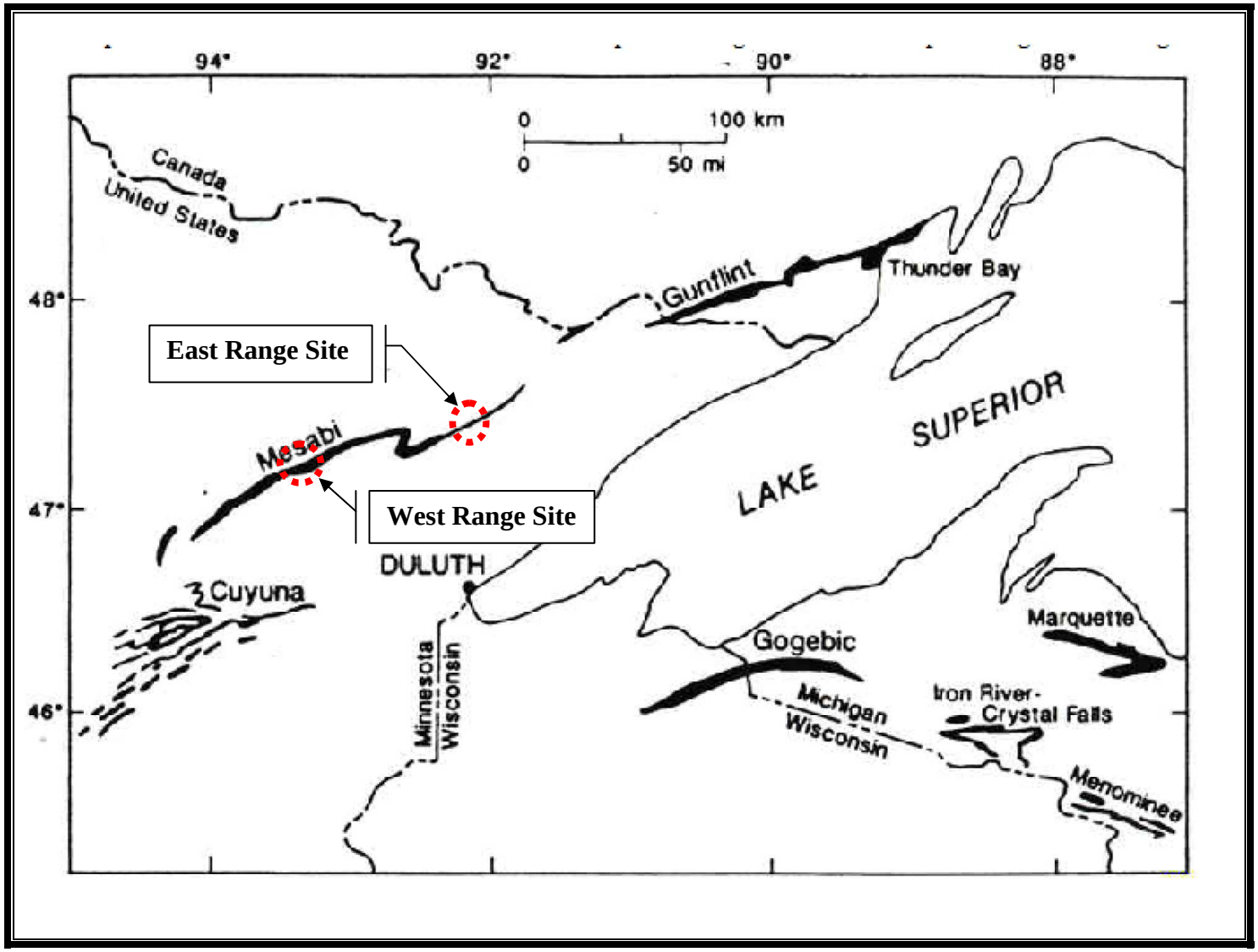


Figure 1.2-3. Geographical Extent of West/Central Mesabi Iron Range

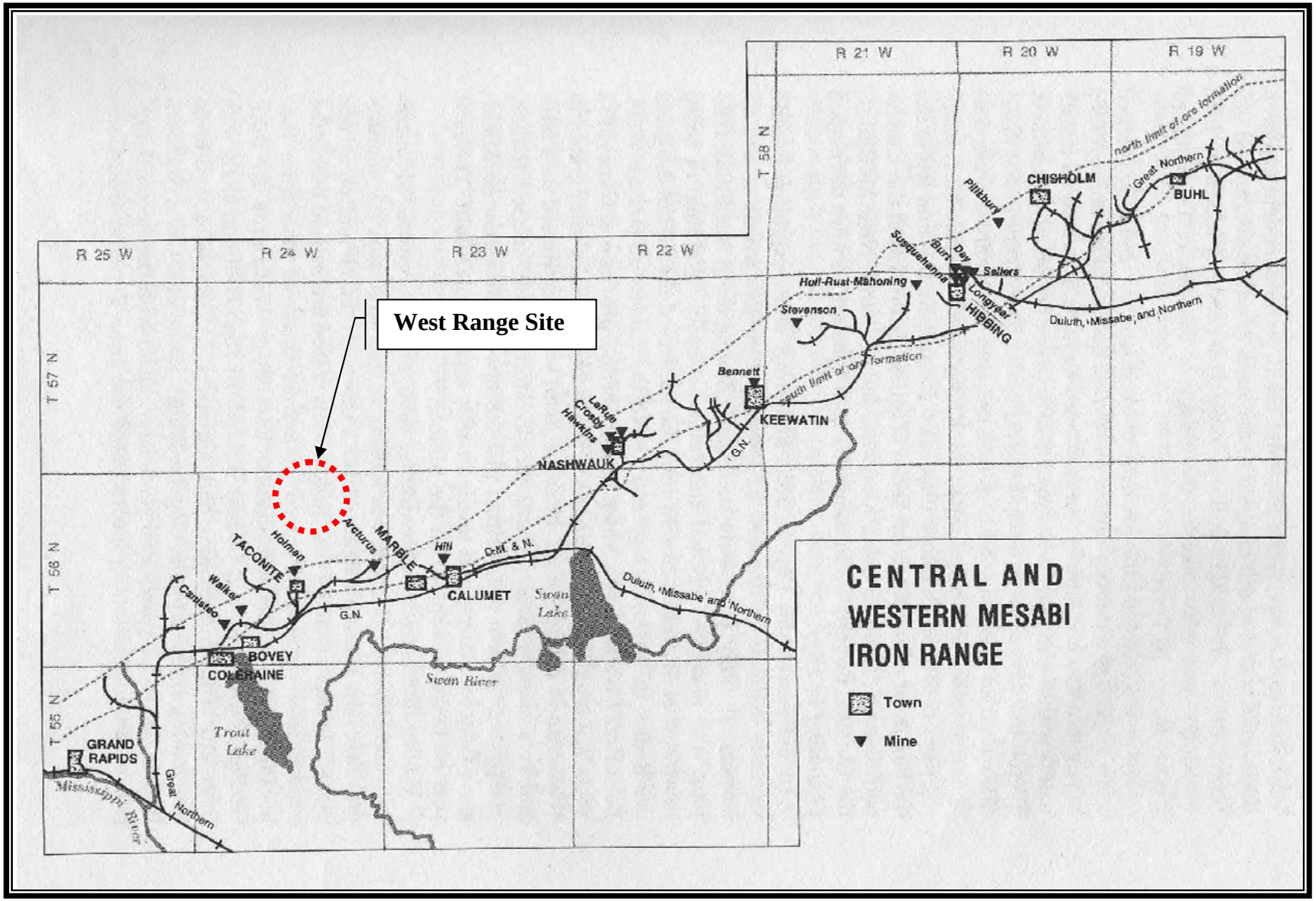


Figure 1.2-4. Geographical Extent of East Mesabi Iron Range

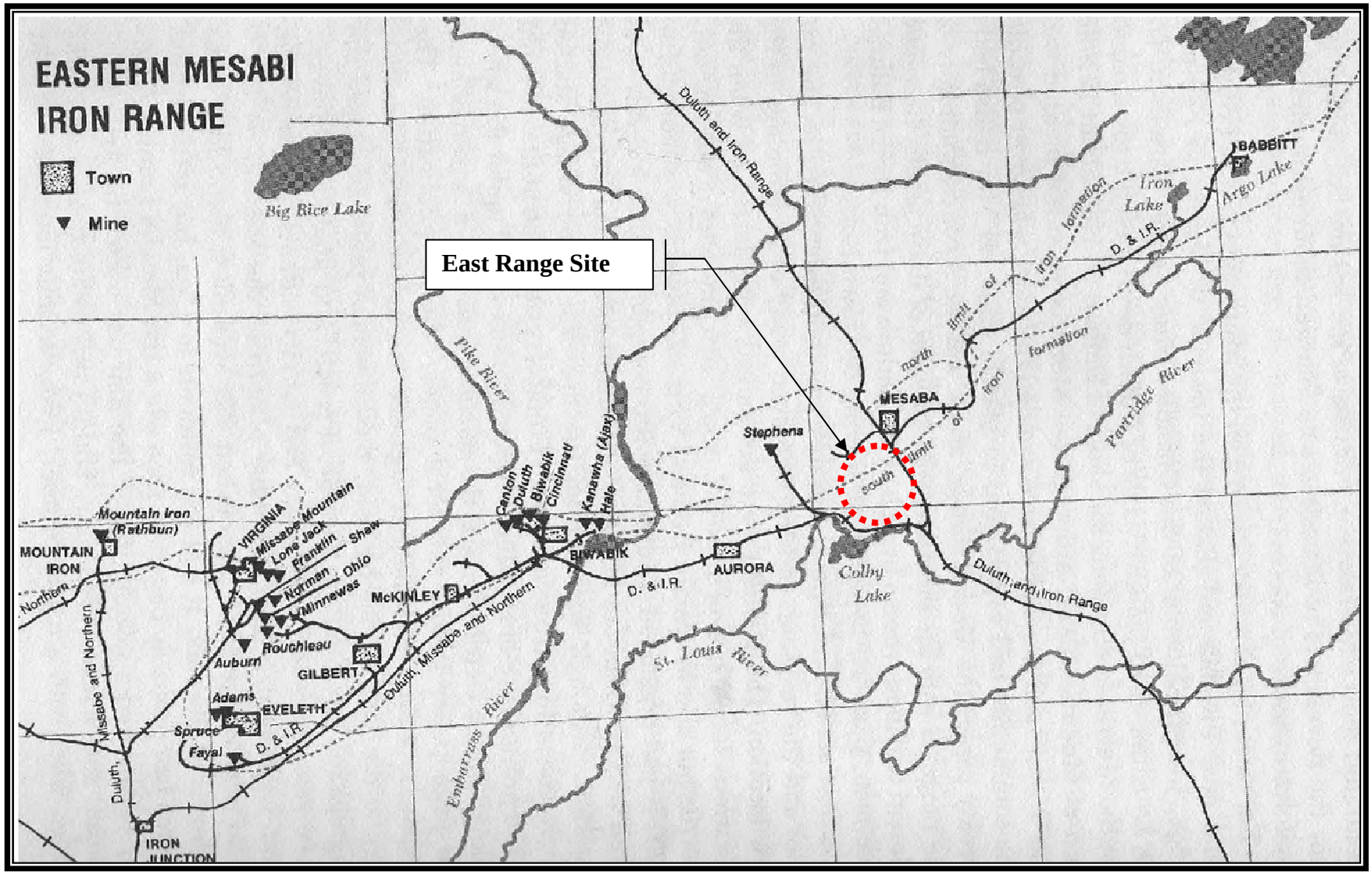


Figure 1.2-5. Federal EIS Process

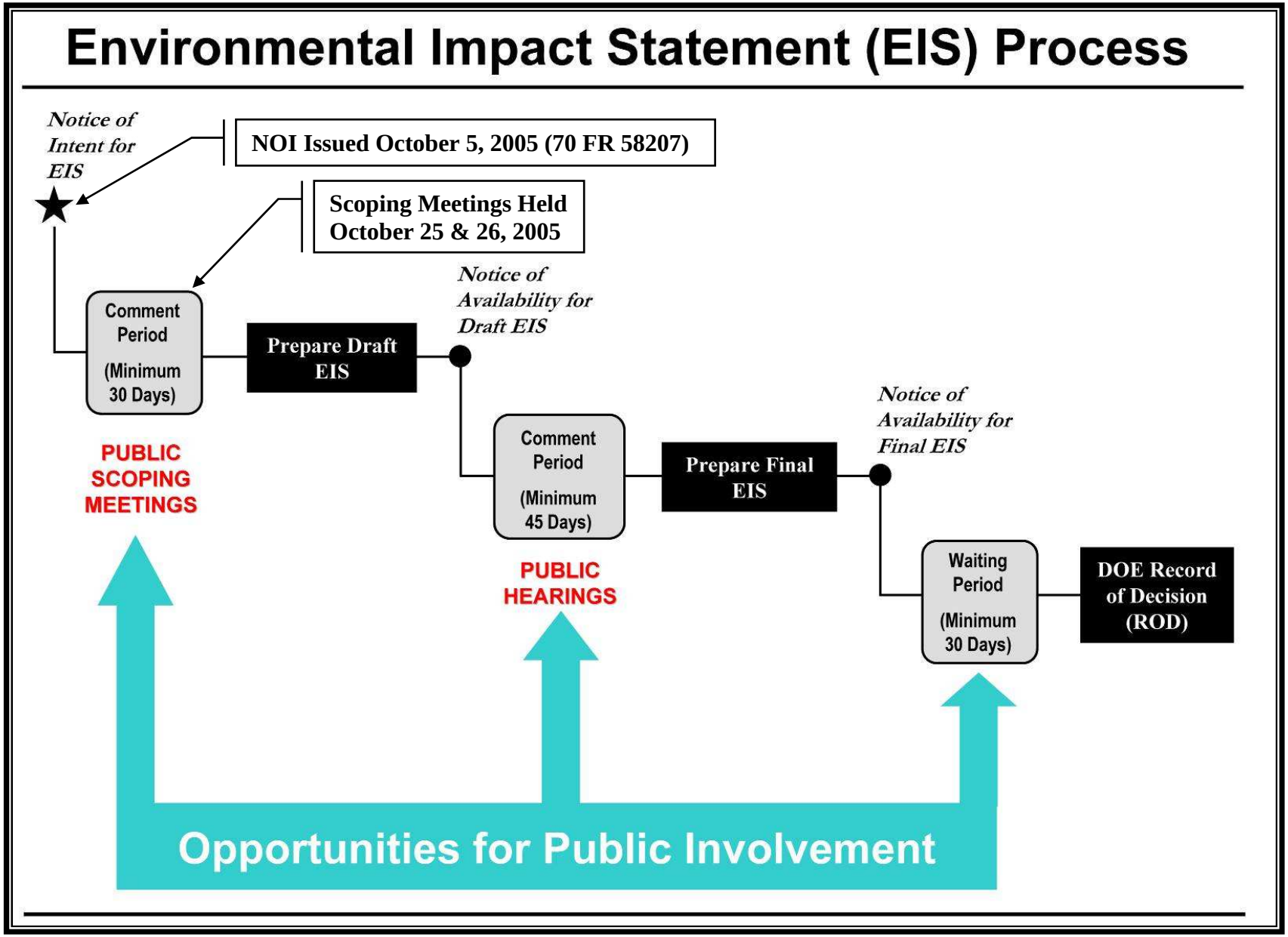


Figure 1.2-6. Minnesota Power Plant Siting Process

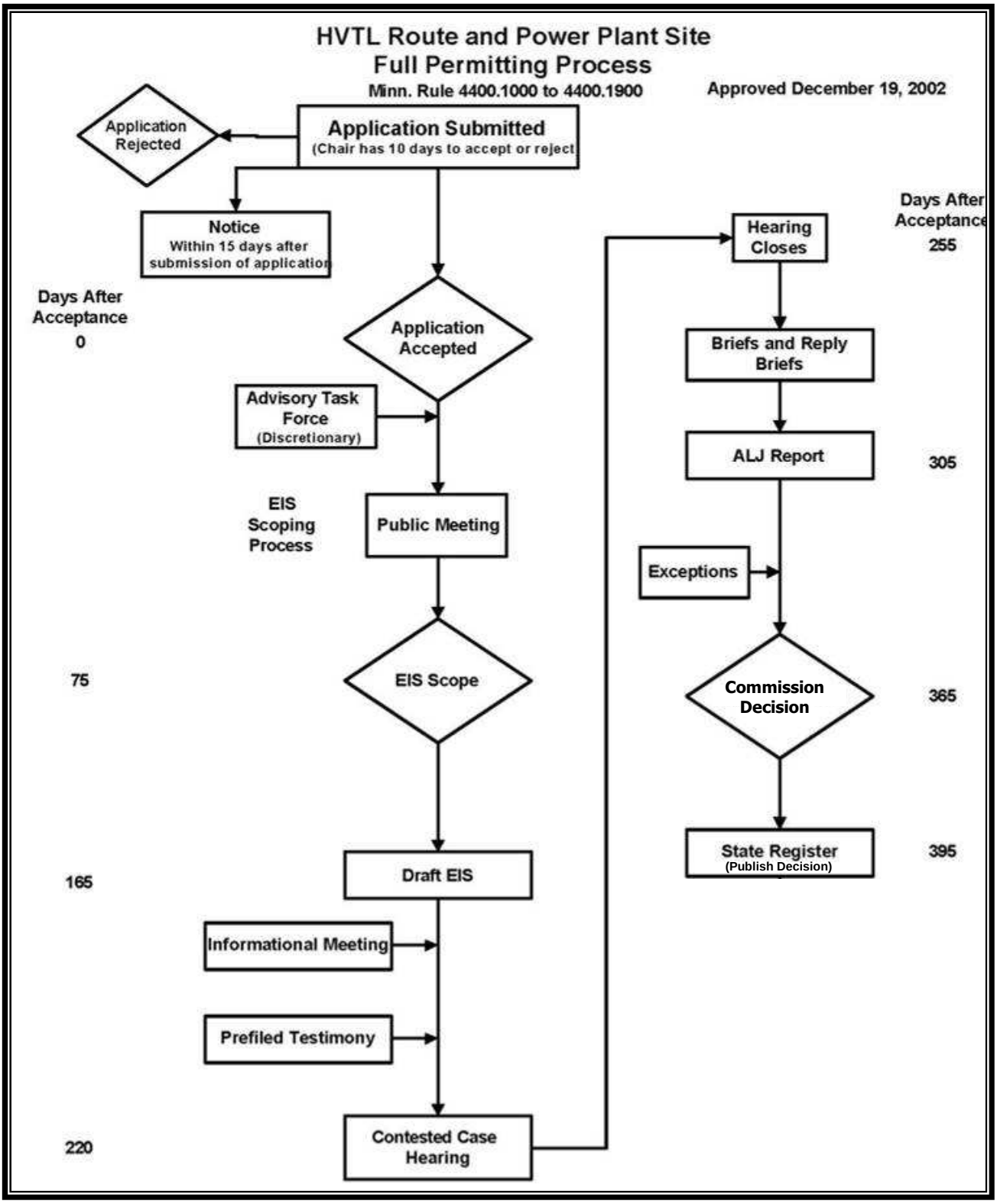


Figure 1.2-7 Coordinated DOE/MPUC Environmental Review Process

NEPA MILESTONE SCHEDULE		STATE EIS PROCESS	
• NOI to DOE/HQ	02 SEP 05		
• NOI Published in Federal Register	05 OCT 05		
• DOE Public Scoping Meeting	25-26 OCT 05		
• Scoping Ends	14 NOV 05		
		• Site/Route Permit Submitted	14 JUN 06
		• Permit Application Accepted	06 JUL 06
		• EIS Scope	07 AUG 06
		• State Scoping Meetings	21-22 AUG 06
		• State Scoping Period Ends	28 AUG 06
• NOA Published in FR	06 DEC 06		
		• Draft EIS	06 DEC 06
		• Public Hearings on Draft EIS	27-28 DEC 06
		• Contested Case Hearing	19 MAR 07
		• Hearing Closes	09 APR 07
• EIS NOA in FR	05 APR 07		
		• ALJ Report	09 MAY 07
• ROD Public Announcement	28 MAY 07		
		• PUC Final Decision	05 JUL 07
		• State Register	06 AUG 07

1.2.6 Licensing and Permitting Requirements

1.2.6.1 Special State Requirements Imposed Under the Power Plant Siting Act

The Act and Applicable Rules require that the Proponent identify at least two potential Sites for the IGCC Power Station, identify which of the Sites it prefers, and provide justification for its preference. In compliance with these Power Plant Siting Act ("PPSA") requirements, the Proponent has identified the West Range Site as the preferred location on which to construct Mesaba One and Mesaba Two. The West Range Site is mostly located within the City of Taconite in Itasca County, Minnesota. The East Range Site is the Proponent's alternate site and is mostly located within the City of Hoyt Lakes in St. Louis County, Minnesota. Figure 1.2-8 shows the location of both Sites relative to one another and the statewide geographical context within which to place them. Figures 1.2-9 and 1.2-10 provide a narrower geographic context for the West and East Range Sites, respectively. Section 1.5 provides a thorough description of the West and East Range Sites and the high voltage transmission line ("HVTL") and natural gas pipeline routes that are proposed to serve the Phase I and II Developments at each location.

1.2.6.2 Permits

1.2.6.2.1 Air Emission Facility Permit

The Proponent will request a Part 70/New Source Review Construction Authorization Permit (Minn. Stat. § 116.07 (2004); Minn. R. 7007.0050-1000) for an air emission facility which covers the IGCC Power Station sources illustrated in Figures 1.6-1 and 1.6-2 and air pollutant emissions identified in Section 1.8.1 of this ES. The Proponent expects to file the Air Permit Application for its preferred Site to the Minnesota Pollution Control Agency ("MPCA") in June 2006.

1.2.6.2.2 Water Appropriation Permits

The Proponent will request a Water Appropriation Permit in accordance with Minn. Stat. §§ 103G.265-.315 (2004) and Minn. R. 6615.0010-0280 in June 2006 for purposes of withdrawing surface water to meet the IGCC Power Station needs at its preferred Site as discussed in Sections 1.12.4.1.1 and 1.12.4.2 of this ES. The Proponent has obtained approval of the Minnesota Legislature for appropriation of water as the IGCC Power Station's water requirements exceed the threshold set forth in Minn. Stat. § 103G.265, subd. 3 (on May 22, 2006, Governor Pawlenty signed into law Senate File No. 2973, Article 5, Section 3, authorizing the use of water in excess of the 2 million gallons per day average [in a 30-day period] as specified in the aforementioned statute.).

Because the East Range Site is located within the Great Lakes Basin, operation of Mesaba Two at the East Range Site would also require that the Minnesota Department of Natural Resources ("MDNR") comply with the provisions of Minn. Stat. § 103G.265, subd. 4. No action has been taken to-date in this regard.

Figure 1.2-8. Mesaba Energy Project General Location Map

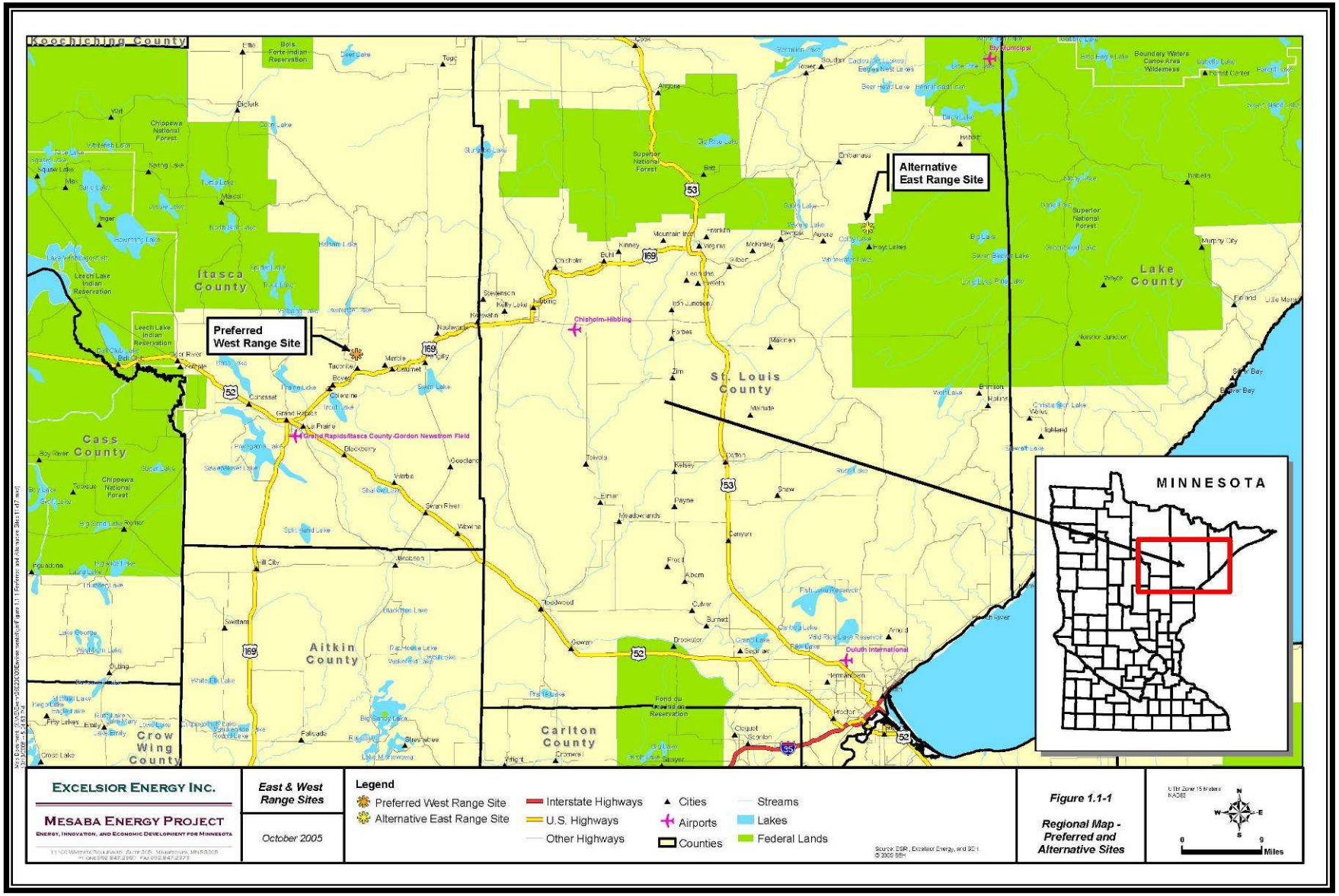


Figure 1.2-9. West Range Site Vicinity Map

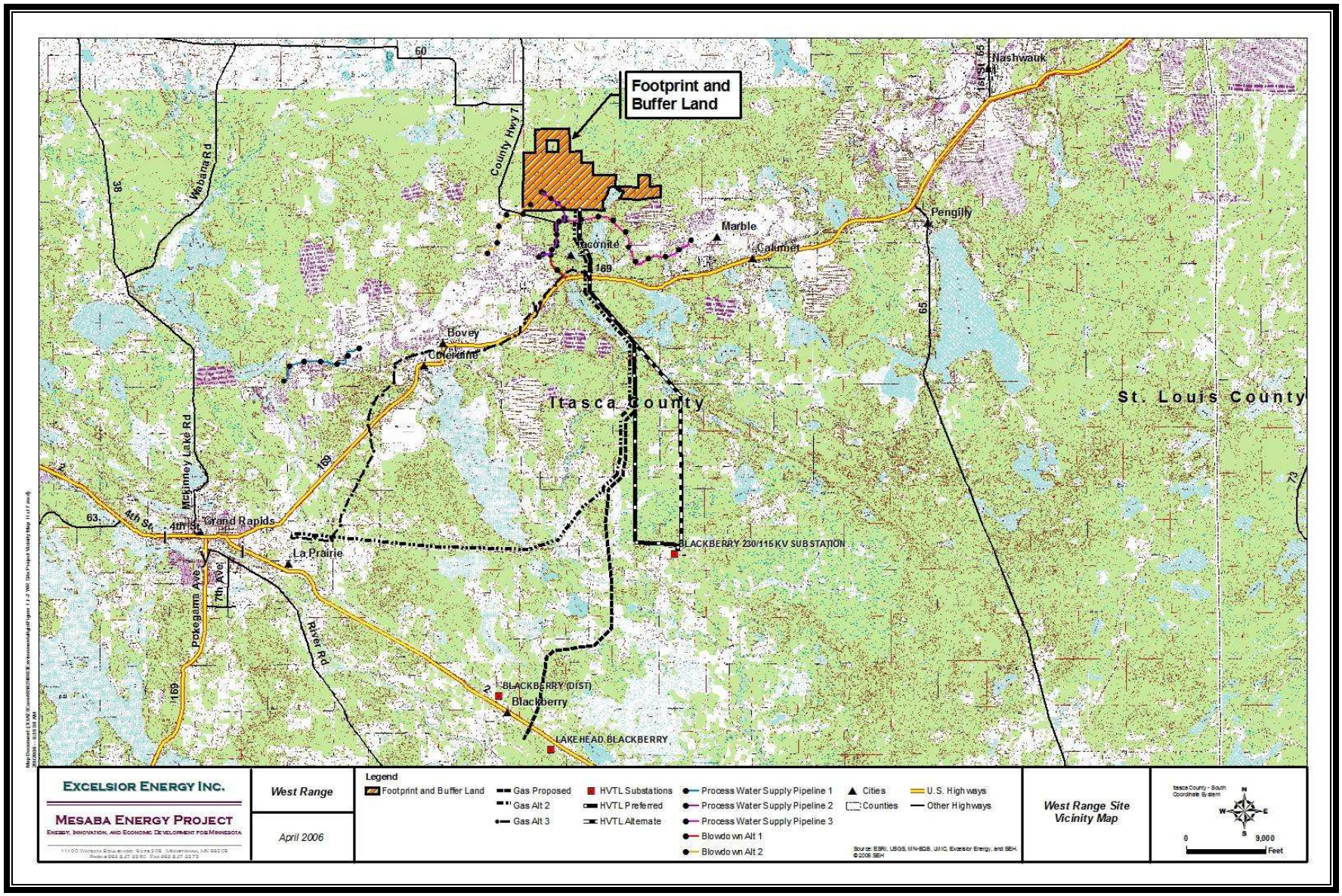
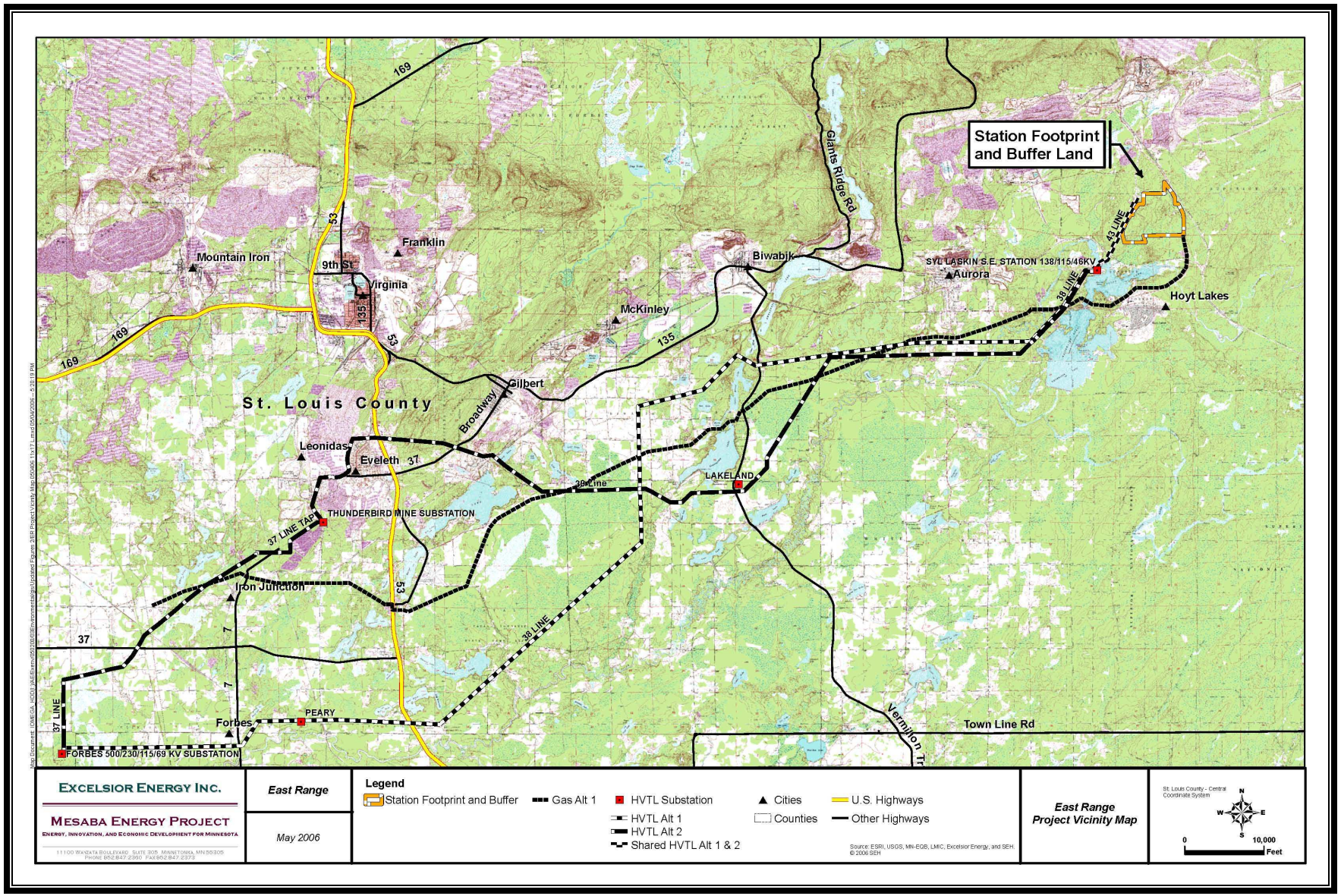


Figure 1.2-10. East Range Site Vicinity Map



1.2.6.2.3 National Pollutant Discharge Elimination System/State Disposal System (NPDES) Permit

The Proponent will request in June 2006 a National Pollutant Discharge Elimination System/State Disposal System ("NPDES") Permit in accordance with Minn. Stat. § 115.03, subd. 5 (2004) and Minn. R. 7001.1030-.1100 and Minn. R. ch. 7050 for the process wastewater discharges from its preferred Site (such discharges are identified and described in Section 1.8.2.2). In addition to discharges of cooling tower blowdown and other miscellaneous wastewater streams, the Proponent must also apply for a permit with the local publicly owned treatment works ("POTW") for disposal of the IGCC Power Station's sanitary wastewaters (see Section 1.2.6.2.6 below).

1.2.6.2.4 MDNR License to Cross Public Lands and Waters

Utility crossings over, under, or through water bodies listed as protected waters or wetlands on the MDNR Protected Waters Inventory ("PWI") will require Licenses for Utility Crossings of Public Lands and Waters under Minn. Stat. § 84.415 and Minn. R. ch. 6135. The MDNR Division of Land and Minerals is the administrative agency responsible for issuing 25 and 50-year licenses, which may be renewed at the end of the licensing period.

The HVTLs and gas pipelines proposed for the West Range IGCC Power Station will cross the Swan River and other bodies of water identified on the MDNR PWI. Such crossings will require a Utility Crossing License. On the East Range Site, HVTLs, domestic wastewater pipelines, and/or potable water lines which cross Colby Lake and other water bodies identified on the MDNR PWI will require such a license. A complete listing of water crossings for the West and East Range Sites is provided in Section 2.7.3.

1.2.6.2.5 Wetlands Permit

A Wetlands Permit Application to the U.S. Army Corps of Engineers ("ACOE"), Itasca County (for the preferred Site) and the Minnesota DNR is required under the Minnesota Wetlands Conservation Act (Minn. R. ch. 8420), Minn. R. 6115.0240, and 33 C.F.R. § 325. These regulations cover, respectively, application requirements for i) wetlands replacement plan approval, ii) Public Waters Work Permits, and iii) Department of the Army Permits. Application requirements for Wetlands Permits are defined at 33 C.F.R. § 325.1(d)(9) and Minn. R. 6115.0240, subp. 3. The following subsections identify instances where such work would be undertaken.

1.2.6.2.5A MDNR Work in Public Waters Permit (Minn. R. 6115.0160)

Projects constructed below the ordinary high water level ("OHWL") of lakes, wetlands, rivers and streams which alter the course, current, or cross-section of the water body, may require a MDNR Public Waters Work Permit. Instances where such permits may be required on the West and East Range Sites are provided in Section 3.4.3 (for rivers, streams and lakes).

1.2.6.2.5B Wetland Conservation Act Wetland Replacement Plan Application

Wetlands replacement plans will be required for applicable West Range Site projects listed in Section 3.6.1. Plans required for East Range Site projects are listed in Section 3.6.2.

1.2.6.2.5C U.S. ACOE Section 10 Work in Navigable Waters and Section 404 Wetland Permit

Authorization from the U.S. ACOE to fill wetlands above the regulatory threshold of 400 square feet will be required for both the West Range and East Range Sites. A listing of the impacted wetlands for the West Range and East Range Sites is provided in Sections 3.6.1 and 3.6.2, respectively.

1.2.6.2.6 Sanitary Wastewater Discharge Approval

The Company may discharge sanitary wastewater to an off-site POTW, an on-site sedimentation pond, or a septic system. Required approval will be obtained from the receiving POTW if off-site discharge is chosen. In the event on-site sedimentation ponds or septic systems are utilized, the State (under the NPDES/State Disposal System Permit process as described in Section 1.2.6.2.3 above) and local governments must provide necessary approvals.

1.2.6.2.7 NPDES Stormwater Program

The construction of Mesaba One and Mesaba Two requires coverage under the MPCA's NPDES Stormwater Permit Program for Construction Activities. The Company, or its contractors, will prepare a Stormwater Pollution Prevention Plan ("SWPPP") and apply for coverage under a general permit prior to commencement of construction activities. The Company will require its contractors to comply with the SWPPP and the provisions of the construction stormwater permits. Stormwater permitting requirements and submittals are discussed in Section 3.4.3.2.1 for the West Range Site. As noted in Section 3.4.3.2.2 in the East Range Site environmental analysis, stormwater permitting requirements and submittals would mirror those for the West Range Site.

For either the West Range Site or the East Range Site and prior to operation of the LEPGP, HVTLs, and gas pipeline (West Range Site only), the Company will apply for coverage under the Minnesota General Permit for Industrial Activity (MN G611000), or will apply for a Certification of No Exposure.

1.2.6.2.8 FERC Interstate Gas Pipeline Certification

If the East Range Site is selected under the PPSA procedure, natural gas supply transportation to the Site would be provided by Northern Natural Gas Company ("NNG"). In addition, either of two existing natural gas pipeline routes (that is, not the route being proposed by the Proponent on the West Range Site) containing pipes owned by NNG could be selected to serve the West Range Site. In such instances, the required facilities would be constructed by NNG pursuant to the prior notice provisions of the regulations governing NNG's blanket certificate issued in FERC Docket No. CP82-401-000. This assumes that no mainline modifications would be required for the project.

1.2.6.2.8A Natural Gas Pipeline Regulatory Procedures

Construction of the natural gas pipeline facilities is governed by the prior notice provisions of the Federal Energy Regulatory Commission ("FERC") regulations (18 C.F.R. 157.208(b)). Pursuant to those regulations, the regulatory process will include the submission of a request to the FERC which includes: (1) a description of the purpose for the proposed facilities; (2) a detailed

description of the proposed facilities specifying length, diameter, wall thickness and maximum operation pressure for the pipeline; (3) a United States Geological Survey ("USGS") 7.5 minute series (scale 1:24000) topographic map showing the location of the proposed facilities; (4) a map showing the relationship of the proposed facilities to NNG's existing facilities; (5) a comparative study showing daily design capacity, daily maximum capacity and operating pressures with and without the proposed facilities for that portion of NNG's existing system affected by the proposal; (6) the estimated cost and method of financing the proposed facilities; and (7) an explanation of how the public convenience and necessity requires the approval of the proposed facilities.

1.2.6.2.8B Natural Gas Pipeline Environmental Filings

The request to the FERC must also include a concise analysis discussing existing environmental conditions and any expected significant impacts that the proposed actions, including proposed mitigation measures, will cause to the quality of the human environment and sensitive environmental areas. The analysis must include a description of the public contacts made by NNG as well as any reports produced and results of consultations which took place to ensure compliance with the Endangered Species Act, National Historic Preservation Act and the Coastal Zone Management Act.

1.2.6.2.8C Notices

NNG will provide a copy of the FERC request to the appropriate state agency. In addition, pursuant to Section 157.203(d)(2) of the FERC's regulations, NNG will make a good faith effort to notify all affected landowners, as defined in Section 157.6(d)(2), within at least three business days following the date that a docket number is assigned to the application or at the time it initiates easement negotiations, whichever is earlier.

Within ten days after NNG's proposal has been submitted to the FERC, a notice of the proposal will be issued and posted to the FERC's Web site. The notice will invite comments from the public, agencies, and any affected stakeholder during a specified time period. Forty-five days after the notice has been issued, the project will be approved to commence construction if no protests have been filed by any person or the FERC staff. If a protest is filed, the applicable parties will have thirty days from the deadline of the comment period within which to resolve the issues and withdraw the protest. If the protest has not been withdrawn within the appropriate time period, the request will be treated by the FERC as an application requesting FERC Section 7 authorization.

1.2.6.2.9 Other Approvals or Notifications

Other permits, approvals or notifications may be required under the following programs:

- Federal Aviation Administration ("FAA") Notice of Proposed Construction or Alteration (as necessary for exhaust stacks and transmission towers)
- Exemption to allow burning of natural gas for power production (DOE, 10 C.F.R. 503)
- Road Crossing Permits (Minnesota Department of Transportation, Minn. R. ch. 8810)
- Miscellaneous State Building and Construction Permits and Inspections

A complete listing of potential permits and approvals is provided in Table 1.2-1.

Table 1.2-1 List of Permits Potentially Required to Construct and Operate Mesaba One and Two

Jurisdiction	Agency	Type of Approval	Authority	Description
Federal	Energy Regulatory Commission	Sales Tap Approval	18 C.F.R. 157.211	Approval to tap into or modify existing interstate gas pipeline
Federal	Federal Aviation Administration	Determination of No Hazard to Air Navigation	14 C.F.R. 77.19	Upon the Proponent's submission of notice of proposed construction of objects potentially affecting navigable airspace, the FAA must confirm such construction constitutes no hazard to air navigation.
Federal	Environmental Protection Agency	Acid Rain Permit	40 C.F.R. 72	Permit required for utility units exceeding threshold limits specified in regulation cited.
Federal	Energy Regulatory Commission	Exempt Wholesale Generator Status	15 U.S.C.79z-5a(e)	Exemption of private generation from certain requirements for public utilities.
Federal	Department of Energy	Permanent exemption for New Facilities	10 C.F.R. 503	Exemption to allow burning of natural gas and fuel oil for power production
Federal	Army Corps of Engineers	Rivers and Harbor Act permit	33 C.F.R. 322	Permit for structures or work in or affecting navigable waters of the United States
Federal	Army Corps of Engineers	Clean Water Act § 404 permit	33 C.F.R. 323	Permit governing the discharge of dredged or fill material to waters of the United States
State of Minnesota	Board of Electricity	Electrical Inspection	Minn. R. ch. 3800	Conformance with electrical code
State of Minnesota	Department of Health	Public Water Supply Plan Review	Minn. R. ch. 4720	Required for drinking water systems serving greater than 25 persons
State of Minnesota	Department of Health	Plant Plumbing Plan Review	Minn. R. ch. 4715	Inspection of plumbing system
State of Minnesota	Department of Health	Environmental Laboratory Certification	Minn. R. 4740.2010 - 4740.2040	Environmental laboratory certification required before data can be submitted in support of permit programs, e.g., as prescribed under National Pollutant Discharge Elimination System ("NPDES") permit program
State of Minnesota	Department of Transportation	Access Permit	Minn. R. 8810.0050	Required whenever there is a request for change in access to or from Mn/DOT ROWs
State of Minnesota	Department of Transportation	Construction of Tunnels Under Highways Permit	Minn. R. 8810.3200 - 8810.3600	Utility construction and relocation on trunk highway ROWs

Table 1.2-1 List of Permits Potentially Required to Construct and Operate Mesaba One and Two

Jurisdiction	Agency	Type of Approval	Authority	Description
State of Minnesota	Department of Transportation	Drainage Permit	Minn. R. 8810.0050	Permit issued for repairs of utility or rebuilding structure (manholes, catch basins, etc) that are already in place.
State of Minnesota	Department of Transportation	Railroad Grade Crossing Operating License	Minn. R. 8830.2150 and 8830.9991	Operating license will be issued upon submittal and approval of railroad grade crossing signal circuit plans.
State of Minnesota	Department of Transportation	Utility Permit on Trunk Highway ROW	Minn. R. 8810.3100 - 8810.3600	Permit required to install/move utilities on highway ROWs.
State of Minnesota	Department of Natural Resources	Easement Across State-Owned Land Managed by the Minnesota Department of Natural	Minn. Stat. § 84.63 Minn. Stat. § 84.631	The DNR may issue an easement to cross state-owned lands for the purpose of constructing and maintaining roads
State of Minnesota	Department of Natural Resources	License to Cross Public Lands and Waters	Minn. R. ch. 6135	For installation of utility services (as defined in statute) across DNR administered land and public waters
State of Minnesota	Department of Natural Resources	Open Burning Permit	Minn. Stat. § 88.16	Registering with local forestry office or fire warden is required in forested counties
State of Minnesota	Department of Natural Resources	Public Waters Work Permit (Protected Waters Permit)	Minn. R. 6115.0110 - 6115.0280	Work permit for activities that change or diminish the course, current or cross section of public waters within the state
State of Minnesota	Department of Natural Resources	Water Appropriation Permit - Long Term (Exceeding two years)	Minn. R. 6115.0600 - 6115.0810 ; 6115.0010	Permit required to appropriate or use waters of the state (ground or surface)
State of Minnesota	Department of Natural Resources	Water Appropriation Permit - Temporary (1-2 year maximum)	Minn. R. 6115.0600 - 6115.0810 ; 6115.0010	General permit notification form for certain temporary appropriations for construction dewatering, landscaping and hydrostatic testing
State of Minnesota	Public Utilities Commission	Site Permit for Large Electric Generating Power Plant	Minn. R. ch. 4400	Preconstruction permit requiring preparation of Environmental Impact Statement and contested case hearing
State of Minnesota	Public Utilities Commission	Route Permit for High Voltage Transmission Lines	Minn. R. ch. 4400	Preconstruction permit requiring preparation of Environmental Impact Statement and contested case hearing

Table 1.2-1 List of Permits Potentially Required to Construct and Operate Mesaba One and Two

Jurisdiction	Agency	Type of Approval	Authority	Description
State of Minnesota	Public Utilities Commission	Route Permit For Natural Gas Pipeline	Minn. R. ch. 4415.0035	Preconstruction permit requiring preparation of Environmental Impact Statement and contested case hearing
State of Minnesota	Pollution Control Agency	Underground Storage Tank (UST) Registration	Minn. Stat. § 116.46	Regulated UST systems must be registered
State of Minnesota	Pollution Control Agency	NPDES/SDS Permit	Minn. R. 7001.0020	Permit required for discharging wastewater to waters of United States (NPDES)
State of Minnesota	Pollution Control Agency	NPDES General Industrial Stormwater Permit	Minn. R. 7001.1035	Permit for stormwater discharges associated with industrial activity
State of Minnesota	Pollution Control Agency	NPDES General Construction Stormwater Permit	40 C.F.R. 122.26; Minn. R. 7001.1035	NPDES permit for stormwater discharge required for construction sites disturbing 1 acre or more of land
State of Minnesota	Pollution Control Agency	Hazardous Waste Generator License	Minn. R. 7045.0225	Any business that generates more than 10 gallons of feeable hazardous waste in a calendar year must be licensed and pay an annual fee
State of Minnesota	Pollution Control Agency	Aboveground Storage Tank (AST) Registration	Minn. R. ch. 7001 and 7151	Owners of Aboveground Storage Tanks larger than 110 gallons must notify the Agency
State of Minnesota	*Pollution Control Agency*	*Part 70 Permit*	*Minn. R. 7007.0200 and 7007.0250*	*Construction of a major new source meeting specifications in rules must receive an air emissions permit prior to commencement of construction*
State of Minnesota	Department of Public Safety	Fire Sprinkler Systems Plan Review	Minn. R. ch. 7512.1100	Permit for Fire Protection System
State of Minnesota	Department of Public Safety	Flammable Liquid Tanks Plan Review	Minn. Stat. § 299F.011	Aboveground Storage Tank Plan Review for Flammable and Combustible Liquids (Private Motor Vehicle Fuel Dispensing Station)
State of Minnesota	Department of Labor and Industry	Pressure vessels	Minn. R. ch. 5225	Permit required for operation of high pressure vessels
State of Minnesota	State Historical Preservation Office	Cultural Resources Review	36 C.F.R. 800	State review required under National Historic Preservation Act

1.3 Project Purpose and Benefits

1.3.1 Project Objectives

The Project will achieve significant performance, efficiency, and technological improvements that will accomplish the following objectives:

1. Confirm that the IGCC Power Station is one of the cleanest utility-scale, coal-based power plants in the world
2. Promote the commercialization of IGCC technology
3. Provide substantive support to achieving the goals of DOE's CCPI program
4. Support the nation's efforts to economically achieve energy independence
5. Provide economic development to an economically distressed region of Minnesota
6. Provide a needed source of electricity to help satisfy Minnesota's base load electrical demand
7. Provide a proven technology to significantly reduce emissions in Minnesota and throughout the Country

1.3.2 Project's Local, Regional, and National Value and Benefit

The DOE, through its CCPI Program, has provided partial funding for the Project as part of a national energy strategy to improve the environment while providing low-cost electricity from domestic coal sources.[2] DOE has deemed IGCC technology "crucial" both for securing a domestic energy supply and for providing "enormous environmental performance gains."[3] IGCC technology is critically important because it utilizes a 250-year reliable domestic supply of low-cost coal and uses it in an environmentally acceptable manner. Beyond the immediate environmental benefits of reducing emissions of criteria pollutants and mercury from conventional coal-fueled power plants, IGCC technology provides a pathway to cost-effective capture of carbon dioxide ("CO_2"), the primary greenhouse gas ("GHG") produced by power plants combusting fossil fuels.

The Project will be the first multi-train IGCC facility that is optimized to provide power at market prices. In doing so, it will prove that IGCC is a commercially viable power generation option, thereby directly addressing the primary obstacle to widespread development of this state-of-the-art technology, a critical element of national energy strategy. The rapid deployment of IGCC technology will have significant national environmental benefits, as is shown in Figure 1.3-1, which depicts the large reductions of criteria pollutant emissions that will result from various levels of IGCC deployment, such deployment replacing conventional coal-fueled power plants that would otherwise be constructed to meet expected electrical demands. Since rapid deployment of IGCC throughout the country will ultimately result in an overall lowering of power plant emission impacts in Minnesota, the state has, through the Enabling Legislation,

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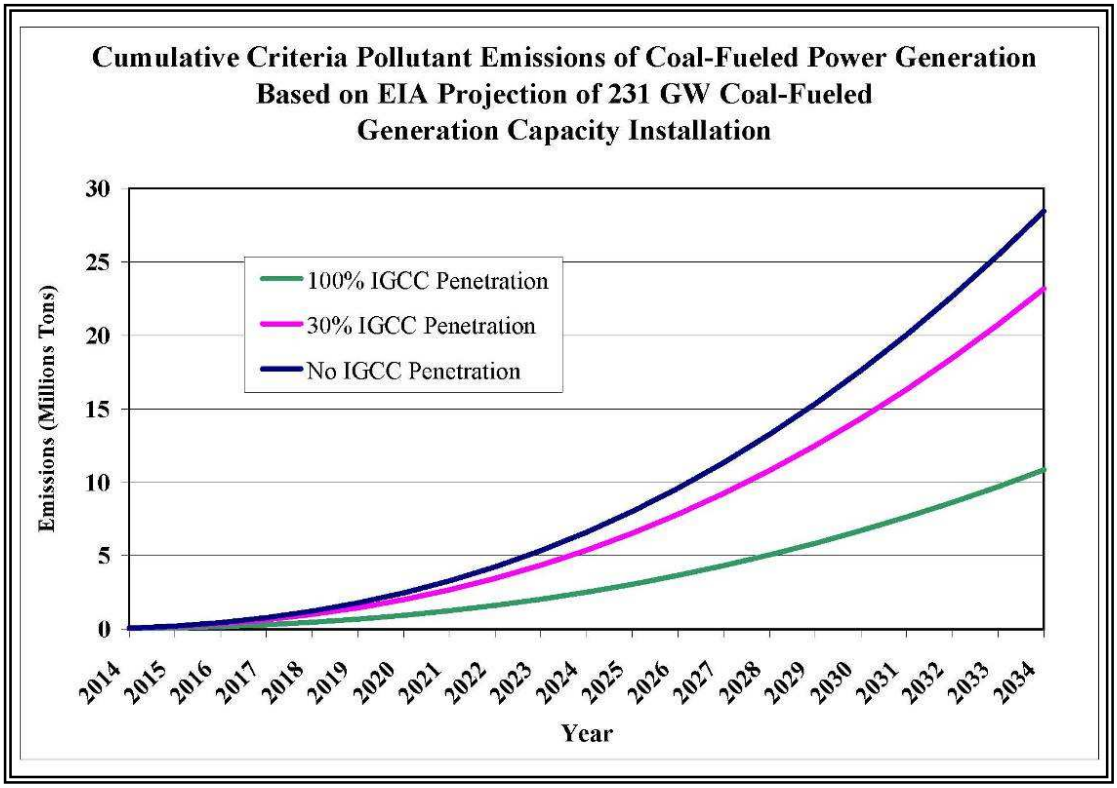
[2] U.S. Department of Energy, Office of Fossil Energy, *Minnesota Company to Receive $36 Million to Construct Clean Coal Plant*, Oct. 26, 2004, *available at* http://www.fe.doe.gov/news/techlines/2004/tl_ccpi2_excelsior.html.

[3] Mark Maddox, Acting Assistant Secretary for Fossil Energy, *Creating a Policy Framework for Clean Energy*, Remarks to the Aspen Clean Energy Roundtable, June 10, 2004, *available at* http://www.fossil.energy.gov/news/speeches/2004/04_mmaddox_aspen_061004.html

recognized that it is in its own self interest to take a leadership role in facilitating such deployment efforts.

Figure 1.3-1. Cumulative Criteria Pollutant Emissions Avoided With IGCC



Source: Annual Energy Outlook 2004, Energy Information Administration

Support for the Project in Minnesota is strong because of its environmental and economic attributes. Minnesota's Governor, federal and state legislators, state development agencies (including the locally-based IRR), and local communities are among the Project's many supporters. The Project would bring renewed economic vitality to the Iron Range by making it a regional production center for state-of-the-art, clean, affordable energy. Each project phase is expected to create 1,000 or more local construction jobs over a three-year construction period and approximately 100 permanent jobs when commercial operations commence. The Project will also provide economic and employment stimulus in surrounding communities, as is documented in the University of Minnesota's Economic Impact Analysis of Mesaba One, a copy of which is provided in Appendix 1.

The Project is also eligible to receive federal loan guarantees and tax credits under the Energy Policy Act of 2005 that are intended to encourage the rapid deployment of IGCC nationwide.

1.3.3 Advancing IGCC Process Technology

The gasification process that the Proponent will use to supply fuel to its combined cycle power station is the ConocoPhillips E-Gas™ technology for gasification of solid feedstocks. The Project's design is based on the 262 MW Wabash River Coal Gasification Repowering Project

("Wabash River") located in Terre Haute, Indiana. Wabash River was built under the DOE's Clean Coal Technology Program (predecessor to the CCPI) and has been in operation since 1995. Following its construction, the DOE funded studies of potential performance and technological upgrades, and nearly 1,600 design and operational lessons learned from Wabash River have been identified. Based in part on the DOE studies and the lessons learned from Wabash River, the Project will integrate numerous design improvements that represent a substantial advance in the original Wabash River technology, design, and systems integration. The Project will incorporate the following features and technologies in its improved IGCC process:

- Improved Environmental Performance – The Project will improve upon Wabash River's results by deploying processes and technologies that will make it among the cleanest coal-based power generating plants in the world. Emission levels for criteria pollutants (sulfur dioxide, nitrogen oxides, carbon monoxide, volatile organic compounds and particulate matter) and mercury are expected to be equal to or below those now considered to represent the lowest emission rates for utility-scale, coal-based generation fueled by similar feedstocks. In addition, carbon dioxide emissions are expected to be 15 to 20% lower than the current average for U.S. coal-based power plants fueled by similar feedstocks, due to the higher efficiency of the IGCC process.
- Increased Capacity – With a two-train design that will more than double the generating capacity of Wabash River, the Project will demonstrate the economies of scale attainable at larger commercial sizes.
- Improved Efficiency – The Project will incorporate advances to improve efficiency, including optimization of the fuel inputs into each stage of the gasifier, referred to as "full slurry quench." Two gasifiers will be operated simultaneously to supply two combustion turbine generators ("CTGs") and one steam turbine generator ("STG").
- Improved Integration of the Air Separation Unit ("ASU") – The Project will extract bleed air from the combustion turbine's air compressor to reduce the parasitic load of the ASU's main air compressor, increasing net plant output and reducing capital cost. Nitrogen extracted from air entering the ASU will be recycled for injection into the CTG to reduce formation of nitrogen oxides by reducing the flame temperature of the combustor and the time that combustion gases remain at elevated temperatures. The injection of recycled nitrogen into the CTG will also increase power output.
- Feedstock Flexibility – The Project will achieve greater feedstock flexibility with the capability of gasifying bituminous coal (such as Illinois No. 6), sub-bituminous coal (such as Powder River Basin ("PRB")), and blends of sub-bituminous coal and pet coke.
- Improved Availability – The Project, with a spare gasification train, will achieve significantly improved availability over Wabash River and have the ability to operate with the same availability as other base load plants combusting solid fossil fuels.

1.4 Description of the Gasification/Combined Cycle Technology

In the E-Gas™ process, coal, petroleum coke, or blends of coal and petroleum coke are crushed, slurried with water, and pumped into a pressurized vessel (the gasifier) along with sub-stoichiometric amounts of purified oxygen (less than the theoretical quantity of oxygen required for complete combustion). In the gasifier, controlled reactions take place, thermally converting feedstock materials into a gaseous fuel known as synthesis gas, or syngas. The syngas is cooled, cleaned of contaminants, and then combusted in a combustion turbine, which is directly connected to an electric generator. The assembly of the combustion turbine and generator is known as a combustion turbine generator. The expansion of hot combustion gases inside the combustion turbine creates rotational energy that spins the generator and produces electricity. The hot exhaust gases exiting the CTG pass through a heat recovery steam generator ("HRSG"), a type of boiler, where steam is produced. The resulting steam is piped to a steam turbine that is connected to an electric generator. The expansion of steam inside the steam turbine spins the generator to produce an additional source of electricity. When a CTG and an STG are operated in tandem at one location to produce electricity in a highly efficient manner, the combination of equipment is referred to as a combined cycle electric power plant. Combining the gasification process with the combined cycle power plant is known as integrated gasification combined cycle, or IGCC, an inherently lower polluting technology to produce electricity from solid feedstocks.

1.5 LEPGP Sites and HVTL/ Pipeline Routes

This section provides for both the West and East Range Sites detailed physical descriptions of the IGCC Power Station Footprint and the layout of equipment therein, the Buffer Land, and the Associated Facilities located apart from the Station Footprint and Buffer Land. The section also provides detailed descriptions of the HVTL and natural gas pipeline routes that are proposed in support of the IGCC Power Station.

1.5.1 Overview

The IGCC Power Station will produce electric power from each project phase in two CTGs (about 220 MW_{gross} each) and one STG (up to 300 MW_{gross}). The syngas used to fuel the IGCC Power Station will be produced in gasifiers located within the Station Footprint. Power generated by the IGCC Power Station will be conveyed to the regional electrical grid by generator outlet ("GO") facilities that will include high voltage transformers, switchgear, and a switchyard located within the Station Footprint, and HVTL traversing the distance between the Power Station and the POI.

Natural gas will be used to start up the IGCC Power Station and as a backup fuel when syngas is unavailable. The maximum natural gas flow is expected to be about 105 million standard cubic feet of gas ("scf") per day per phase of the IGCC Power Station.

1.5.1.1 LEPGP Sites

The geographical extent of the West and East Range Sites is shown in Figure 1.5-1 and Figure 1.5-2, respectively and includes the IGCC Power Station Footprint, Buffer Land and Associated Facilities.

The Mesaba One Station Footprint at either site will encompass approximately 100 acres. An additional 80 acres of land is required for a temporary construction laydown area for the Mesaba One equipment and five acres for a concrete batch plant. Mesaba Two will be similar to Mesaba One and its balance-of-plant equipment. Therefore, the area required for Mesaba One and Two would be approximately double that required for the Mesaba One layout (approximately 200 acres will be required for Mesaba One and Two, excluding construction and laydown areas).

Figure 1.5-3 illustrates the equipment layout plan for Mesaba One and Mesaba Two. An artist's visualization of the Phase I and II Developments is shown in Figure 1.5-4 (the visualization does not reflect the Site-specific grading plans outlined for the Phase I and II Developments in the following two subsections). The final surfaces proposed for the Phase I and II Developments are shown in Figure 1.5-5 and a drainage plan is provided in Figure 1.5-6.

Easements across public and private lands will be required for the IGCC Power Station's Associated Facilities. The location of such easements is Site specific. The environmental setting for such easements and the impacts on the West and East Range Sites due to construction and operation of Mesaba One and Mesaba Two are discussed throughout Sections 2 and 3.

1.5.1.1.1 West Range Site

Figure 1.5-7 provides a more detailed illustration of the infrastructure immediately surrounding the Station Footprint and Buffer Land on the West Range Site. An overview of these Associated Facilities is presented in Section 1.11. Detailed descriptions of the Associated Facilities and their alternatives at the West Range Site are provided in Section 1.12. Preliminary grading plans for the IGCC Power Station Footprint are presented in Figure 1.5-8. Preliminary cross sections of the Phase I and II Developments are shown in Figure 1.5-9. High surfical groundwater levels in the soils in the vicinity of the IGCC Power Station Footprint may require permanent water table control measures.

The environmental setting of the West Range Site and the environmental impact of constructing the IGCC Power Station and its Associated Facilities at this location is provided in Sections 2 and 3 of this ES.

1.5.1.1.2 East Range Site

Figure 1.5-10 provides a more detailed illustration of the infrastructure immediately surrounding the IGCC Power Station Footprint and Buffer Land on the East Range Site. An overview of these Associated Facilities is presented in Section 1.11. Detailed descriptions of the Associated Facilities and their alternatives on the East Range Site are provided in Section 1.12. Preliminary grading plans for the East Range IGCC Power Station Footprint are presented in Figure 1.5-11. The environmental setting of the East Range Site and the environmental impact of constructing the IGCC Power Station and its Associated Facilities at this location is provided in Sections 2 and 3 of this ES.

Figure 1.5-1 West Range Site Showing IGCC Power Station Footprint, Buffer Land, Associated Facilities and Additional Lands

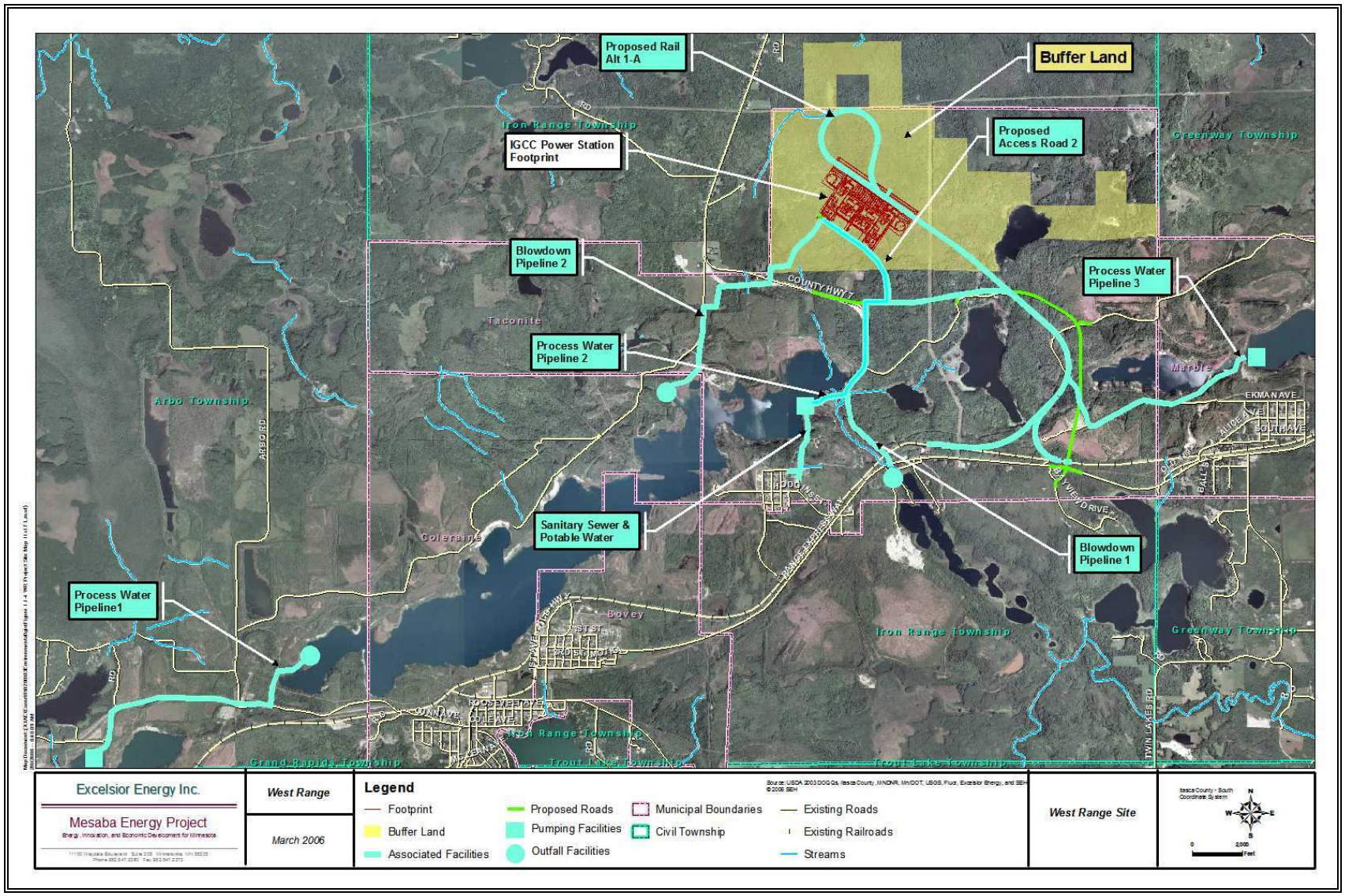


Figure 1.5-2 East Range Site Showing IGCC Power Station Footprint, Buffer Land, Associated Facilities and Additional Lands

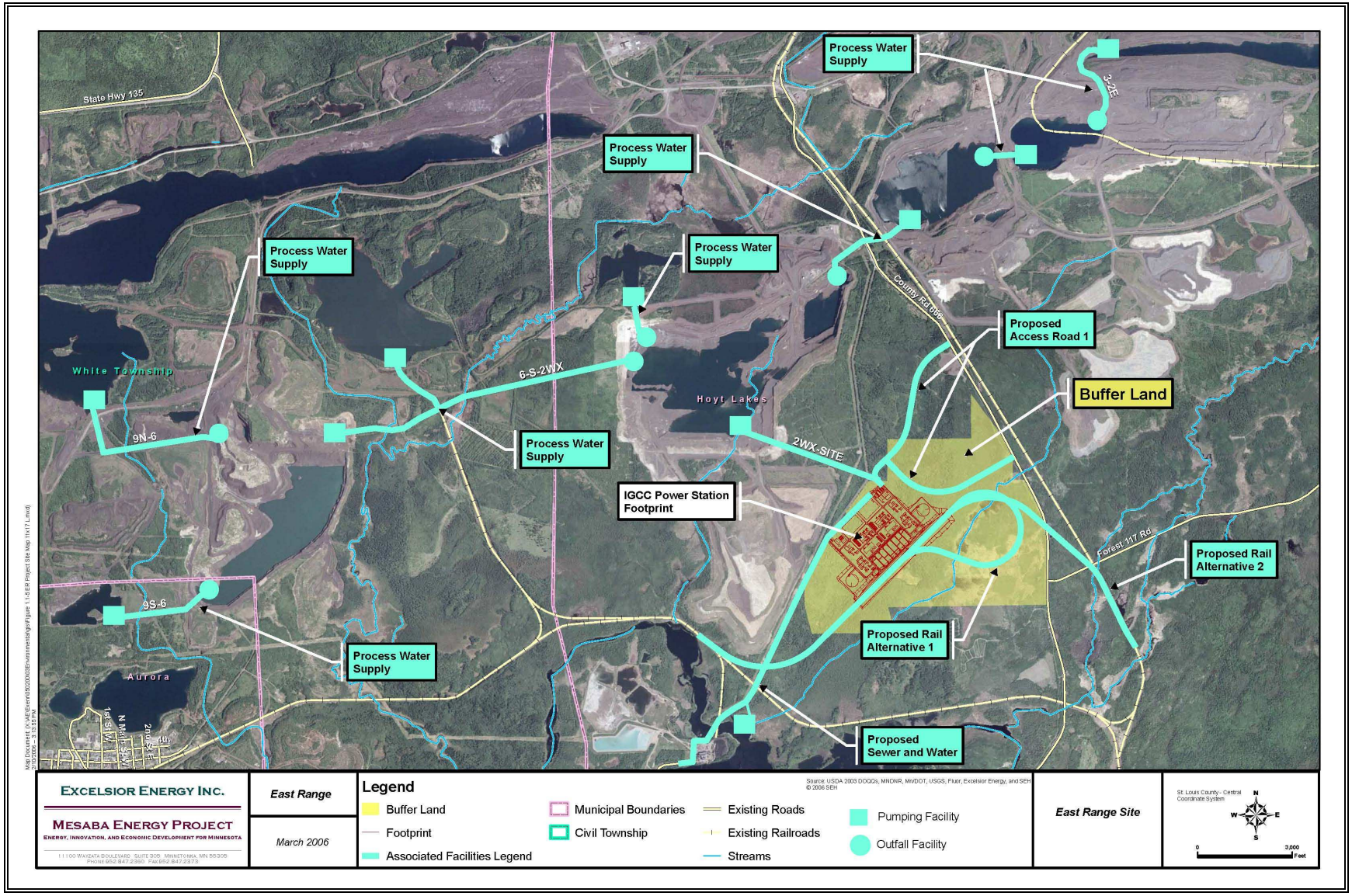


Figure 1.5-3 Phase I and II IGCC Power Station Layout

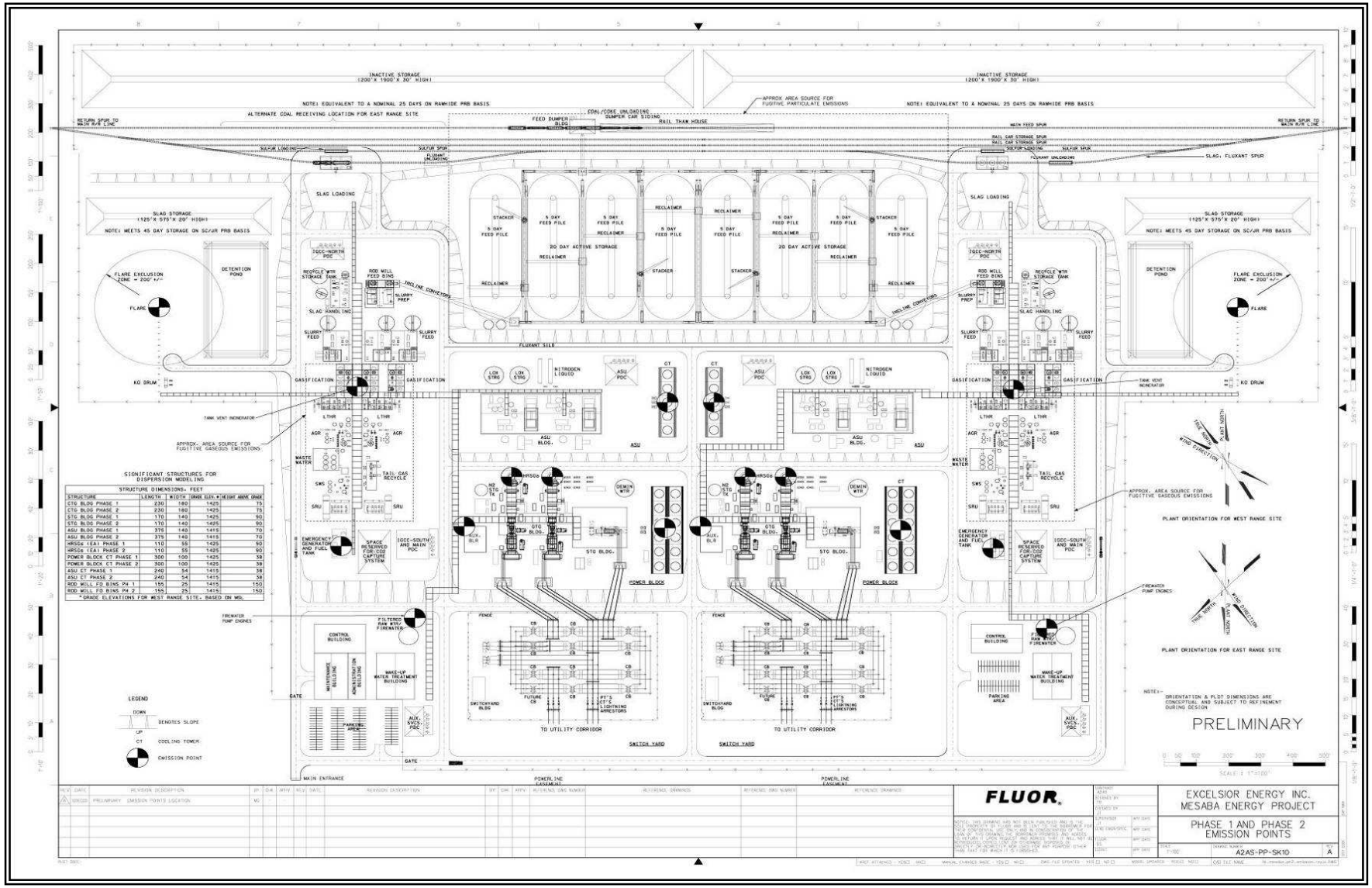


Figure 1.5-4 Visual Rendering of Phase I and II

Figure 1.5-5 Surfacing Plan for Phase I and II Developments

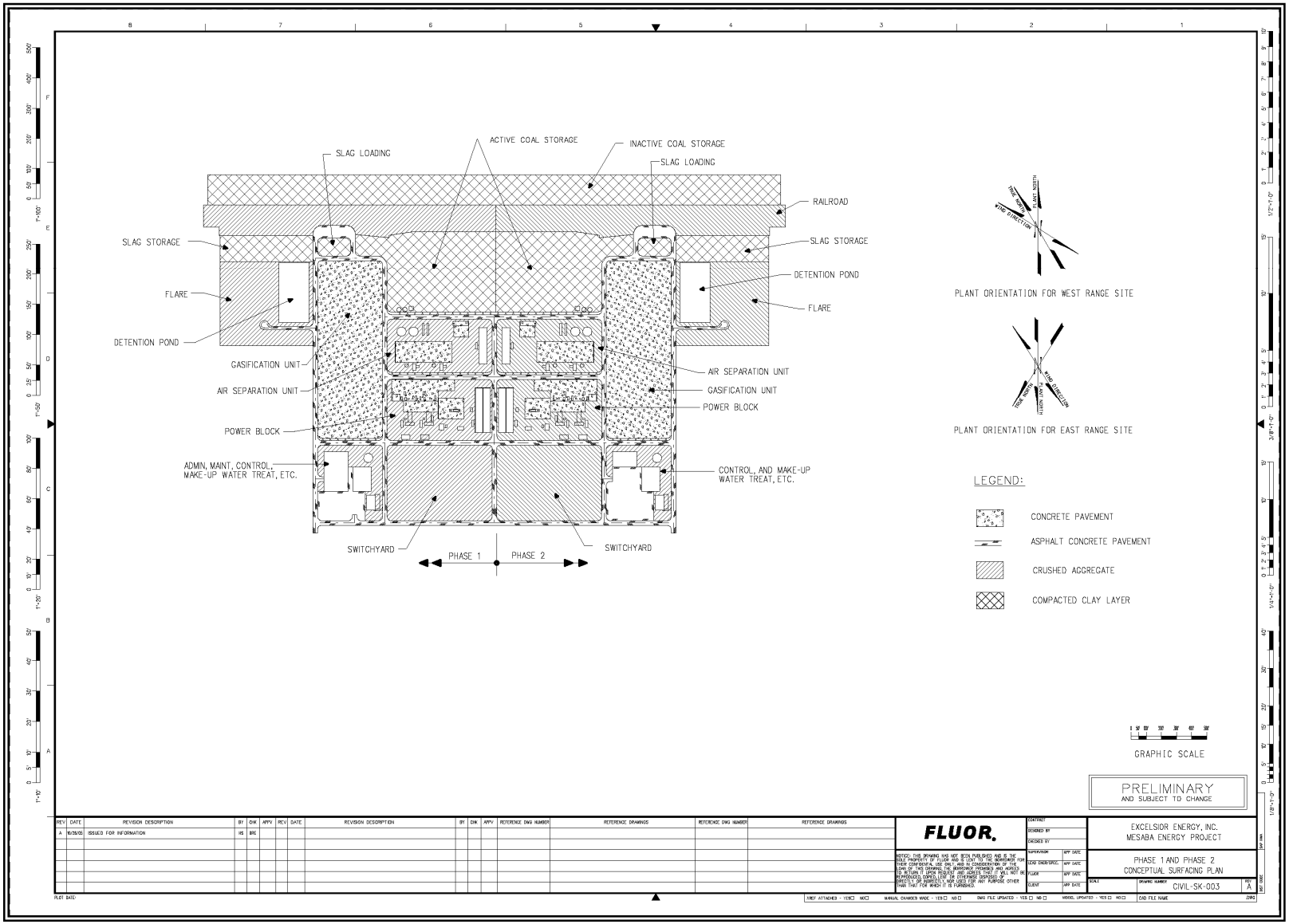


Figure 1.5-6 Current Drainage Plan for Phase I and II Developments

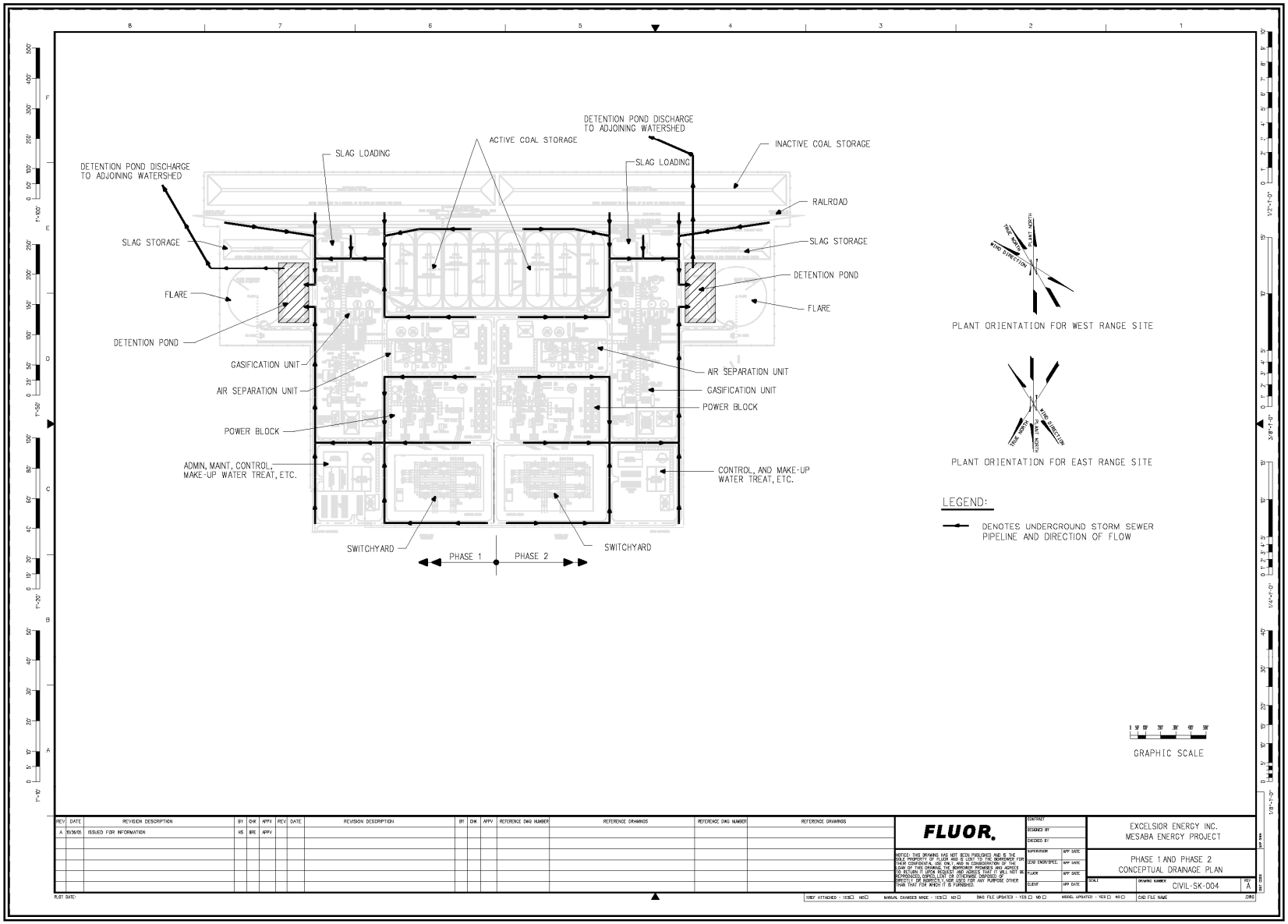


Figure 1.5-7 West Range Site Showing Phase I and II IGCC Power Station Footprint, Buffer Land and Associated Facilities

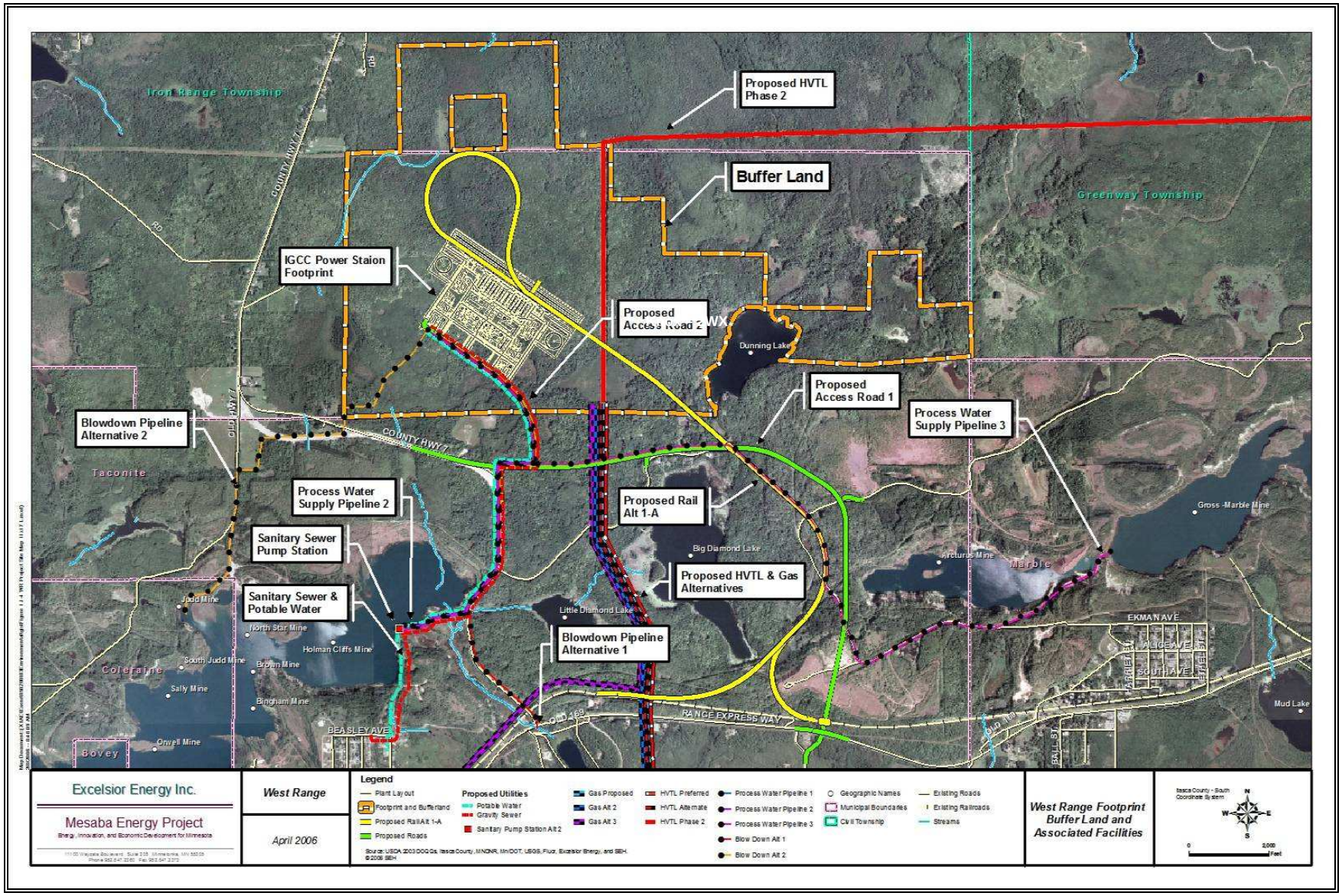


Figure 1.5-8 Preliminary Grading Plan for Phase I and II IGCC Power Station on West Range Site

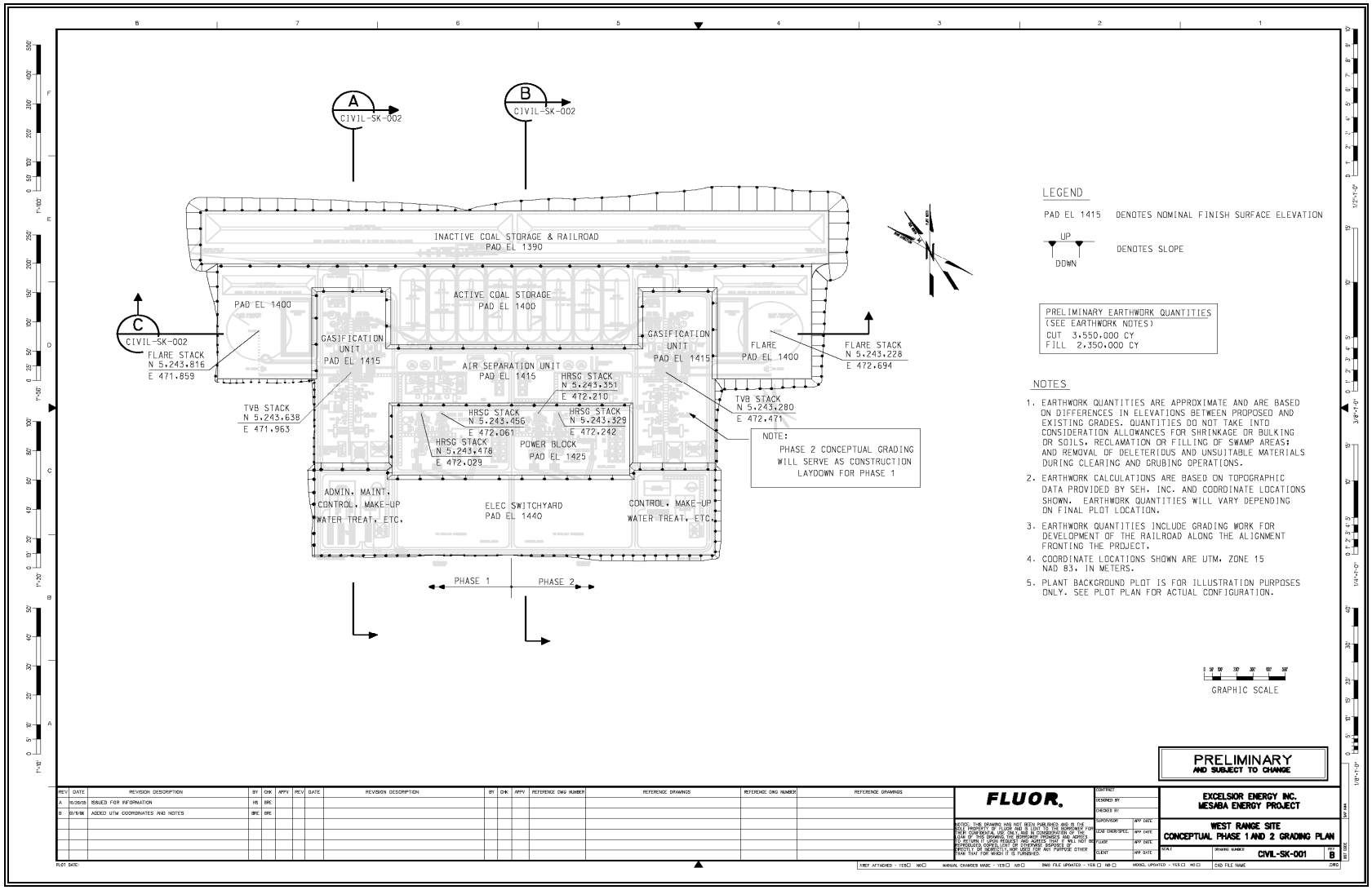


Figure 1.5-9 Cross Sections of Phase I and II IGCC Power Station on West Range Site

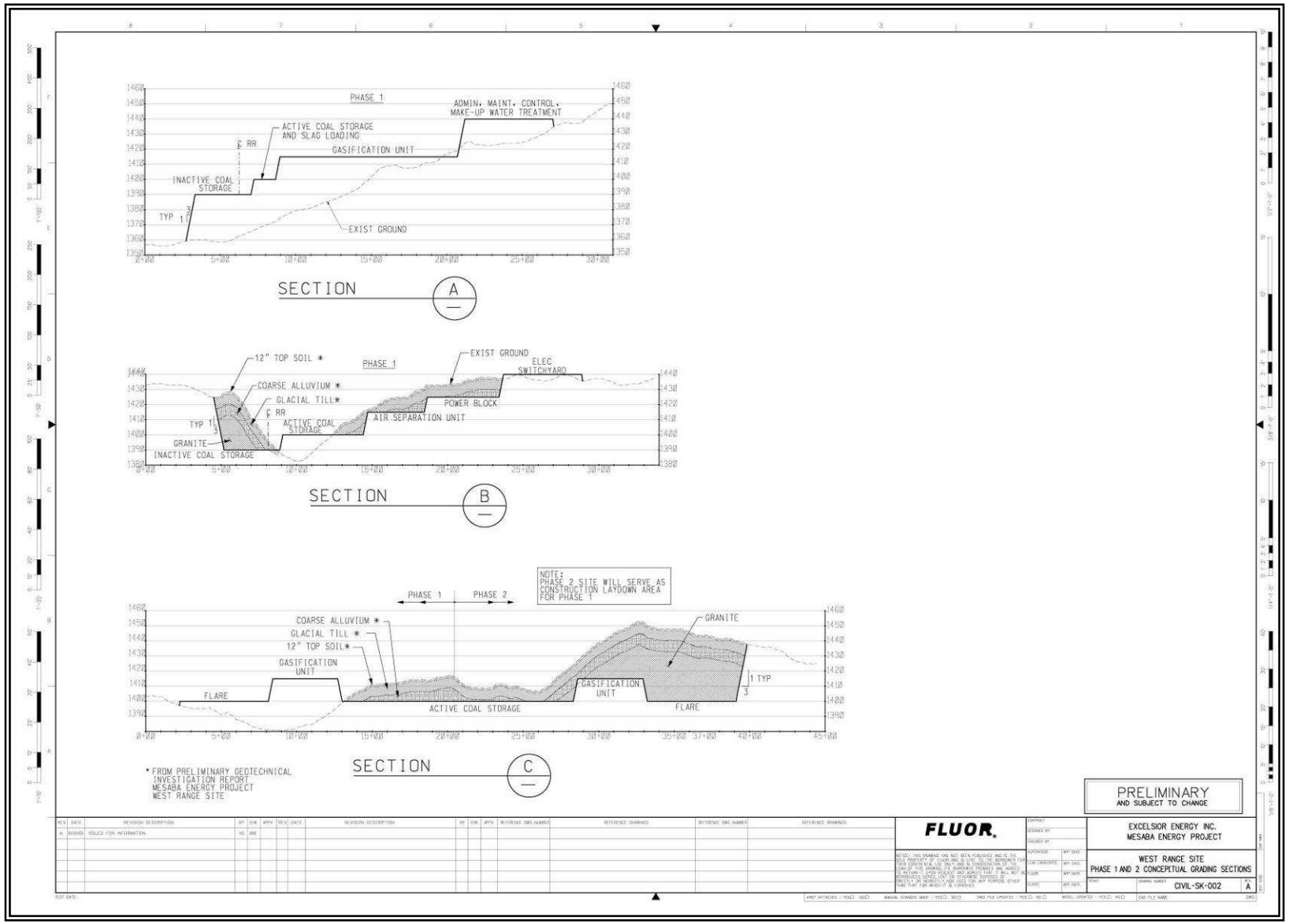


Figure 1.5-10 East Range Phase I and II IGCC Power Station Footprint, Buffer Land and Selected Associated Facilities

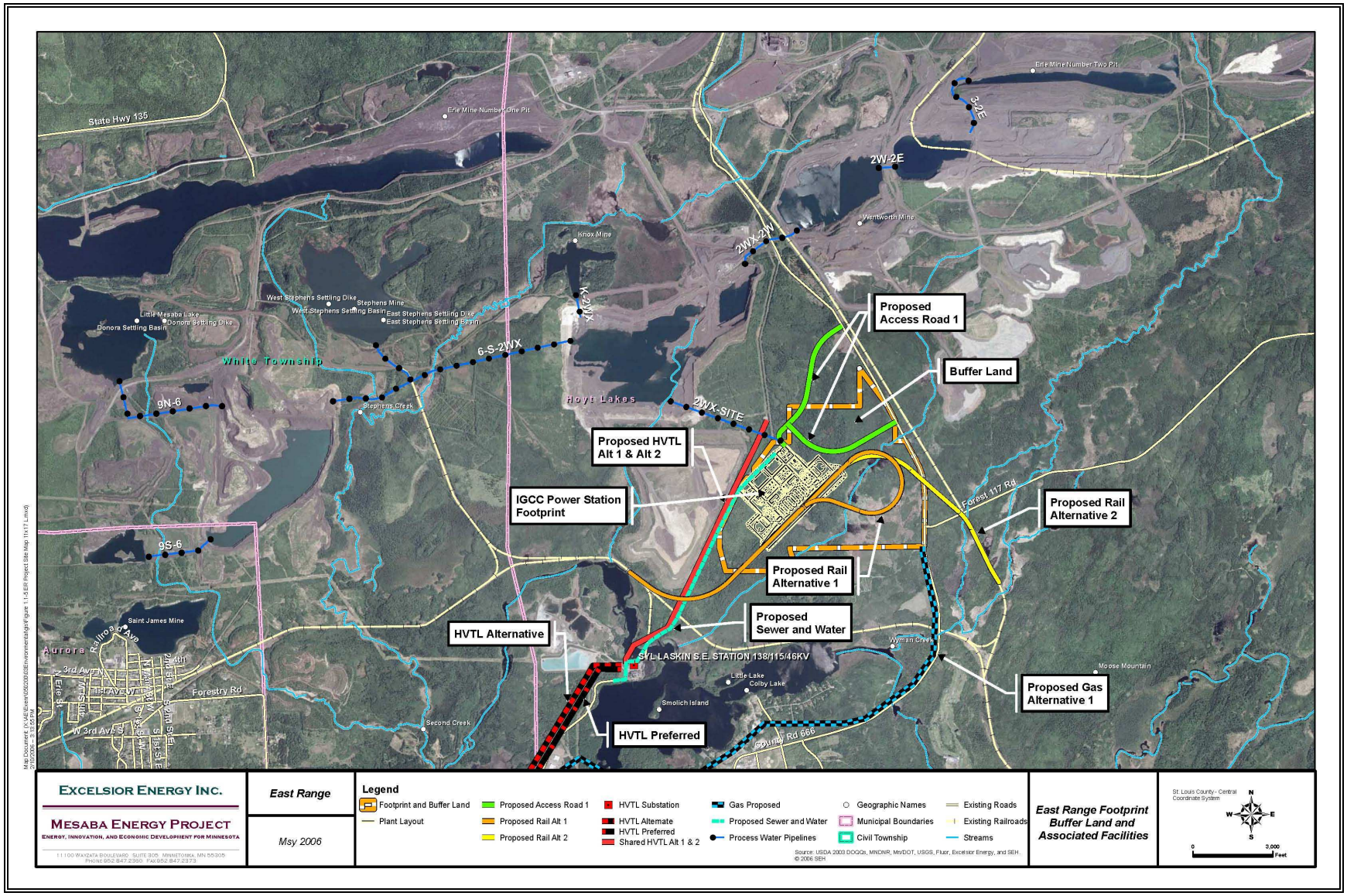
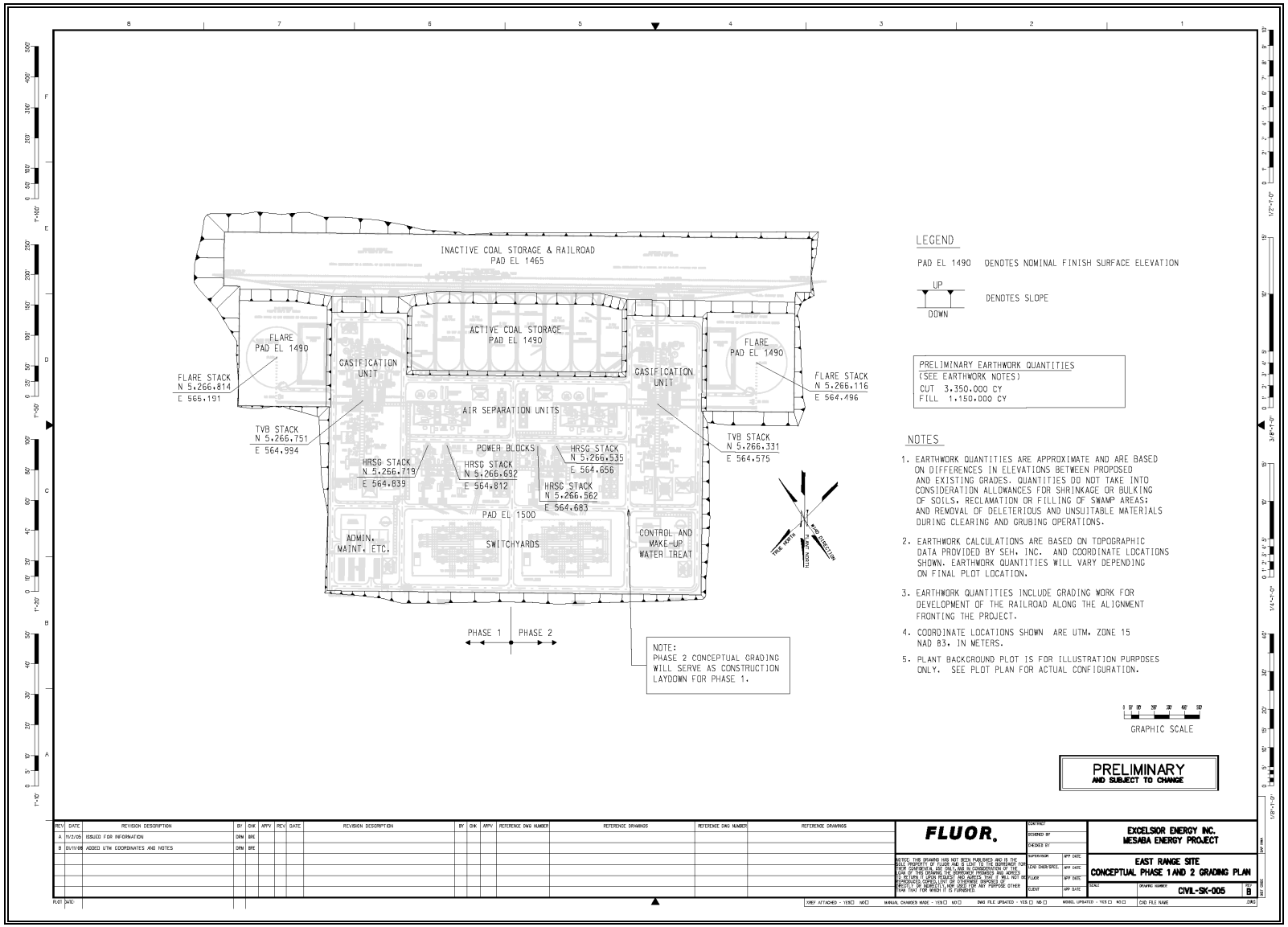


Figure 1.5-11 East Range Grading Plan



1.5.1.2 HVTL Routes

The Act requires the Proponent to identify at least two potential routes for its proposed HVTLs, identify which of the routes it prefers, and provide justification for its preference. The West Range and East Range Sites each have preferred and alternate HVTL routes (specifically described below in Section 1.5.1.2.2 and Section 1.5.1.2.3 for the West and East Range Sites, respectively) which are referred to in this ES by the names given to them in Tables 1.5-1 and 1.5-3, respectively. The proposed HVTL alignment for each of the routes named in these tables is shown in a milepost route map, the figure reference of which is provided in the tables.

The HVTL "route" is defined in Minn. R. 4400.0200, subp.16 as an area between two substation end points that "may have a variable width of up to 1.25 miles within which a right-of-way ("ROW") for a HVTL can be located." The Proponent is requesting a narrower one-half mile wide route for each of the requested HVTLs. The requested one-half mile route would be one quarter-mile (1,320 feet) in width on each side of the proposed HVTL centerline alignments. The requested route width will be sufficient to minimize impacts and accommodate land owners' concerns during final route design. The Proponent will attempt to acquire a minimum 150-foot wide temporary ROW for construction of the HVTL and a minimum 100-foot wide permanent ROW.

1.5.1.2.1 Single Failure Criterion (n-1)

Most bulk power systems are designed according to the (n-1)-criterion, also called the single failure criterion, which means that the power system must withstand the loss of a single line, generator, transformer or bus bar without any severe disturbance of power supply. For example, a single circuit transmission line interconnecting a plant with its POI will not meet the "single failure criteria" since loss of that one line due to a forced or scheduled maintenance outage would require plant operations to be curtailed and result in a complete loss of power to the grid.

For either the West Range Site or the East Range Site, two separate HVTL circuits are needed to reliably connect the IGCC Power Station to the POI. For Mesaba One alone, a minimum of two 230kV circuits (or two 345kV circuits) are required in order to provide the necessary transmission redundancy should one circuit fail. For Mesaba One and Two together, two 345kV circuits (one 345kV HVTL being sufficient to handle the output of Mesaba One and Mesaba Two), or the combination of one double circuit 230kV line and one single circuit 230kV line (two 230kV circuits being sufficient to handle the output of Mesaba One and Mesaba Two), are needed to provide the necessary n-1 redundancy.

1.5.1.2.2 West Range

The Proponent is applying for one HVTL Route Permit for a combination of circuits and routes that will provide the necessary reliable interconnection of Mesaba One and Mesaba Two to the POI. Under the West Range Site preferred plan ("Plan A"), as described below, two 345kV HVTL circuits would be installed on the same structure in a single route (345kV double circuit). However, should the Midwest Independent System Operator ("MISO") deem this configuration incompatible with regional plans, the Proponent is also applying for an HVTL Route Permit under a contingent plan ("Plan B"). Under Plan B, described below, one double circuit 230kV HVTL and one single circuit 230kV HVTL would be installed on separate transmission structures located on separate routes.

1.5.1.2.2A Background: Existing HVTL Corridors and POI

The POI for the West Range IGCC Power Station is an existing 230/115kV substation owned and operated by Minnesota Power ("MP"). This substation, known as the Blackberry Substation, is located approximately 8.5 miles (in straight line distance) south-southeast of the Power Station Footprint at the intersection of Itasca County Road ("CR") 10 and CR 434, about equidistant between the unincorporated community of Blackberry, Minnesota and the community of Marble, Minnesota. The Blackberry Substation is the major HVTL hub in the area.

MP currently owns north of the IGCC Power Station Footprint and Buffer Land an existing 115kV HVTL designated as 28Line (hereafter, all HVTLs will be identified by their number followed by the letter "L" for "Line", e.g., 28L). The line runs between the Clay Boswell Generating Station and a 115kV substation near Nashwauk, Minnesota. MP also owns the 83L, a 230kV HVTL that connects the Clay Boswell Station with the Blackberry Substation, and the 20L, a 115kV HVTL that interconnects the Grand Rapids and Blackberry Substations. Finally, MP operates between the Nashwauk and Blackberry Substations, two 115kV HVTLs known as 62L and 63L. At one time, two 115kV tap lines identified as 45L ran along the east side of the Project Site and connected 28L to the Greenway 115kV Substation (just north of Holman Lake). The two 115kV tap lines have since been de-energized and the Greenway Substation retired.

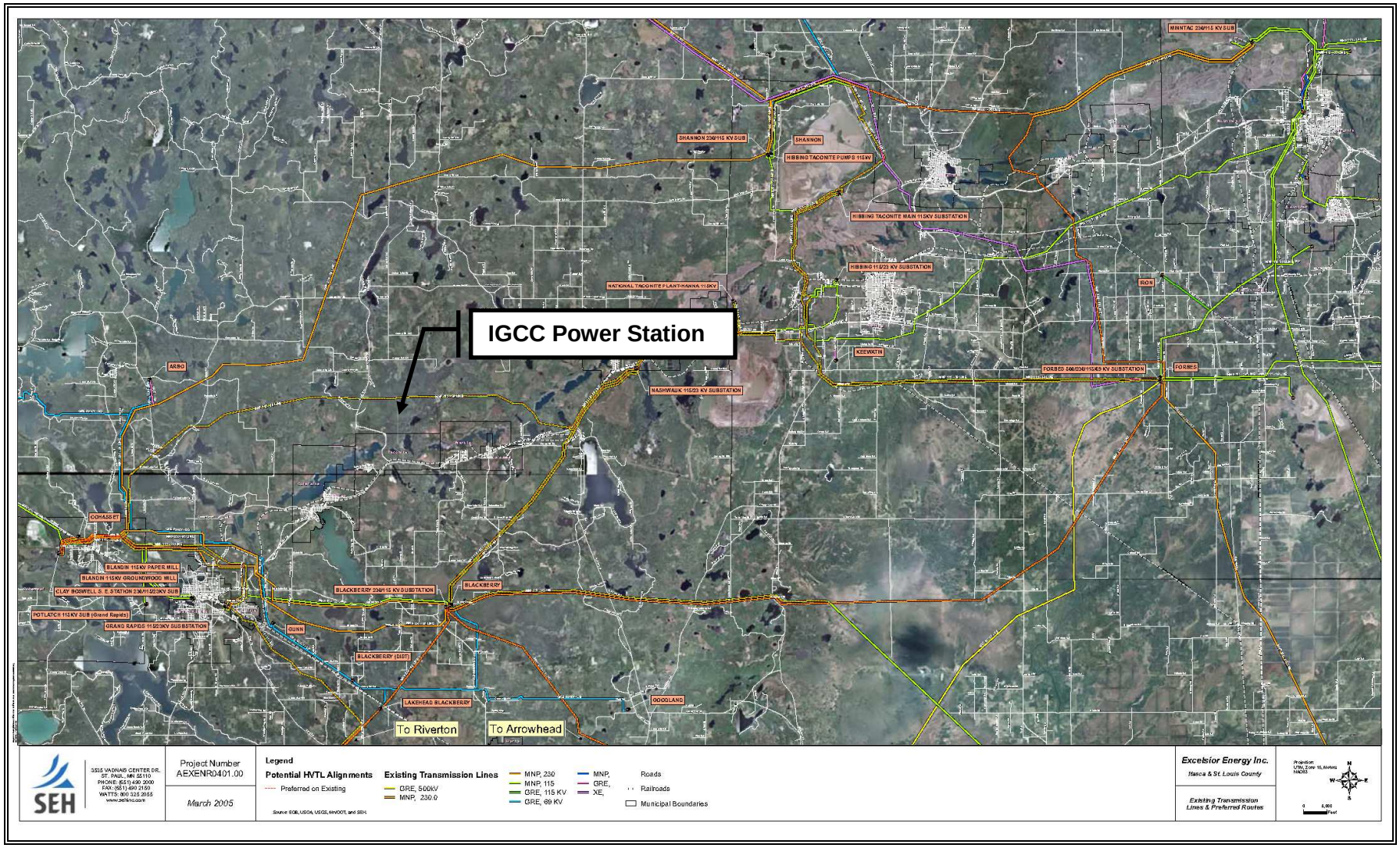
Figure 1.5-12 shows the existing HVTLs in the vicinity of the West Range Site and the Blackberry Substation.

Three plausible routes for HVTLs from the West Range IGCC Power Station Footprint to the proposed POI have been identified. Two of the routes are associated with the Proponent's 345kV development plan (see Plant A below). A third route is available as an alternative should MISO preclude the Proponent's use of the 345kV development plan.

1.5.1.2.2B Transmission Plan A

Plan A involves interconnecting to the Blackberry Substation (the West Range POI) with two 345kV HVTLs on a single steel pole structure. This double circuit 345kV plan will accommodate the full 1,212 MW output of Mesaba One and Mesaba Two and meet the (n-1) single failure criterion (see Section 1.5.1.2.1 above). Each 345kV HVTL has sufficient transfer capacity to carry Mesaba One and Mesaba Two electrical output and both lines would be installed with construction of Mesaba One. For Mesaba One, each of the two 345kV HVTLs will be operated at 230kV and either line will be capable of supporting the entire output of the Station in the event of a contingency forcing one line out of service. Before Mesaba Two comes on line, each of the 345kV HVTLs operating at 230kV would be upgraded to their rated 345kV capacity and thereafter be capable of conveying the entire output capacity of Mesaba One and Mesaba Two to the POI. The necessary upgrades would only apply to electrical substation equipment and involve no modification to the HVTL structures or conductors installed to accommodate Mesaba One.

Figure 1.5-12 High Voltage Transmission Lines in Vicinity of West Range Site



The routes considered under Plan A are discussed in the following two subsections and shown on Figure 1.5-13. A detailed description of the Plan A routes and a series of maps showing each alignment superimposed on aerial photographs is contained in Section 1.5.2.3.1.

1.5.1.2.2B(1)(a) Plan A Preferred HVTL Route (WRA-1)

The preferred 345kV double circuit HVTL route ("Route WRA-1") would use the following two segments of existing ROW: i) about 1.6 miles of existing ROW between the southern boundary of the Buffer Land and the retired Greenway Substation located just south of US 169 and ii) about one mile of existing ROW shared with MP's 230kV 83L and 115kV 20L HVTLs just before their interconnection with the Blackberry Substation.

Route WRA-1 would require acquisition of about six miles of new ROW between the Greenway Substation and the point of intersection with MP's 83L and 20L HVTLs. As the length of new ROW exceeds that exempted under Minn. R. 4400.1150, subp. 2.C (see Section 1.5.2.3.1.B), an alternate route must be proposed.

1.5.1.2.2B(1)(b) Plan A Alternate HVTL Route (WRA-1A)

The alternate HVTL route ("Route WRA-1A") follows the same alignment as the preferred route for the first 3.2 miles from the southern boundary of the Buffer Land. Route WRA-1A also shares about 0.9 miles of ROW in common with the 115kV 62L HVTL route just prior to its interconnection with the Blackberry Substation.

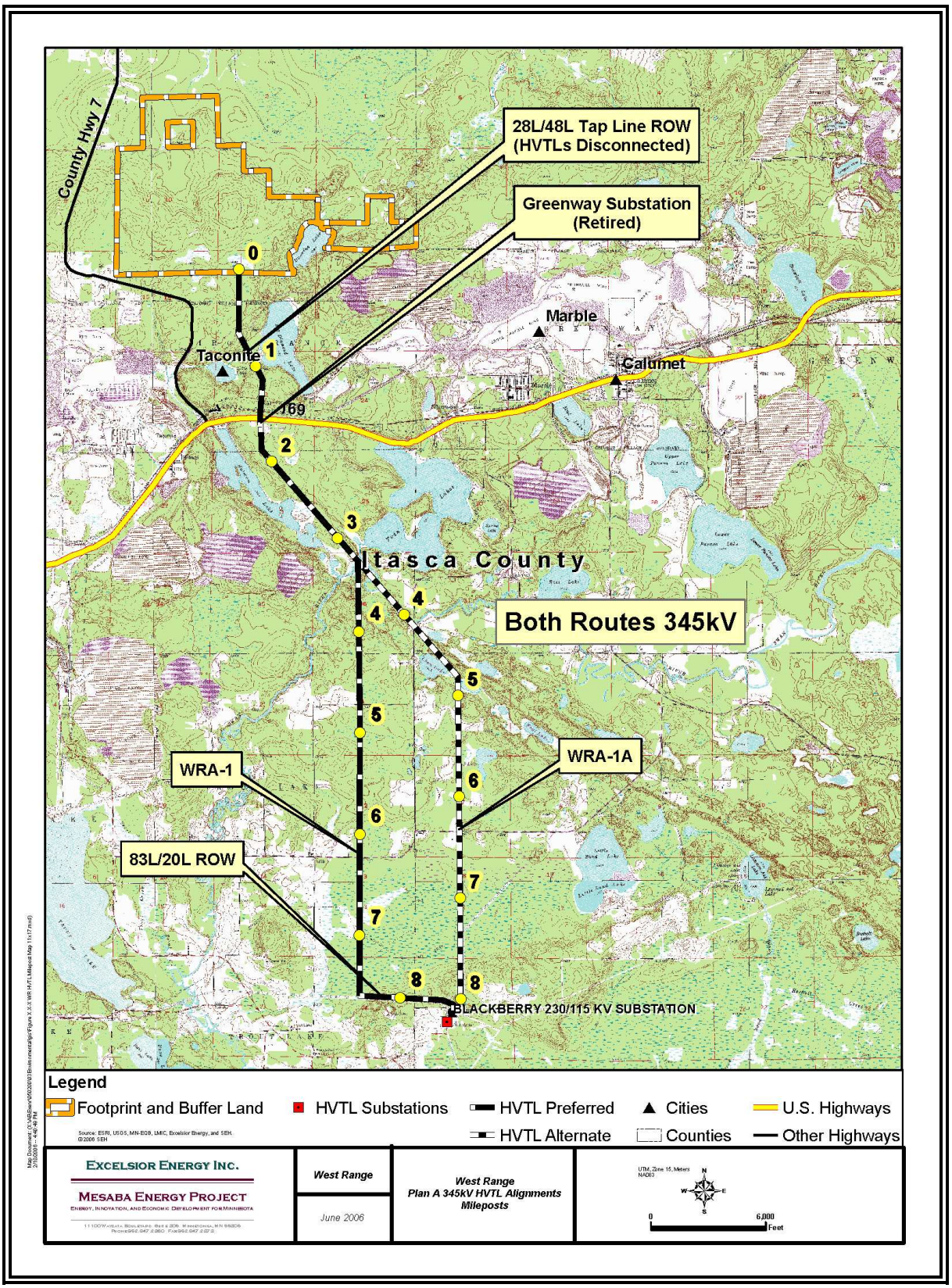
The major difference between Route WRA-1A and the preferred route is that Route WRA-1A runs east of and parallel to Twin Lakes Road (the preferred route runs west of and parallel to Twin Lakes Road) as shown in Figure 1.5-13. Route WRA-1A is located about 0.44 miles east of Twin Lakes Road to avoid residences located on the road. Route WRA-1A will require about the same length of new ROW (approximately 5.8 miles) and be about one-half mile shorter in overall length than Route WRA-1. In general, Route WRA-1 is preferred because it traverses areas that are less developed (that is, it is more remote, has fewer water crossings, crosses fewer open fields, avoids gravel mining operations, and would generally be less visible). Both routes are similar in that they traverse areas that have a similar residential density profile and are the shortest and most direct routes to the POI.

1.5.1.2.2C Transmission Contingent "Plan B"

In the event MISO determines that the 345kV transmission infrastructure is incompatible with regional transmission planning initiatives or the Proponent determines that the timing for building 345kV transmission in the region is outside the timeframes it contemplated, then the Proponent would construct and install the 230kV transmission scheme as described in Plan B below.

Plan B would involve first interconnecting Mesaba One to the POI with two 230kV HVTL circuits mounted on a single steel pole structure. This double circuit 230kV plan will accommodate the full 606 MW output of Mesaba One and meet the (n-1) single failure criterion.

Figure 1.5-13 West Range Plan A Preferred (WRA-1) and Alternate (WRA-1A) 345kV HVTL Routes



Although the double circuit 230kV HVTLs installed to accommodate Mesaba One can accommodate the entire 1,212 MW output of Mesaba One and Mesaba Two, they do not meet the single failure criterion (that is, the 1,212 MW IGCC Power Station would be required to reduce its generating capacity should one of the 230kV HVTLs be taken or forced out of service). Plan B therefore includes an additional HVTL with the construction of Mesaba Two.

The rating of the additional HVTL required to reliably convey the combined full-load output of Mesaba One and Mesaba Two will depend upon the route selected between the IGCC Power Station and its POI at the Blackberry Substation.

The routes considered under Plan B are discussed in the four subsections below and shown on Figures 1.5-14, 1.5-15 and 1.5-16. A detailed description of the Plan B route and a series of maps showing each alignment superimposed on aerial photographs is contained in Section 1.5.2.3.2.

1.5.1.2.2C(1)(a) Plan B Phase I Preferred Route (WRB-1)

The preferred route for the 230kV double circuit HVTLs for Phase I of Plan B ("Route WRB-1") is the same as Plan A's Route WRA-1 (see Sections 1.5.1.2.2B(1) and 1.5.2.3.1A), including the need to acquire about six miles of new ROW.

1.5.1.2.2C(1)(b) Plan B Phase I Alternate Route (WRB-1A)

The alternate route for the 230kV double circuit HVTLs for Phase I of Plan B ("Route WRB-1A") is the same as Route WRA-1A (see Sections 1.5.1.2.2B(2) and 1.5.2.3.1B above).

1.5.1.2.2C(1)(c) Plan B Phase II Preferred Route (WRB-2)

The Proponent's preferred HVTL route for Phase II of Plan B ("Route WRB-2") is to use the route not selected for the 230kV double circuit HVTL for Phase I of Plan B. That is, if the Proponent's preference of Route WRB-1 is approved, the Proponent proposes Route WRB-1A to be considered the preferred route for the single circuit 230kV Phase II development.

Because the total line length of WRB-2 is only one-half mile shorter in length than the length for WRB-1, the single circuit HVTL required for Plan B (to reliably accommodate the combined full-load output of Mesaba One and Mesaba Two) can be designed at 230kV.

Conversely, if the Proponent's preference of Route WRB-1 is not approved as the preferred route under Plan B Phase I, the Proponent will propose Route WRB-1 as the preferred route for Phase II of Plan B.

Figure 1.5-14 West Range Plan B Phase I Preferred (WRB-1) and Alternate (WRB-1A) 230kV HVTL Routes

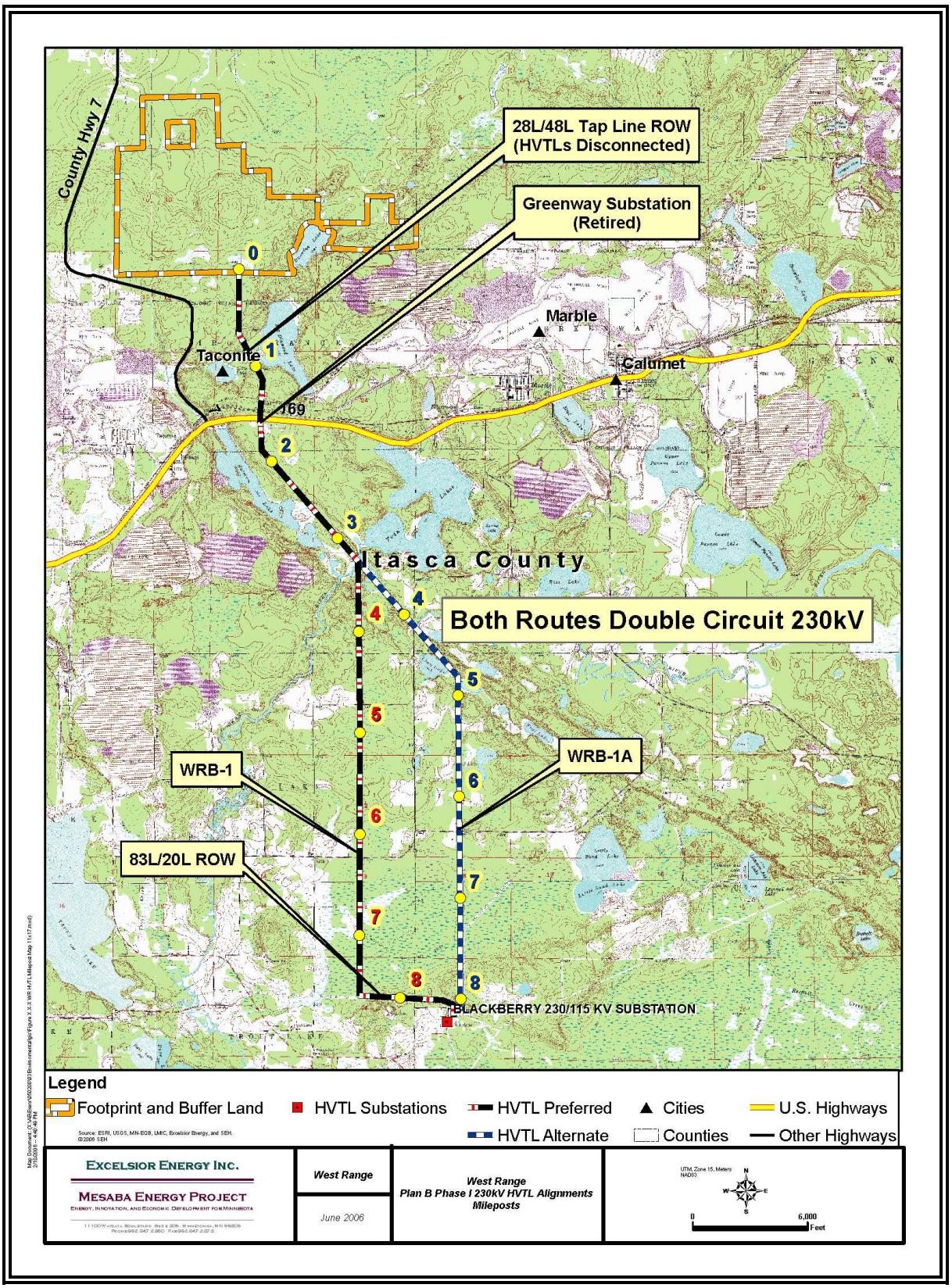


Figure 1.5-15 West Range Plan B Phase II Preferred (WRB-2) and Alternate (WRB-2A) HVTL Routes

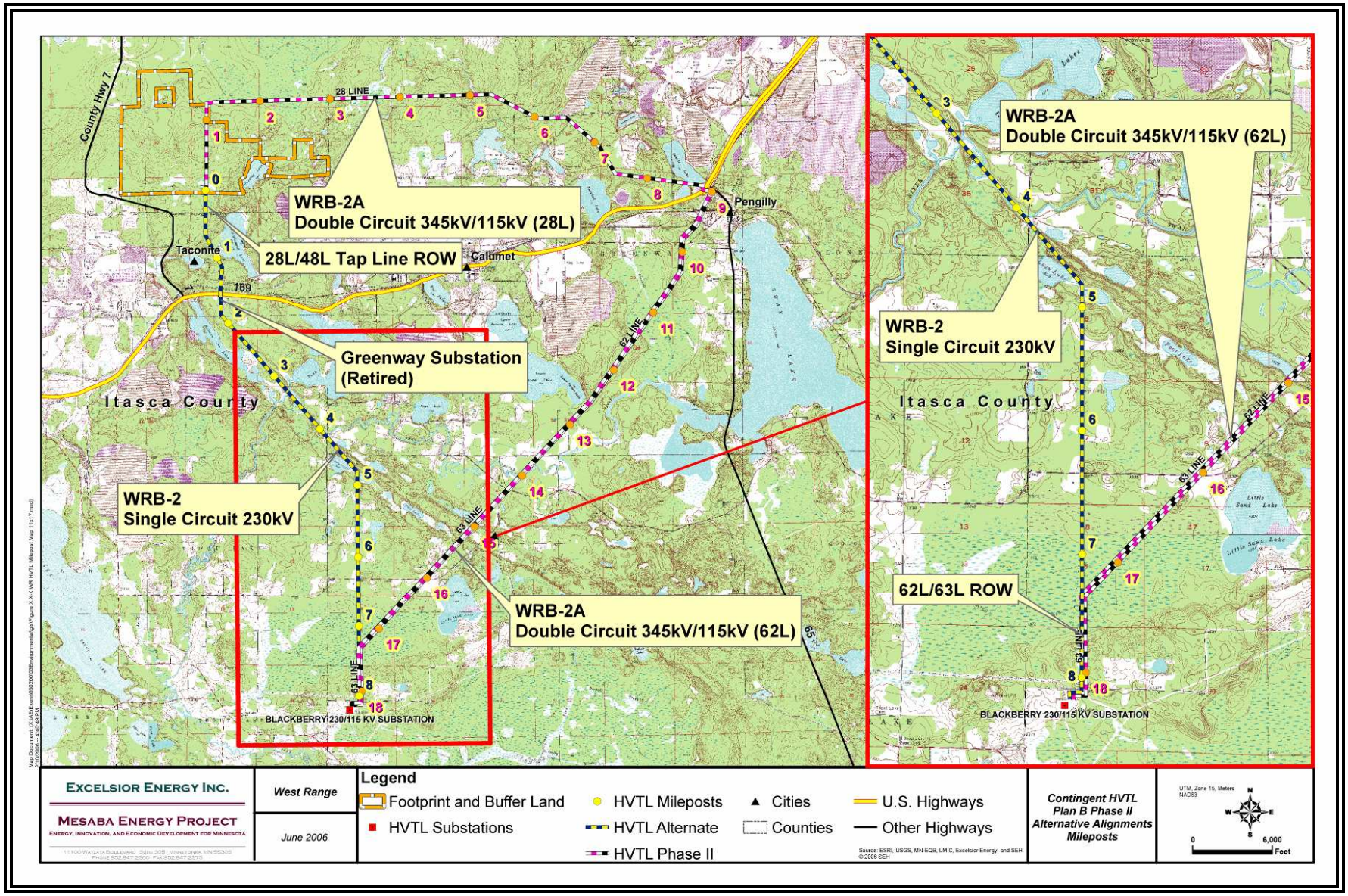
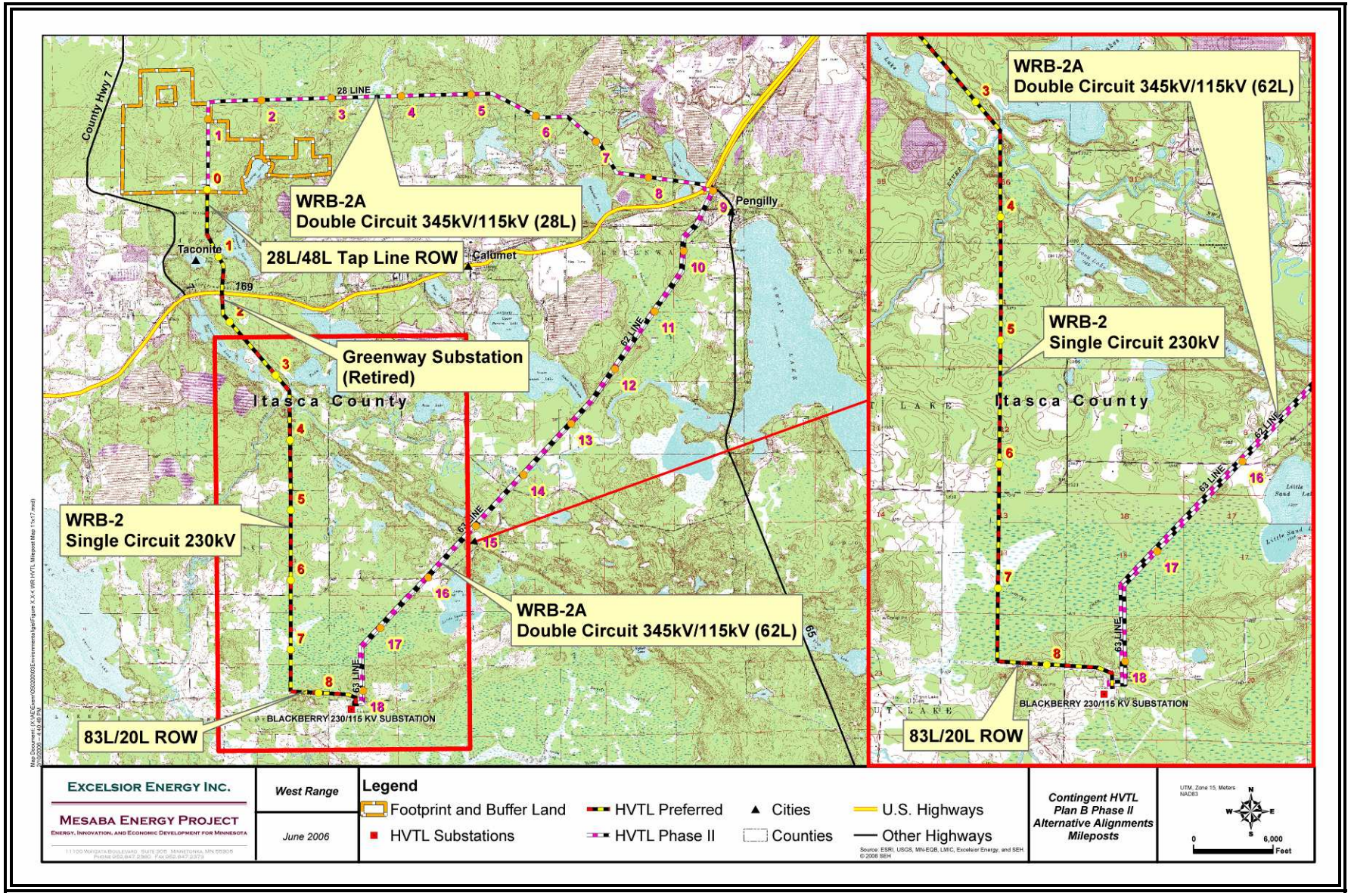


Figure 1.5-16 West Range Plan B Phase II Preferred (WRB-2)* and Alternate (WRB-2A) HVTL Routes



* The Plan B Phase II Preferred Route shown in the figure would not be available unless it was not selected as the Plan B Phase I Preferred Route

1.5.1.2.2C(1)(d) Plan B Phase II Alternative Route (WRB-2A)

Because the length of new ROW associated with either of the routes proposed as the preferred route under Plan B Phase II is greater than five miles, an alternative route must be proposed.

The alternate route proposed for Phase II of Plan B ("Route WRB-2A") combines segments from two existing HVTL corridors, one of which traverses the northern section of the West Range Buffer Land. The length of the HVTL required to reach the POI via Route WRB-2A is about 18 miles. The Proponent proposes to use HVTLs rated at 345kV on this route to avoid excessive line losses and elaborate switching requirements that would be required if 230kV were utilized on this route.

Both of the existing corridors are presently occupied by 115kV HVTLs structures owned by MP. The Proponent is proposing to use delta configuration 345kV structures with an underbuild feature that will the carry the existing 115kV HVTLs below the arms holding the 345kV conductors.

1.5.1.2.2D West Range Plan A and Plan B Summary Table

A summary of the Proponent's transmission plans for the West Range IGCC Power Station is presented in Table 1.5-1 below.

Table 1.5-1 Proponent's HVTL Plans for West Range IGCC Power Station (See Note)

	Phase I Development						Phase II Development					
	Preferred Route			Alternate Route			Preferred Route			Alternate Route		
	Capacity & Type	Route Name	Figures Showing Route	Capacity & Type	Route Name	Figures Showing Route	Capacity & Type	Route Name	Figures Showing Route	Capacity & Type	Route Name	Figures Showing Route
Plan A	345kV D/C	WRA-1	1.5-13	345kV D/C	WRA-1A	1.5-13	Additional Phase II Developments Not Needed					
Plan B	230kV D/C	WRB-1	1.5-14	230kV D/C	WRB-1A	1.5-14	230kV S/C	WRB-2	1.5-15 or 1.5-16	345kV S/C	WRB-2A	1.5-15 or 1.5-16

D/C = Double circuit; S/C = Single circuit

Note: The first two letters of the route name identify the Site to which the route applies; the third letter refers to the plan; the number that follows the first three letters refers to the phase of development, and the letter "A" following the phase descriptor identifies whether the route is an alternate (the absence of the letter "A" implies the route is preferred).

1.5.1.2.3 East Range Site

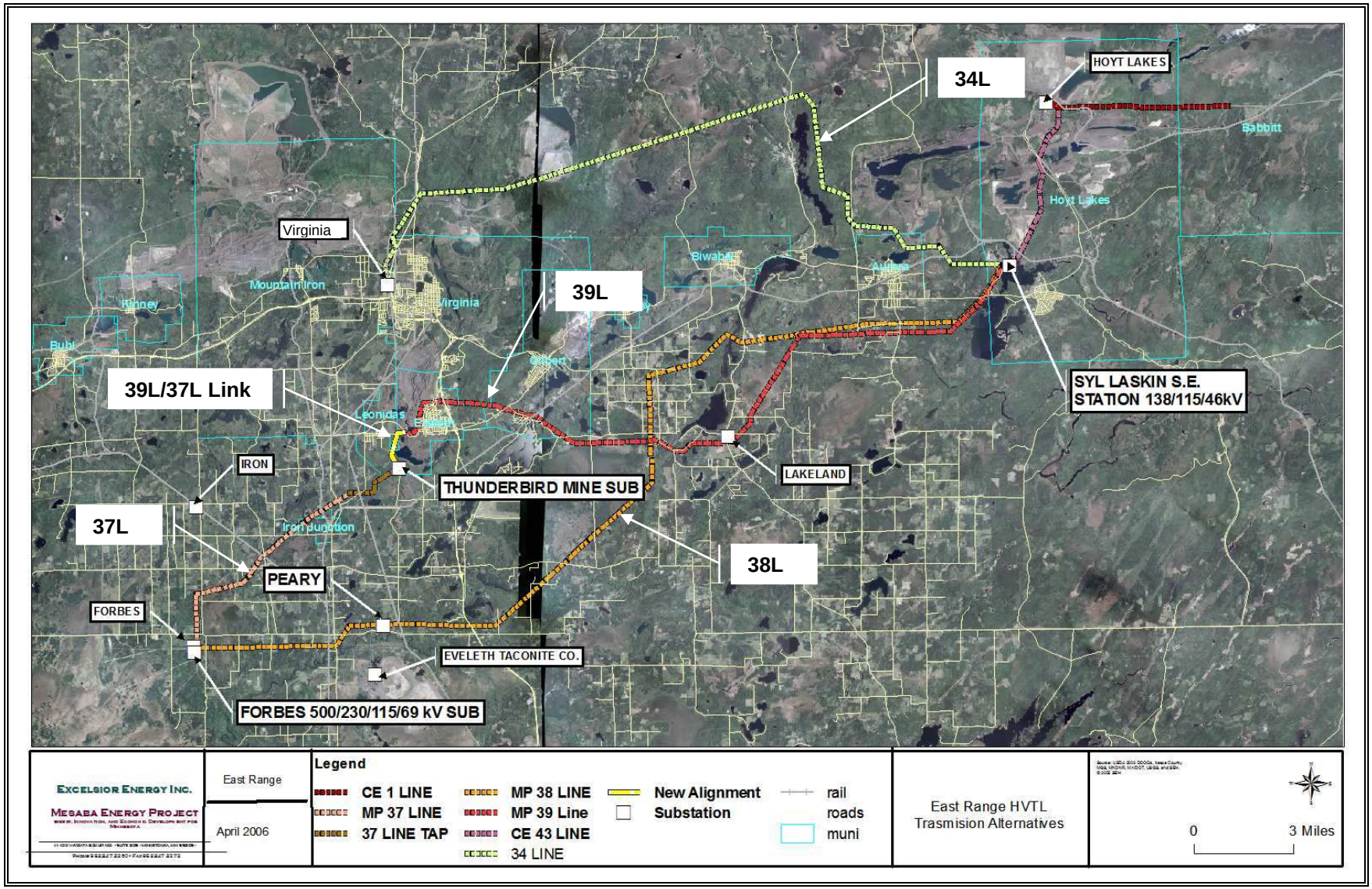
1.5.1.2.3A Preferred Interconnection Voltage

The Proponent's preferred transmission plan for the East Range IGCC Power Station consists of constructing two new 345kV HVTLs to link the IGCC Power Station to the Forbes Substation POI. As noted in Section 1.5.1.2.1, even though one 345kV HVTL is sufficient to accommodate the combined full load output of Mesaba One and Mesaba Two, both new lines must be constructed concurrently with installation of Mesaba One to address the single failure criterion concerns. Each line would follow existing corridors now occupied by 115kV HVTLs owned by MP and that interconnect the Syl Laskin Energy Center ("Laskin") with the Forbes Substation.

1.5.1.2.3B Background: Existing HVTL Corridors and POI

The East Range IGCC Power Station Footprint and Buffer Land is located on about 768 acres of property (now owned by Cliffs-Erie, LLC ["CE"]) about 0.75 miles north of the limit of residential housing in Hoyt Lakes, Minnesota and about 3.5 miles south of the former taconite processing plant. An existing 138 kV substation is located adjacent to the processing plant to provide electric service to CE (hereafter, the "CE Substation"). Three 138 kV transmission lines traverse CE property to deliver power to this substation, two of which occupy the same corridor and link the CE Substation to the coal fueled power plant at Taconite Harbor (located on the North Shore of Lake Superior near Schroeder, Mn). A third 138kV HVTL runs between a substation serving MP's Syl Laskin Energy Center (the "Laskin Substation") and the CE Substation. These facilities are part of the MP transmission network known as the "North Shore Loop" which extends from the east end of the Iron Range, along the North Shore of Lake Superior, and into Duluth. The 115/138 kV transmission facilities that make up this "loop" are heavily loaded and currently operate with several special protection schemes involving generation reduction and/or unit tripping to avoid overloading the remaining transmission facilities during critical equipment outages. Figure 1.5-17 provides an overview of the existing HVTL system and substations in the vicinity of the East Range site and shows the three 115kV lines that serve as generator outlet HVTLs (34L, 38L, and 39L) for connecting the Syl Laskin Energy Center with the Forbes Substation (38L) or the Virginia 115kV Substation (34L and 39L). The Forbes Substation is a major electrical hub on the east end of the Iron Range and has 500kV, 230kV, 115kV buses owned by both MP (230kV and 115kV) and Xcel Energy (500kV). This substation would be used as the POI for Mesaba One and Mesaba Two. The Proponent's plan is to utilize mostly existing 115kV and 138 kV transmission line corridors and minimize any interruption in electrical service of the HVTLs within the corridors selected.

Figure 1.5-17 Existing HVTLs and Substations in the Vicinity of the East Range Site



1.5.1.2.3C Interconnections Between the Forbes Substation and Mesaba One and Mesaba Two

The 38L interconnects directly to the Forbes Substation, is about 35.5 miles in length, is rated at 146 Mega Volt-Amps ("MVA") (see Table 1.5-2), and has one intermediate distribution load service substation (the Peary Substation owned by Great River Energy) to maintain service during reconstruction.

Table 1.5-2
HVTL Line Ratings*

Line No.	Summer Rating (MVA)	Winter Rating (MVA)
43L (138kV Hoyt Lakes to Syl Laskin)	173	222
34L (115kV Syl Laskin to Virginia Substation)	90	114
38L (115kV Syl Laskin to Forbes Substation)	146	185
39L (115kV Syl Laskin to Virginia Substation)	98	125
128L (115kV Taconite Harbor to Silver Bay)	207	242
42L (115kV Silver Bay to Duluth)	98	125

* From G329 Impact Study dated 10/10/2003 posted by MISO

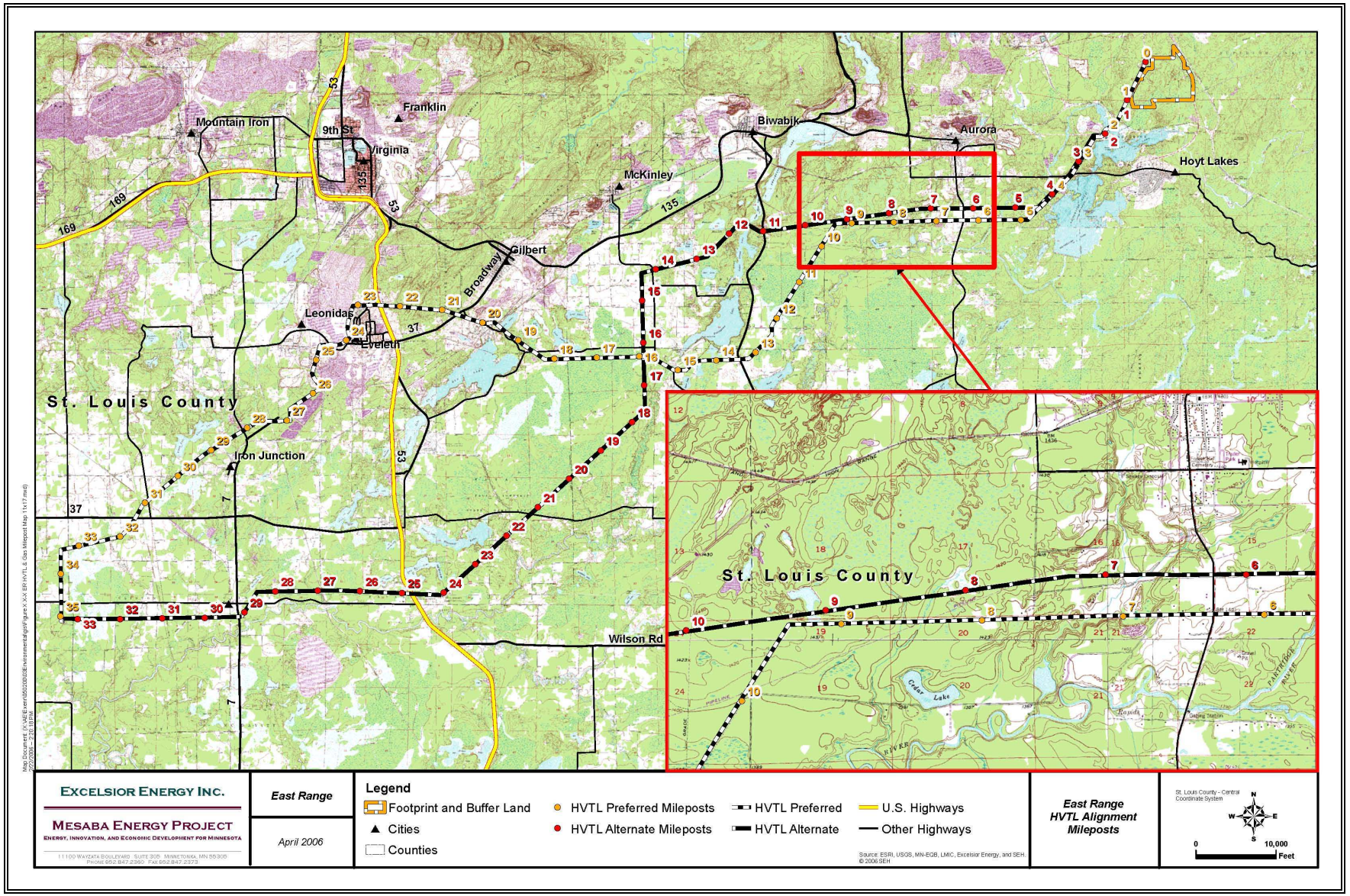
For the 39L and 34L routes that connect to the Virginia Substation, there are existing 115kV lines (37L direct to the Forbes Substation and 16L/18L to the Forbes Substation via United Taconite) that could be reconstructed as double circuit lines (one circuit carrying MP's 115kV line and the other carrying an HVTL from the IGCC Power Station) to support the direct routing of the 39L to the Forbes Substation. The lengths of the GO lines utilizing these routes are estimated at 35.5 miles on the 39L/37L route and 39 miles on the 34L/16L/18L route. All three of these lines are candidates for replacement with new double circuit structures to carry the IGCC Power Station's HVTLs. Due to the congestion of HVTLs in the vicinity of the Virginia Substation, there is a very low likelihood of using the 34L as part of the Proponent's strategy to minimize interruption of electrical service and avoid construction of new ROWs where reasonable.

1.5.1.2.3D Route Selection

The two existing corridors the Proponent proposes to use as routes for its two 345kV HVTLs are the 39L/37L corridor and the 38L corridor. These routes are generally described in Sections 1.5.1.2.3F and 1.5.1.2.3G below and shown in Figure 1.5-17. A more detailed description of the routes and a series of maps showing each segment of each alignment superimposed on aerial photographs are contained in Sections 1.5.3.3.1 and 1.5.3.3.2. The Proponent will build new GO lines directly from the East Range Station Footprint to the Forbes Substation, the East Range IGCC Power Station's proposed POI.

The ROW of the single 138 kV line (43L) connecting the Laskin and CE Substations is contiguous with the western boundary of the IGCC Power Station Footprint and Buffer Land. The southern portion of this line could theoretically be replaced with double circuit structures to carry via the existing ROW the GO lines from the IGCC Power Station and the existing 138 kV HVTL to the Laskin Substation. However, the Proponent will avoid taking the existing 138 kV HVTL out of service due to the critical role it plays as part of MP's North Shore Loop.

Figure 1.5-18 East Range HVTL Route Milestone Map Showing the Preferred and Alternate Route



The distance between the IGCC Power Station and the Laskin Substation is about two miles in length.

1.5.1.2.3E Fully Loaded Existing HVTLs Complicate Construction Scheme

To minimize the impact of the IGCC Power Station on this already constrained local transmission system, the Proponent proposes to avoid removing any of the 115/138 kV facilities (the 43L, the Laskin Substation, and the interconnecting HVTLs between the Laskin Substation and the Forbes Substation) from service without providing a replacement HVTL option. This can generally be done in one of two ways. First, to avoid taking any new ROW, the existing 115kV HVTLs can be handled in "hot" conditions allowing the new HVTL structures to be constructed within the existing ROW and the existing "hot" lines (that is, working with HVTLs that are energized during the handling process) to be transferred to the new structures with no interruption of service. Second, the Proponent could acquire a minimal width of additional ROW along the existing corridor so that new structures can be constructed with less risk. These two options are explained in more detail in Section 1.12.1.3.2.

The Proponent proposes to avoid the high cost and dangerous conditions associated with "hot" construction methods and therefore proposes to acquire an additional 30 feet of ROW along one of the routes between the Laskin and Forbes Substations. The construction sequence is summarized in the following steps:

- Construct new 345kV/115kV double circuit structures (shown in Figure 1.12-31 to 35) along the existing 115kV structures (using a new 30 foot section of ROW to allow such construction to occur)
- String the 345kV conductor on the new single pole structures
- Once installed, operate the new 345kV conductor at 115kV (that is, transfer the load carried by the existing 115kV line to the new 345kV conductor)
- De-energize the existing 115kV HVTL
- Move the existing, de-energized 115kV HVTL to the new 345kV/115kV double circuit structure
- Operating both lines at 115kV until construction of the new 345kV/115kV double circuit structure (see Figures 1.12-25 to 27) in the other ROW is complete
- Re-energizing the 345kV conductor to its rated capacity for use by Mesaba One and Mesaba Two

Operating both lines at 115kV (the sixth bullet in the above list) will allow the 115kV HTVL in the remaining corridor to be removed and the new HVTL double circuit 345kV/115kV structures to be constructed therein without the need to acquire additional ROW.

1.5.1.2.3F Preferred Route Configuration and Basis for Its Selection

The Proponent has reviewed aerial photographs and video taken during an overflight of the routes in September 2005 to help determine which corridor would be the best from which to take the additional 30 feet of ROW identified above. These efforts resulted in the Proponent selecting the 39L/37L corridor on which to acquire the additional ROW. However, to ensure that both corridors have received adequate consideration, a comparison between the two options is presented in Sections 3.7.2.2 and 3.7.2.3.

In the two subsections below, the route configuration labeled as "preferred" involves i) acquiring 30 feet of new ROW from the existing 39L/37L corridor and ii) working within the existing boundaries of the ROW associated with the 38L. The "alternate" route configuration involves i) acquiring 30 feet of new ROW from the existing 38L corridor and ii) working within the existing boundaries of the ROW associated with the 39L/37L corridor.

The preferred configuration for the two 345kV/115kV double circuit HVTLs will require acquisition of two new ROW segments. One new segment will be about 2 miles in length and travel alongside an existing MP HVTL corridor (43L) and connect the IGCC Power Station to the initiation point of the 39L and 38L corridors. The short segment of new ROW added between the IGCC Power Station and Laskin will be used as a part of both the 39L/37L and 38L routes.

A second section of new ROW about 2 miles in length will be required to link the 39L and 37L corridors. This new segment of ROW crosses mostly areas that are disturbed from past mining activities.

The ROW associated with the 38L corridor will not require modification.

The length of the 39L/37L and 38L routes is about 35 miles and 33.3 miles, respectively.

1.5.1.2.3G Alternate Configuration of Routes

The alternate configuration for the two 345kV/115kV double circuit HVTLs will require acquisition of the same two new ROW segments identified in the preceding paragraph. The only difference is that the 30 feet of ROW will be taken from the 38L instead of the 39L/37L. The length of the two routes remains unchanged from those presented for the preferred configuration.

1.5.1.2.3H East Range Summary 345kV Route Table

Table 1.5-3 identifies the preferred and alternative route configurations for the East Range IGCC Power Station

Table 1.5-3 Proponent's HVTL Plans for East Range Site (See Note)

	Phase I Development				Phase II Development			
	Route Name: 39L/37L		Route Name: 38L		Route Name: 39L/37L		Route Name: 38L	
	Capacity & Type	30 ft New ROW	Capacity & Type	30 ft New ROW	Capacity & Type	30 ft New ROW	Capacity & Type	30 ft New ROW
P See Figure 1.5-18	345kV/115kV Double Circuit (Figure 1.12-31 to 35)	Yes	345kV/115kV Double Circuit (Figure 1.12-24 to 27)	No	Additional Phase II Developments Not Needed		Additional Phase II Developments Not Needed	
A See Figure 1.5-18	345kV/115kV Double Circuit (Figure 1.12-24 to 27)	No	345kV/115kV Double Circuit (Figure 1.12-31 to 35)	Yes				

P= Preferred route configuration; A= Alternate route configuration

1.5.1.2.4 Comparison of GO Facilities Development for the West and East Range Sites

Table 1.5-4 was developed to enable a comparison of key measures associated with the GO facilities development at each site.

Table 1.5-4
Comparison of GO Facilities for West and East Range Sites

	East Range Site		West Range Site			
			Plan A		Plan B	
PHASE I	**Preferred Route**	**Alternative**	**Preferred Route**	**Alternate**	**Preferred Route**	**Alternate**
Total HVTL Circuit (miles)	68.3	68.3	17.4	16.6	17.4	17.4
New ROW (acres)	4	4	6.2	5.8	6.2	5.8
Widened ROW (acres)	31.5	29	0	0	0	0
Permanent Land Use (acres)	166	165	134	121	134	121
Line Loss (MW)	11	11	1.4	1.4	2.2	2.2
PHASE I + PHASE II						
Total Circuit (miles)	68.3	68.3	17.4	16.6	25.7	35.5
New ROW (acres)	4	4	6.2	5.8	12	6.2
Widened ROW (acres)	31.5	29	0	0	0	0
Permanent Land Use (acres)	166	165	134	121	194	134
Line Loss (MW)	12	12	3.5	3.5	6.5	5.8

The new land use impact of the West Range GO facilities of 134 acres is less than that required for the East Range GO facilities. The 17.4 ROW miles is also about one-fourth of that for the East Range Site. These shorter lengths reduce potential visual and environmental impacts. Lower line losses of one-fourth to one-half effectively increases the Project's overall thermal efficiency, and reduces emission rates.

A comparison of GO HVTL costs between the West Range and East Range Sites is presented in Section 2.8 of the Joint Permit Application.

Transmission constructability is another component aspect that must be considered when comparing site GO facility developments. Since all plans were developed to minimize the need for new ROW by utilizing existing transmission corridors to the maximum extent possible, issues associated with obtaining extended outages of the existing transmission lines to either upgrade or replace with new double circuit structures is of importance. In the case of the West Range GO facilities development, there are only minor constructability issues in Phase I (the only one identified is associated with the existing HVTL corridor for the last mile entering into the Blackberry Substation). Depending on MISO study results, Phase II development could involve replacing portions of two existing 115kV lines with new double circuit 345/115kV structures for about 18 miles (Plan B Alternate Route, WRB-2A). However, there appears to be sufficient redundancy in the local area 115kV system that would allow for extended outages, especially if coordinated with outages of the Clay Boswell Generating Station and large industrial loads in the area.

For the East Range GO facilities development, the three 115kV lines emanating from Laskin that are proposed to be rebuilt as new double circuit structures are a critical component of the transmission which make up the "North Shore Loop" system. This system provides service to the entire Arrowhead region of the East Range and Lake Superior North Shore and serves as generator outlet for the Laskin, Taconite Harbor, and Silver Bay generating stations. An outage on any of these three lines necessitates a reduction in this generation and places service to the area load at risk. To avoid potential disruption of service, the concept of building the first new double circuit line alongside (off-centerline) of one of the existing 115kV lines by acquiring an additional 30 feet of ROW has been incorporated into the GO facilities development plans. This would reduce the outages necessary for construction and the cut over to the new circuits. These short duration outages should be able to be coordinated with planned generating unit outages to minimize impacts. Nonetheless, constructability is a much more significant issue with the East Range GO facility development plans than with the West Range GO facility development.

1.5.1.3 Natural Gas Pipeline Routes

Natural gas will be used to start up Mesaba One and Two and as a backup fuel when syngas from the gasifiers is unavailable. The maximum one day natural gas flow is expected to be about 105 million standard cubic feet of gas per phase of the IGCC Power Station. This ES describes natural gas pipelines necessary to supply this quantity of fuel to the Phase I and II Developments located at the West and East Range Sites. The proposed natural gas pipeline routes are referred to herein as the "West Range Proposed Natural Gas Pipeline Route" and the "East Range Proposed Natural Gas Pipeline Route."

Minnesota Rule 4415.0010, subpart 32 defines the permitted gas pipeline "route" as "the proposed location of a pipeline between two end points. A route may have a variable width from the minimum required for the pipeline ROW up to 1.25 miles." The Proponent is requesting a narrower one-half mile wide route for each of the requested gas pipelines. The requested one-half mile route would be one quarter-mile (1,320 feet) in width on each side of the proposed natural gas pipeline centerline alignment. Minnesota's Iron Range is served by two major natural gas pipeline transmission companies: Great Lakes Gas Transmission Company ("GLG") and NNG. The GLG natural gas pipeline transmission system interconnects with NNG's natural gas pipeline system near Carlton, Minnesota. Figure 1.5-19 shows the location of the natural gas transmission pipelines north of Carlton for both companies. Figure 1.5-20 shows the routing of currently operating GLG and NNG natural gas pipelines in the vicinity of the West Range IGCC Power Station.

The proposed natural gas pipeline alignment is shown in Figures 1.5-38 through 1.5-41. The requested route width will be sufficient to allow flexibility to minimize impacts and accommodate land owners concerns during final route design. Within the requested routes, the Proponent intends to acquire a minimum 100-foot wide temporary ROW for construction of the pipeline and a minimum 70-foot wide permanent ROW.

1.5.1.3.1 West Range Proposed Natural Gas Pipeline Route

The Proponent is requesting a partial exemption from the pipeline routing permit procedures for the Proposed Natural Gas Pipeline Route. Under the state rules governing the partial exemption, the Proponent is not required to complete a detailed environmental analysis of multiple potential pipeline routes. The Proponent must only identify alternate routes that have been considered and

provide evidence in the Application of such alternate route consideration (Minn. R. 4415.0140, subp. 2). Such evidence is provided in Section 1.5.2.4.2. A detailed description of the Proposed Natural Gas Pipeline Route is provided in Section 1.5.2.4.1.

1.5.1.3.2 East Range Proposed Natural Gas Pipeline Route

For the East Range Site, the proposed natural gas pipeline would be constructed, owned and operated by NNG, and would be an extension of NNG's interstate pipeline system. As an interstate pipeline, the East Range natural gas supply pipeline would not be subject to Minnesota Pipeline Route Permit requirements, but would be permitted by NNG under the FERC review process described in Section 1.2.6.2.8. A detailed description of the East Range Proposed Natural Gas Pipeline Route is provided in Section 1.5.3.4.

Figure 1.5-19 GLG (Red) and NNG (Blue) Natural Gas Pipelines in the Vicinity of the Iron Range

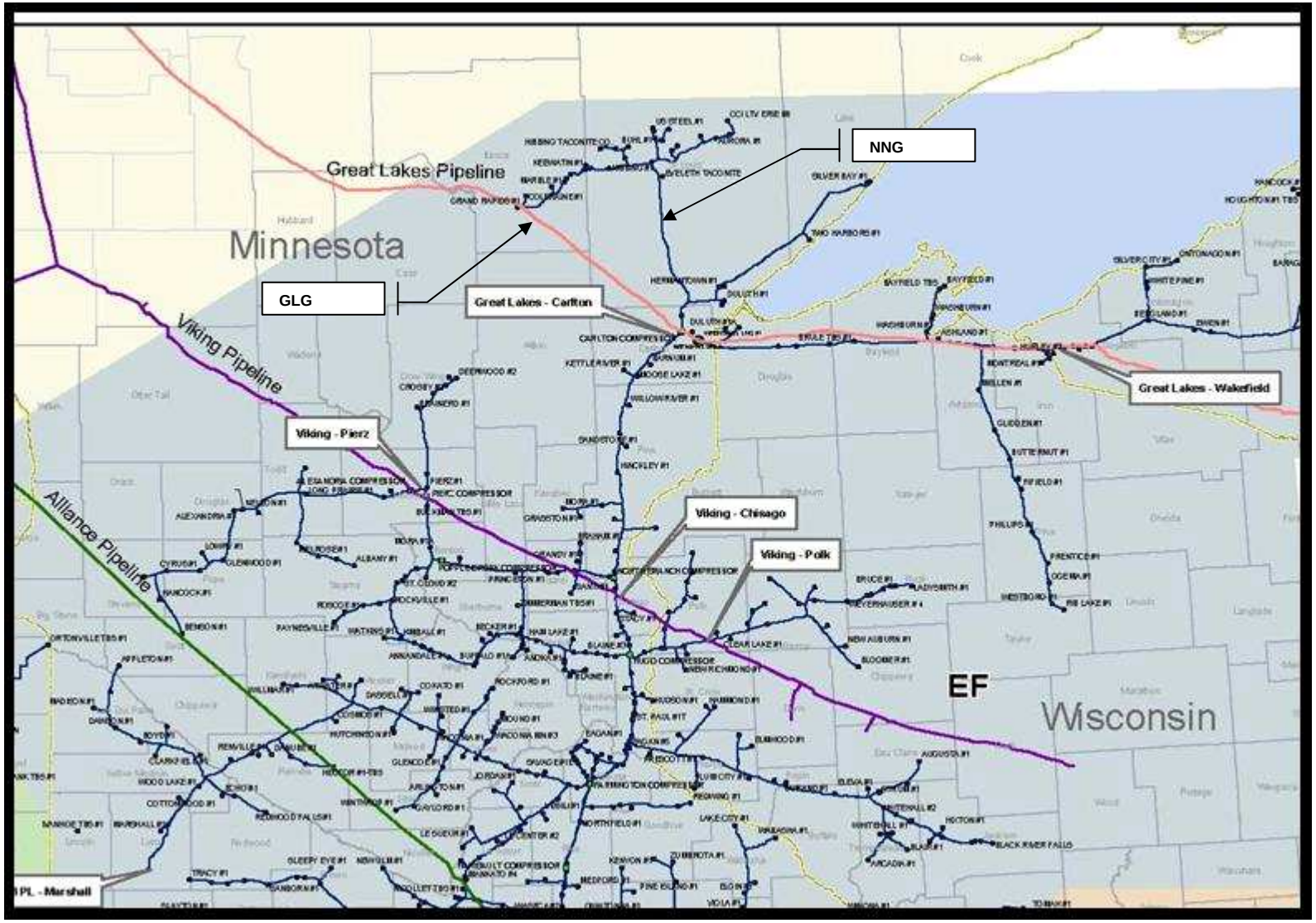
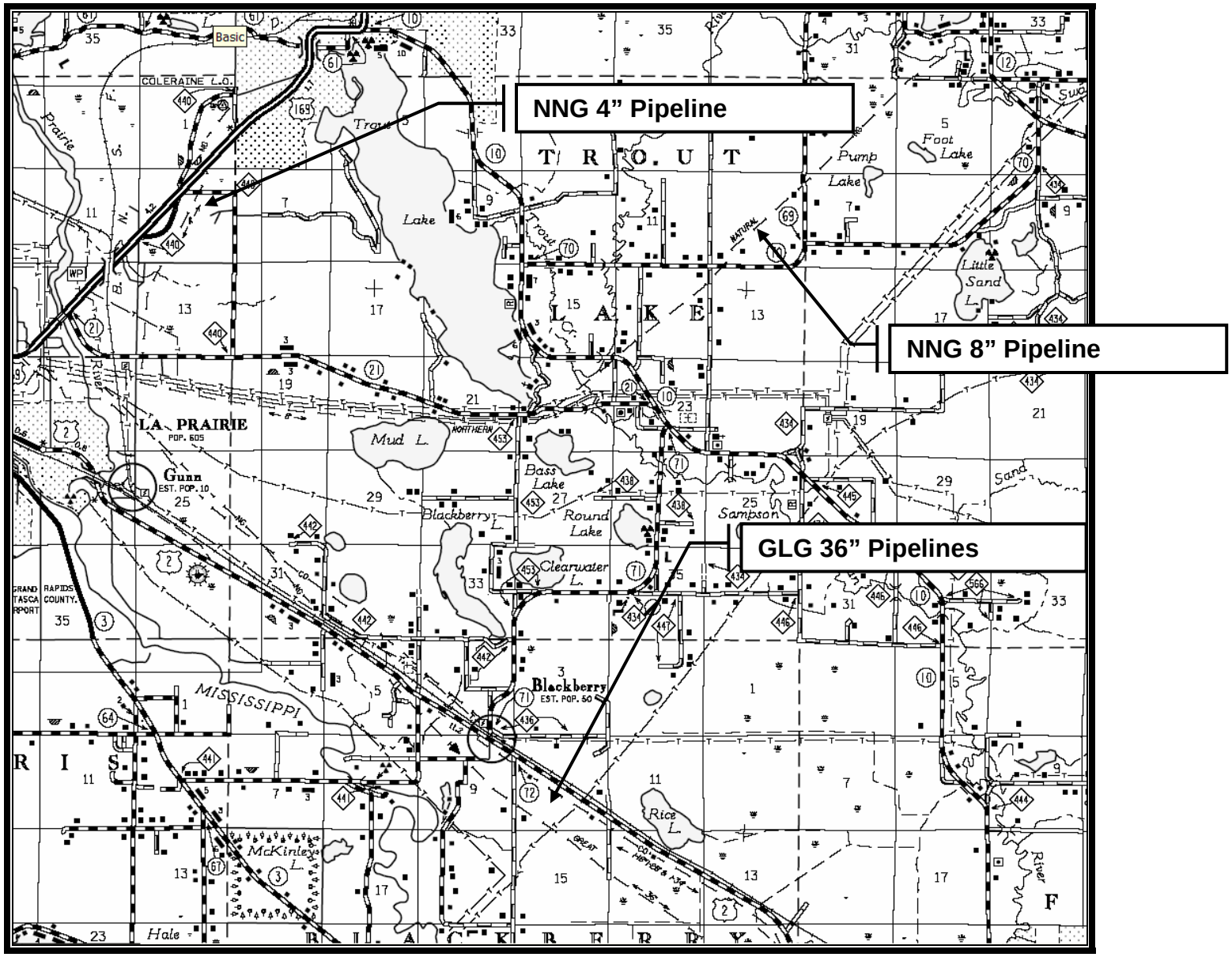


Figure 1.5-20 Natural Gas Pipelines In the Vicinity of the West Range Site



1.5.2 Preferred Site-West Range

This section describes the IGCC Power Station Footprint, Buffer Land, and the Associated Facilities that comprise the West Range Site.

1.5.2.1 IGCC Power Station Footprint and Buffer Land

The IGCC Power Station Footprint and Buffer Land includes approximately 1,260 acres of undeveloped land that is unoccupied, but is located in the immediate vicinity of former iron ore mining operations. The IGCC Power Station Footprint and Buffer Land is located completely within the City limits of Taconite, Minnesota in Iron Range Township (i.e., 4th Principal Meridian, T56N, R24W) and is generally bounded by CR 7 to the west, an HVTL corridor to the north, and the Township boundary to the east. Only the northern-most 200 acres of the Buffer Land is outside the City limits. Figure 1.5-1 shows the Taconite city limits in relationship to the Station Footprint, Buffer Land, and Associated Facilities.

The Station Footprint and Buffer Land lie completely within an area that is zoned industrial by Itasca County. The current zoning designations for property in the vicinity of the West Range Site are shown in Figure 1.5-21 (Itasca County, MN). Zoning in the area immediately surrounding the Station Footprint and Buffer Land is shown in Figure 1.5-22. The equipment layout within the Station Footprint is shown in Figure 1.5-3.

The IGCC Power Station Footprint and Buffer Land are mostly wooded and include about 300 acres of wetlands. Data provided by the Manitoba Remote Sensing Centre shows the site to have a mix of deciduous forest, mixed forest, regeneration/young forest, and wetland bogs (see Figure 2.8-1). Approximately 35 acres of wetlands will be permanently affected by the Station Footprint and require wetland mitigation. Additional wetlands exist within transportation and utility corridors located outside Station Footprint and Buffer Land, and through which project-related infrastructure will traverse. Figure 2.8-2 from the Manitoba Remote Sensing Centre shows land uses across such corridors. The Proponent has obtained option rights to purchase the 1,260 acre parcel that includes the IGCC Power Station Footprint and Buffer Land. Several areas of the optioned property could be used to offset wetlands impacts caused by the construction of the IGCC Power Station and its Associated Facilities.

Figure 1.5-23 shows that the terrain on site is dominated by two hills between which the IGCC Power Station will be situated. The hill to the east of the Station Footprint rises approximately 60 feet above the 1,425 foot elevation at which the base of the Station's HRSGs would be located. The other dominant hill is located immediately west of the Station Footprint and rises to nearly the same height. Due to significant cuts that must be made to accommodate the IGCC Power Station Footprint within this area and the presence of surficial groundwater (see Section 2.5.2.1.1), soils within the Station Footprint and Buffer Land may require permanent water table control measures beyond temporary construction dewatering.

Two HVTL corridors traverse the Buffer Land, one in a north/south direction and a second in an east-west direction. The HVTLs that occupy the north-south corridor are not currently used. Man-made disturbances on the Project Site include numerous all terrain vehicle ("ATV") trails and a number of deer-hunting stands.

Information on the environmental setting and potential environmental consequences from construction and operation of Mesaba One and Mesaba Two and their Associated Facilities on

the West Range Site are discussed in detail in Sections 2 and 3. The current owners of properties occupying the West Range IGCC Power Station Footprint and Buffer Land are provided in Appendix 1 of the Proponent's Joint Application to the MPUC for LEPGP Site Permit, HVLT Route Permit, and Natural Gas Pipeline Permit (hereafter, the "Joint Application").

1.5.2.2 Associated Facilities

Easements across public and private lands will be required to accommodate the Associated Facilities. Ownership of properties within one quarter mile on both sides of the center alignment is provided in Appendix 1 of the Joint Application.

Figures 1.5-1 and 1.5-7 show the location of the Associated Facilities and Additional Land on the West Range Site. Environmentally relevant details of the Associated Facilities required for the construction, maintenance, and operation of Mesaba One and Mesaba Two are presented in Sections 1.12.3 to 1.12.7. Information on the current environmental setting of the Associated Facilities and the potential environmental impacts that would result from construction and operation of Mesaba One and Mesaba Two are discussed in Sections 2 and 3.

Figure 1.5-21 Zoning Designations in the Region Surrounding the West Range Site

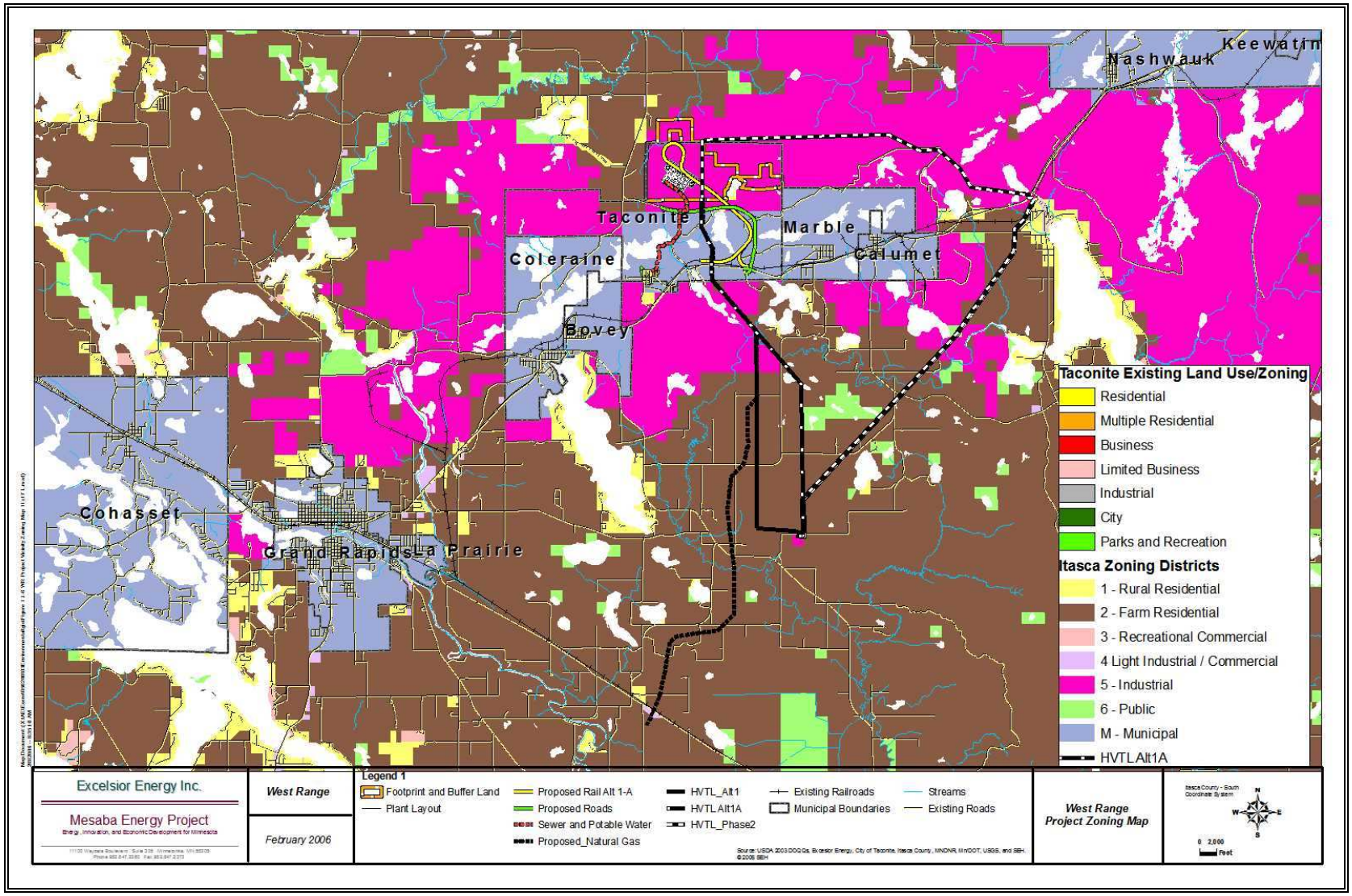


Figure 1.5-22 Zoning Designations in the Immediate Vicinity of the IGCC Power Station and Buffer Land

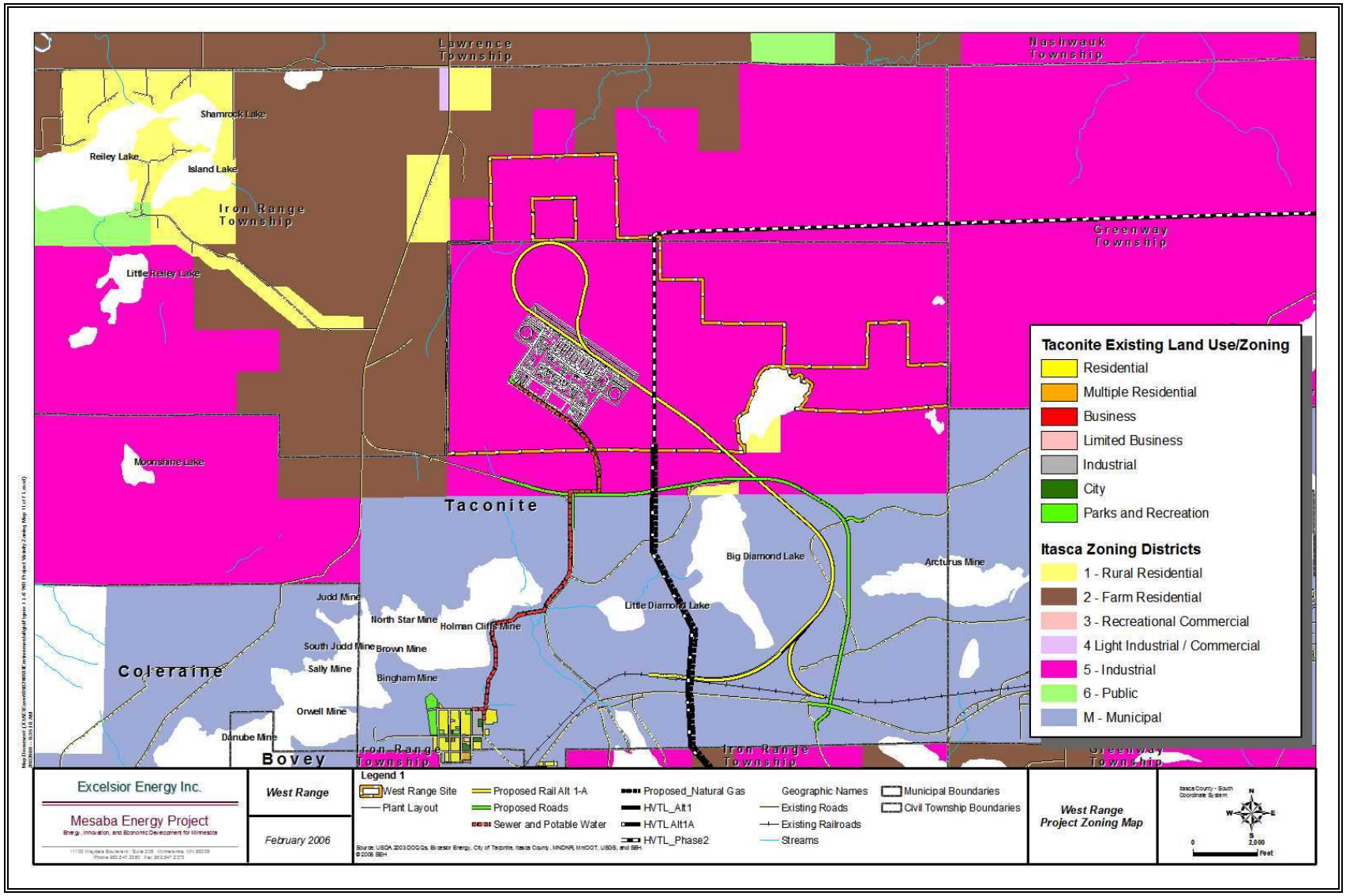
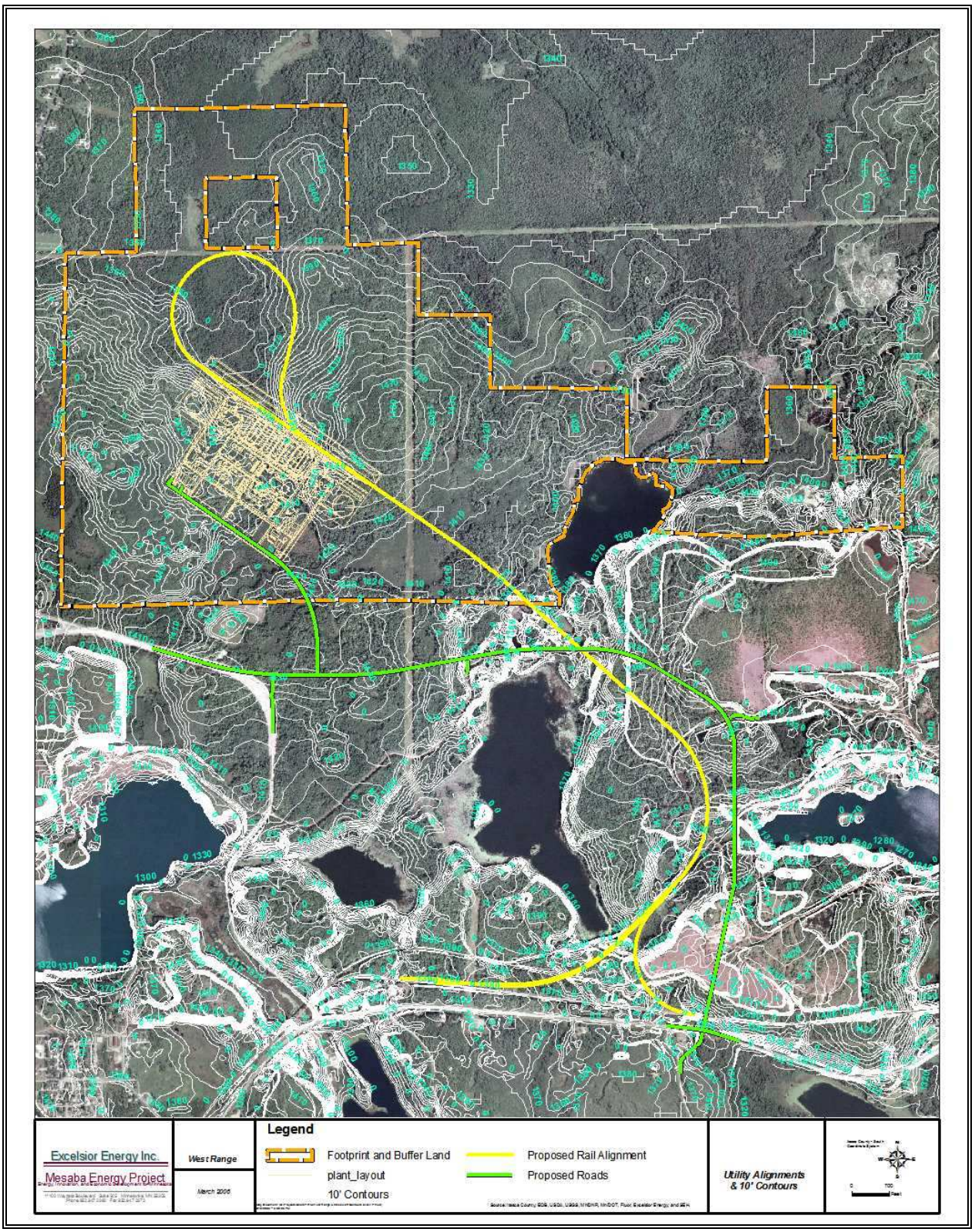


Figure 1.5-23 Topographical Map in the Vicinity of the IGCC Power Station Footprint and Buffer Land



1.5.2.3 HVTL Routes

The Proponent considered a range of alternate HVTL configurations, including staggered and unstaggered 230kV and 345kV transmission concepts, each of which offered varying levels of cost and reliability. The development of alternative transmission configurations to meet the Phase I and II IGCC Power Station generator outlet ("GO") requirements is discussed in Section 3. Figure 1.5-13 shows the Proponent's West Range Preferred and Alternate HVTL Routes for interconnecting Mesaba One and Two to the POI. Subsections 1.5.2.3.1.A and 1.5.2.3.1.B below contain a narrative description of these two routes. Figure 1.5-24 shows the significant receptors that are in the vicinity of the two routes. In accordance with Minn. R. 4400.1150 subp. 2.G, each owner whose property is within or abuts any of the proposed HVTL routes must be notified. Ownership of properties within one quarter mile on both sides of the centerline alignment of the proposed routes is provided in Appendix 2 of the Joint Application.

1.5.2.3.1 West Range Preferred Plan (Plan A)

The Proponent believes its preferred 345kV double circuit plan is the superior transmission choice. In addition to making use of exiting ROW, it also minimizes the distance between the Station Footprint and the Blackberry Substation. Further, the Proponent believes that over time, 345kV transmission development will be necessary or desirable both on the Iron Range and from the Blackberry POI to other facility interconnection points. Thus, designing the Mesaba generator outlet facilities to initially operate at 230kV and then convert to 345kV will both minimize capital costs and be in concert with necessary longer term regional transmission needs.

The design and configuration of the proposed line is described in detail in Section 1.12.1. Information on the environmental setting and potential environmental impacts of the West Range Preferred HVTL Route are discussed in detail in Sections 2 and 3.

1.5.2.3.1A Preferred Route (WRA-1)

The West Range Preferred HVTL Route would be developed in two stages. The corridor would contain single pole, double circuit structures and would carry a bundled conductor rated as 345kV between the West Range IGCC Power Station and the Blackberry Substation (see Figures 1.12-12 and 1.12-13). The double circuit 345kV HVTLs would be initially operated at 230kV voltage to support Mesaba One operations. When operation of Mesaba Two commences, the necessary transformers and other substation equipment would be added to upgrade the HVTL to its rated 345kV capacity.

Route WRA-1 extends east from the IGCC Power Station's high voltage switchyard to MP's existing 45 Line ROW and then south from the southern boundary of the Buffer Land about 1.6 miles to the retired Greenway Substation. The route continues south from the Greenway Substation approximately 6.2 miles over new, but relatively remote, ROW to intersect MP's 83L and 20L. At that point, the route would follow the existing MP ROW about 1 mile east to the Blackberry Substation.

Route WRA-1 is shown in a series of maps in Figure 1.5-25, Figure 1.5-26, and Figure 1.5-27.

1.5.2.3.1B Alternative Route (WRA-1A)

Minnesota Rule 4400.1150, subpart 2.C requires that at least one alternate route be proposed if the HVTL exceeds 200kV, is five miles or greater in length, and less than 80 percent of the HVTL is located along existing HVTL rights of way (Minn. R. 4400.2000, subps. 1.D and 1.E). Because the West Range Preferred HVTL Route will require additional new ROW of about six miles, the Proponent must propose at least one alternative HVTL route.

The alternative route proposed by the Proponent to satisfy the above requirements is shown in Figures 1.5-28, 1.5-29 and 1.5-30. This alternate route shares in common with the Preferred Route WRA-1 about 3.3 miles of ROW and parallels about 2 miles of the secondary road known as Twin Lakes Road. Route WRA-1A crosses or abuts the Swan River in several locations and crosses numerous areas that have been cleared but are unoccupied. This route provides a direct path to the POI, affects a limited number of residents (see Section 2.1.1.3), can be moved to generally avoid nearby residents, and shares 0.9 miles of ROW with MP's existing 62L corridor.

1.5.2.3.2 West Range Contingent Plan (Plan B)

As noted in Section 1.5.1.2.2, Plan B will be implemented if MISO determines that the 345kV development associated with Plan A is inconsistent with regional transmission planning initiatives. The design and configuration of the proposed HVTL and structures are described in detail in Section 4. Information on the environmental setting and potential environmental impacts of the West Range Alternative HVTL Route are discussed in detail in Sections 2 and 3.

1.5.2.3.2A Plan B: Phase 1

1.5.2.3.2A(1)(a) Preferred Route (WRB-1)

See Section 1.5.1.2.2.B(1). The preferred Route WRB-1 is identical to the preferred Route WRA-1 but involves the use of a double circuit 230kV HVTL instead of a 345kV double circuit. The Plan B preferred route will also require the same additional new six miles of ROW and, therefore, the Proponent must propose at least one alternative HVTL route.

1.5.2.3.2A(1)(b) Alternate Route (WRB-1A)

See Section 1.5.1.2.2.B(2). The alternate Route WRB-1A is identical to the preferred Route WRA-1A with the exception that Route WRB-1A will involve use of a double circuit 230kV HVTL.

1.5.2.3.2B Plan B: Phase II

1.5.2.3.2B(1)(a) Preferred Route (WRB-2)

See Section 1.5.1.2.2C(3). The preferred route WRB-2 for Phase II under Plan B will be the route not selected in Phase I of Plan B (in other words, one of the two routes identified above in Section 1.5.2.3.2.A(1) or 1.5.2.3.2.A(2).

1.5.2.3.2B(1)(b) Alternate Route (WRB-2A)

See Section 1.5.1.2.2C(4). The alternate route WRB-2A will involve use of the existing 28L and 62L corridors as shown in Figures 1.5-31 through 1.5-34. See Figure 1.12-22 to identify HVTL structure differences used in this route.

Figure 1.5-24 Significant Receptors Along the West Range Preferred and Alternate HVTL Routes

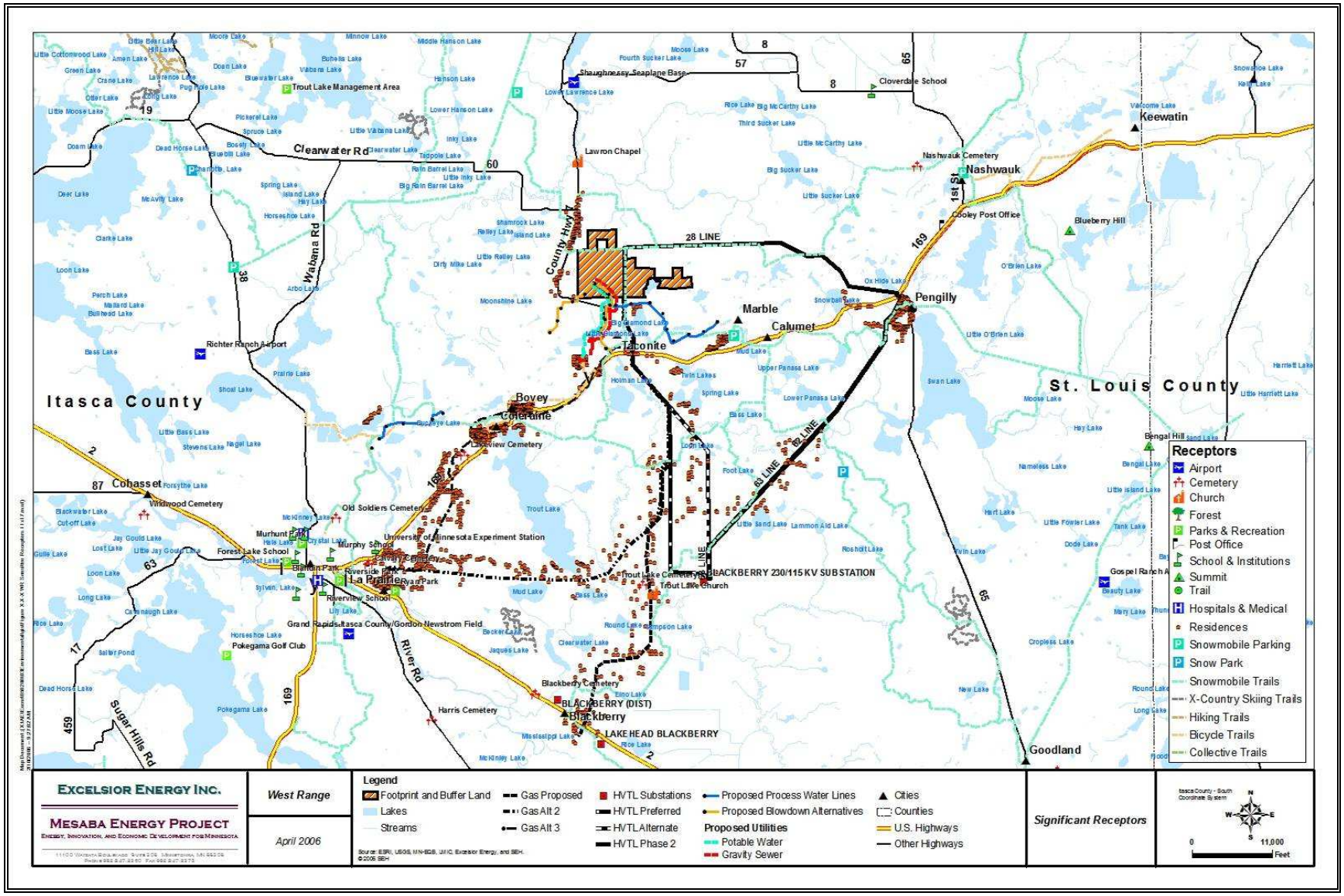


Figure 1.5-25 West Range Plan A: Preferred HVTL Route (WRA-1), Segment 1

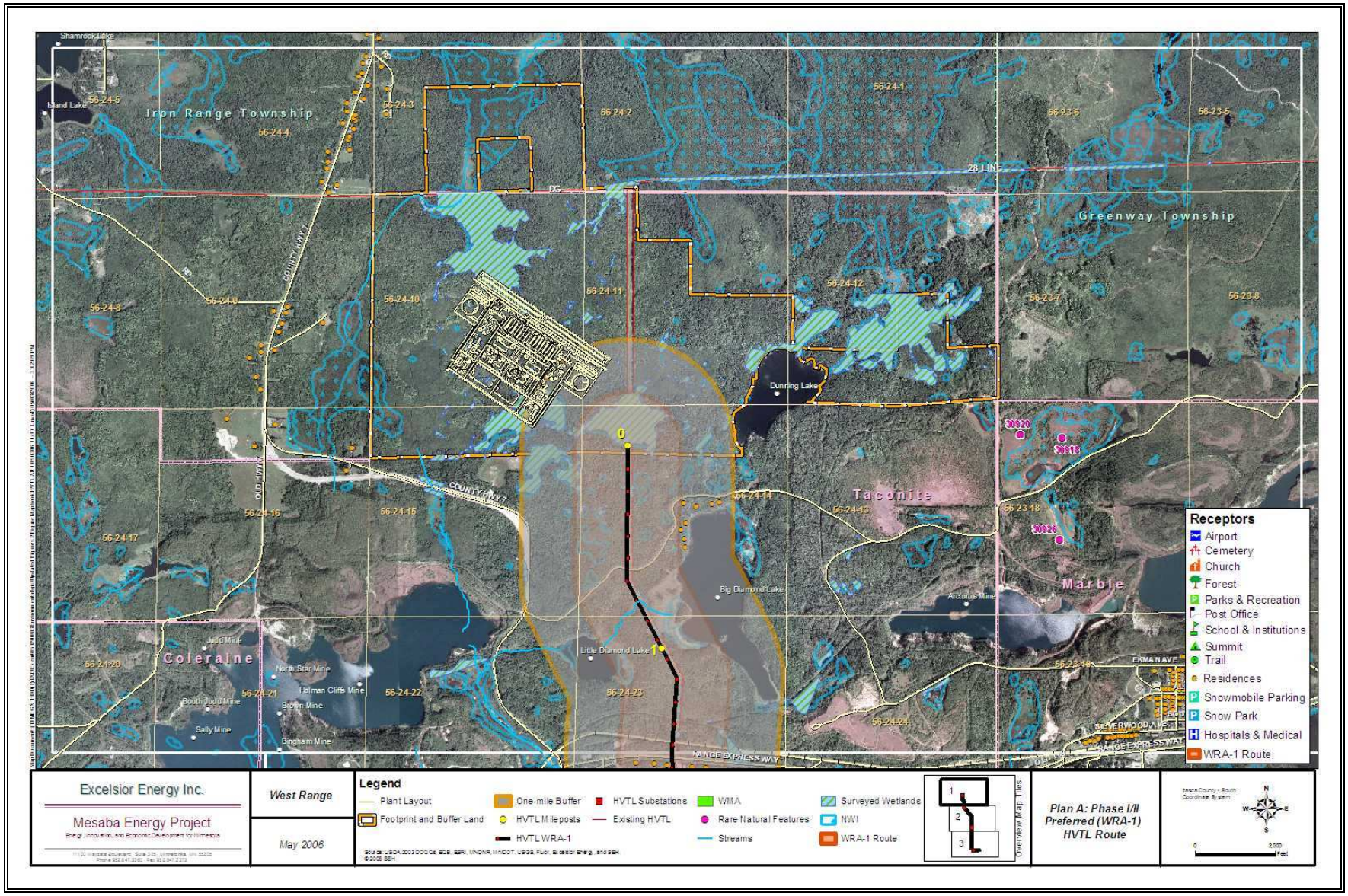


Figure 1.5-26 West Range Plan A: Preferred HVTL Route (WRA-1), Segment 2

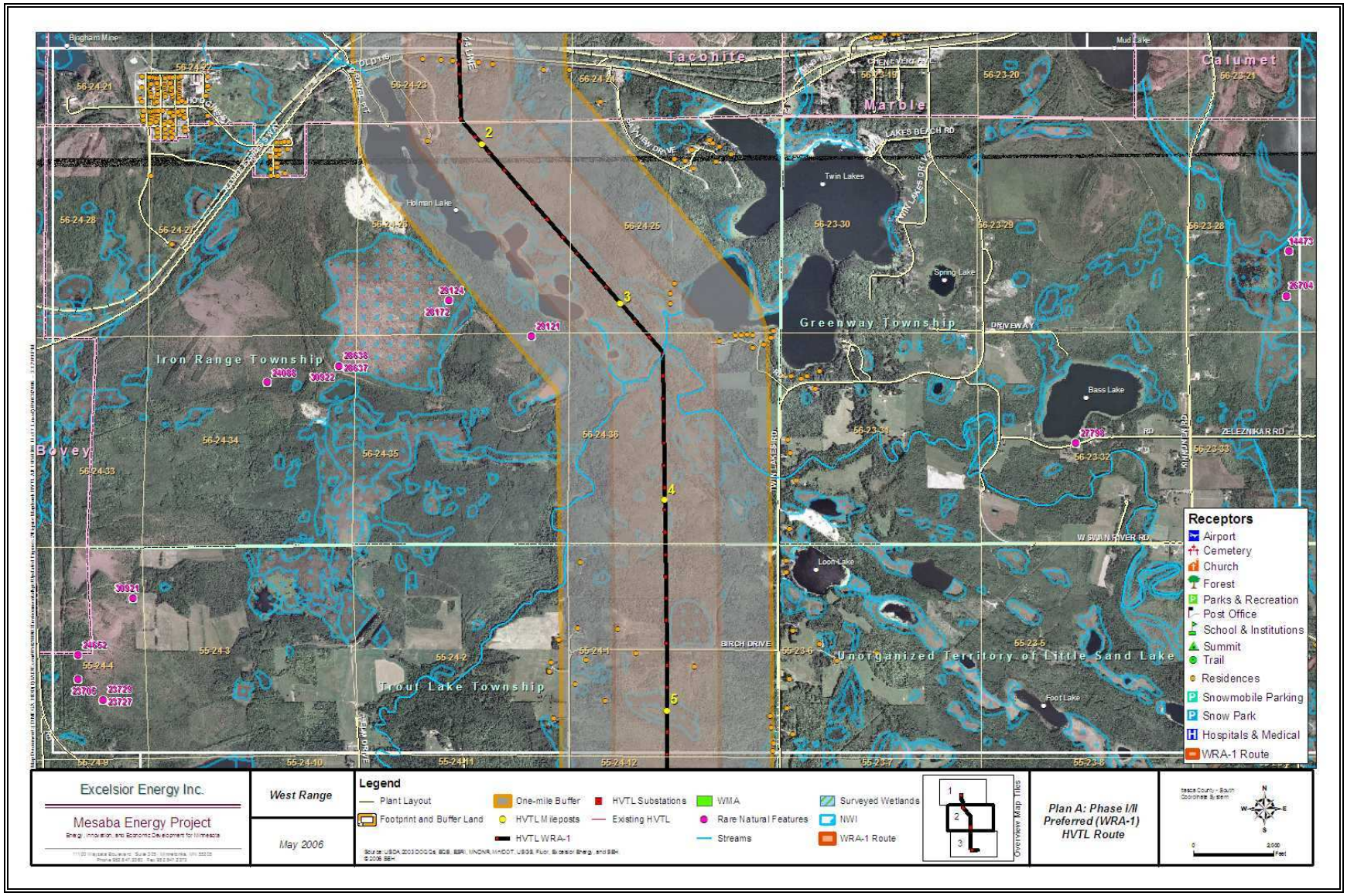


Figure 1.5-27 West Range Plan A: Preferred HVTL Route (WRA-1), Segment 3

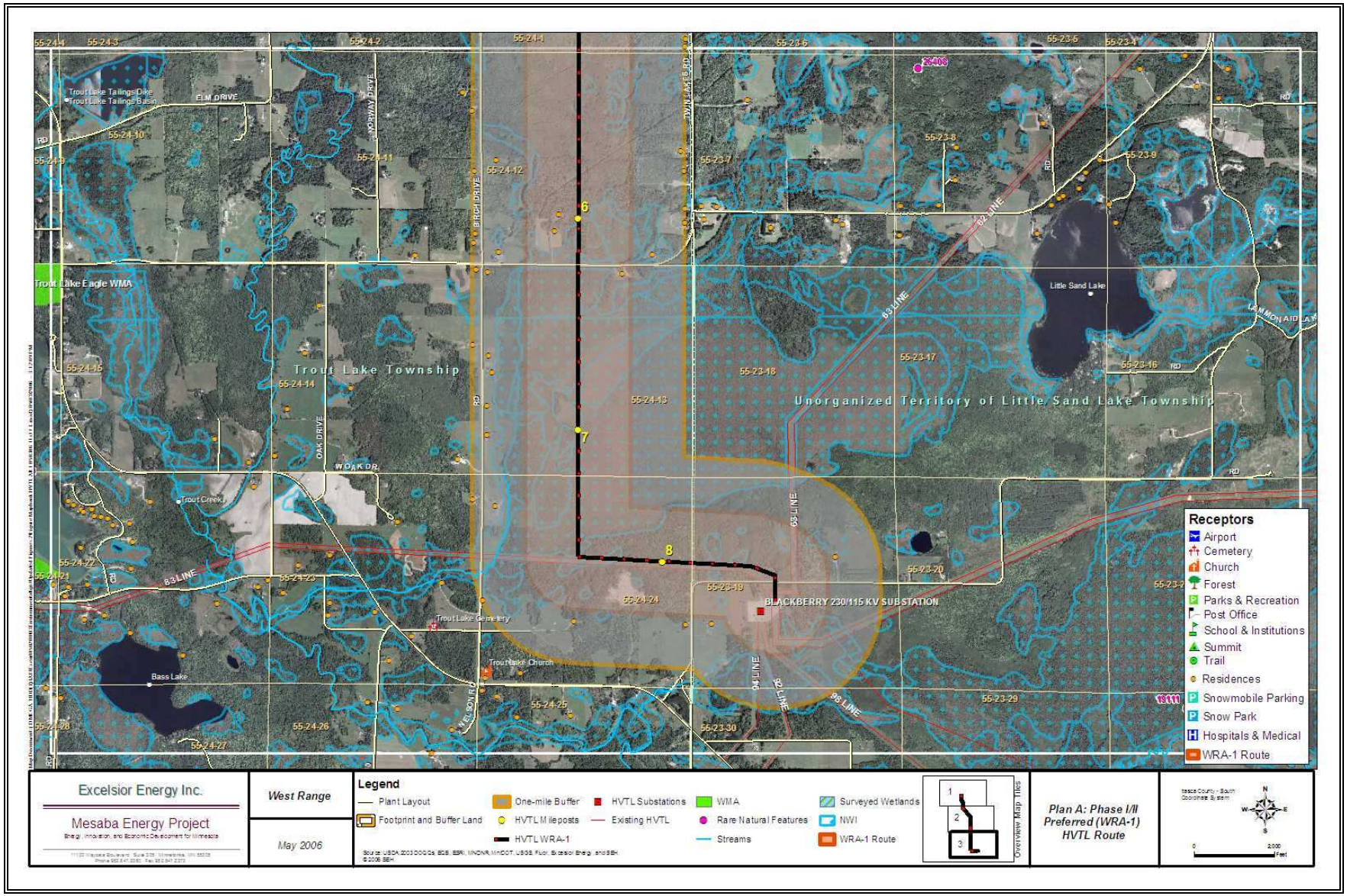


Figure 1.5-28 West Range Plan A: Alternate HVTL Route (WRA-1A), Segment 1

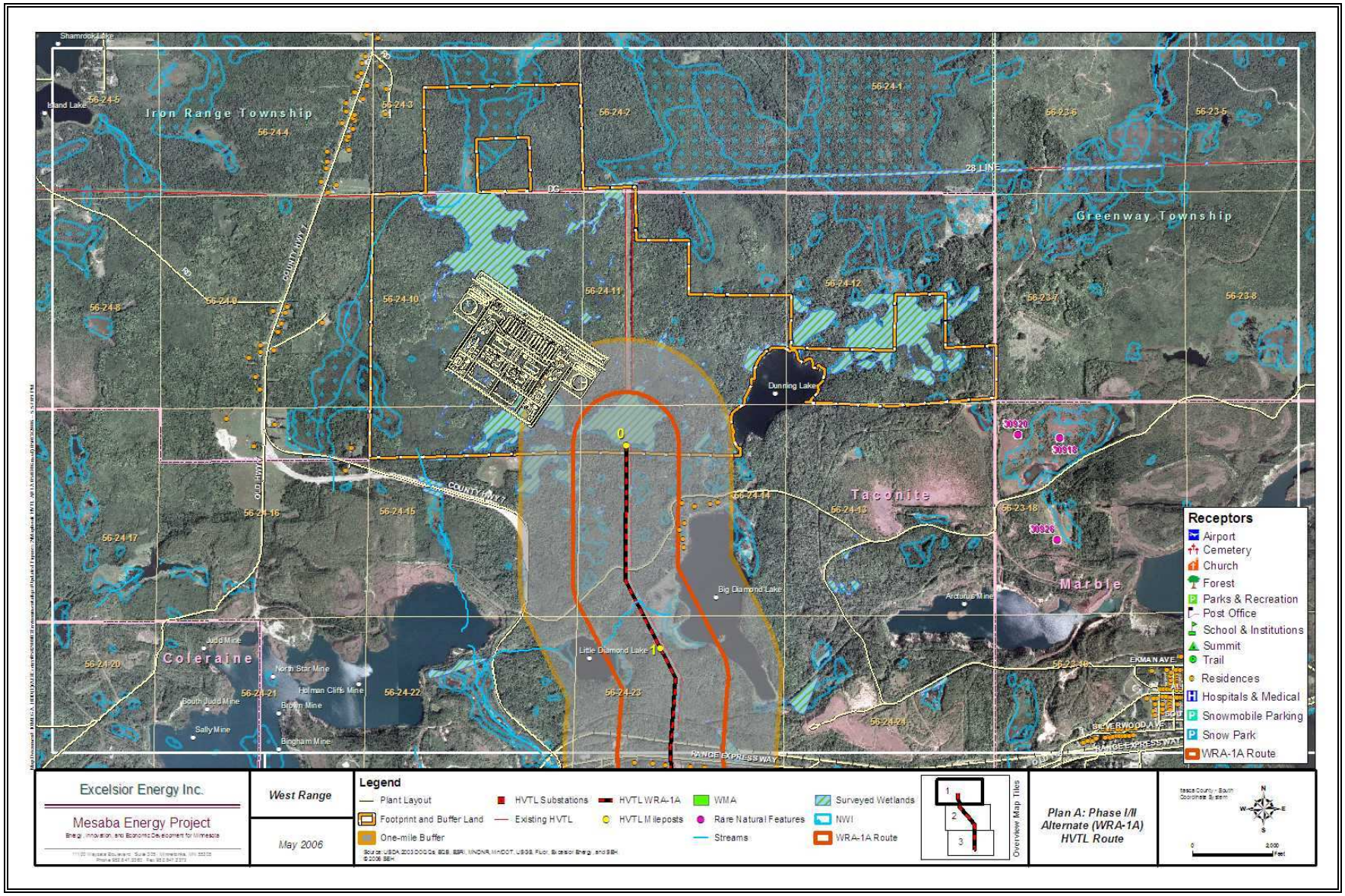


Figure 1.5-29 West Range Plan A: Alternate HVTL Route (WRA-1A), Segment 2

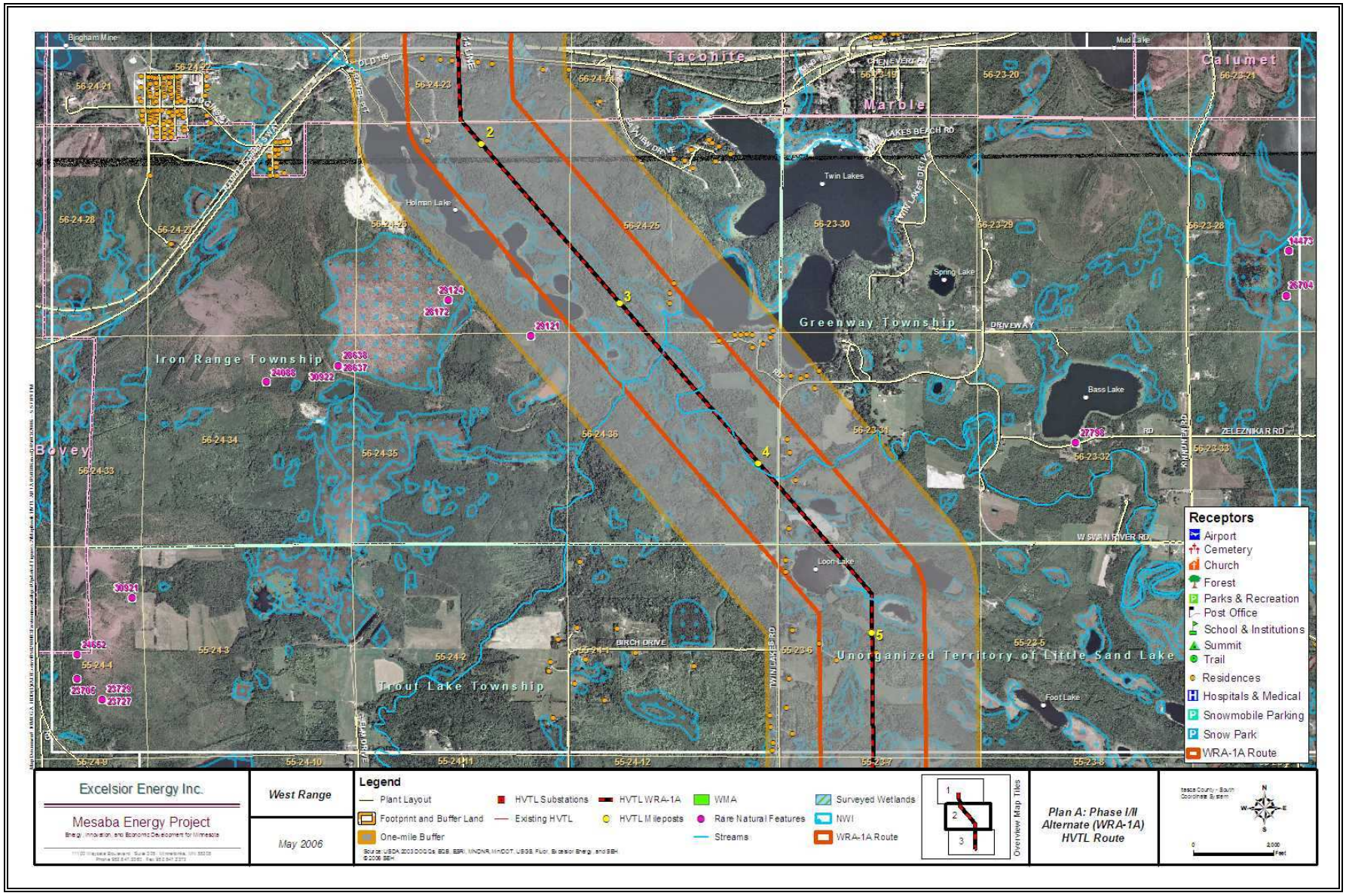


Figure 1.5-30 West Range Plan A: Alternate HVTL Route (WRA-1A), Segment 3

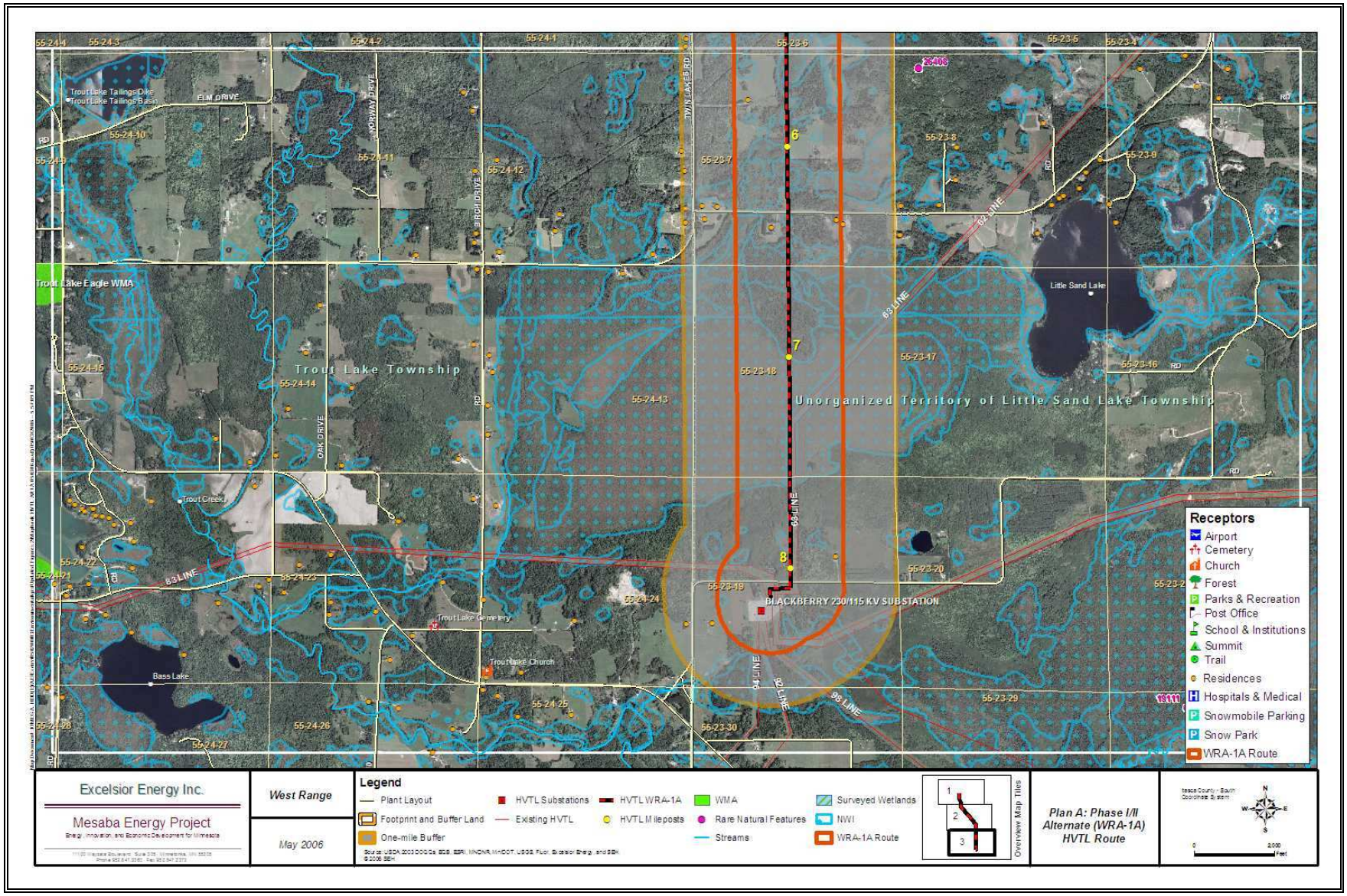


Figure 1.5-31 West Range Plan B: Alternate Route Phase II (WRB-2A), Segment 1

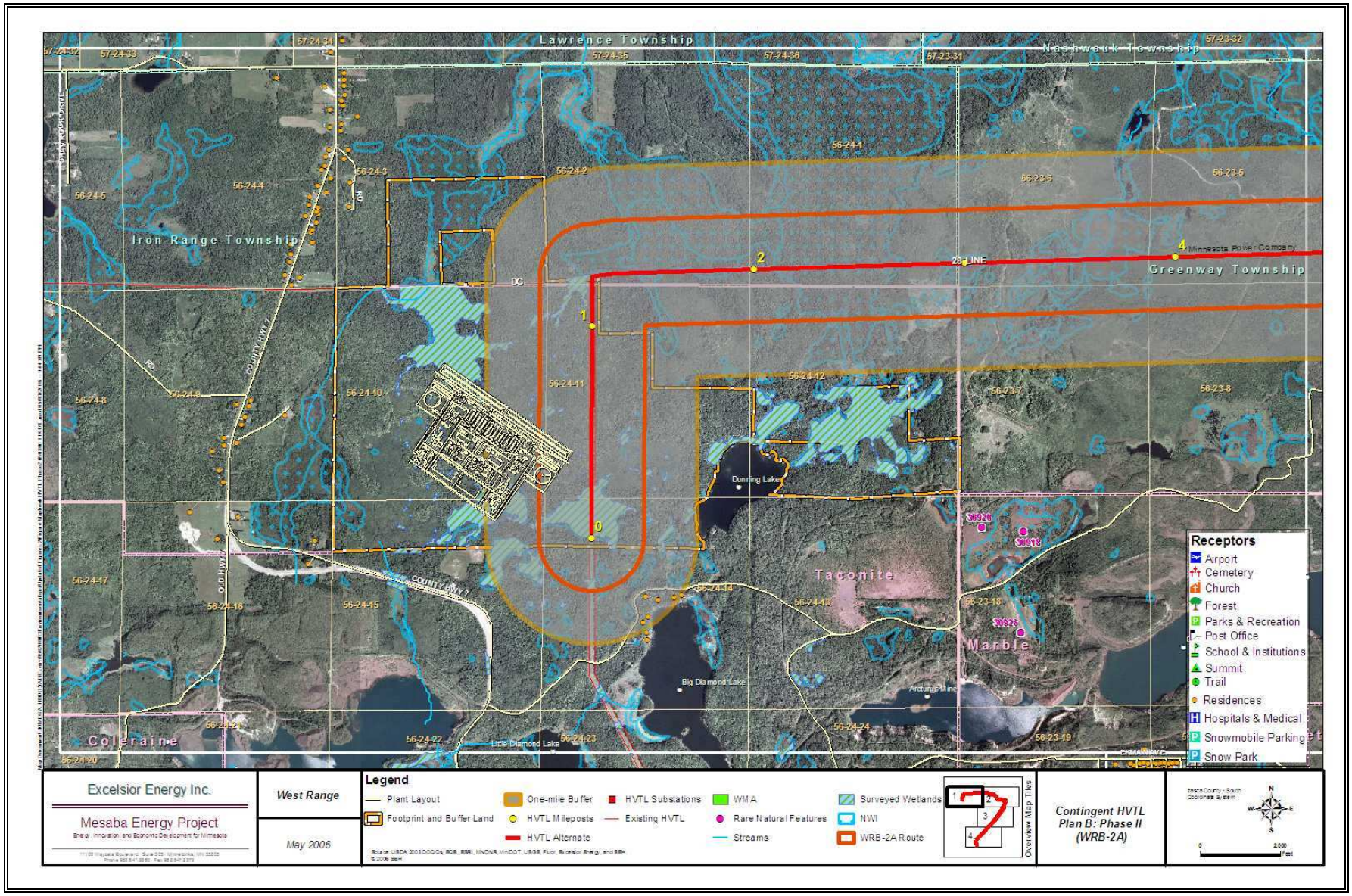


Figure 1.5-32 West Range Plan B: Alternate Route Phase II (WRB-2A), Segment 2

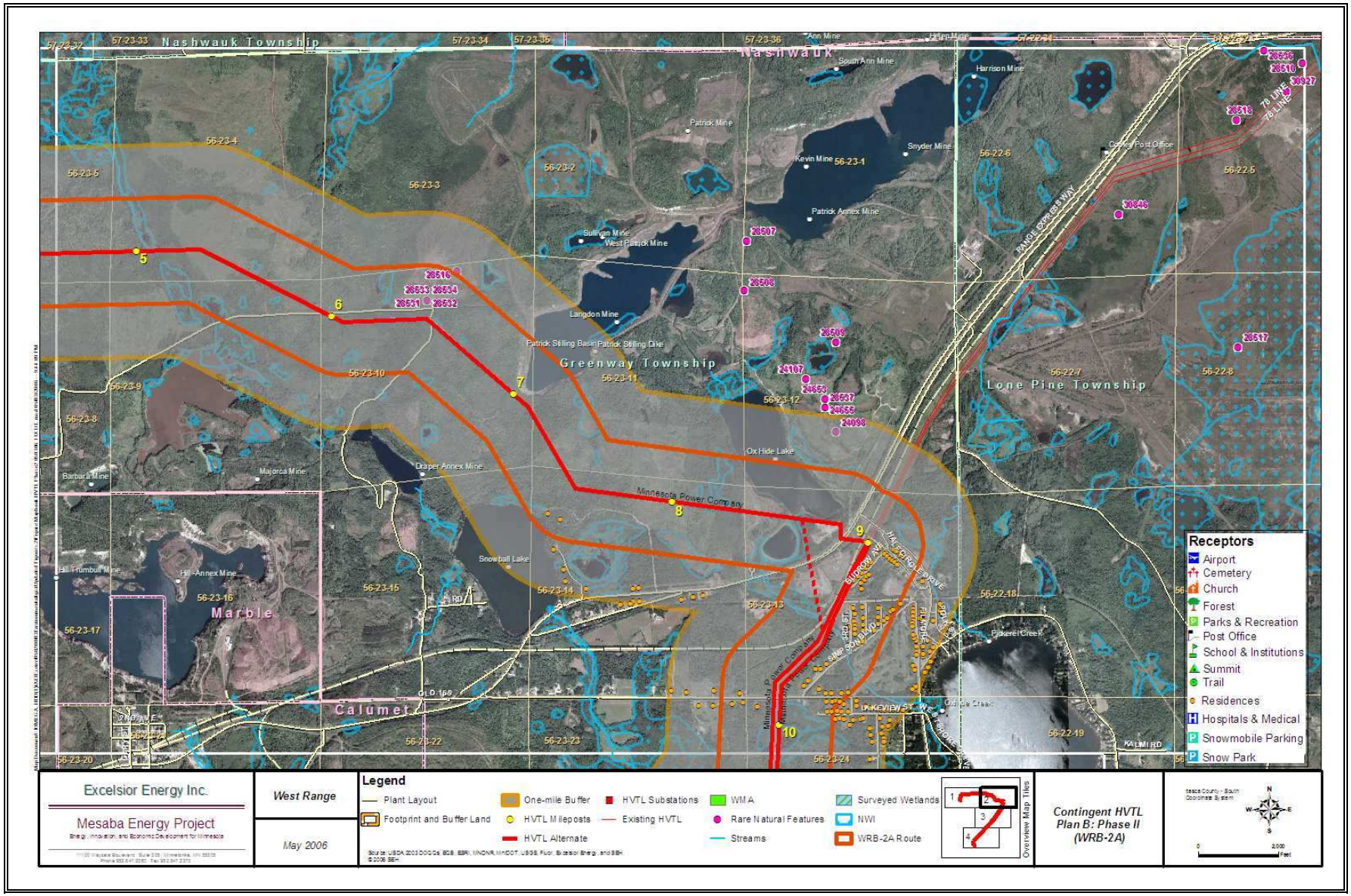


Figure 1.5-33 West Range Plan B: Alternate Route Phase II (WRB-2A), Segment 3

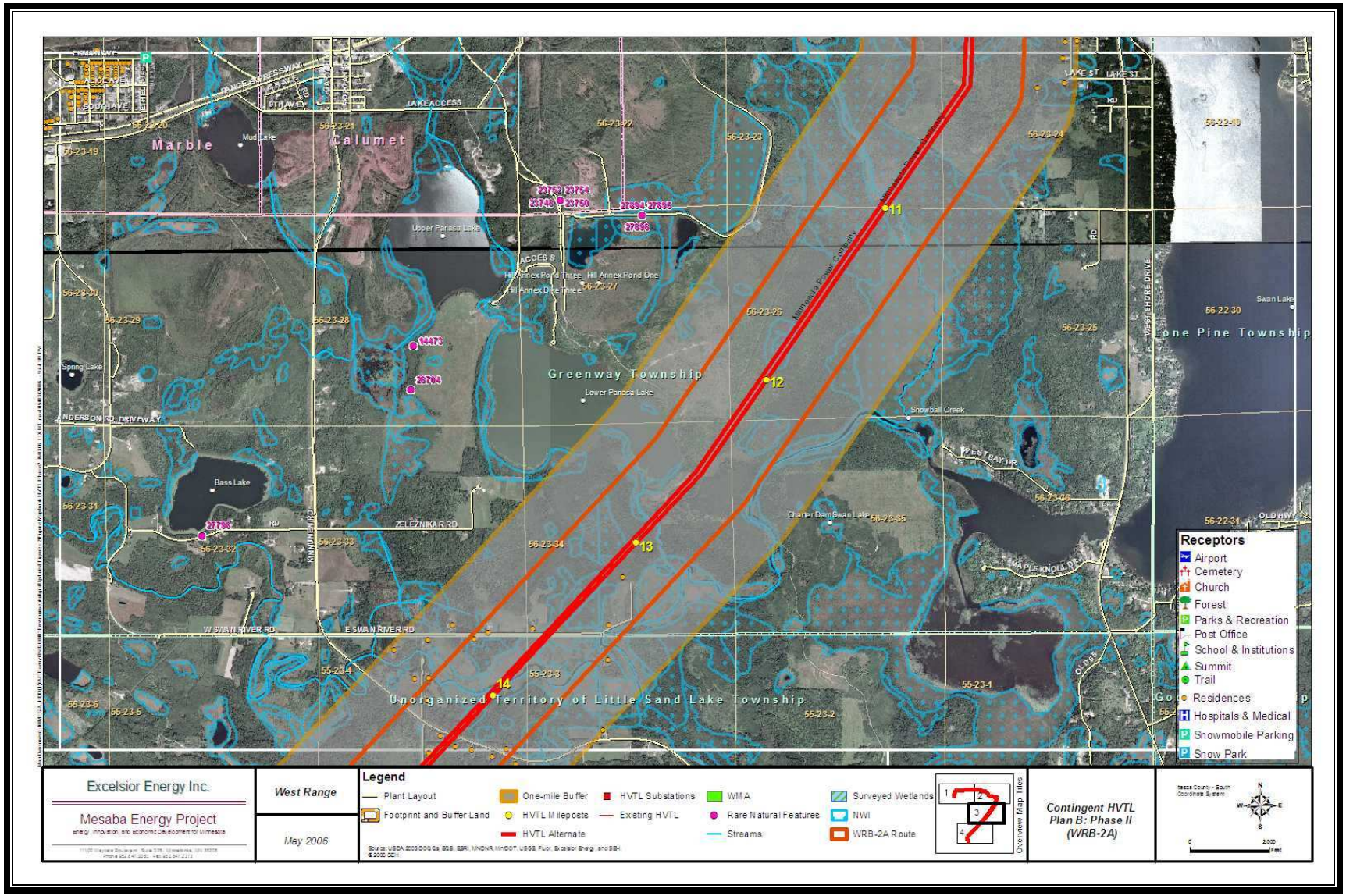
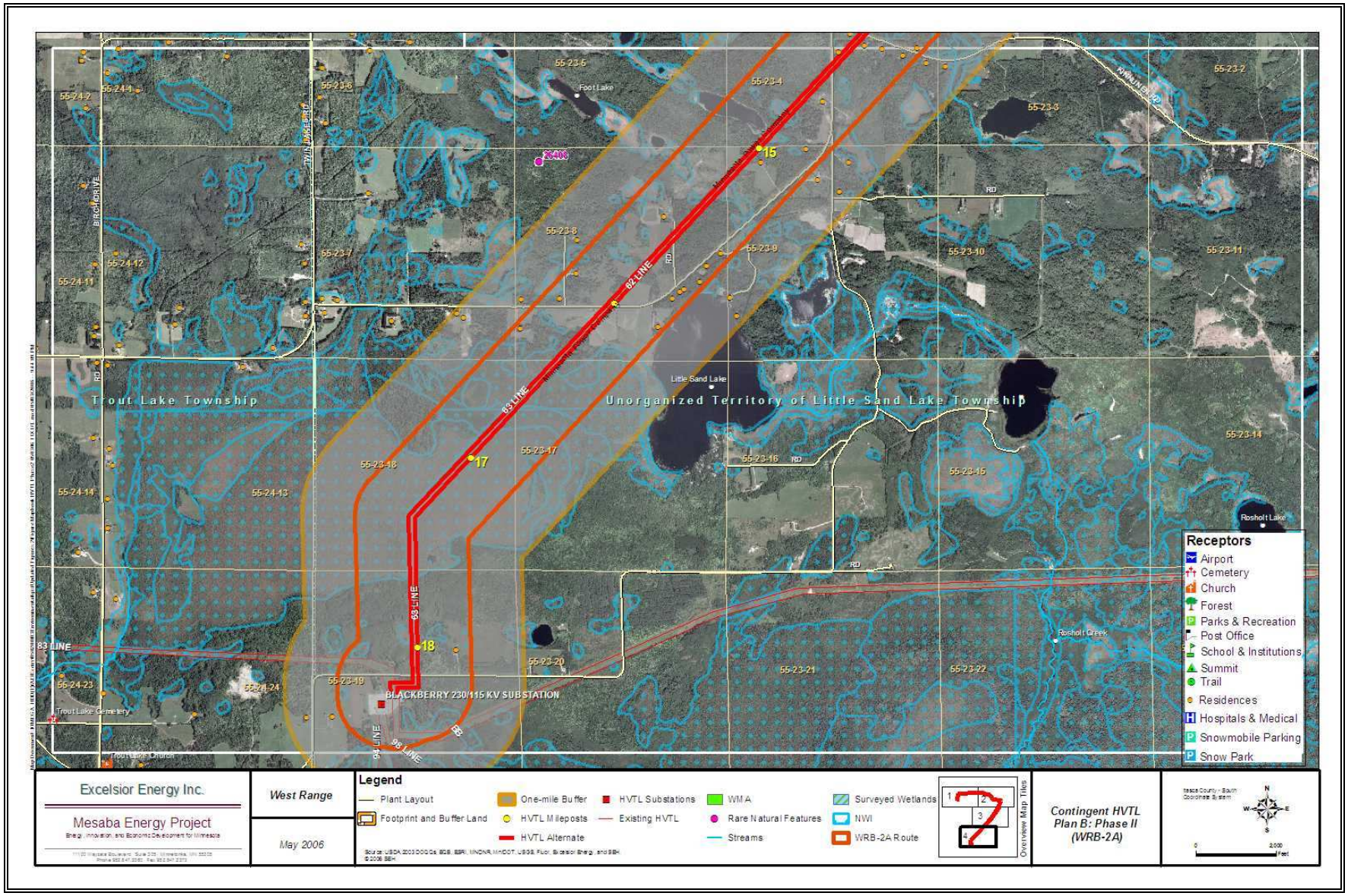


Figure 1.5-34 West Range Plan B: Alternate Route Phase II (WRB-2A), Segment 4



1.5.2.4 Natural Gas Pipeline Routes

1.5.2.4.1 Proposed Gas Pipeline Route

The Proponent proposes to construct, own and operate one 16 inch (or one 24 inch diameter pipeline if Minnesota Steel Industries and the Proponent mutually agree on the conditions of service) diameter gas pipeline to supply natural gas to the IGCC Power Station that would tap the two existing 36-inch GLG pipelines approximately 12 miles due south of the West Range Power Station Footprint. The proposed gas pipeline route would originate about 0.6 miles southeast of the GLG block valve station located just south of U.S. Highway 2 near the unincorporated town of Blackberry, Minnesota (see Figure 1.5-35). The proposed pipeline route will follow 0.9 miles of existing pipeline route and/or HVTL ROWs. The proposed route will require approximately 12.3 miles of new pipeline easements along its 13.2 mile proposed route. Figures 1.5-35 through 1.5-38 provide detailed aerial photographs along the proposed pipeline route and display the significant receptors identified in Figure 1.5-24.

The first 2.0 miles of the route would extend north-northeast to avoid a large wetland bog north of U.S. Highway 2. From there the proposed route would turn due east approximately 2 miles to be aligned directly south of the West Range IGCC Power Station. The proposed route would extend north from this point about 1.5 miles where it would cross the Swan River and then continue until intersecting with NNG's 8-inch pipeline ROW. The route would parallel the NNG pipeline 0.9 miles and then follow along the proposed HVTL preferred corridor ROW for 4.2 miles. Within this segment, the route would cross the Swan River for a second time. The last 1.3 miles of the proposed route would run within an existing, albeit presently unused HVTL corridor to the West Range IGCC Power Station. A milepost map is provided as Figure 1.5-39 to help in identifying where significant features are to be found along the West Range Proposed Natural Gas Pipeline Route and the other pipeline routes considered.

The following information is required, in part, by Minn. R. 4415.0115, subps. D.1 through D.5 for the West Range Proposed Natural Gas Pipeline Route:

- The general location of the West Range Proposed Natural Gas Pipeline Route is shown in 1.5-39 as traversing from the GLG 36 inch diameter pipeline south of State Highway 2 near the unincorporated community of Blackberry, Minnesota to the West Range IGCC Power Station termination point, approximately 12 miles north in the City of Taconite, Minnesota. Figure 1.5-20 and 1.5-35 shows the GLG natural gas pipeline near the proposed tapping point.
- The planned use and purpose of the natural gas pipeline will be to provide startup and backup fuel for Mesaba One and Mesaba Two.
- The planned in-service date for the West Range Proposed Natural Gas Pipeline Route is the 4th quarter of 2010. For Mesaba Two, the planned in-service date is the 4th quarter of 2012. (See Section 1.12.2.1 for a compilation of pipeline design and operational information.)
- Land uses traversed by the proposed route include grasslands, regeneration/young forest, deciduous forest land and smaller tracts of agricultural lands and wetlands. Detailed information regarding the existing land uses along the route and the environmental impacts to be expected in constructing and operating the West Range Proposed Natural Gas Pipeline are provided in Sections 2 and 3. Three residences appear to be located between 100-300 feet of the centerline of the proposed route (see Section 2.1). Sections 1.12.2.1.5 and 1.12.2.1.6

provide further descriptions of ROW requirements and pipeline construction procedures, respectively. The design and configuration of the proposed pipeline is described in Section 1.12.2.1.

Ownership of properties within one quarter mile on both sides of the center alignment of the proposed routes is provided in Appendix 3 of the Joint Application

1.5.2.4.2 Other Considered Gas Pipeline Routes

The Proponent has considered two other possible natural gas pipeline routes to bring the required natural gas to the West Range IGCC Power Station. Both alternate routes, like the proposed route, would involve tapping the two existing 36-inch diameter GLG pipelines. Unlike the proposed route, a pipeline developed along either of the other considered routes would be licensed/permitted, constructed, owned and operated by NNG rather than the Proponent (see Section 1.2.6.2.8). Both alternate routes would originate approximately 9.4 miles southwest of the West Range IGCC Power Station at the La Prairie tap and metering point located in La Prairie, Minnesota. These potential pipeline routes are presented in two sets of figures in this section for comparison purposes only as they are described in more detail and compared with the proposed route in the ES.

Figures 1.5-40 to 1.5-43 trace the NNG pipeline route labeled Alternate 2 from its tapping point in La Prairie to the IGCC Power Station Footprint via Trout Lake. Figures 1.5-44 through to 1.5-46 trace the NNG pipeline route labeled Alternate 3 from its tapping point in La Prairie to the IGCC Power Station Footprint via Coleraine and Bovey. Either of these two routes would be utilized by NNG for construction of its pipelines. However, the Proponent has evaluated each to assess its licensability and has placed such evaluations into the record of this proceeding in recognition of the potential for working with NNG to supply natural gas to Mesaba One and Mesaba Two.

Table 1.5-5 presents an environmental comparison of the three alternative natural gas pipeline routes.

Table 1.5-5
Environmental Comparison of Pipeline Routes West Range Project Site

Environmental Attribute		Alternative 1	Alternative 2	Alternative 3
Pipeline Length	Existing Corridor	2.5 miles	10.5 miles	7 miles
	New Corridor	10.7 miles	4.5 miles	5.5 miles
Diameter/Pressure	New	16-20”ID/1098psi	TBD ID/1098psi	TBD ID/1098psi
Landowners Along Route				
Residential Dwellings	Pipeline <300’	3	5	22
Water Crossings	Stream	4	4	4
	Lake	0	0	0

Figure 1.5-35 West Range Proposed Natural Gas Pipeline Route: Segment 1

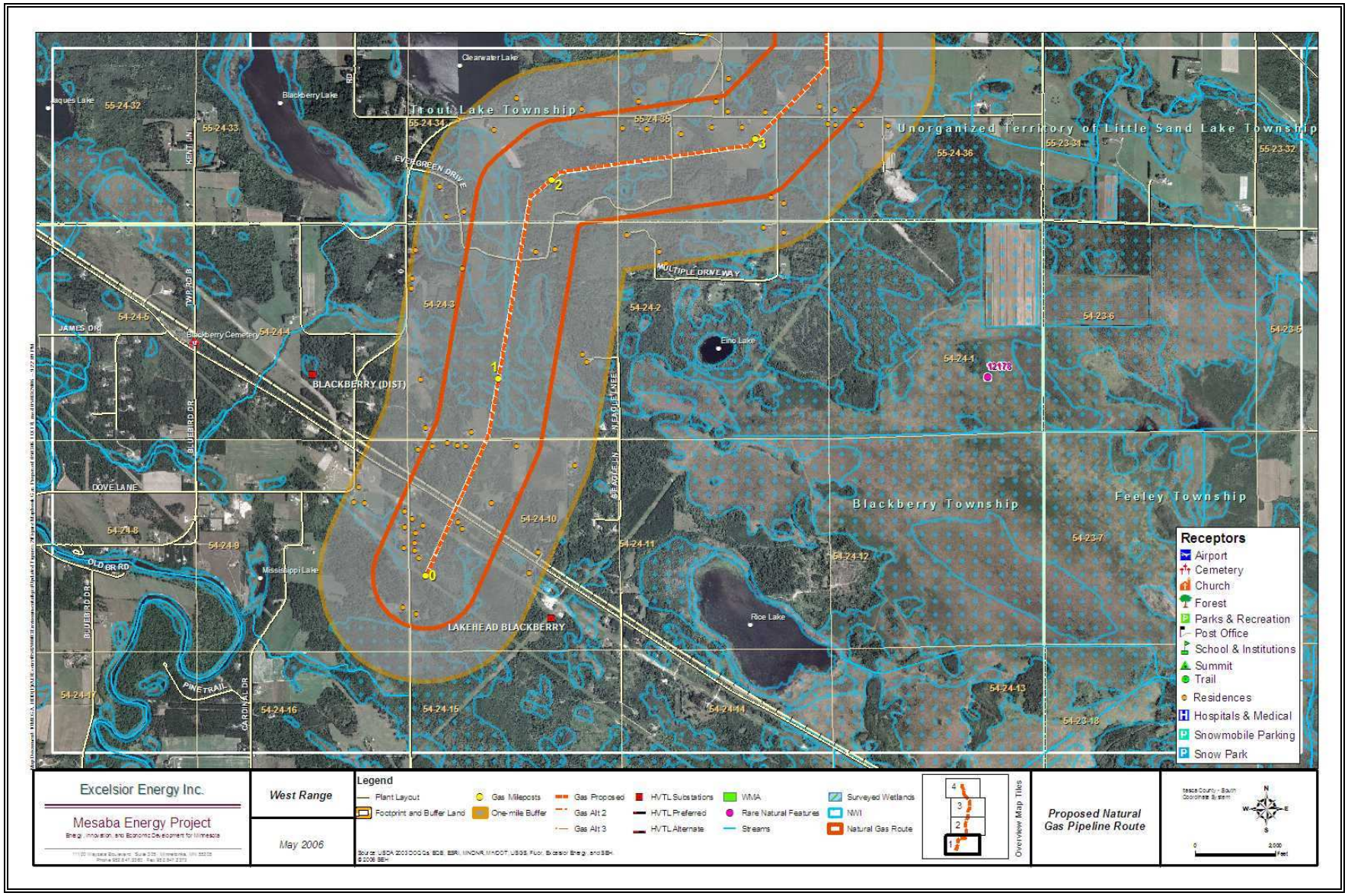


Figure 1.5-36 West Range Proposed Natural Gas Pipeline Route: Segment 2

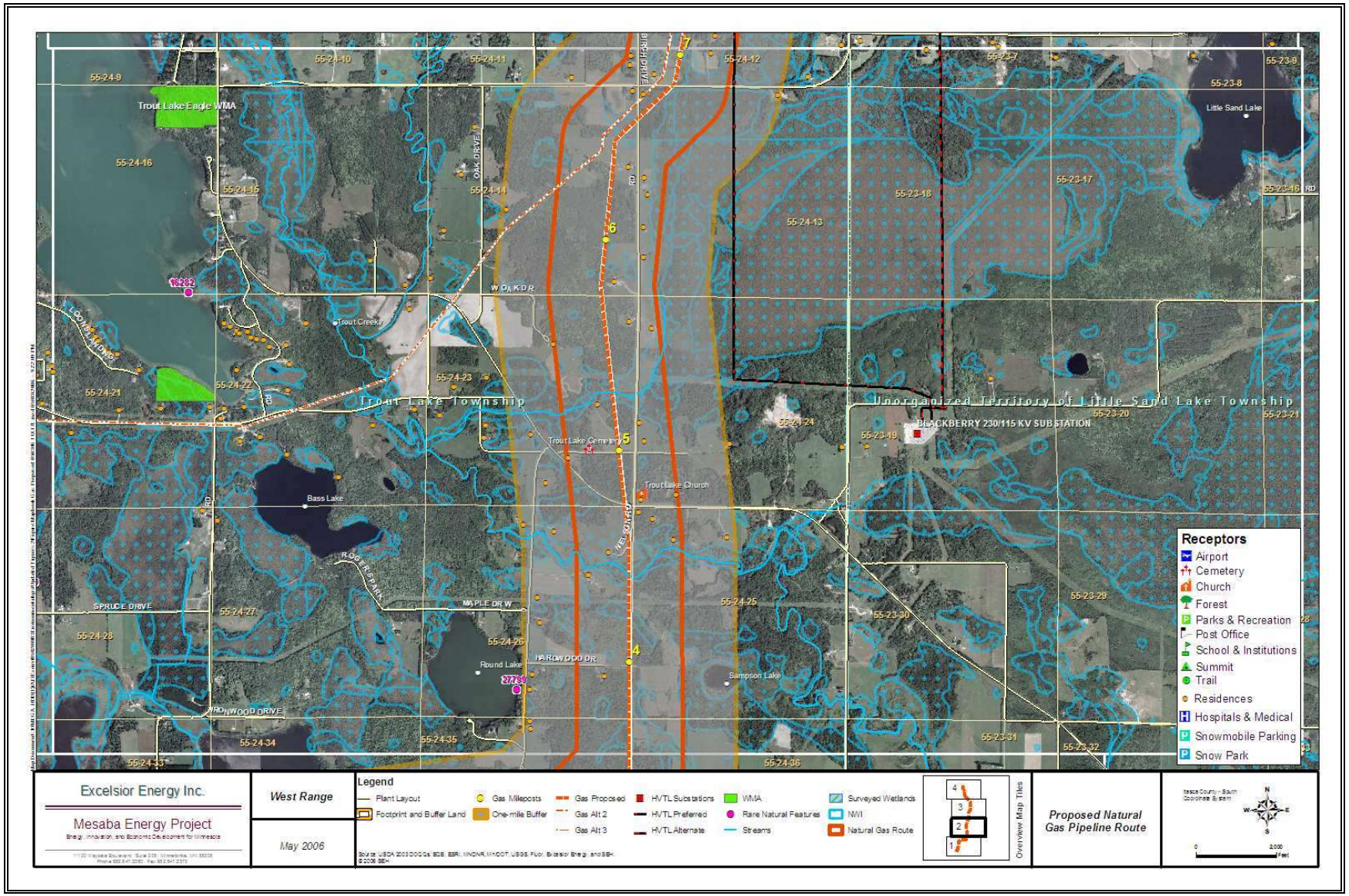


Figure 1.5-37 West Range Proposed Natural Gas Pipeline Route: Segment 3

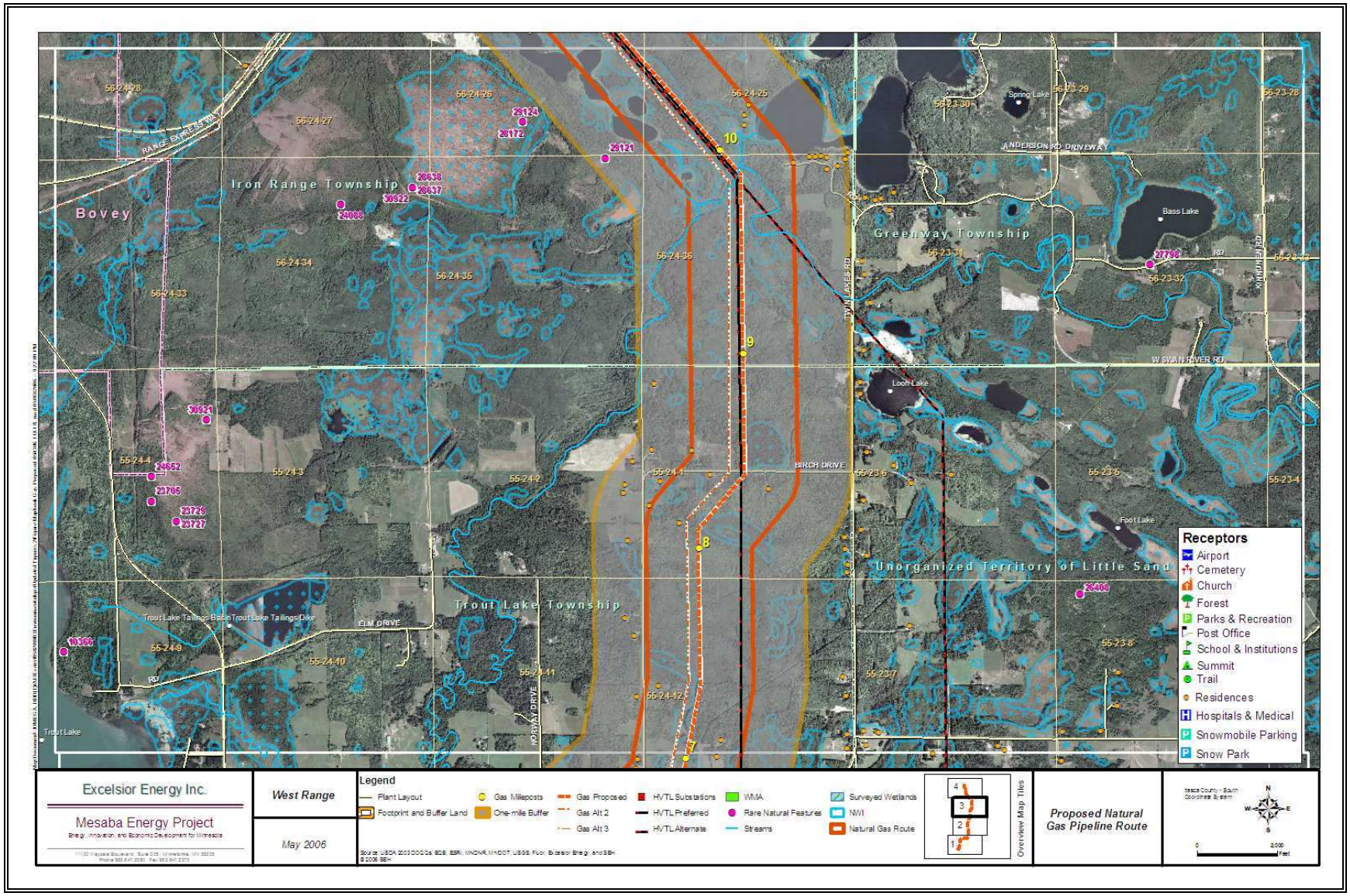


Figure 1.5-38 West Range Proposed Natural Gas Pipeline Route: Segment 4

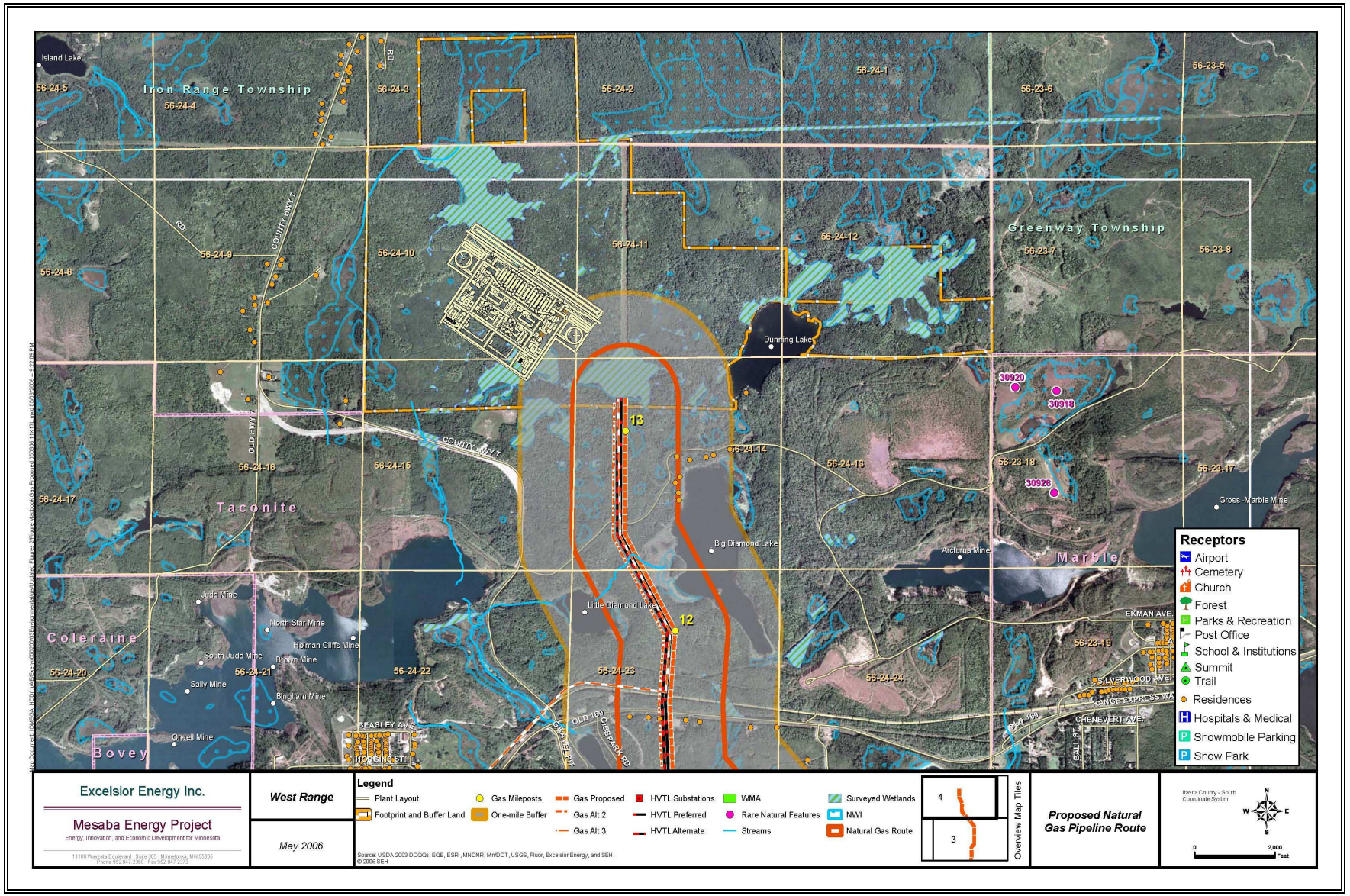


Figure 1.5-39 West Range Natural Gas Pipeline Route Milepost Map

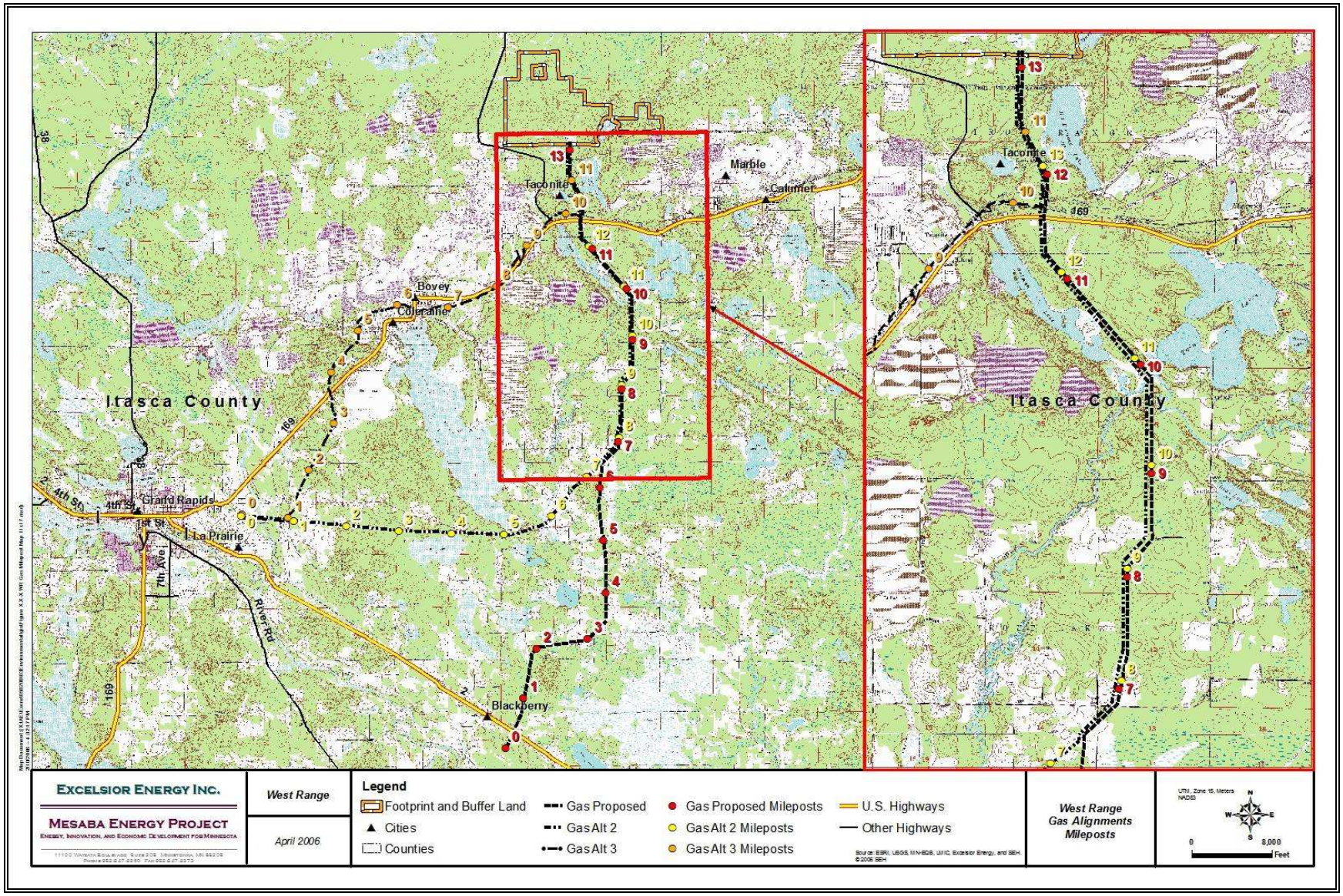


Figure 1.5-40 West Range Alternate Natural Gas Pipeline Route: NNG No.2, Segment 1

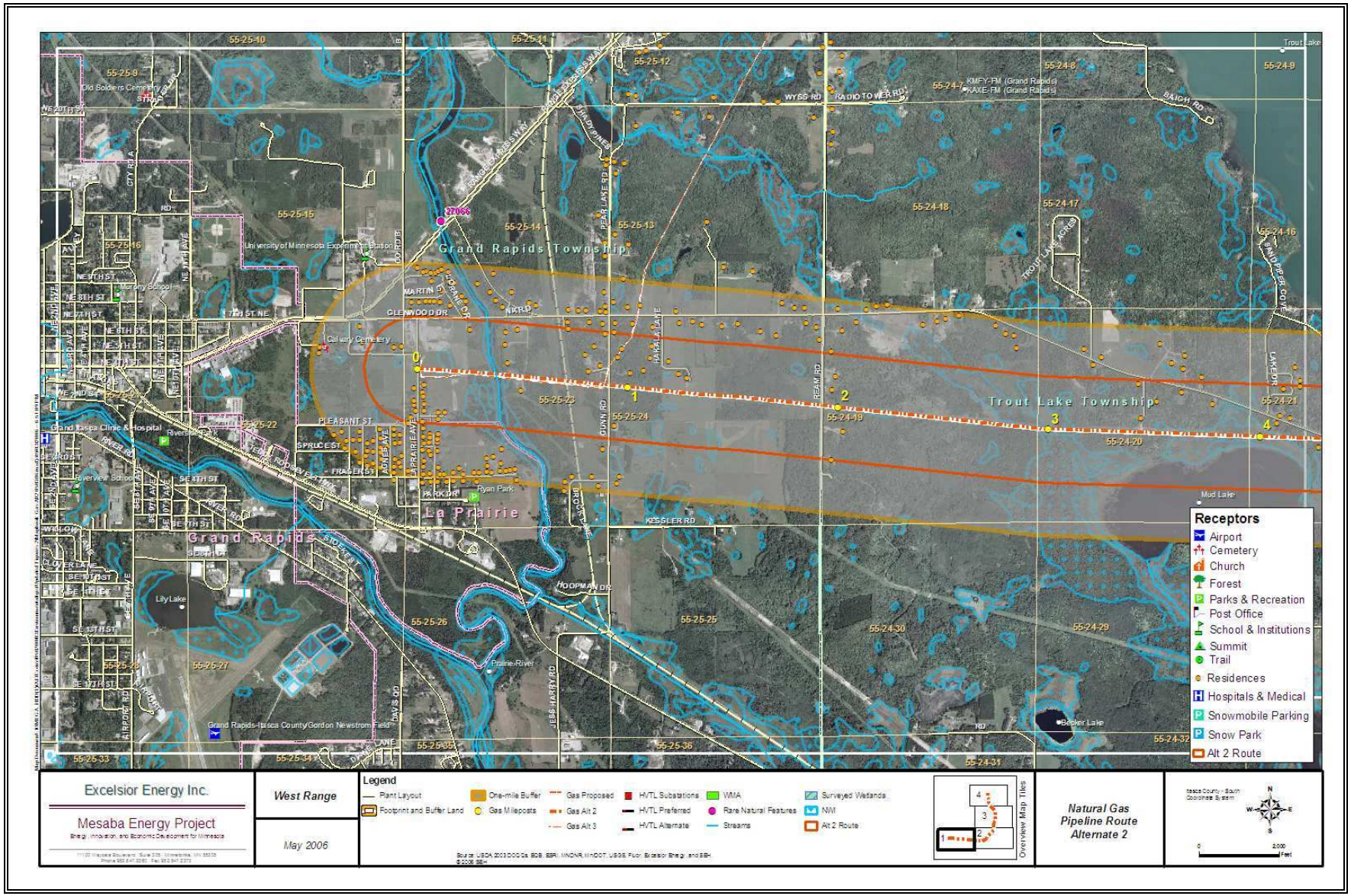


Figure 1.5-41 West Range Alternate Natural Gas Pipeline Route: NNG No.2, Segment 2

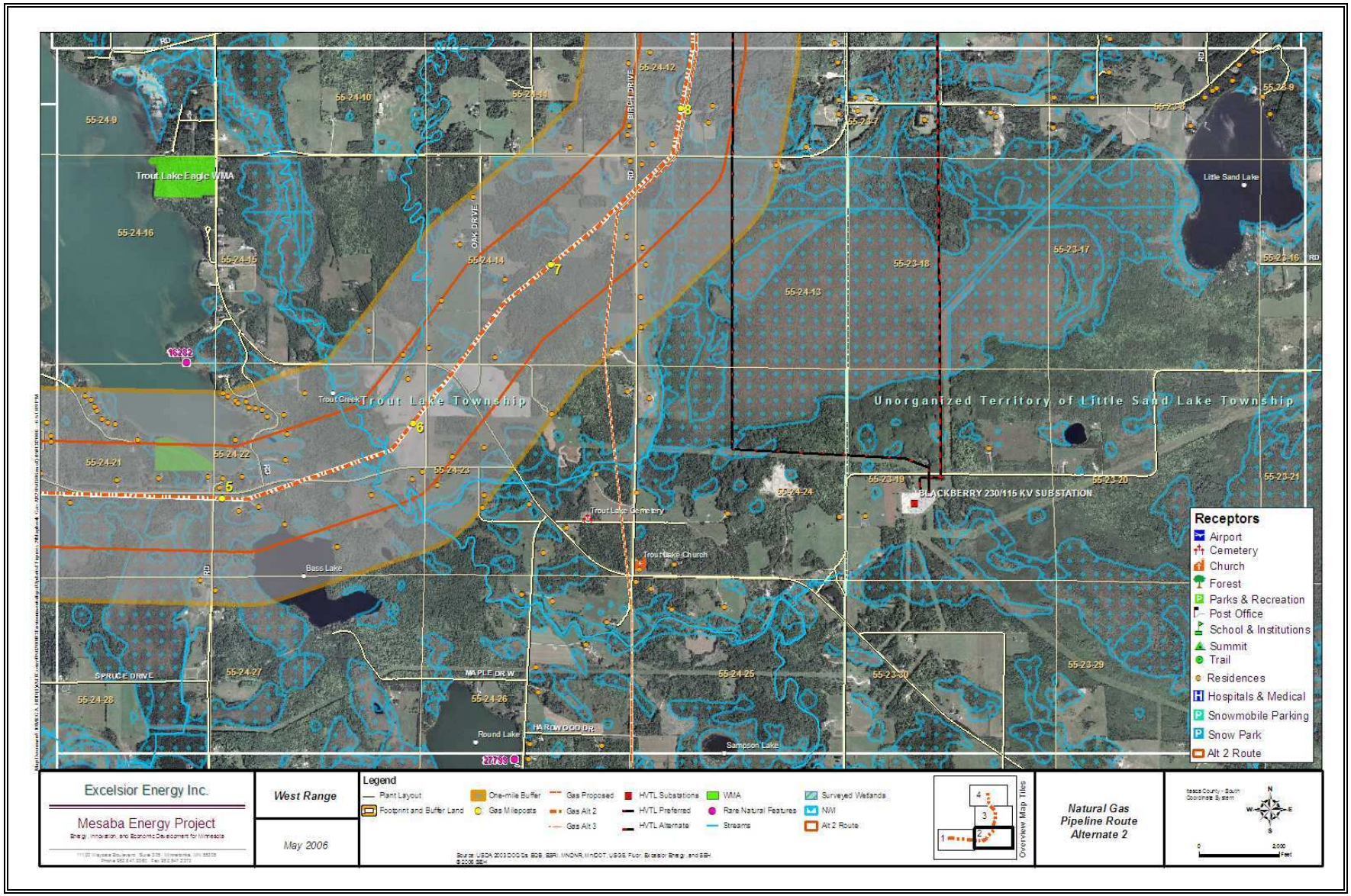


Figure 1.5-42 West Range Alternate Natural Gas Pipeline Route: NNG No.2, Segment 3

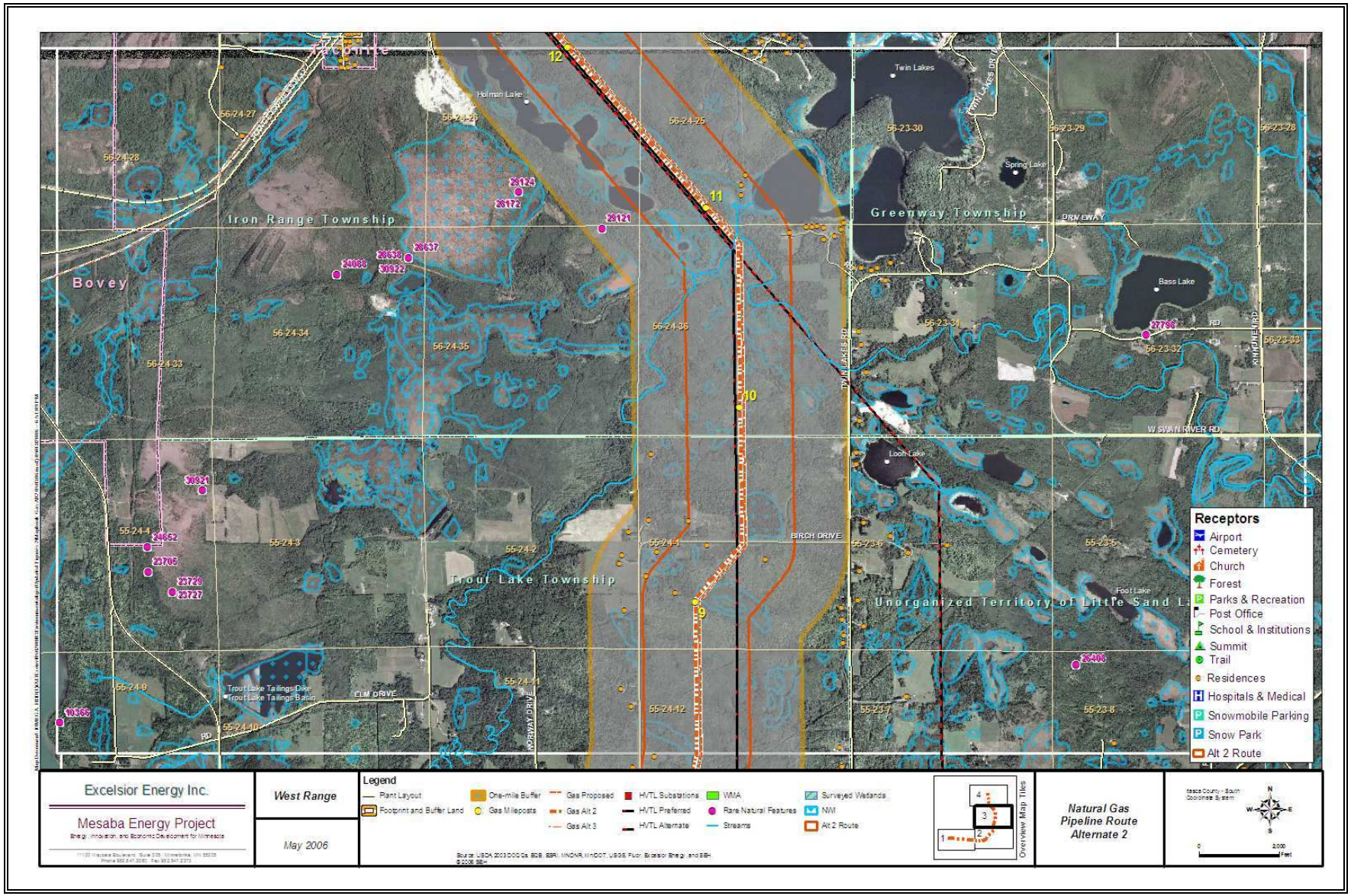


Figure 1.5-43 West Range Alternate Natural Gas Pipeline Route: NNG No.2, Segment 4

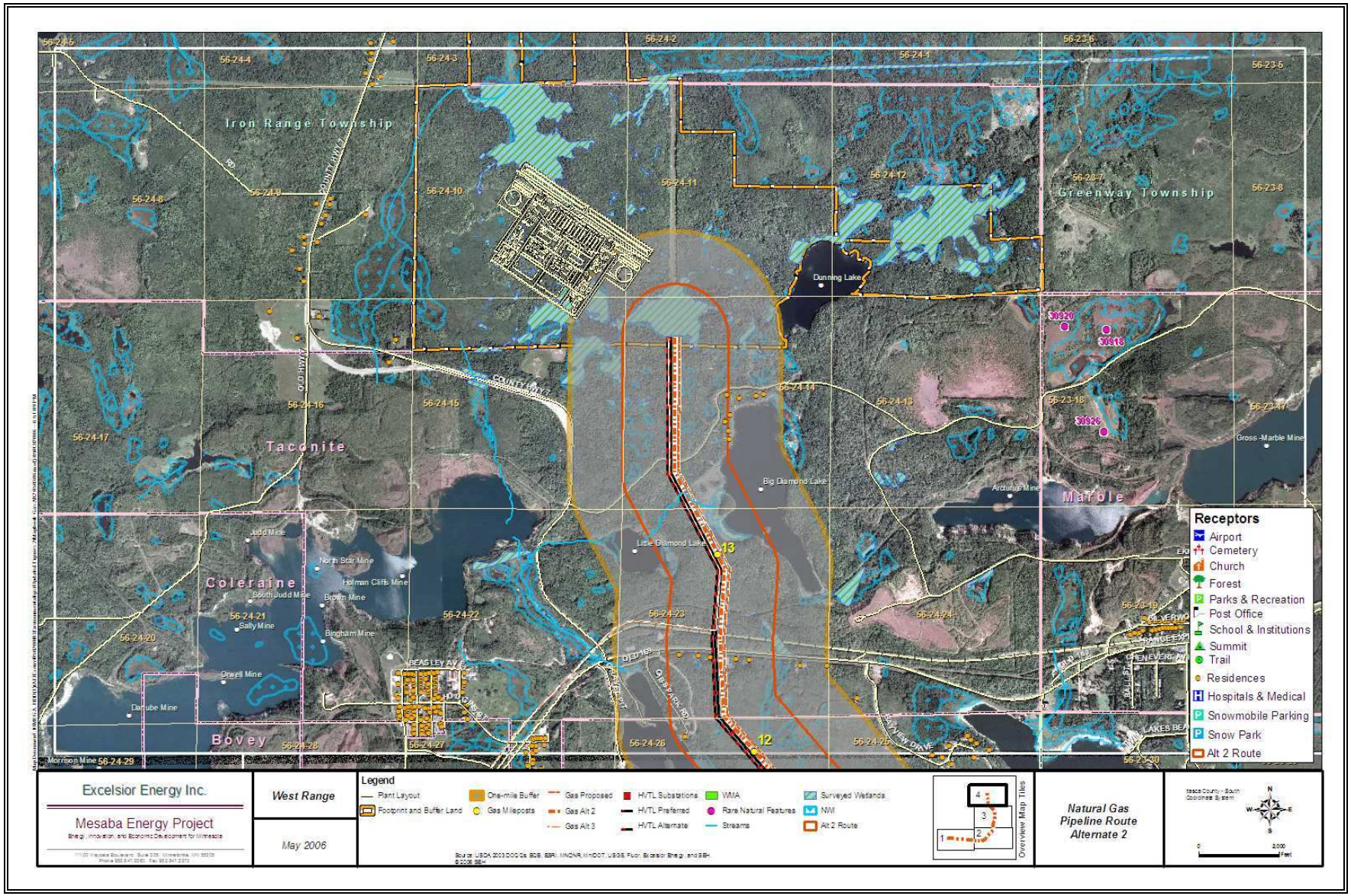


Figure 1.5-44 West Range Alternate Natural Gas Pipeline Route: NNG No.3, Segment 1

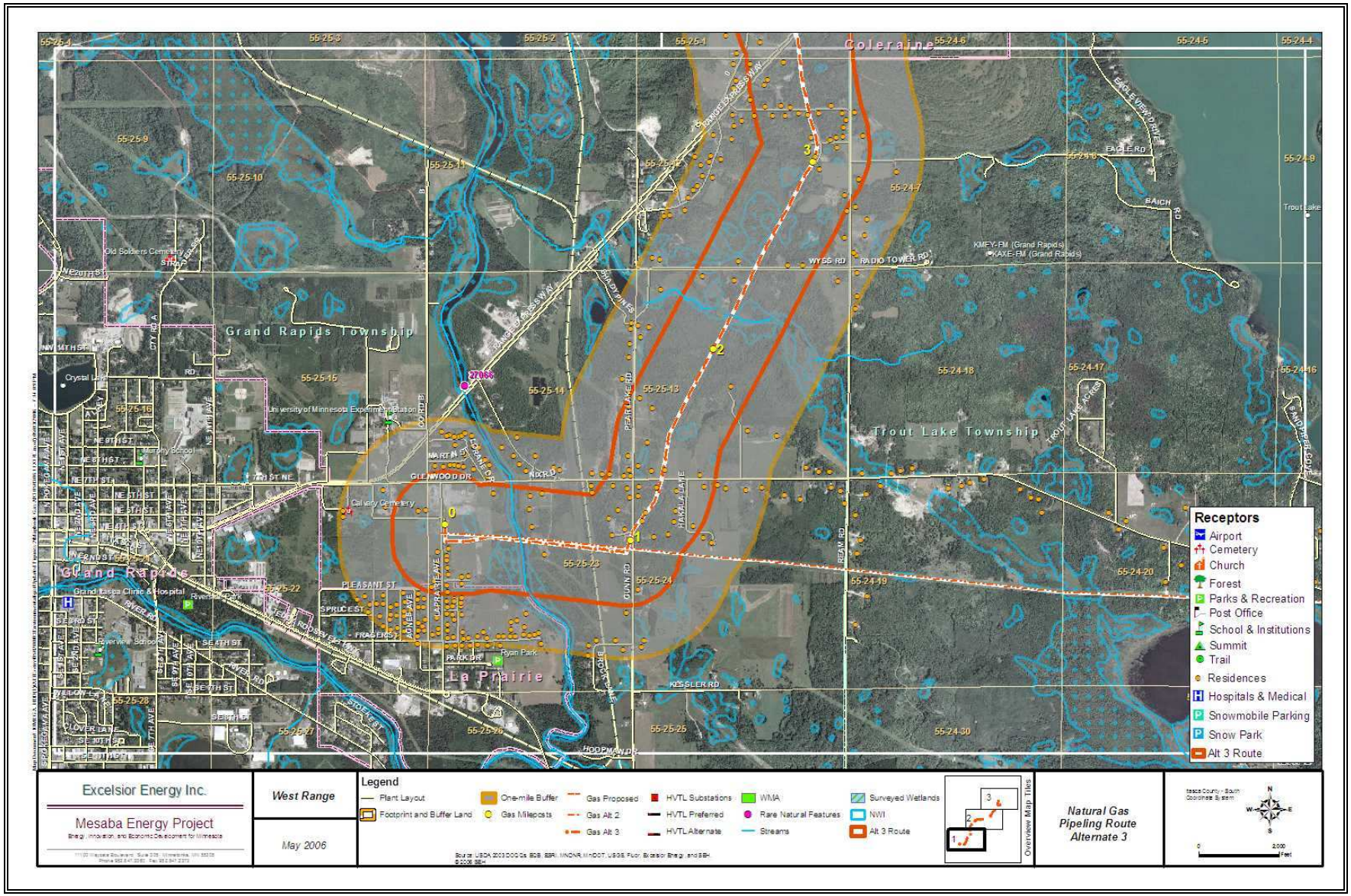


Figure 1.5-45 West Range Alternate Natural Gas Pipeline Route: NNG No.3, Segment 2

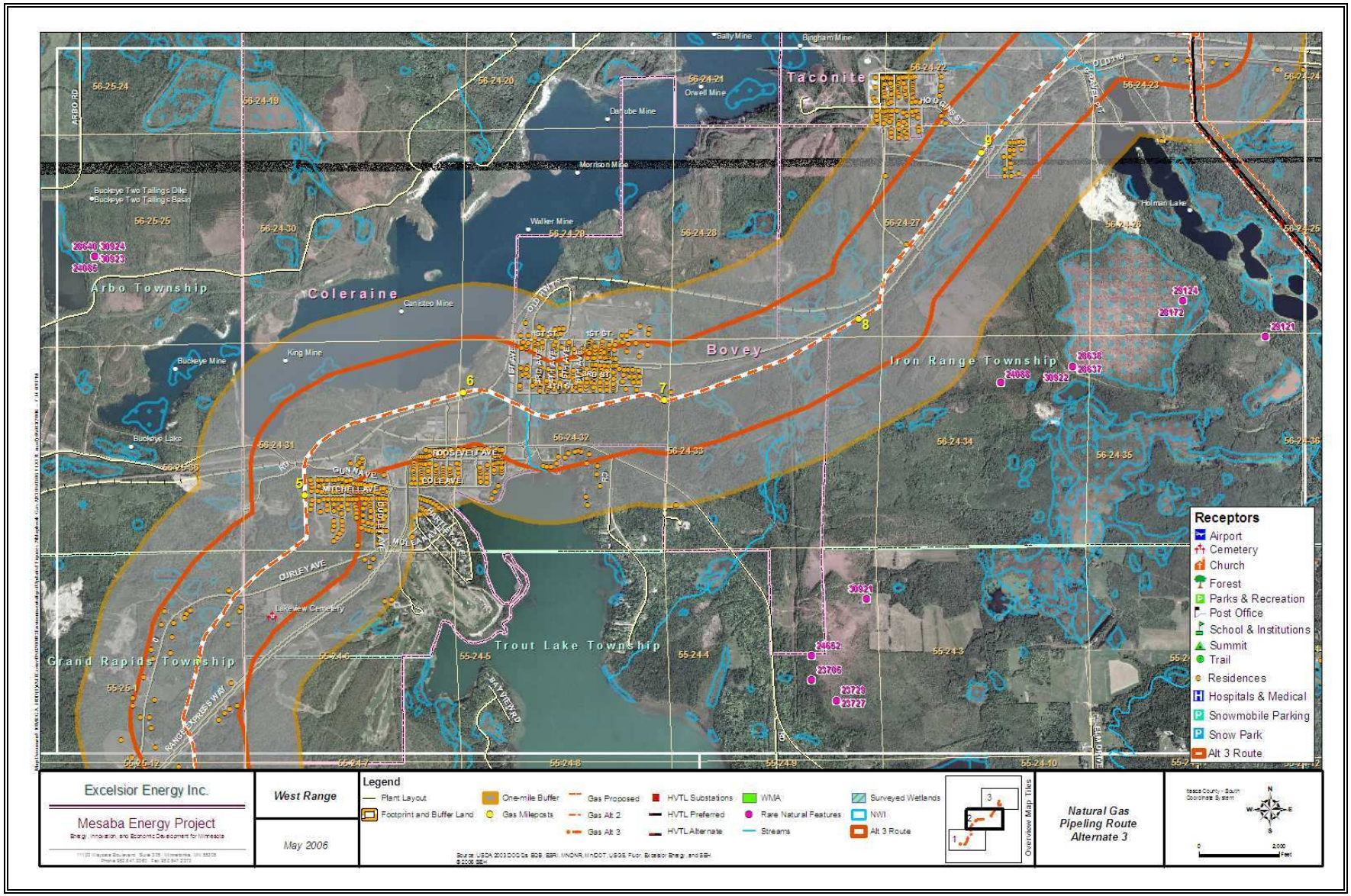
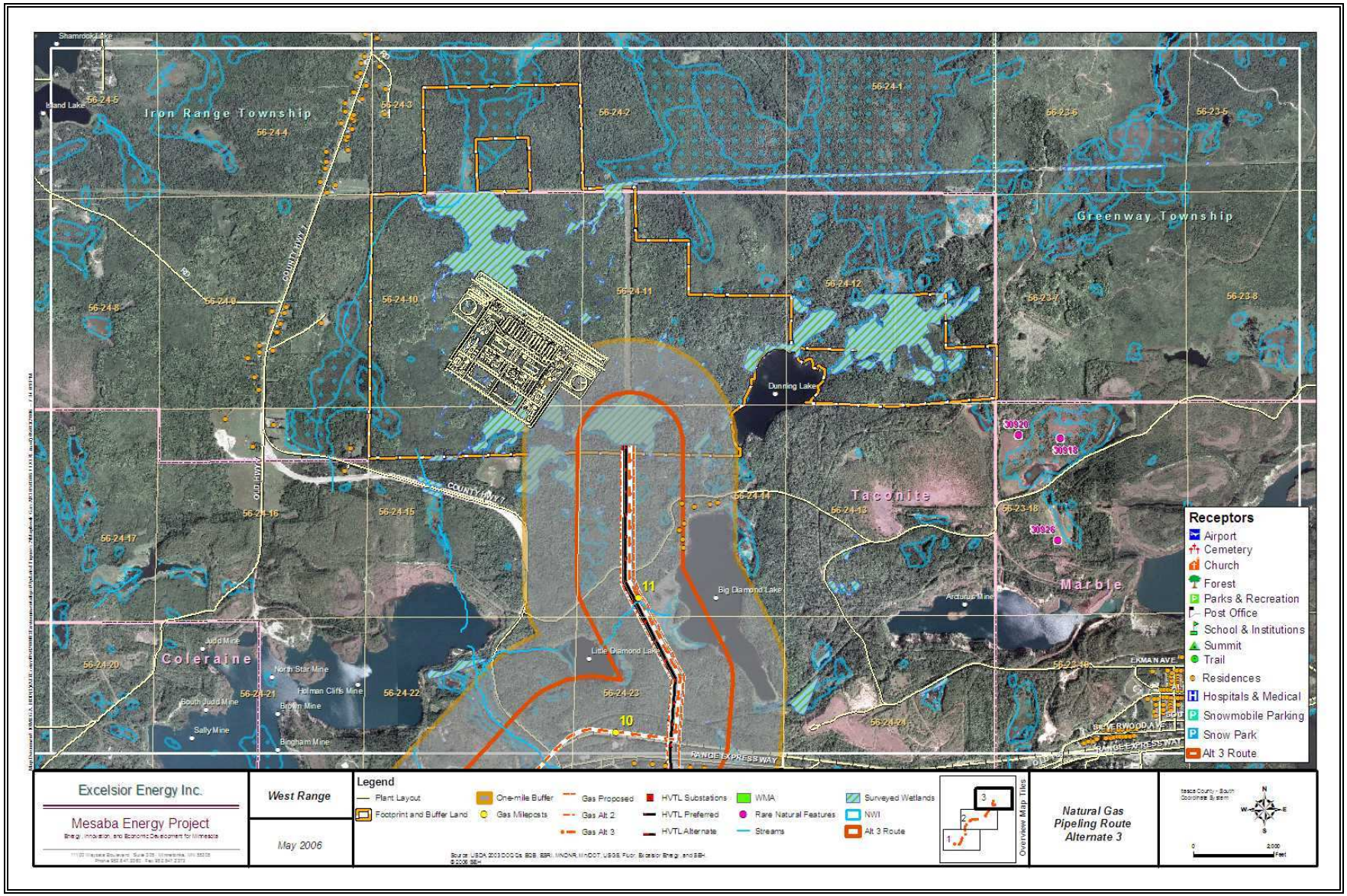


Figure 1.5-46 West Range Alternate Natural Gas Pipeline Route: NNG No.3, Segment 3



1.5.3 Alternate Site – East Range

The alternate site for Mesaba One and Mesaba Two is the East Range Site. This section describes the IGCC Power Station Footprint, Buffer Land, the Associated Facilities, and the Additional Lands that comprise the East Range Site.

1.5.3.1 IGCC Power Station Footprint and Buffer Land

The East Range IGCC Power Station Footprint and Buffer Land shown in Figure 1.5-2 and Figure 1.5-10 comprise approximately 810 acres of undeveloped property located completely within the city limits of Hoyt Lakes, Minnesota. The Station Footprint and Buffer Land are located within Township 59N, Range 14W and are generally bounded by CR 666 to the east and the Superior National Forest boundary to the north. A wetland area found along the southern part of the Buffer Land drains via an unnamed creek to Colby Lake, and an existing 138kV HVTL corridor leading to MP's Laskin Substation runs along the Site's western boundary.

The IGCC Power Station Footprint and Buffer Land is currently owned by Cliffs-Erie, LLC ("CE") and is zoned MD (mineral mining district) to support mining operations that historically took place within the immediate vicinity of the Site. The purpose of the MD district is to "identify areas of existing and potential mineral mining, processing, storage and loading, tailings and waste disposal, and accessory and support activities required for proper operation of mining activities located outside of the limits of the open pit and ore formation, and to assure the compatibility of these uses to other uses within the City of Hoyt Lakes." The current Hoyt Lakes zoning map is shown in Figure 1.5-47. The Station Footprint and Buffer Land are currently unoccupied, but have direct access to CR 666 and include a private, unpaved road used by CE to access its pump house on Colby Lake. A Canadian National ("CN") railroad line is located about one-half mile south of the site.

Land uses within the IGCC Power Station Footprint and Buffer Land are natural, exhibiting no structures or other major land use conversions. Upland forests occur on the north, west and east sides of the East Range IGCC Power Station Footprint and Buffer Land. All of the East Range uplands are vegetated with northern mesic mixed forest – aspen birch forest (balsam fir subtype) as described in the "Field Guide to Native Plant Communities in Minnesota: The Laurentian Mixed Forest Province" (MDNR, 2003). Within the past year, a sizable portion of the site's upland forest cover has been cut for timber production. The remaining forest cover is relatively young, with those lands having been harvested within the past 25 years. There is no old growth forest cover within the IGCC Power Station Footprint and Buffer Land. The upland forest composition and character demonstrates that the area has served as a timber source and been impacted by timber production for several decades. The site topography of the upland portion of the Buffer Land generally varies between 1,490-1,525 feet above mean sea level ("ft MSL"). A small but relatively pronounced hill approximately 15 acres in size and located immediately north of the unnamed creek and about 2,000 feet from CR 666, rises to about 1,550 ft MSL. The 2003 aerial photograph in Figure 1.5-48 shows evidence of the following notable terrain features:

- A large waste rock pile approximately 300 acres in size (resulting from placement of overburden materials excavated as part of past mining operations) is located immediately west of the IGCC Power Station, and quickly rises in elevation about 80-100 feet above the ground surface of the Station Footprint.

Figure 1.5-47 Hoyt Lakes Zoning Map

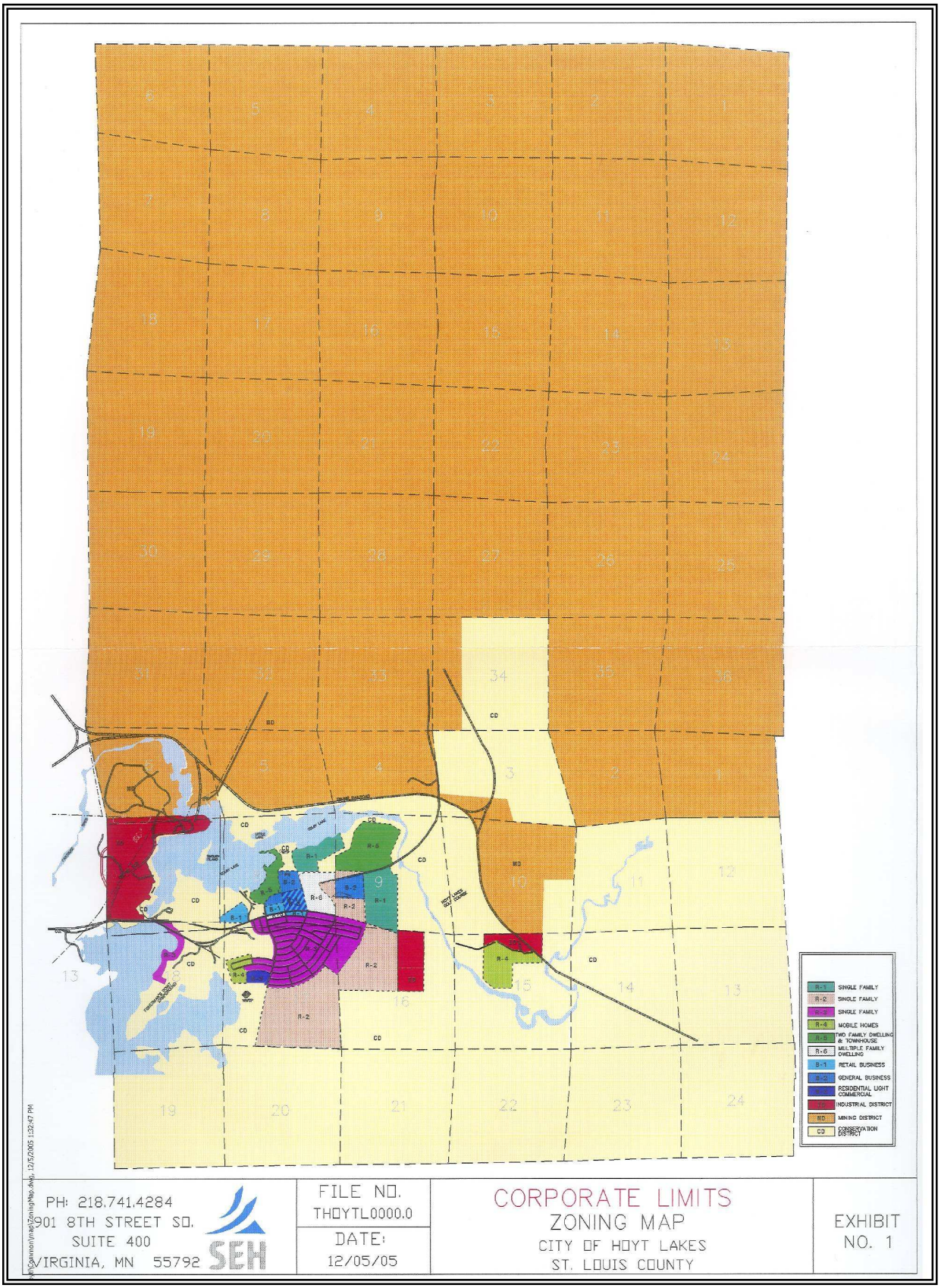
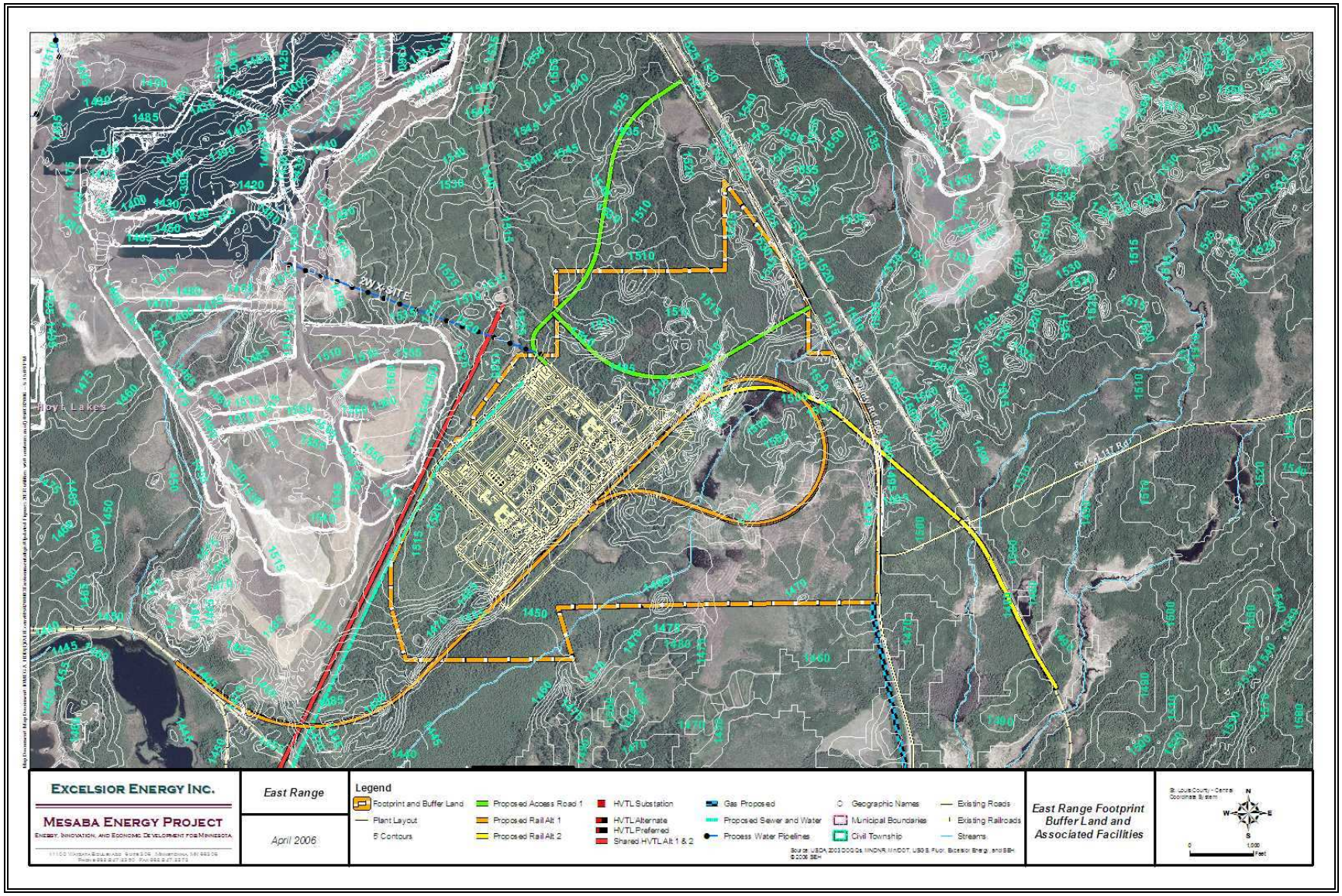


Figure 1.5-48 East Range IGCC Power Station Footprint and Buffer Land Topography



- A 20-40 foot drop in elevation on the southeastern part of the site to a large wetland area.

There are no lakes, major bedrock outcrops, unique ecological resources, or other natural features within the area occupied by the Station Footprint and Buffer Land. Figure 1.5-2 shows the orientation of the IGCC Power Station Footprint, the Buffer Land and the infrastructure required for the Station's operations. The layout of the IGCC Power Station on the property reserved for the Station Footprint and Buffer Land differs from that presented for the West Range IGCC Power Station with respect to its orientation, rail approach, rotary dumper location, and access road configuration. The equipment layout plan within the Station Footprint is shown in detail in Figure 1.5-3.

Some wetlands on the IGCC Power Station Footprint and Buffer Land would be impacted by the Phase I and II Developments. Information on the environmental setting and potential impacts on the Footprint and Buffer Land from Mesaba One and Mesaba Two are discussed in Sections 2 and 3.

The current owners of properties occupying the East Range IGCC Power Station Footprint and Buffer Land are provided in Appendix 1 of the Joint Application.

1.5.3.2 Associated Facilities

Easements across public and private lands would be required for Associated Facilities. Figure 1.5-2 and Figure 1.5-10 show the location of Associated Facilities for the East Range Site. A detailed description of the Associated Facilities required for the construction, maintenance, and operation of Mesaba One and Mesaba Two is provided in Sections 1.12.3 through 1.12.7. Information on the current environmental setting of the Associated Facilities' corridors and the potential environmental impacts that would result from construction and operation of Mesaba One and Mesaba Two is presented in Sections 2 and 3. Ownership of properties within one quarter mile on both sides of the center alignment of the Associated Facilities is provided in Appendix 1 of the Joint Application.

1.5.3.3 HVTL Routes

The Proponent has investigated alternatives for the HVTL GOs for Mesaba One and Mesaba Two at the East Range Site. As a result of this analysis, 345kV HVTLs have been selected for the East Range generator outlet facilities. In this approach, two unstaggered HVTLs are required to provide the necessary route diversity required by the (n-1) single failure criterion (see Section 1.5.1.2.1). The development of alternative transmission configurations to meet the Phase I and II IGCC Power Station outlet needs is discussed in Section 1.12.1.3.

Three existing transmission lines emanate from Laskin, located approximately 2 miles southwest of the IGCC Power Station Footprint, and connect with either the Forbes or Virginia Substations. Figure 1.5-49 shows the three 115kV lines that interconnect the Laskin Substation (34L, 38L, and 39L) to these substations. All three of these lines are candidates for replacement with new double circuit structures to carry the IGCC Power Station's HVTLs and the existing 115kV HVTLs.

Figure 1.5-18 is a milepost map showing the East Range Preferred and Alternate HVTL Routes for interconnecting Mesaba One and Two to the Forbes Substation POI. Significant receptors along each route are shown in Figure 1.5-50.

Figure 1.5-49 Existing HVTL Corridors Between the East Range IGCC Power Station and the Forbes Substation

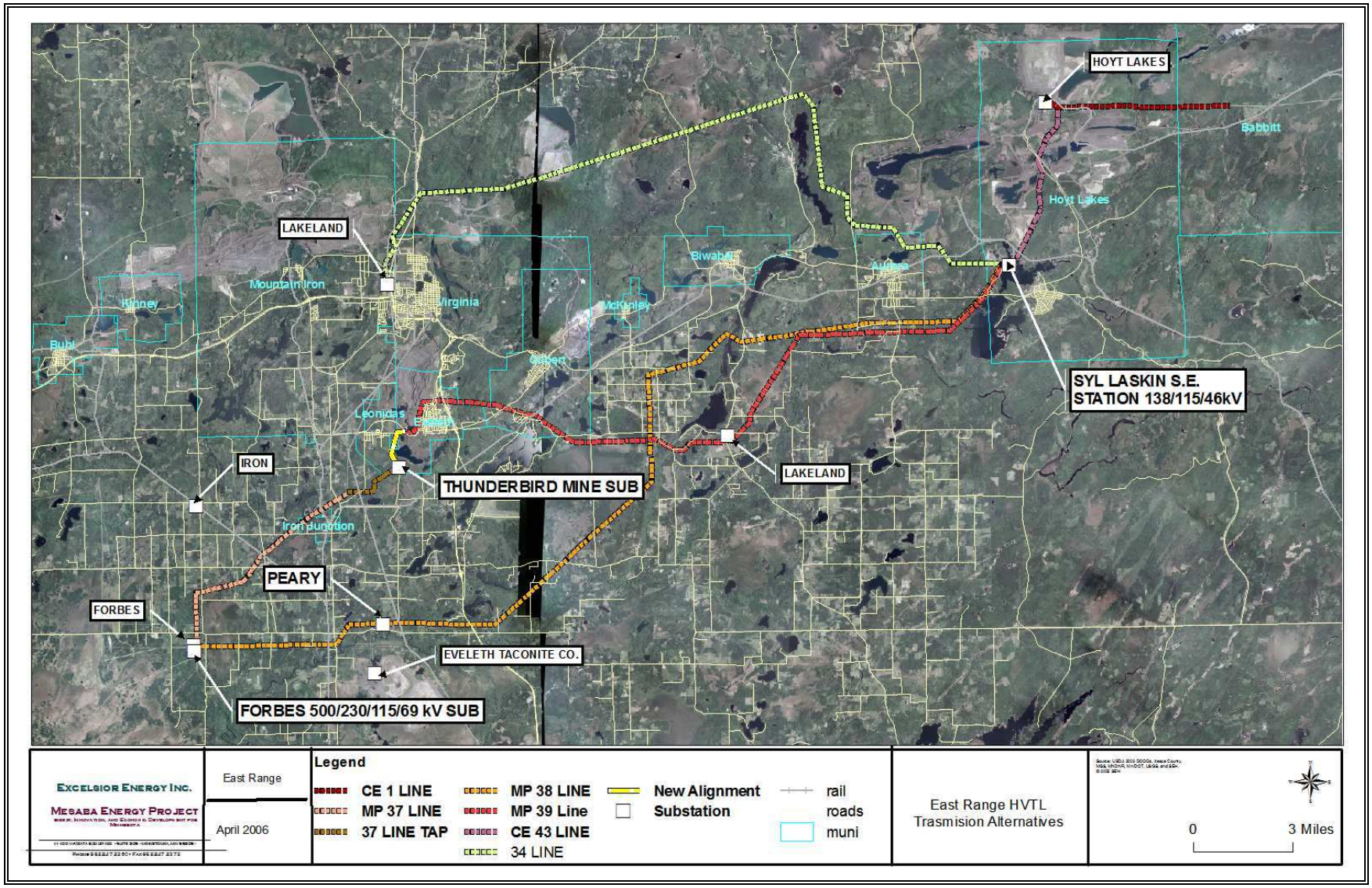
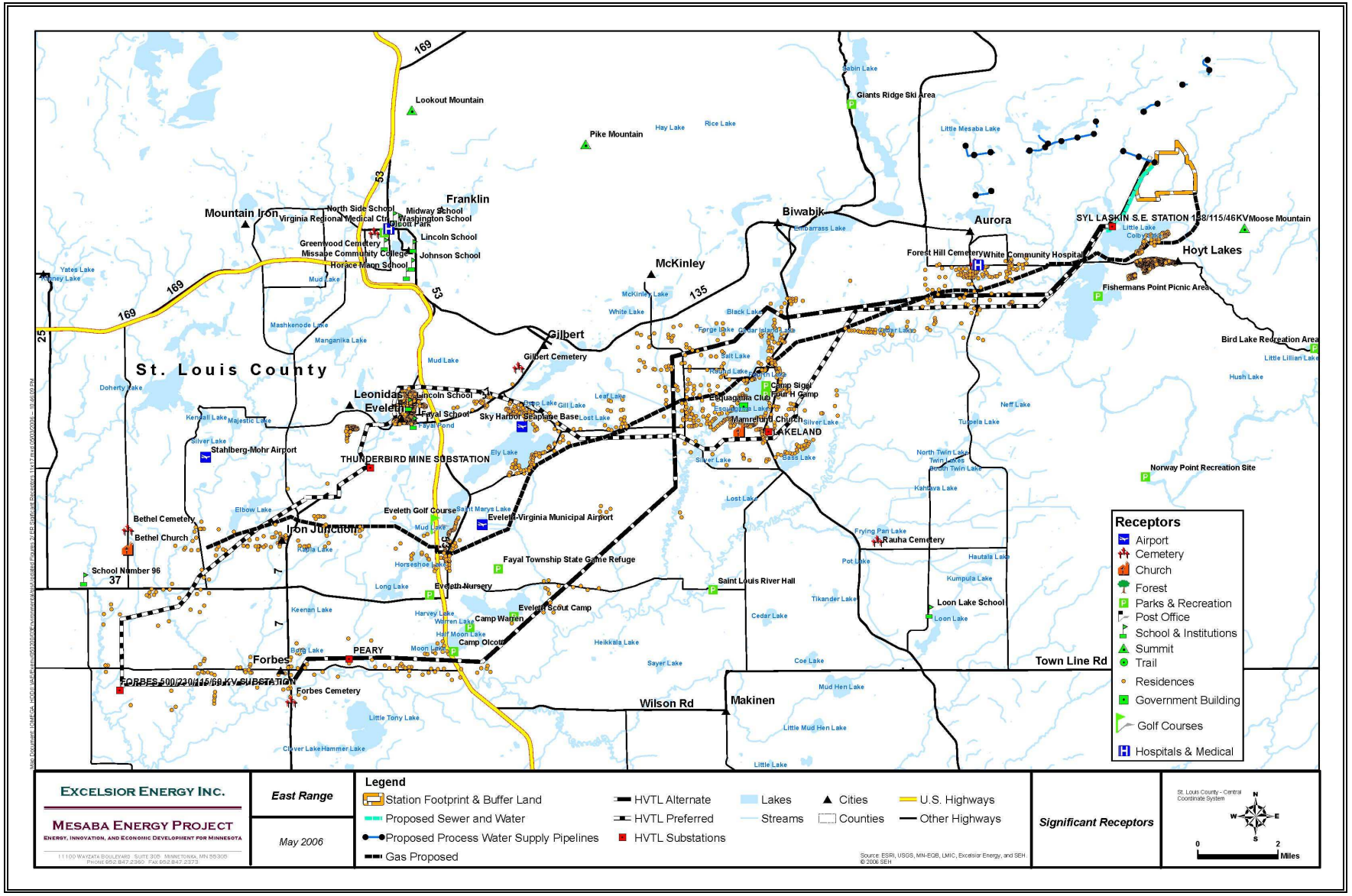


Figure 1.5-50 Significant Receptors Along the East Range Preferred and Alternate HVTL Routes and the Proposed Natural Gas Pipeline Route



The 38L interconnects directly to the Forbes Substation, is about 33 miles in length, is rated at 146 MVA, and has one intermediate distribution load service substation (the Peary Substation) to maintain service during potential reconstruction. For the 39L and 34L routes that connect to the Virginia Substation, there are existing 115kV lines (37L direct to the Forbes Substation and 16L/18L to the Forbes Substation via United Taconite) that could be reconstructed as double circuits to support the direct routing of the HVTLs to the Forbes Substation. The lengths of the GO lines utilizing these routes is 35.5 miles on the 39L/37L route and 39 miles on the 34L/16L/18L route. The possibility of routing the 34L into the Virginia Substation using existing HVTL routes is not deemed to be a practical alternative given the present spatial constraints that arise from too many HVTLs converging into a narrow corridor and the substation's limited footprint to expand. Therefore, the most likely option for use of the 34L corridor is to re-route the corridor around the Virginia Substation. This would defeat the rationale for using existing corridors and, therefore, the Proponent limited the HVTL routes it considered to the 39L/37L and 38L options.

To minimize the impact of the IGCC Power Station on the already constrained 115kV transmission system between the Laskin Substation and the Forbes Substation, the Proponent would avoid removing either the 39L/34L or 38L HVTLs from service without providing a replacement HVTL option.

1.5.3.3.1 Preferred Transmission Line Route Configuration: Alternate Route 2

The East Range preferred HVTL routes include the construction of two 345kV segments. The first segment extends southwest from the IGCC Power Station Footprint past Laskin to the Forbes Substation, approximately 35.5 miles in length. This route follows the existing 39L/37L ROW along most of its length, as shown in Figure 1.5-18. The first two miles of this route are on new ROW along 43L and will carry a single 345kV circuit. The next 23.6 miles parallels the existing 39L and would be a 345kV/115kV double circuit line. The existing 39L would be moved to the new structures and comprise the 115kV circuit on the new line. The next 2 miles would carry a single 345kV circuit on new ROW connecting to 37L at the Thunderbird Mine Substation. From the Thunderbird Mine Substation and along the next 7.4 miles to the Forbes Substation, the line will parallel the existing 37L line and would be a 345kV/115kV double circuit line. The existing 37L line would be moved to the new structures and comprise the 115kV circuit on the new line. Figures 1.5-51 through 1.5-57 show the 39L/37L route in a series of maps superimposed on aerial photos.

The second 345kV transmission outlet extends southwest from the IGCC Power Station Footprint past Laskin to the Forbes Substation, a distance of approximately 35.5 miles. The first two miles would parallel the first segment on a new ROW (adjacent to the existing 43L) and carry a single 345kV circuit. The remaining 31 miles parallel the 38L and would be a 345kV/115kV double circuit line. The existing 38L would be moved to the new structures and comprise the 115kV circuit on the new line. Figures 1.5-58 through Figure 1.5-64 show the 38L route in a series of maps superimposed on aerial photos. The owners of property within the affected area of the East Range Preferred HVTL Route are listed in Appendix 2 of the Joint Application.

The sequence that would allow construction of the new lines without disrupting existing service will require that an additional 30 feet of ROW be acquired immediately adjacent to either the 39L/37L ROW or the 38L ROW. The design, configuration and construction sequencing of the

proposed line is described in detail in Section 1.5.1.2.3. Information on the environmental setting along the existing 39L/37L route, and the potential environmental impacts associated with acquiring an additional 30 feet along its entire length are discussed in Sections 2 and 3.

1.5.3.3.2 Alternate Transmission Line Route 1

In accordance with Minn. Stat. ch. 116C (Sections 116C.51 to 116C.69, of the Minnesota Power Plant Siting Act) and Minnesota Rules (Minn. R. 4400.1150, subp. 2.C), at least one alternate route must be proposed if the HVTL exceeds 200kV, is five miles or greater in length, and less than 80 percent of the HVTL is located along existing HVTL rights of way (Minn. R. 4400.2000 subps. 1.D and 1.E). Although the applicant is thus not required to propose an alternative route because the preferred alternative is at least 80 percent located along an existing ROW, the Proponent nonetheless believes it is appropriate to propose an alternate route for consideration.

The East Range alternate HVTL route includes the same two corridors as the preferred route. The difference between the alternate and the preferred route configurations is the HVTL along which the Proponent will acquire the additional 30 feet of ROW. For the alternate route, an additional 30 feet of ROW would be acquired adjacent to the complete length of the 38L. Information on the environmental setting of the existing 38L route and the potential environmental impacts associated with acquiring an additional 30 feet of ROW are discussed in Sections 2 and 3. The owners of property within the affected area of the Alternate HVTL Route are listed in Appendix 2 of the Joint Application.

Figure 1.5-51 East Range Preferred HVTL Route Along 39L/37L Corridor: Segment 1

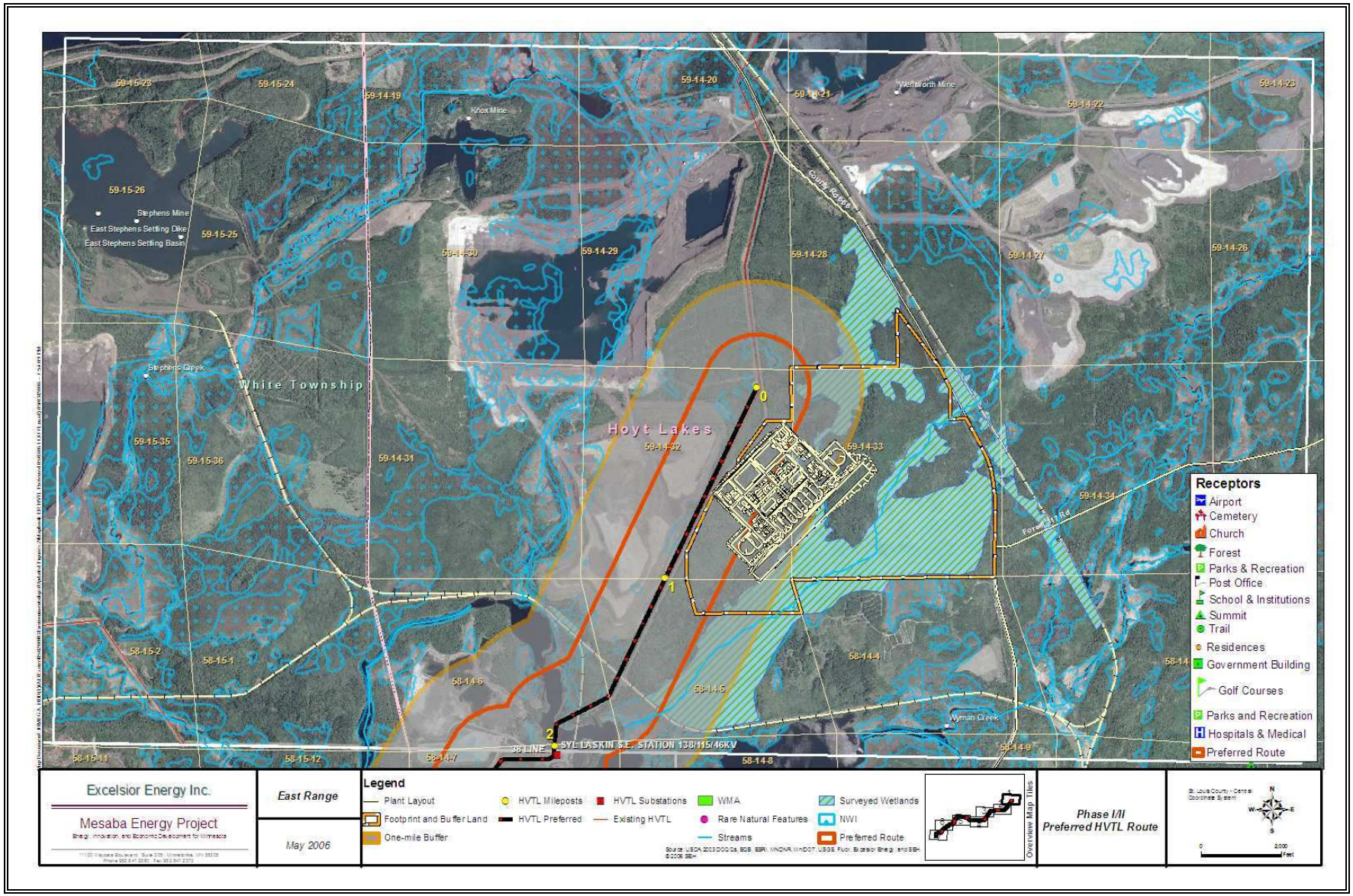


Figure 1.5-52 East Range Preferred HVTL Route Along 39L/37L Corridor: Segment 2

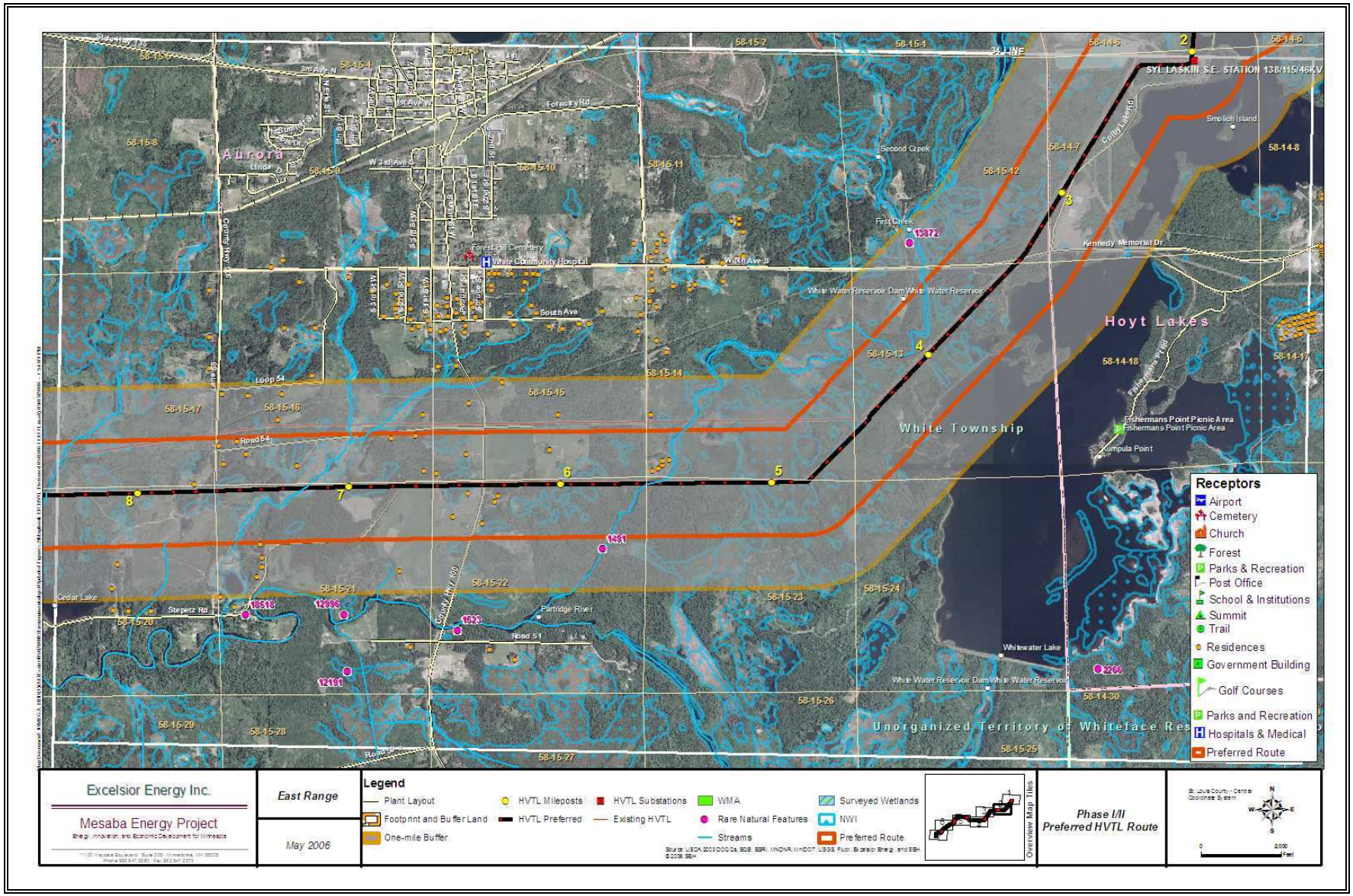


Figure 1.5-53 East Range Preferred HVTL Route Along 39L/37L Corridor: Segment 3

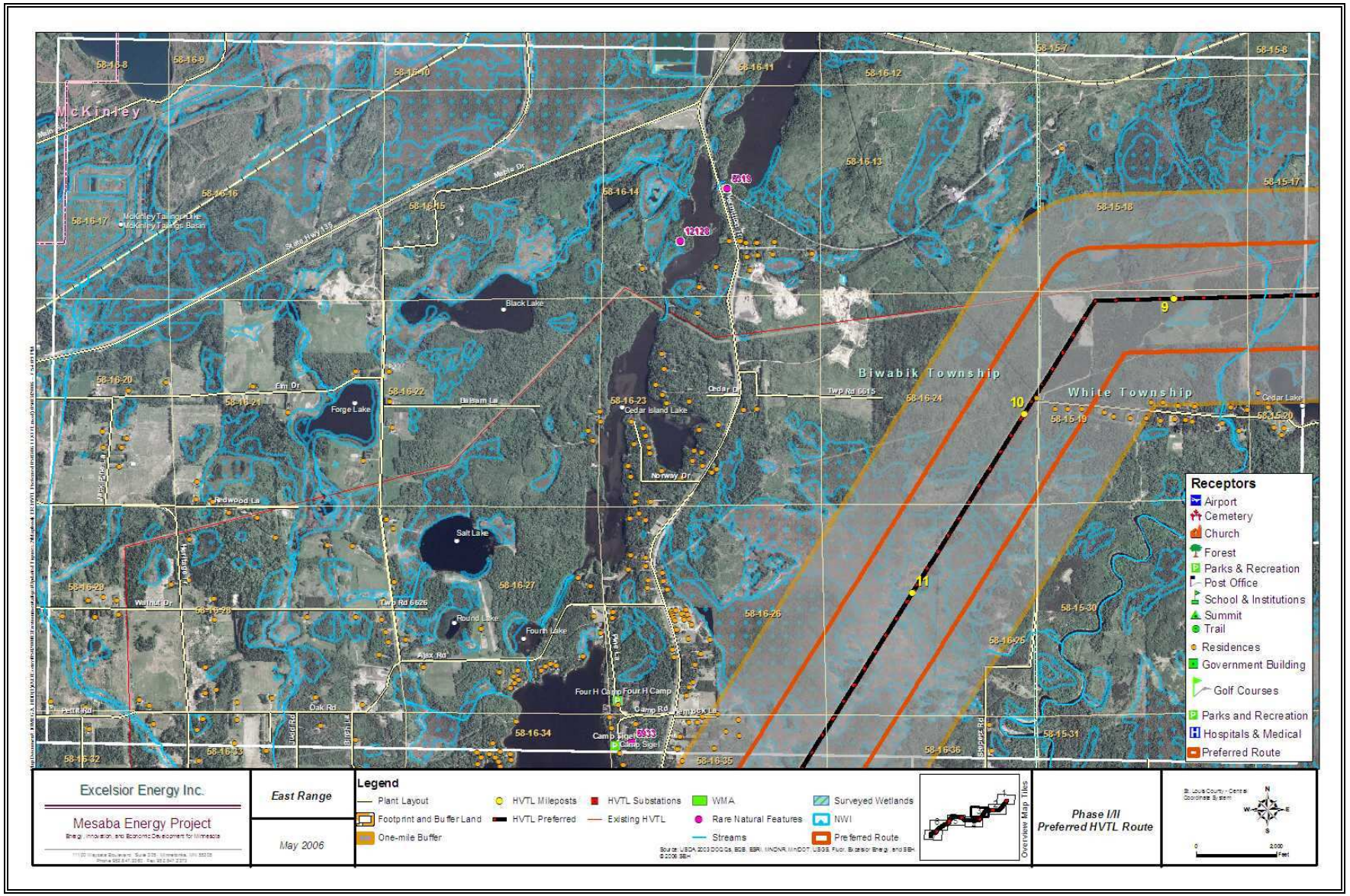


Figure 1.5-54 East Range Preferred HVTL Route Along 39L/37L Corridor: Segment 4

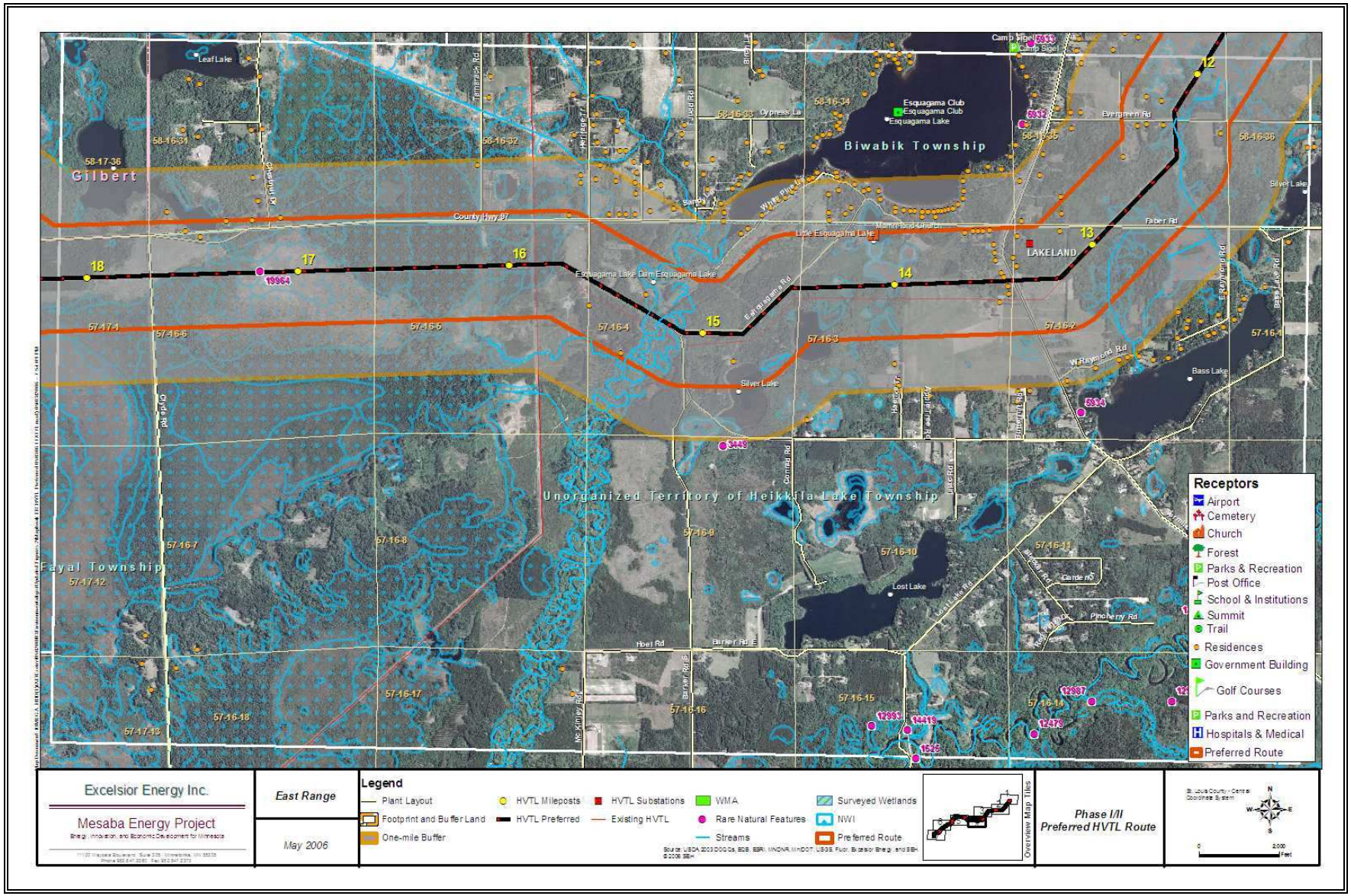


Figure 1.5-55 East Range Preferred HVTL Route Along 39L/37L Corridor: Segment 5

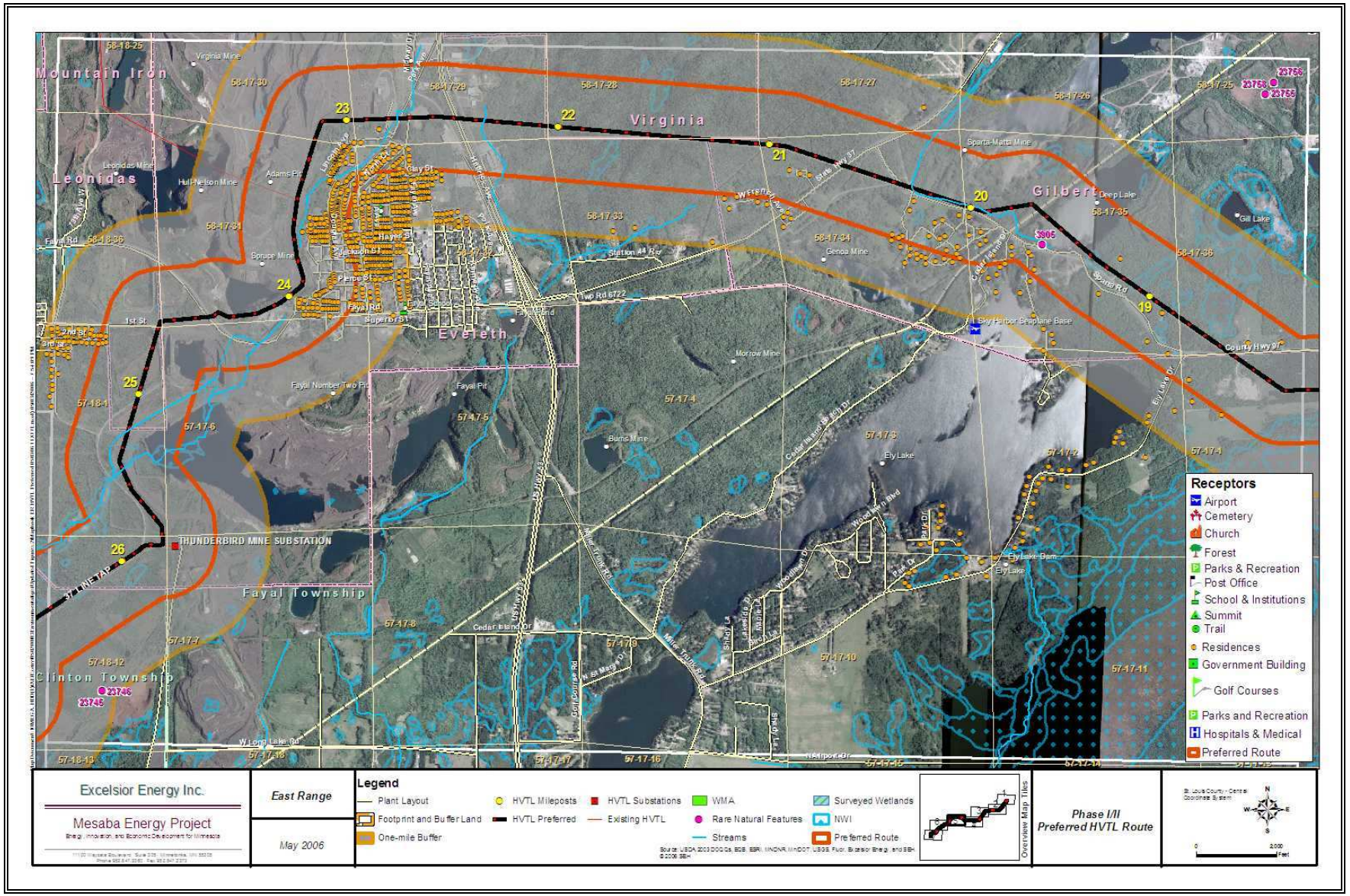


Figure 1.5-56 East Range Preferred HVTL Route Along 39L/37L Corridor: Segment 6

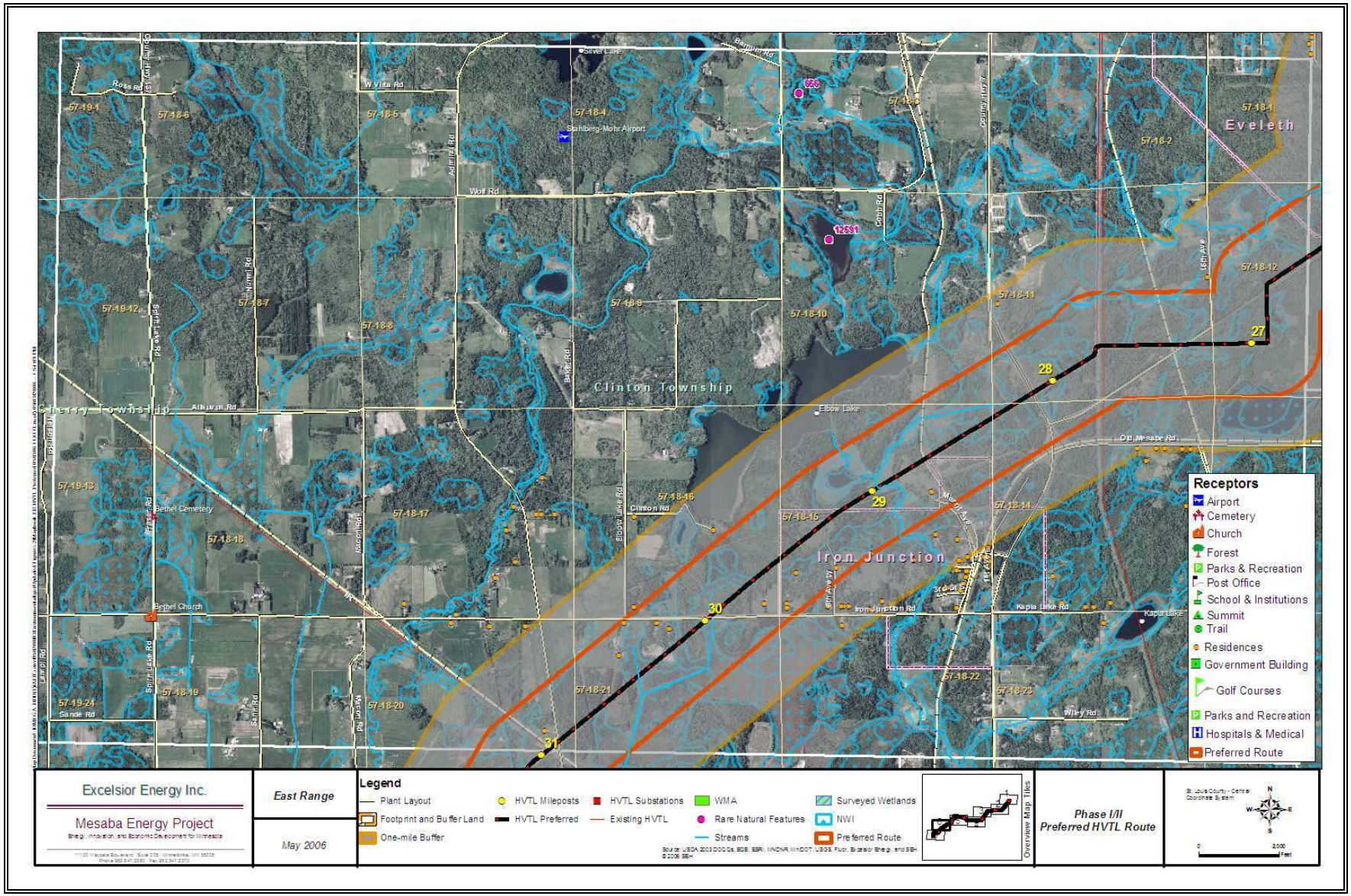


Figure 1.5-57 East Range Preferred HVTL Route Along 39L/37L Corridor: Segment 7

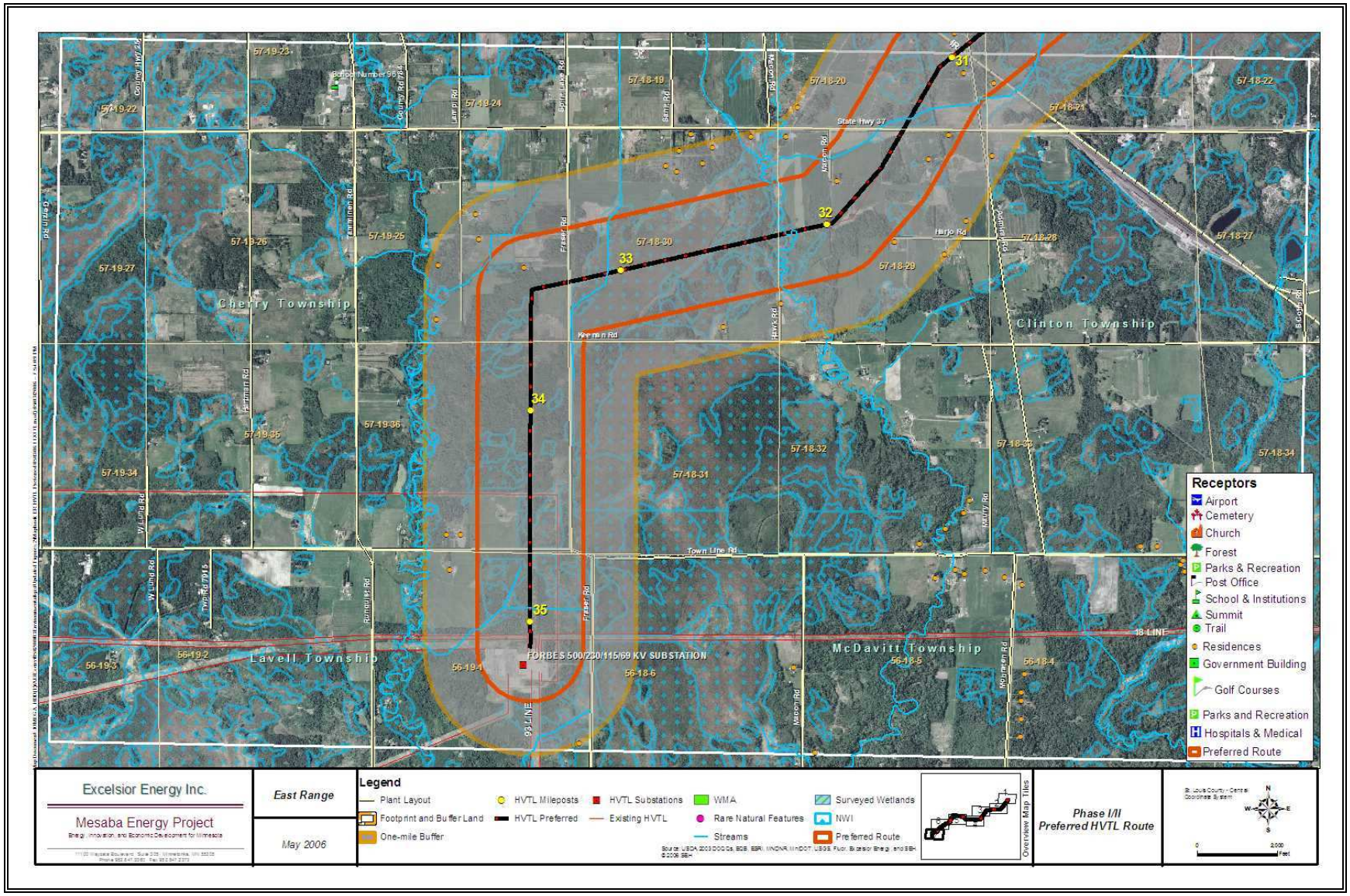


Figure 1.5-58 East Range Alternate HVTL Route Along 38L Corridor: Segment 1

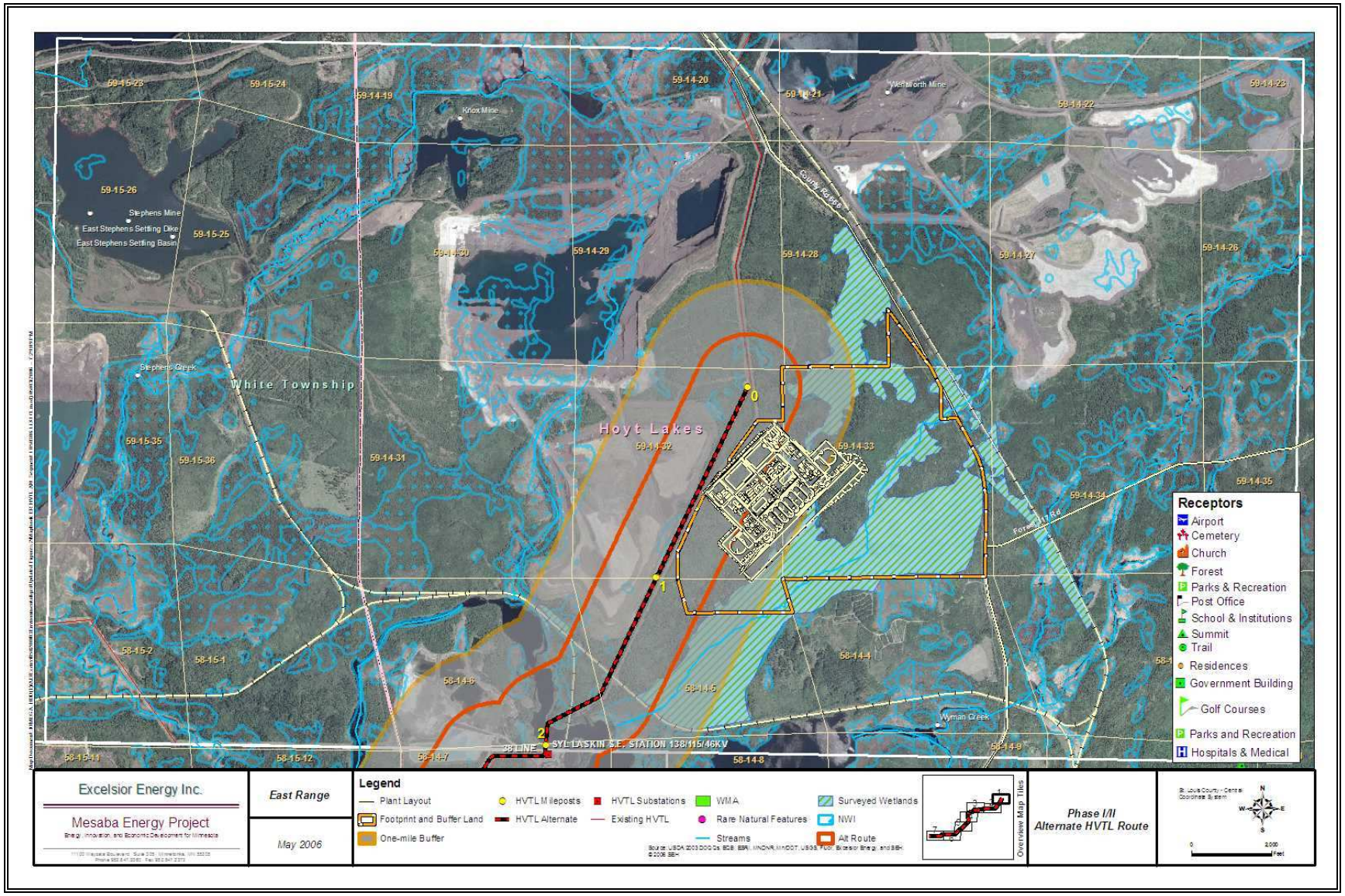


Figure 1.5-59 East Range Alternate HVTL Route Along 38L Corridor: Segment 2

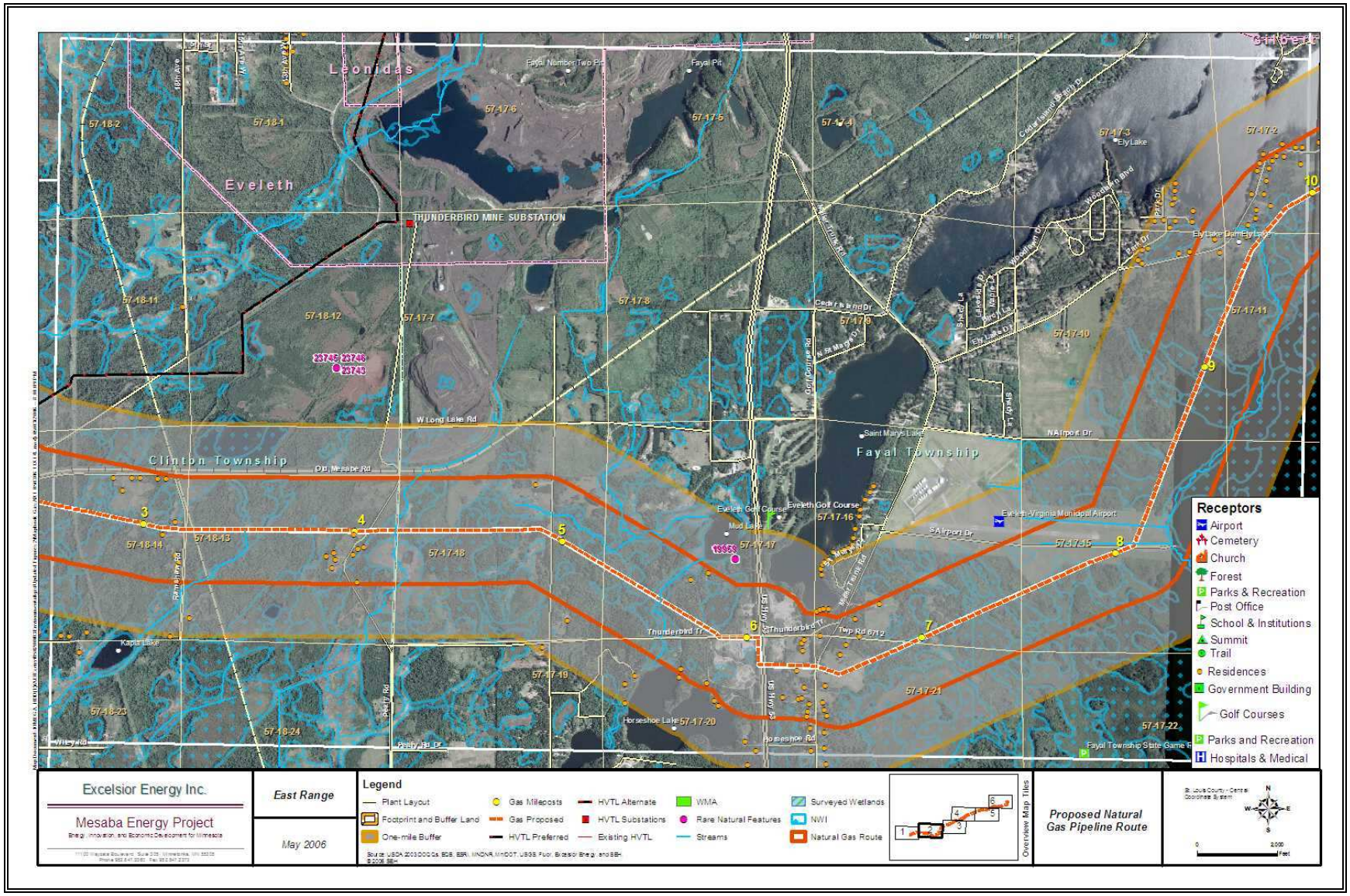


Figure 1.5-60 East Range Alternate HVTL Route Along 38L Corridor: Segment 3

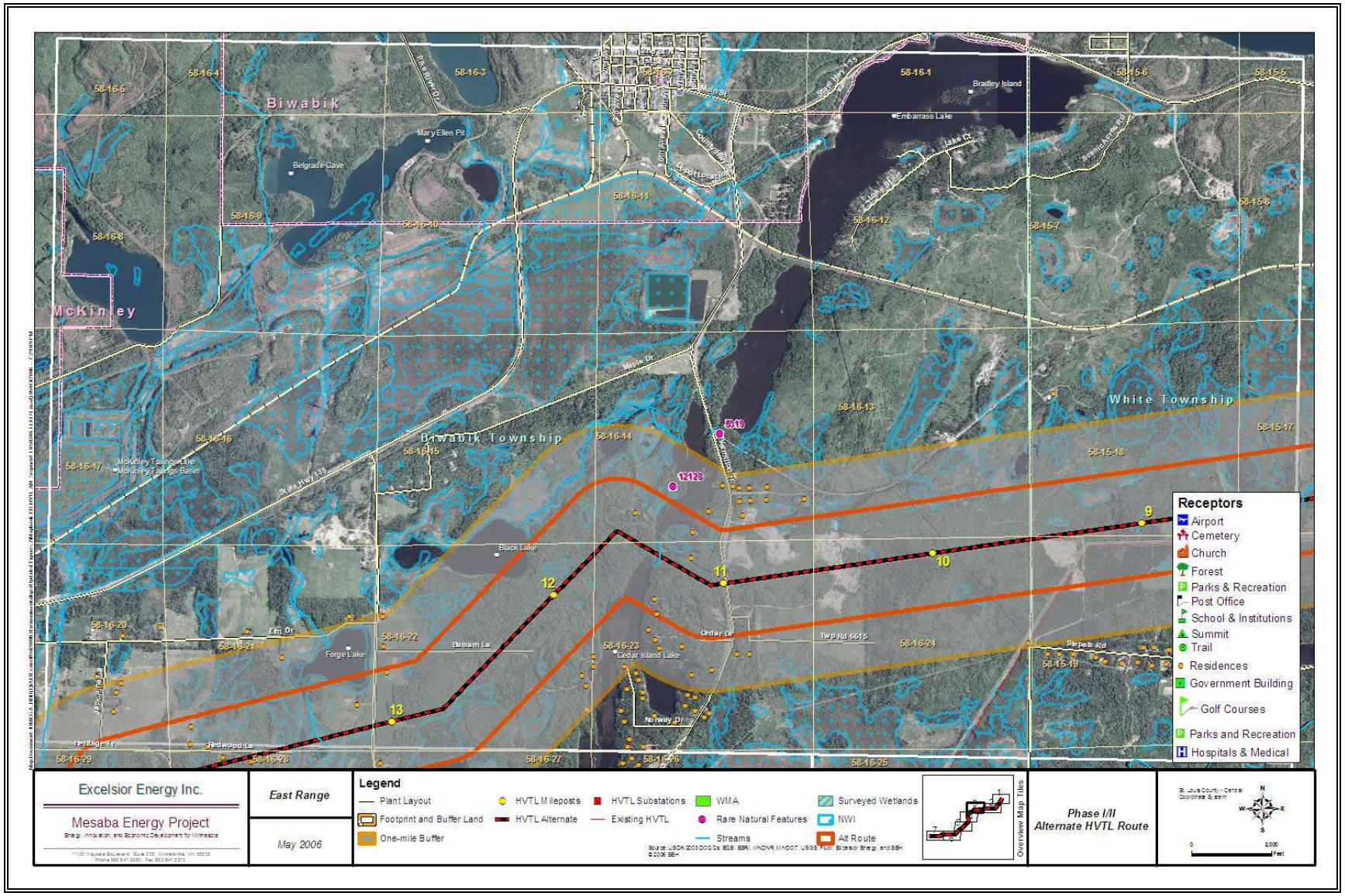


Figure 1.5-61 East Range Alternate HVTL Route Along 38L Corridor: Segment 4

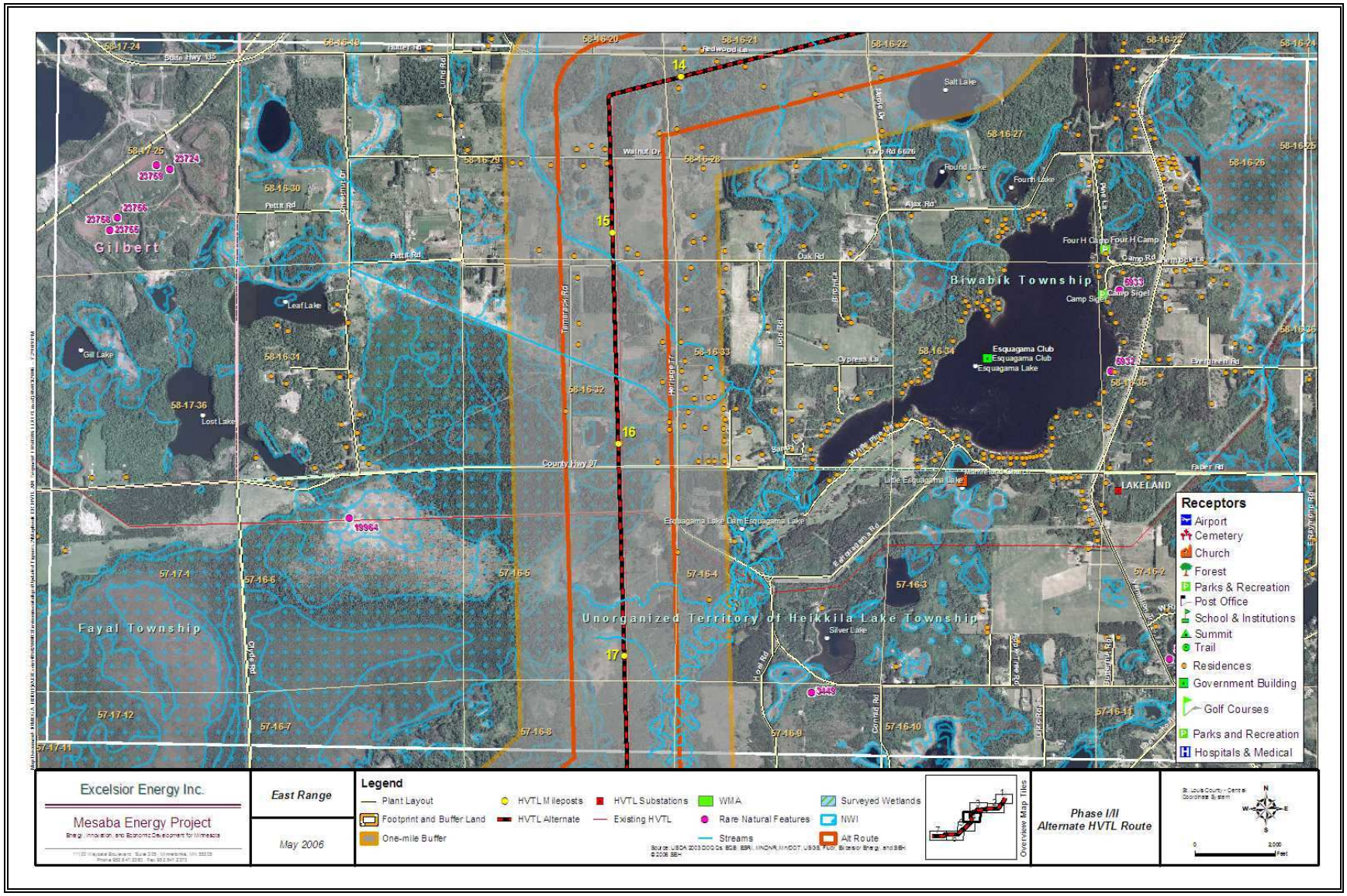


Figure 1.5-62 East Range Alternate HVTL Route Along 38L Corridor: Segment 5

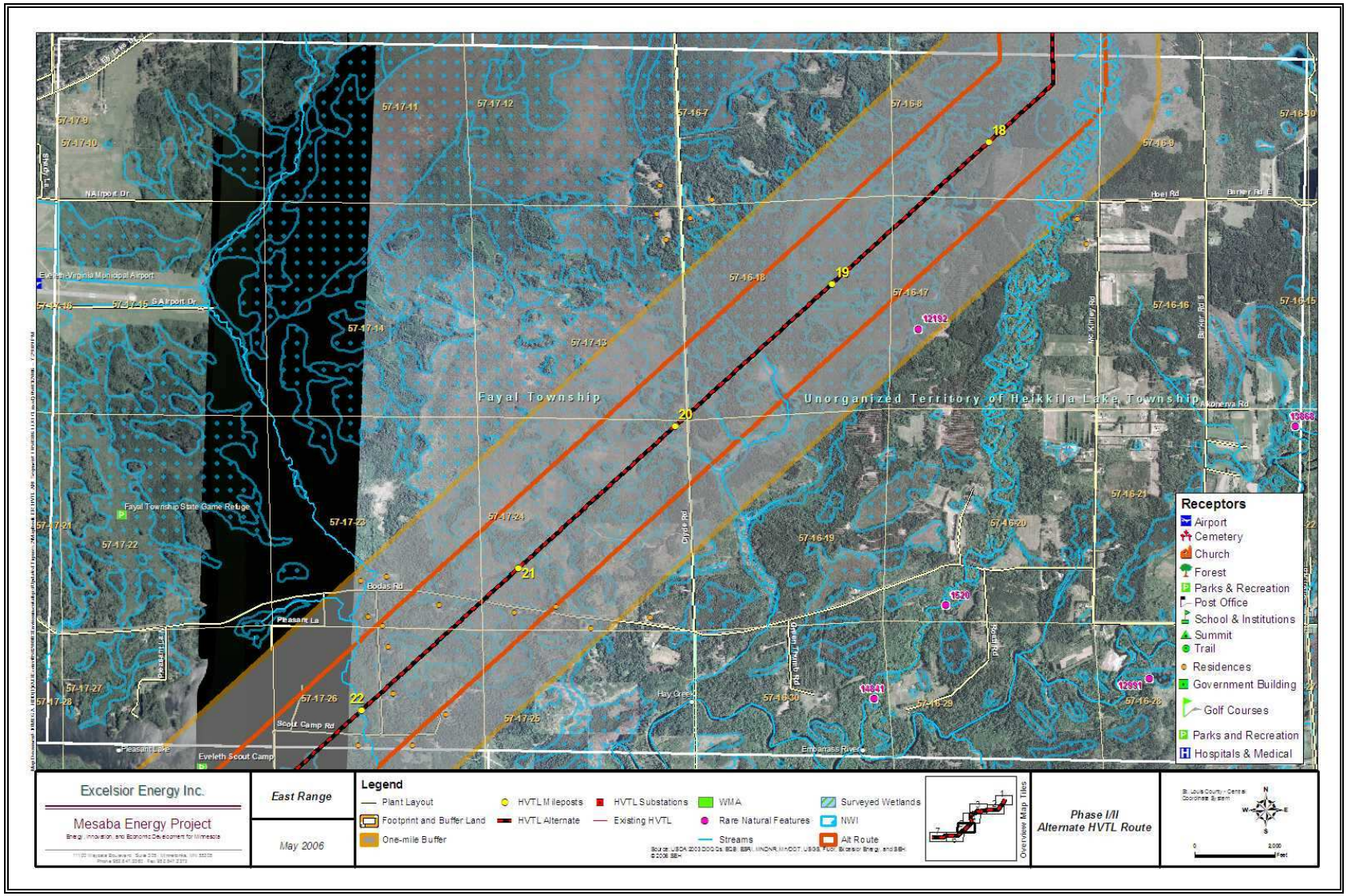


Figure 1.5-63 East Range Alternate HVTL Route Along 38L Corridor: Segment 6

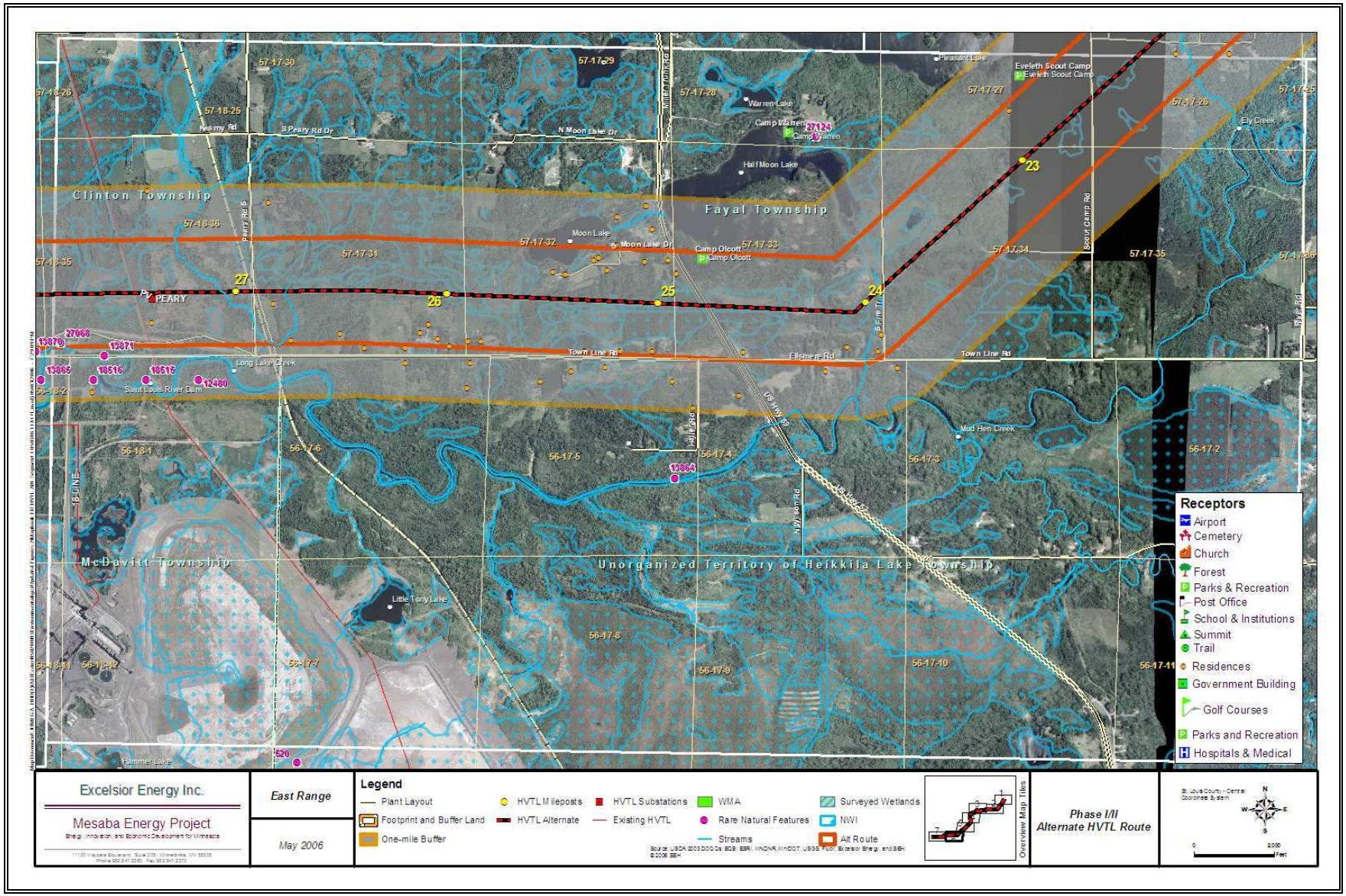
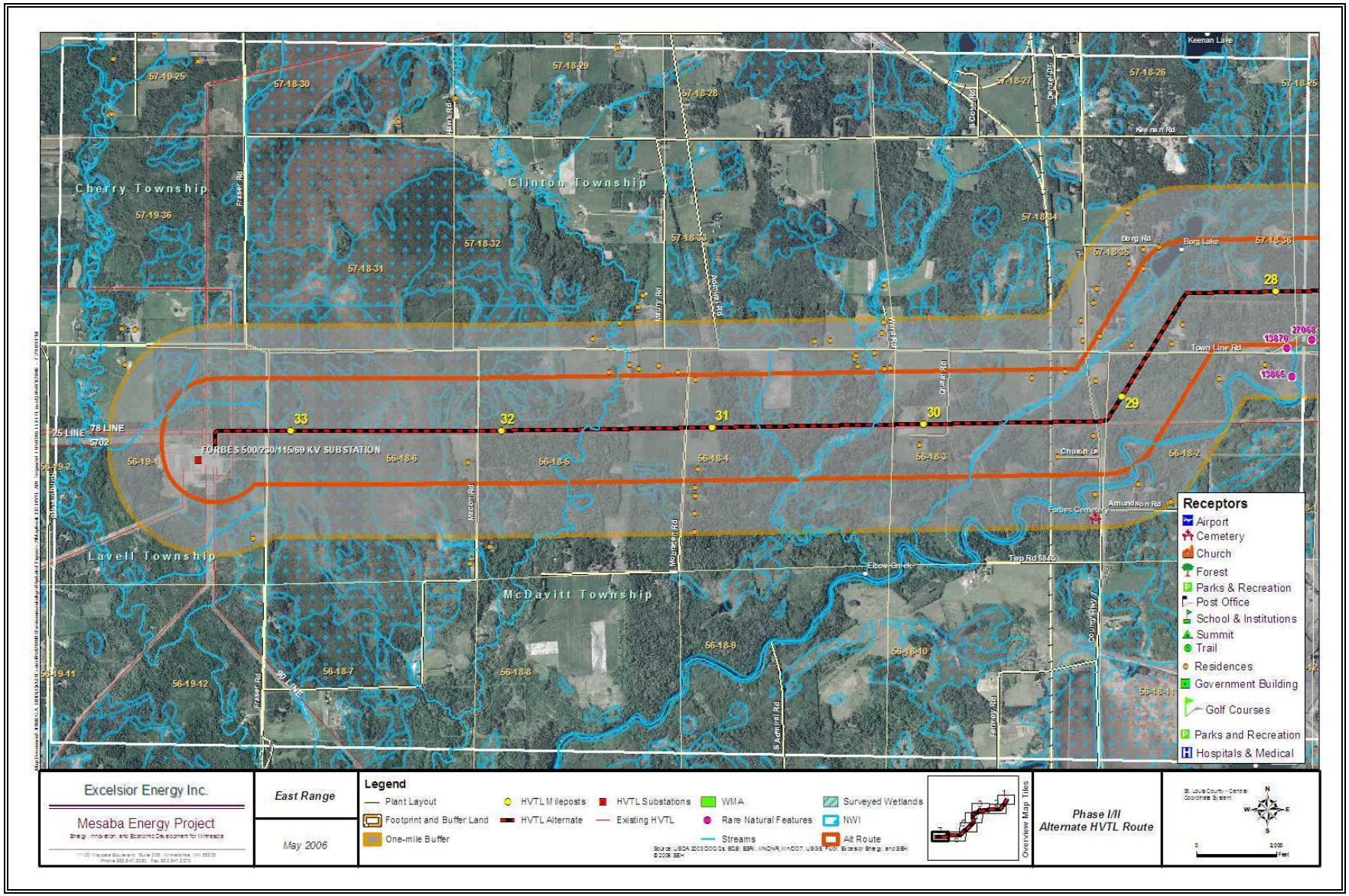


Figure 1.5-64 East Range Alternate HVTL Route Along 38L Corridor: Segment 7



1.5.3.4 Natural Gas Pipeline Route

NNG represents the only feasible option for supplying Mesaba One and Two with natural gas as it is the only pipeline company within the immediate vicinity of the East Range Site. NNG's existing pipeline serves CE (and the former LTV mining operation) and abuts the IGCC Power Station Footprint on its eastern boundary. The diameter of NNG's pipeline at the point of its interconnection near Carlton, Minnesota with the GLG pipeline is 20-inches. From Carlton, NNG's line generally travels northward until it reaches the junction of St. Louis CR 454 and CR 315 about one mile west of Iron Junction, Minnesota. From there, the pipeline branches into two pipelines. One of the two branches is a 12-inch pipeline that serves the Hibbing area, the other a 10-inch branch line that travels past the eastern boundary of the East Range Buffer Land to serve CE. A milepost map covering the CE branch line from the "T" at CR 454 and CR 315 to the IGCC Power Station Footprint and Buffer Land is shown in Figure 1.5-65. In order to provide natural gas in the quantity and at the pressure required to supply the Project's two phases, the following will be required:

- Installation of approximately 33 miles of new, 16-24-inch pipe placed within the existing ROW for 10-inch branch line now serving CE.
- Addition of a new compressor at the existing point where the GLG and NNG pipelines interconnect.
- Installation of an ultrasonic meter facility to serve the IGCC Power Station.

Figures 1.5-66 through 1.5-71 present an overview of NNG's existing natural gas pipeline route from the pipeline tap near Iron Junction, Minnesota to the IGCC Power Station. Significant receptors are shown along the pipeline route in the series of figures presented. Table 2.1-11 in Section 2.1.3 shows the number of residences and special receptors (churches, hospitals, cemeteries, etc.) located within a one-half mile band on each side of the centerline of the proposed natural gas pipeline.

Ownership of properties within one quarter mile on both sides of the center alignment of the proposed route is provided in Appendix 3 of the Joint Application.

Figure 1.5-65 East Range Natural Gas Pipeline Milepost Map

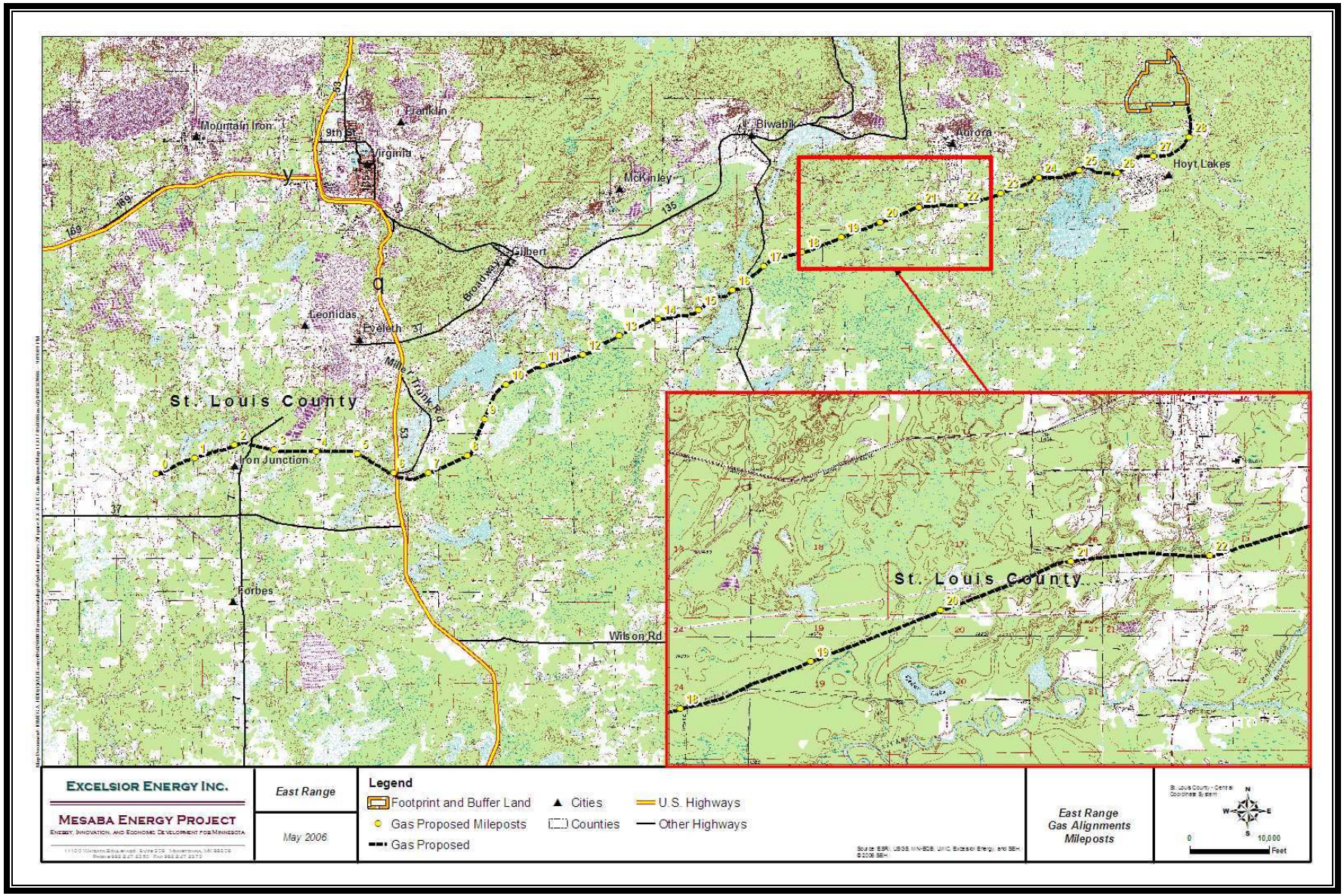


Figure 1.5-66 East Range Proposed Natural Gas Pipeline Route: Segment 1

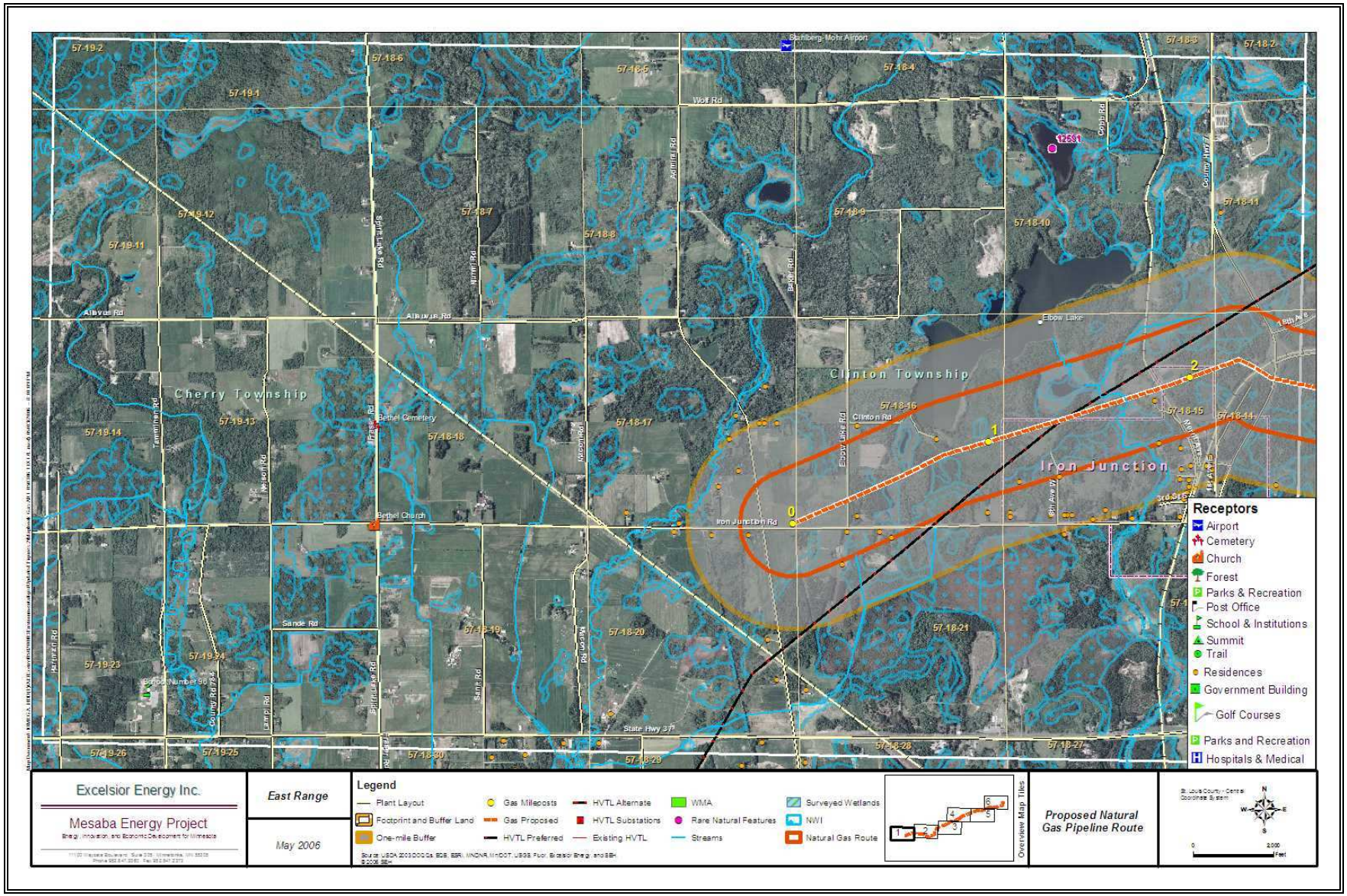


Figure 1.5-67 East Range Proposed Natural Gas Pipeline Route: Segment 2

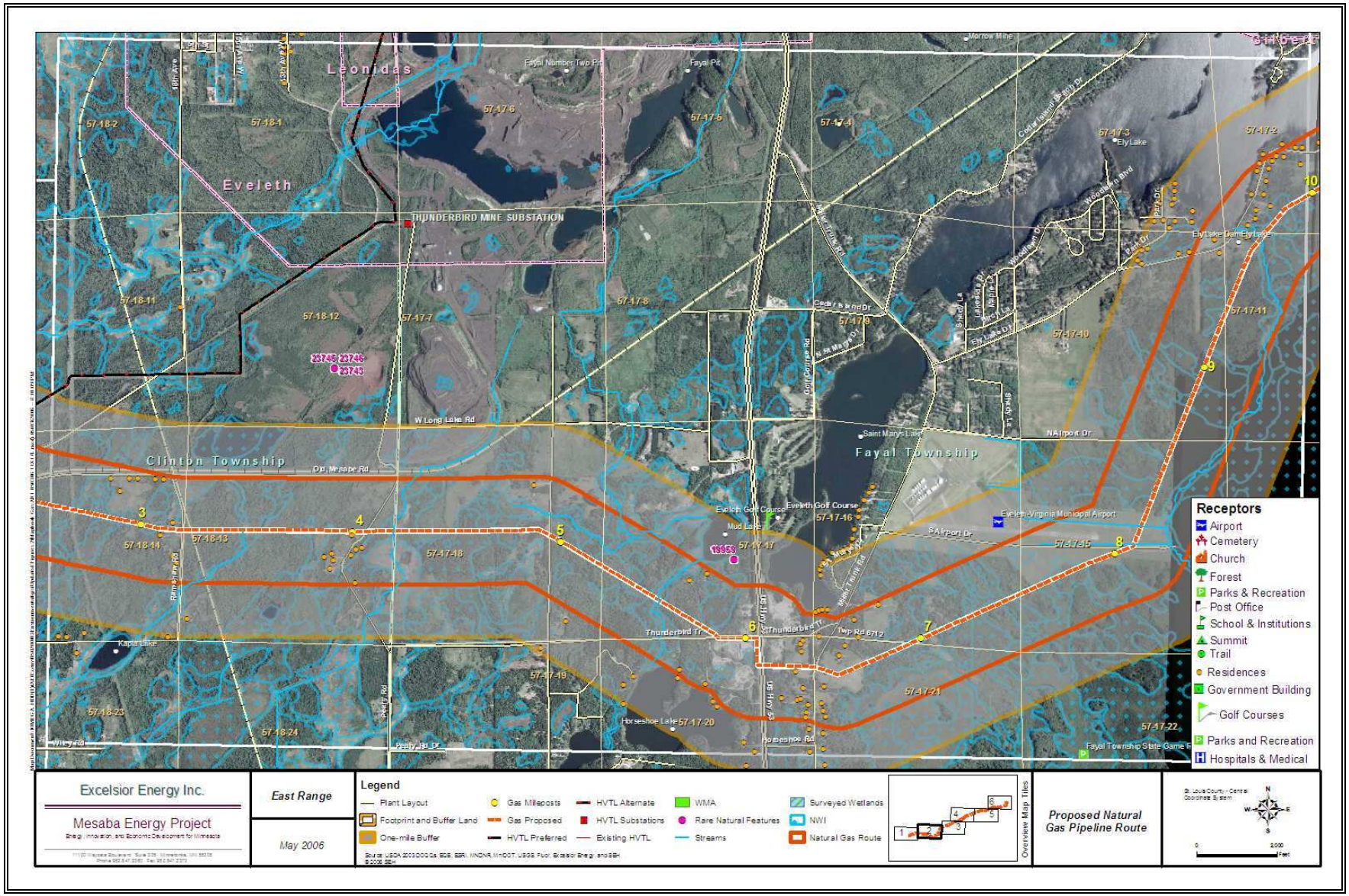


Figure 1.5-68 East Range Proposed Natural Gas Pipeline Route: Segment 3

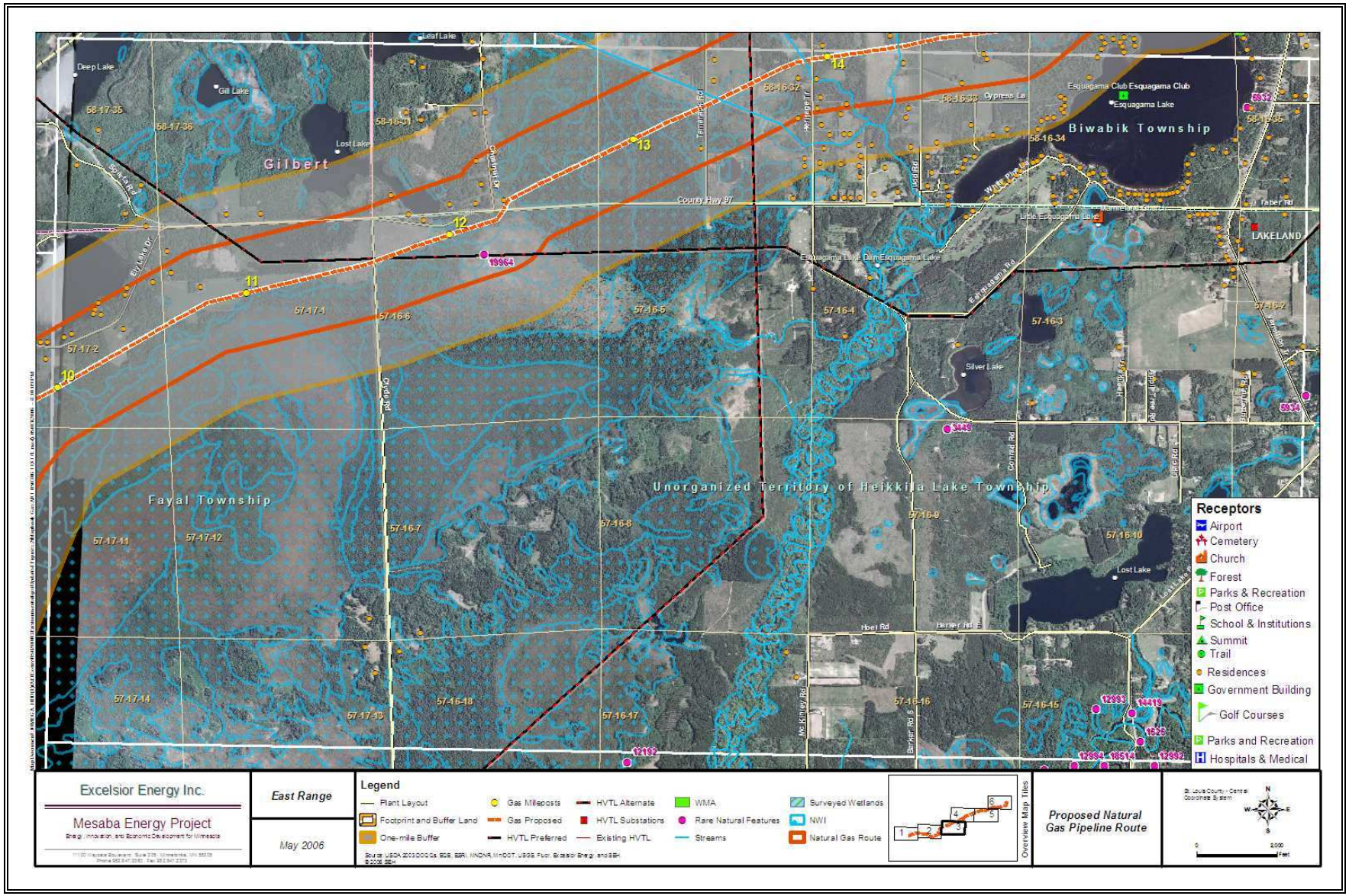


Figure 1.5-69 East Range Proposed Natural Gas Pipeline Route: Segment 4

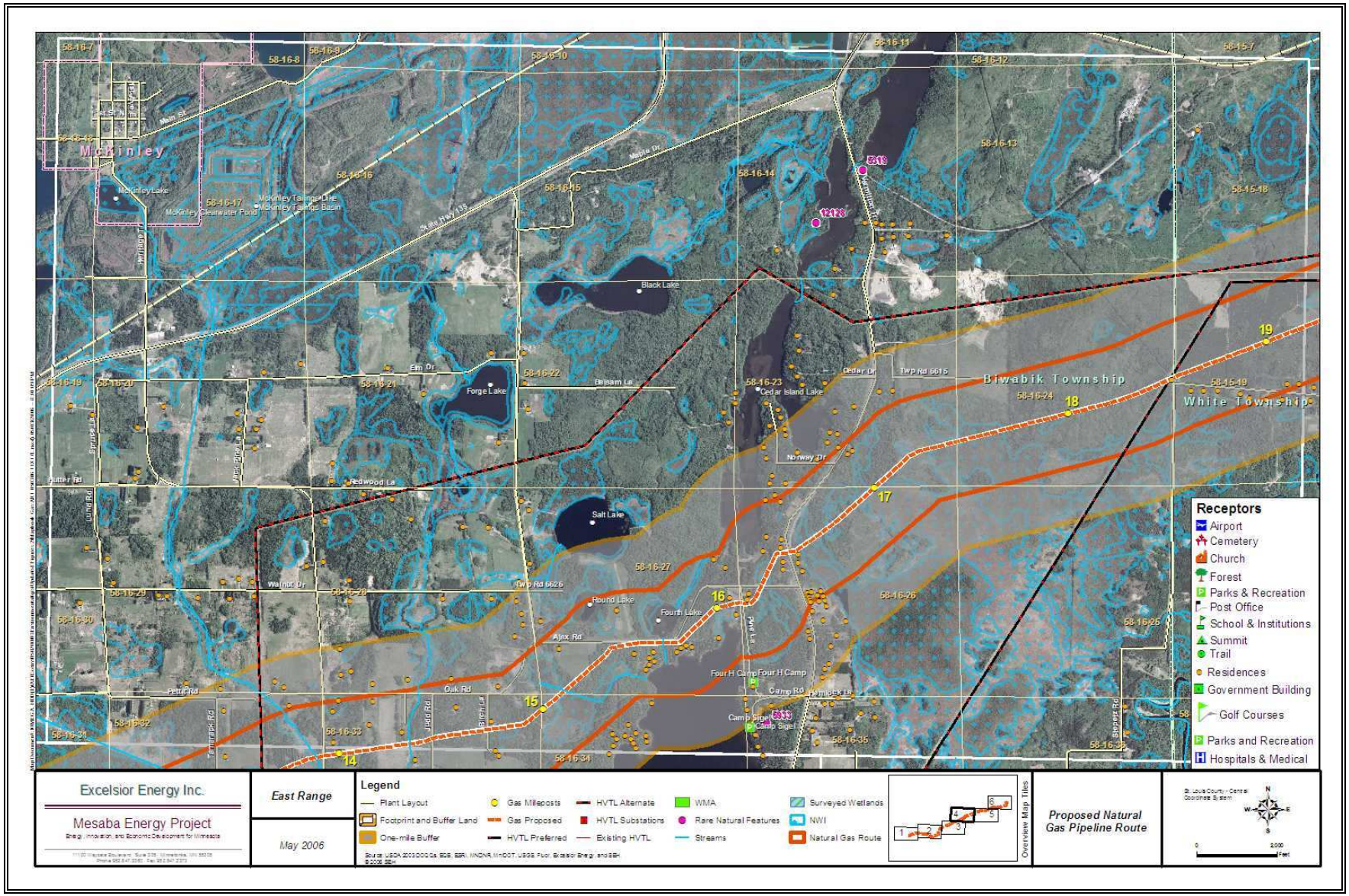


Figure 1.5-70 East Range Proposed Natural Gas Pipeline Route: Segment 5

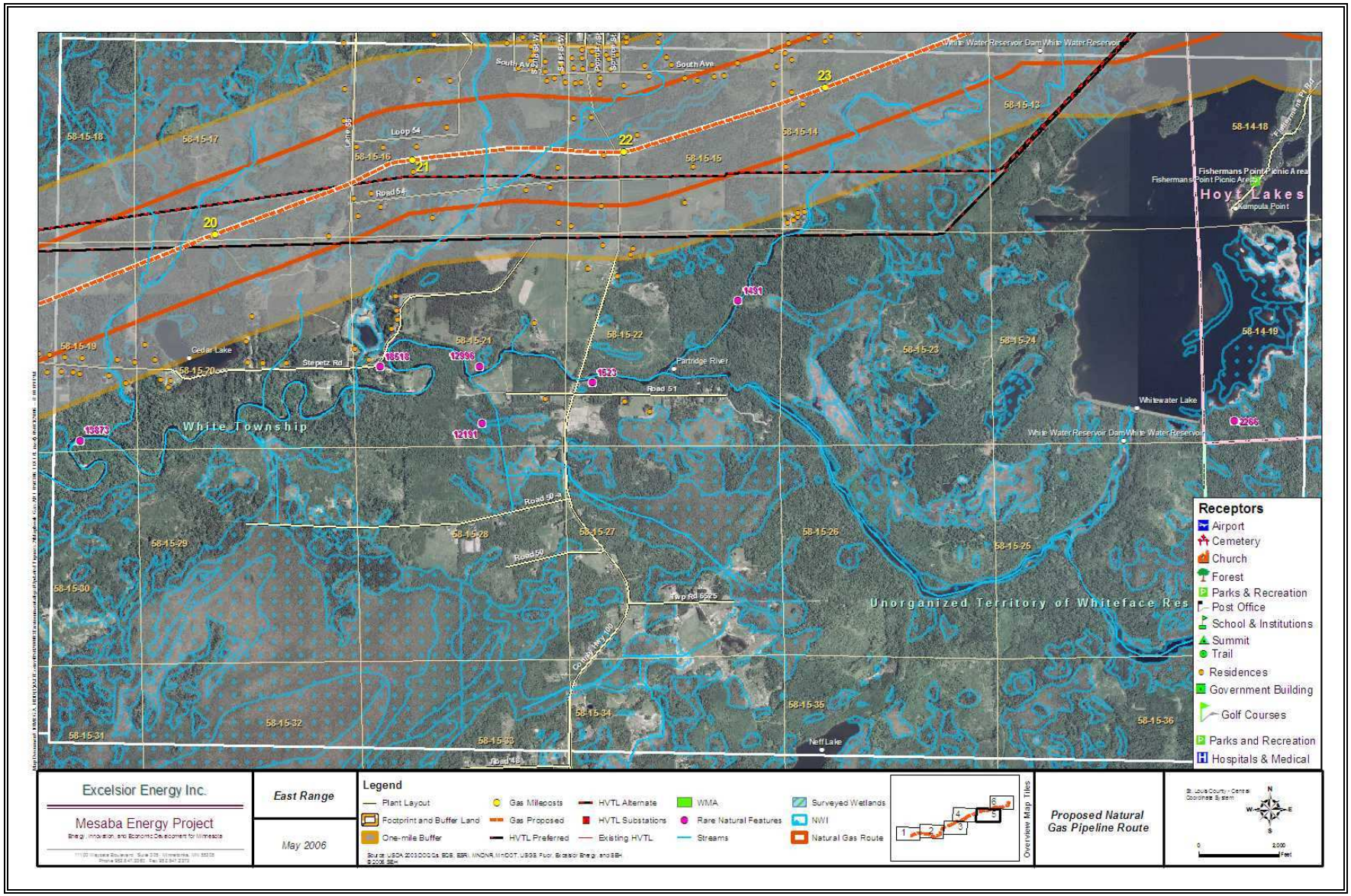
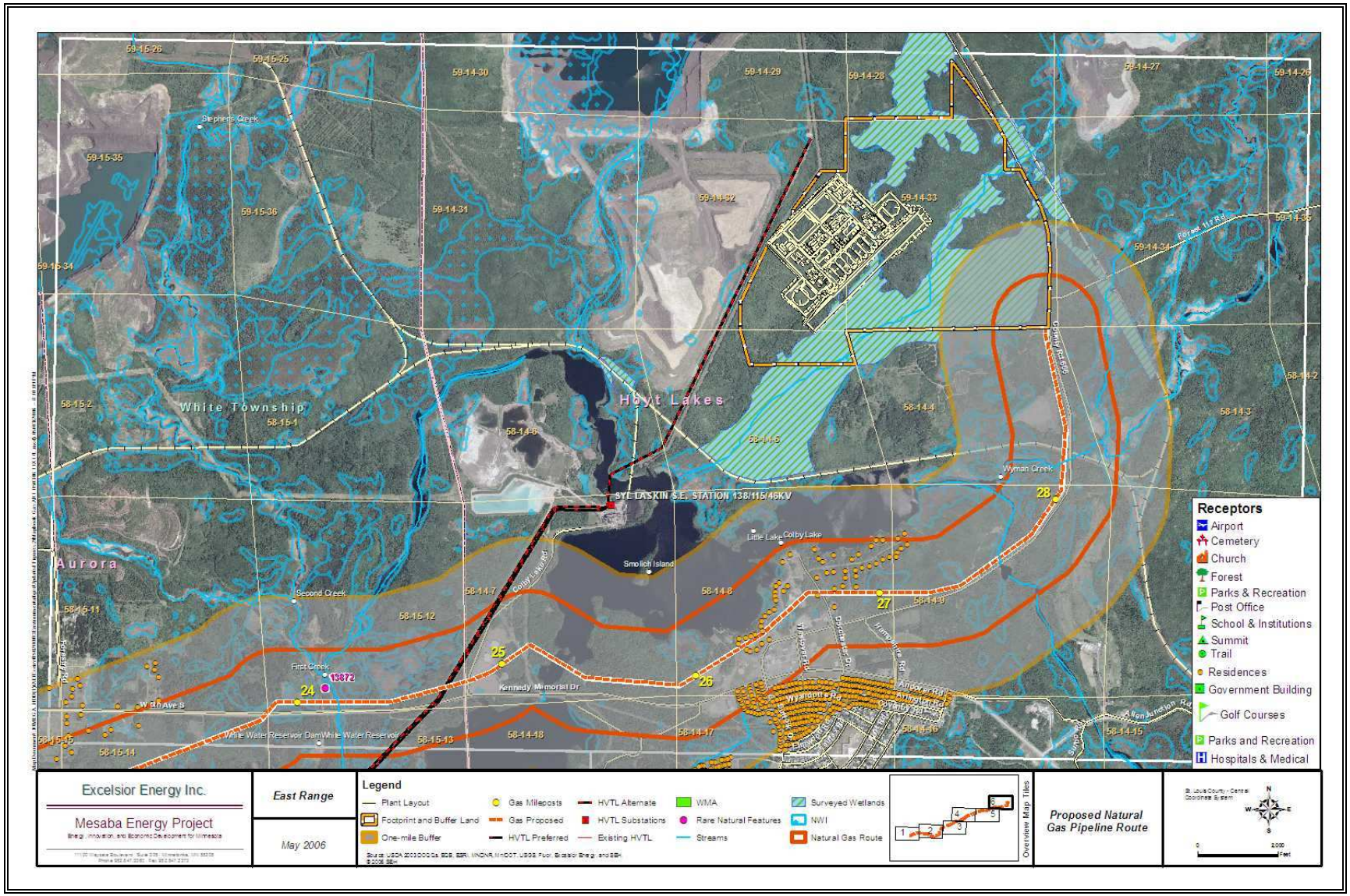


Figure 1.5-71 East Range Proposed Natural Gas Pipeline Route: Segment 6



1.6 Technology Selection and Process Description

This section describes the IGCC Power Station (an LEPGP) and its Associated Facilities. The HVTL GO outlet facilities and the natural gas pipeline facilities are described in Section 1.12.1 and Section 1.12.2, respectively.

1.6.1 Technology Selection

ConocoPhillips was selected as the gasification technology licensor for the Project in the spring of 2004. Following its selection announcement, the Proponent began working with ConocoPhillips to explore using different solid feedstocks utilizing ConocoPhillips' E-Gas™ technology. Based upon optimization analyses conducted over a one year period, the Proponent determined that Mesaba One and Mesaba Two should be designed as "feedstock flexible" facilities capable of utilizing petroleum coke, bituminous coal, sub-bituminous coal, and combinations of such feedstocks. Such design will minimize energy costs and provide significant long-term benefits to consumers given the IGCC Power Station's capability to utilize different feedstocks and feedstock transportation systems.

1.6.2 Process and Equipment Descriptions: Introduction

Detailed descriptions of the gasification/power production processes characteristic of an E-Gas™ Technology-based IGCC Power Station are provided in the remainder of this Section. The descriptions provided will address the following elements:

- Underlying basis for all computations included in this ES (Section 1.6.3)
- Process chemistry (Section 1.6.4)
- Process subsystems and their operation (Section 1.6.5)
- IGCC Power Station utility systems (Section 1.6.6)
- Major process equipment (Section 1.6.7)
- Operating characteristics (Section 1.6.8)

The major subsystems of the IGCC Power Station that are discussed in detail below include: oxygen supply, feedstock slurry preparation, gasification, slag handling, syngas cooling, particulate matter removal, syngas scrubbing, low temperature heat recovery, acid gas removal, sulfur recovery, tank vent collection, sour water treatment and the combined cycle power block.

Overall schematic block flow diagrams ("BFD") identifying important equipment and processes related to air pollutant emissions from the Phase I and II Developments are presented in Figures 1.6-1 and 1.6-2, respectively. The only difference in these two figures is the numbers assigned to the emission/control points (the identification numbers that are used in the BFDs correspond to the numbers used in the Proponent's Part 70/New Source Review Construction Authorization Permit Application). The emission/control points identified in the BFDs are essentially independent of the development phase and/or the Site.

1.6.3 Maximum Emission/Discharge Scenarios Quantified

During the environmental review and permitting process, the Proponent is required to identify operating scenarios producing maximum emissions/discharges associated with construction and

operation of the IGCC Power Station. Such scenarios are primarily defined by the operating characteristics of Station equipment and the amounts and characteristics of feedstock to be transported, handled and consumed. Maximum quantities of feedstock consumed and feedstock characteristics are further discussed in Sections 1.6.8 through 1.7.3 below.

For development of its "worst case" scenario, the Company focused on identifying operating parameters yielding maximum emissions. In general, these scenarios reflect the highest heat input rates and a cautious approach regarding the design optimizations expected to occur (during the Front End Engineering and Design ["FEED"] process, the preliminary equipment designs used to estimate environmental releases will be refined and uncertainties that now require conservatively high assumptions to be used will be better understood). In employing such an approach, the Proponent is confident that environmental releases and their associated impacts are conservatively analyzed and presented.

Operating conditions producing maximum emissions/discharges from the IGCC Power Station are identified in Tables 1.6-1 and 1.6-2 in Section 1.6.8. Table 1.6-1 assumes operation of the gasifiers under partial slurry quench ("PSQ") conditions and considers known seasonal influences and the range of potential feedstocks for which the IGCC Power Station will be designed to utilize. Table 1.6-2 assumes the same scenarios as Table 1.6-1, but with the gasifier operating in full slurry quench ("FSQ") mode. FSQ is achieved by increasing the slurry feed to the second stage of the gasifier to the point where only slurry is used to quench the syngas, thereby eliminating the thermal loss associated with water used to cool the syngas and increasing the overall efficiency of the IGCC Power Station. These efficiency gains will translate into reduced feedstock use and, consequently, reduced pollutant emissions/discharges. However, FSQ is an IGCC Power Station design improvement that is subject to further engineering and verification by experience at Wabash River. Therefore, FSQ's expected benefits are shown in Table 1.6-2, but not reflected in either the maximum resource requirements or maximum pollutant emissions/discharges quantified in this ES.

Figure 1.6-1. Phase I IGCC Power Station Emission Source Block Flow Diagram

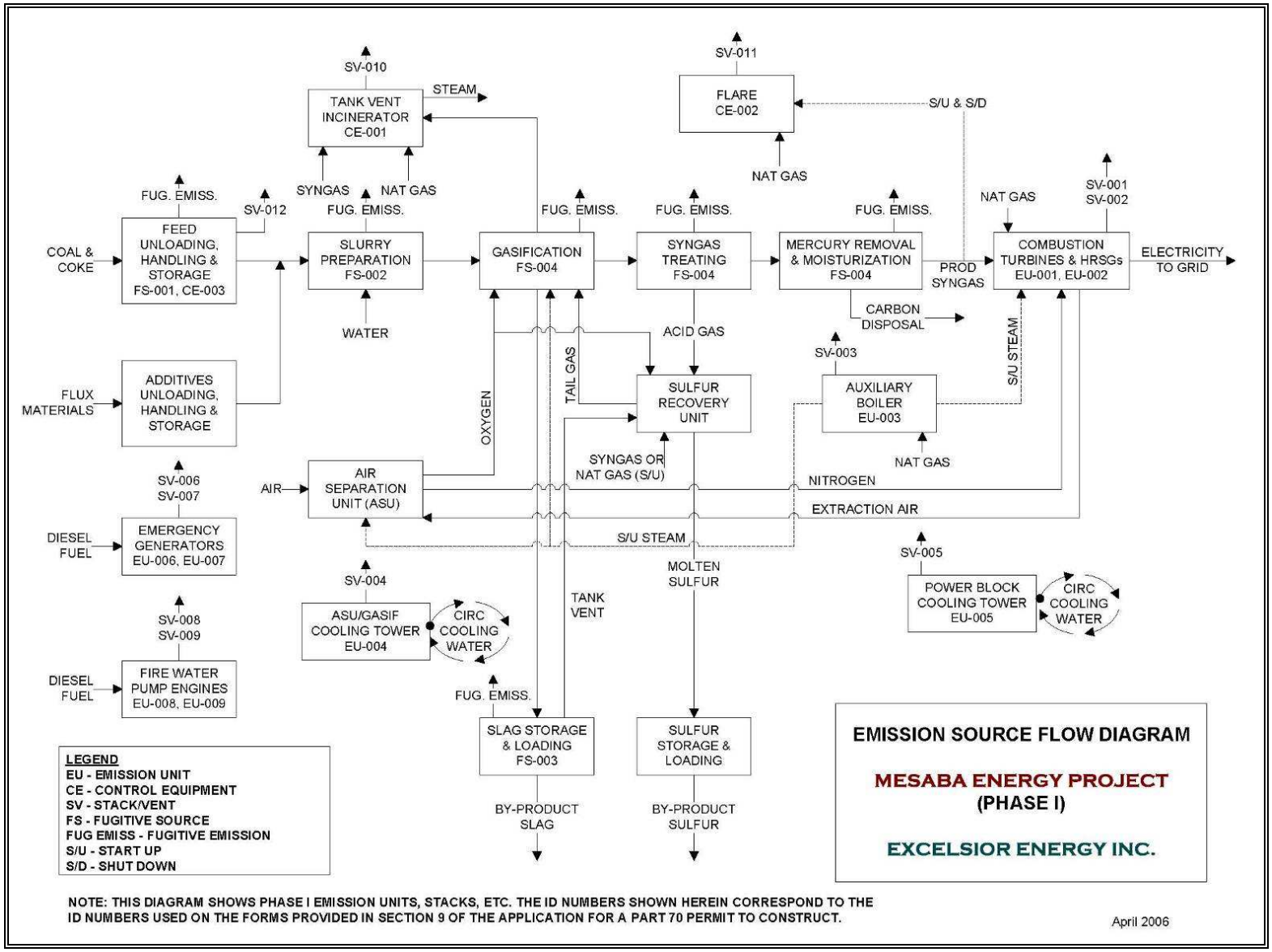
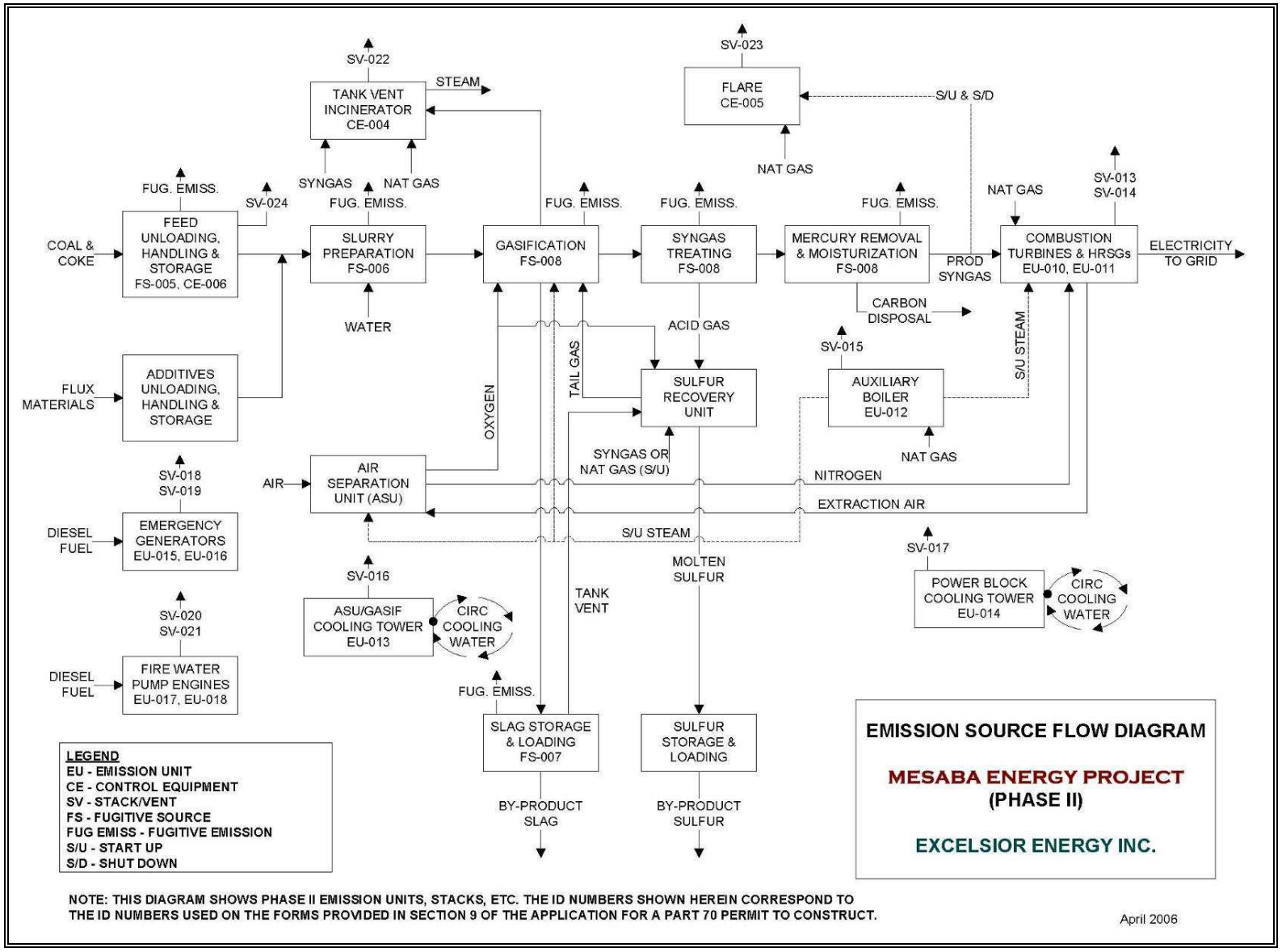


Figure 1.6-2. Phase II IGCC Power Station Emission Source Block Flow Diagram



1.6.4 Process Chemistry

1.6.4.1 Gasification

Coal and petroleum coke are typically characterized by their heating value, elemental analysis (weight percent carbon, hydrogen, nitrogen and sulfur), mineral matter (also known as ash), and moisture content. Unlike traditional pulverized coal power plants where fuel is actually combusted, in an IGCC power station, coal and/or petroleum coke slurry is fed to the gasifier along with pure oxygen ("O_2"), and a number of complex chemical reactions occur. A portion of the feedstock is partially oxidized to provide the temperatures necessary for gasification. The gasification temperature is high enough to break essentially all the chemical bonds present in the coal and establish a new mix of smaller molecules based on the following primary reactions:

$C + O_2 = CO_2$ (rapid exothermic, or heat releasing, oxidation reaction)

$C + ½ O_2 = CO$ (rapid exothermic oxidation reaction)

$C + H_2O = CO + H_2$ (slower endothermic, or heat consuming, reaction)

$C + CO_2 = 2CO$ (slower endothermic reaction)

$CO + H_2O = H_2 + CO_2$ ("water gas shift reaction", exothermic and rapid)

$CO + 3H_2 = CH_4 + H_2O$ ("methanation reaction", exothermic)

$C + 2H_2 = CH_4$ (direct methanation, exothermic)

Most of the sulfur in the feedstock is converted to hydrogen sulfide ("H_2S") during the gasification process. A small portion of the sulfur is converted into carbonyl sulfide ("COS"). Most of the nitrogen in the feedstock is converted to ammonia ("NH_3"). The syngas composition leaving the gasifier is determined by the gasifier operating temperature and the relative kinetics of the above reactions. Most of the energy in the feedstock is ultimately converted into carbon monoxide ("CO") and hydrogen ("H_2"), and a small amount of methane ("CH_4"). Low grade coals with lower heating values and higher moisture contents will generate a syngas with more CO_2 and H_2, the additional CO_2 generated from the water gas shift reaction shown above. Higher quality coals and petroleum coke will result in a syngas that has a much higher CO content.

1.6.4.2 COS Hydrolysis

Because the small fraction of COS formed in the gasifier is difficult to remove in the Acid Gas Removal ("AGR") system, the COS is "hydrolyzed" in a catalytic reactor before the syngas is sent to the AGR system. The hydrolysis reaction is shown below:

$COS + H_2O = H_2S + CO_2$

The conversion of COS to H_2S is not 100%, and is limited by the equilibrium conditions at the COS reactor operating temperature.

1.6.4.3 Acid Gas Removal

The AGR system uses methyl diethanolamine ("MDEA"), a weak base, to remove the H_2S from the syngas. H_2S is a weak acid that forms weak chemical bonds with the cold lean MDEA solution. Once the MDEA solution absorbs the H_2S, it is called a "rich" solution. The rich MDEA solution is regenerated to a lean MDEA solution by reducing the pressure, applying heat

and boiling it. The H_2S released from the rich MDEA under such conditions is sent to the sulfur recovery unit ("SRU").

1.6.4.4 Sulfur Removal

The SRU uses Claus technology to convert H_2S to elemental sulfur. The Claus reactions are shown below:

$$H_2S + \frac{3}{2}O_2 = SO_2 + H_2O$$

$$SO_2 + 2H_2S = 2S + 2\,H_2O$$

The Claus reactions occur in two steps. In the first step a portion of the H_2S is combusted with O_2. The sulfur dioxide ("SO_2") that is formed is mixed with additional H_2S and passed over catalyst beds. The Claus reactions are exothermic and reaction heat is recovered, generating low pressure steam. The "tail gas" stream leaving the Claus reactors contains nitrogen (N_2) and other inert gases that entered with the feeds, along with traces of unconverted H_2S. The tail gas is recycled to the gasifier.

1.6.5 Process Operations

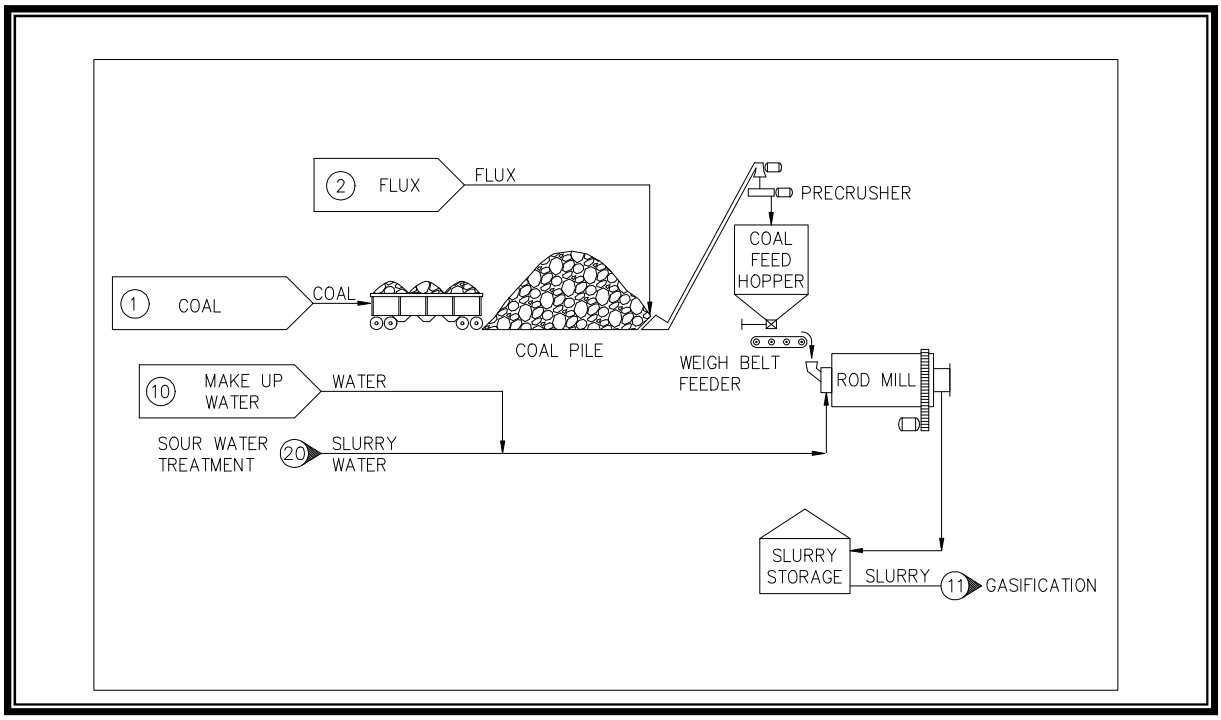
1.6.5.1 Slurry Preparation

To produce slurry gasifier feed, the solid feedstock is placed on a weigh belt feeder and directed to the rod mill where it is mixed and ground with treated recycled water and slag fines that are recycled from other areas of the gasification island. The resulting slurry has a paste-like consistency. The use of a wet rod mill reduces potential fugitive particulate matter emissions from the grinding operations and is an efficient method for producing essentially homogeneous slurry. Collection and reuse of water within the gasification island minimizes water consumption and discharge.

Slurry feeding allows for consistent and safe introduction of feed into the gasifiers. Prepared slurry will be stored in an agitated tank. The capacity of the slurry storage tank will be sufficiently large to supply the gasifiers' needs without interruption when the rod mill undergoes normal maintenance requirements. The feedstock grinding and slurry preparation area is depicted in Figure 1.6-1.

Tanks, drums and other areas of potential atmospheric exposure to the slurry or recycle water will be covered and vented into the tank vent collection system for vapor emission control. The entire feedstock grinding and slurry preparation facility will be paved and curbed to contain spills, leaks, wash down, and storm water runoff. A trench system will carry this water to a sump where it will be pumped into the recycle water storage tank.

Figure 1.6-3. Feedstock Grinding and Slurry Preparation



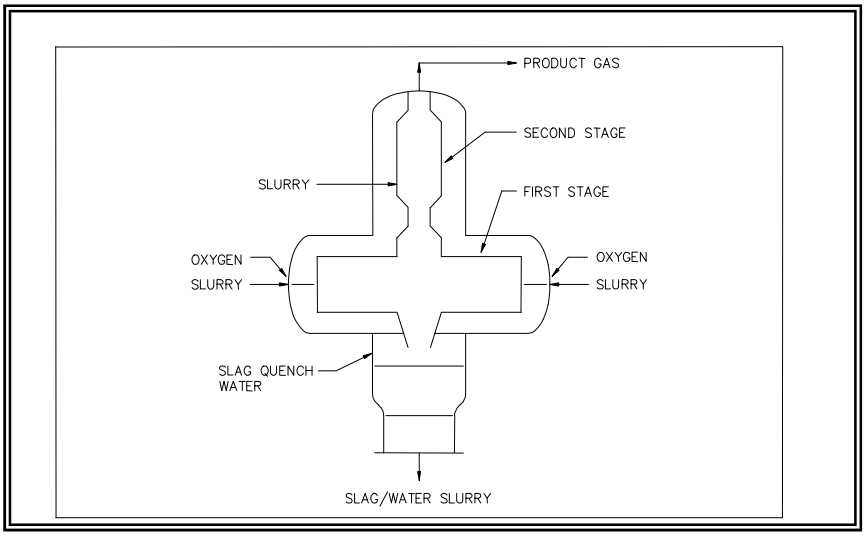
1.6.5.2 Gasification and Slag Handling

The E-Gas™ gasifier consists of two stages: a slagging first stage, and an entrained flow, non-slagging second stage, as shown in Figure 1.6-4. The first stage is a horizontal refractory-lined vessel in which feedstocks will be exposed to sub-stoichiometric quantities of oxygen at an elevated temperature and pressure. Oxygen and preheated slurry are fed to each of two opposing mixing nozzles, one on each end of the horizontal section of the gasifier. The oxygen feed rate to the nozzles will be carefully controlled to maintain the gasification temperature above the ash fusion point to allow good slag removal and high carbon conversion. The feedstock will be almost totally gasified in this environment to form syngas consisting principally of hydrogen, carbon monoxide, carbon dioxide and water.

Sulfur in the fuel will be converted to primarily H_2S, with a small portion converted to COS. With the AGR cleanup provided downstream, over 99% of the sulfur will be removed from high sulfur feedstocks; over 97% of the sulfur would be removed from low-sulfur, sub-bituminous coal feedstocks. The removal rate from low sulfur coal nonetheless results in approximately equal sulfur emission rates to the higher removal rate from higher sulfur coal. In other words, the final SO_2 emission rate achieved using E-Gas™ technology is independent of the starting sulfur concentration in the feedstock. Therefore the percentage of SO_2 removed from a higher sulfur feedstock that exhibits the same SO_2 emission rate as a lower sulfur feedstock, would show a higher percentage removal rate.

To illustrate, assume the emission rates when using Coal A or Coal B equal 0.025 pounds per million British thermal unit ("Btu") heat input (note that this emission rate is far lower than the New Source Performance Standard emission rate imposed by Federal law for coal-fueled steam electric generating units shown in Figure 1.6-5).

Figure 1.6-4. E-Gas™ Gasifier



The percentage of SO_2 removed for Coal A and Coal B would be as follows:

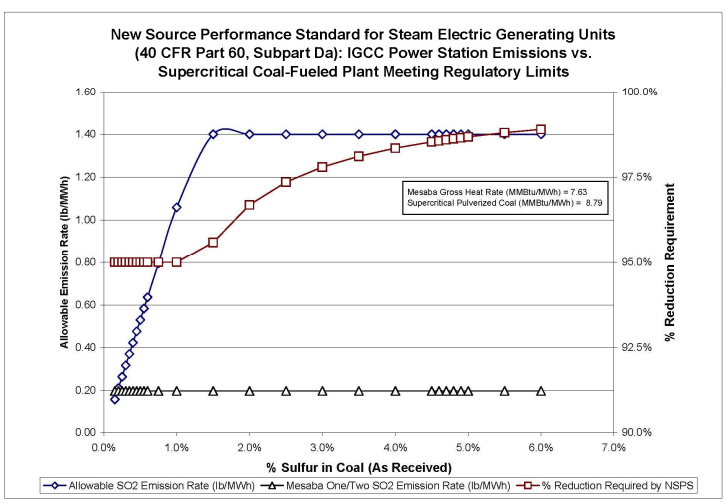
% SO_2 removal, Coal A (3.0% S, 11,500 Btu/pound higher heating value):

$$\frac{\{[(0.03\,\text{lbs S/lb Coal A})*(2\,\text{lbs SO2/lb S})*(10^6\ \text{Btu/MMBtu})/11{,}500\ \text{Btu/lb Coal A}]-0.025\,\text{lb/MMBtu}\}}{[(0.03\,\text{lbs S/lb Coal A})*(2\,\text{lbs SO2/lb S})*(10^6\ \text{Btu/MMBtu})/11{,}500\ \text{Btu/lb Coal A}]}\times 100\% = 99.5\%$$

% SO_2 removal, Coal B (0.5% S, 8,300 Btu/pound higher heating value):

$$\frac{\{[(0.005\,\text{lbs S/lb Coal B})*(2\,\text{lbs SO2/lb S})*(10^6\ \text{Btu/MMBtu})/8{,}300\ \text{Btu/lb Coal B}]-0.025\,\text{lb/MMBtu}\}}{[(0.005\,\text{lbs S/lb Coal B})*(2\,\text{lbs SO2/lb S})*(10^6\ \text{Btu/MMBtu})/8{,}300\ \text{Btu/lb Coal B}]}\times 100\% = 97.9\%$$

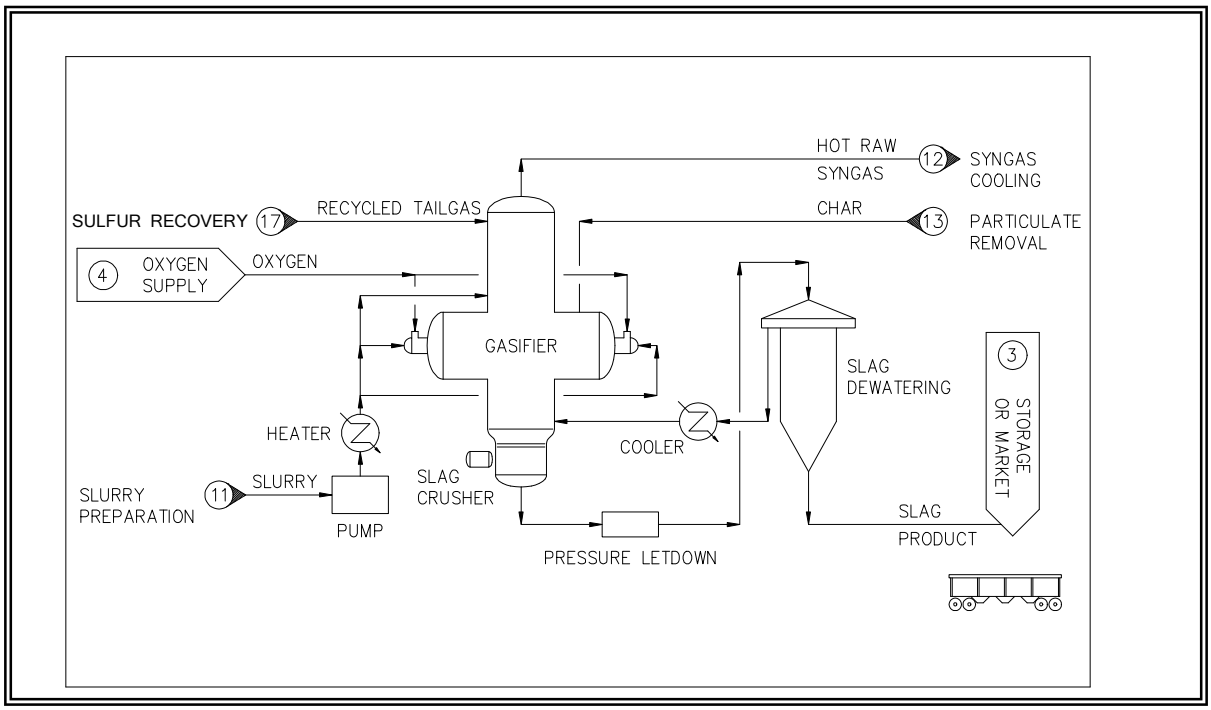
Figure 1.6-5 New Source Performance Standard vs. Mesaba One/Two SO_2 Emission Rates



Mineral matter in the feedstock and any added flux (see Section 1.7.2 for a description of fluxing agents) forms a molten slag, which flows continuously through a tap hole in the floor of the gasifier horizontal section into a water quench bath, located below the gasifier's first stage. The characteristics of the slag produced in the gasifier will vary with the mineral matter content of the feedstock. As depicted in Figure 1.6-6, the solidified slag exits the bottom of the quench section, is crushed, and flows through a continuous pressure-letdown system as a slag/water slurry. This continuous slag removal technique eliminates high maintenance, problem-prone lockhoppers and prevents the escape of raw syngas to the atmosphere during slag removal. The slag/water slurry is then directed to a dewatering and handling area (described later). The raw syngas generated in the gasifier's first stage flows up from the horizontal section into the second stage of the gasifier.

Typically, the ash content of coal will be in the range of 5-11%, as received, and ash in petroleum coke is expected to average about 0.6%, as received. Slag production at full load will thus vary from about 500 tons per day up to a maximum of about 800 tons per day, per phase. The slag will be conveyed from the slag dewatering unit to the slag storage pile using covered conveyors. The storage area will be provided with dust suppression systems. The slag from the storage area will be conveyed to rail cars or trucks for transport to market or storage.

Figure 1.6-6. Gasification and Slag Handling



The gasifier second stage is a vertical refractory-lined vessel in which additional slurry is reacted with the hot syngas stream exiting the first stage. The feedstock undergoes devolatilization (separation of organic components) and pyrolysis (high temperature decomposition), thereby generating more syngas with higher heat content (less carbon being converted to CO_2) since no additional oxygen is introduced into the second stage. This additional slurry lowers the temperature of the syngas exiting the first stage by the endothermic nature of the devolatilization and pyrolysis reactions. In addition to the above reactions, water reacts with a portion of the

carbon to produce additional CO and H_2 for subsequent use as syngas fuel for power generation and CO_2. Unreacted solid fuel (carbonaceous char) is carried out of the second stage with the syngas.

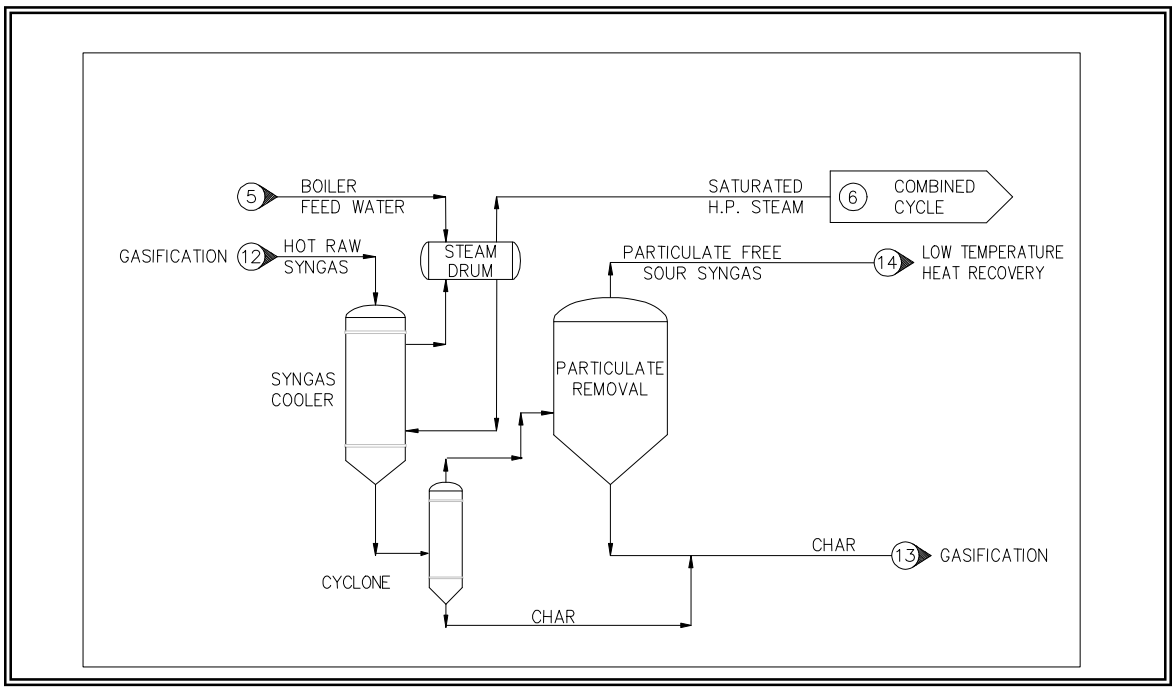
Certain metals present in the feedstocks in trace quantities and volatile at the temperatures typical of the gasifier will also be carried out in their gaseous state as components of the syngas, and removed in the cleanup stage.

The slag/water slurry will flow continuously into a dewatering bin. The bulk of the slag will settle out in the bin while water overflows into a basin in which the remaining slag fines will settle. The clear water from the settler will pass through heat exchangers where it will be cooled as the final step before being returned to the gasifier quench section. Dewatered slag is transferred to the slag storage area to be loaded into trucks or rail cars for transport to market or storage. The slurry of fine slag particles from the bottom of the settler will be recycled to the slurry preparation area to be fed back into the gasifier, ensuring maximum carbon utilization.

1.6.5.3 Syngas Cleanup and Desulfurization

As shown in Figure 1.6-7, the next two steps in the process are to cool the syngas and then remove the particulate matter from the syngas stream. Captured particulate matter is recycled back to the gasifier.

Figure 1.6-7. Particulate Matter Removal



The hot raw syngas (with entrained particulate matter) exiting the gasifier system is cooled in the syngas cooler, converting a significant portion of the heat from the gasifier to high pressure steam for use in power generation.

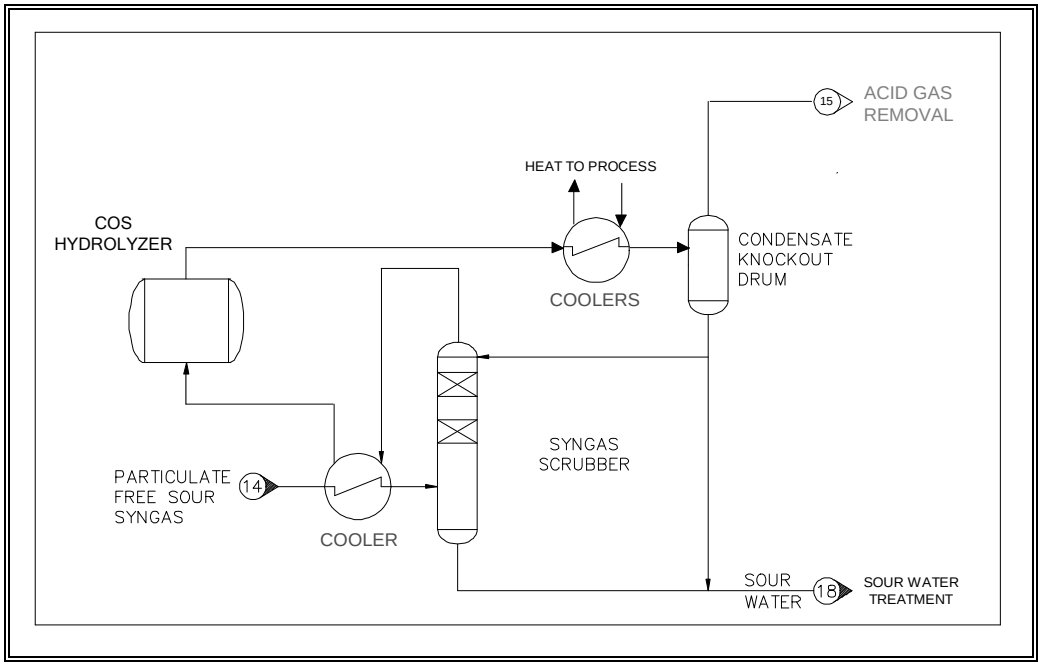
1.6.5.3.1 Particulate Matter Removal

After cooling, the syngas is directed to the particulate matter removal system, as shown in Figure 1.6-7 above. The gas flows first through a hot gas cyclone for removal of relatively large particulate matter and then passes to the particulate matter filter. The filter vessel contains numerous porous filter elements to remove particulate matter. The cleaned syngas exits the unit as a particle free syngas. Particulate matter removal efficiency is expected to be 99.9%. Removed particulate matter from both the hot gas cyclone and the dry filter vessel is recycled to the first stage of the gasifier to improve carbon conversion efficiency. With the particulate matter being recycled to the gasifier from both devices, near complete gasification of the carbon content of the feedstock is obtained. The particle-free syngas proceeds to the low temperature heat recovery system.

1.6.5.3.2 Syngas Scrubbing, COS Hydrolysis and Low Temperature Heat Recovery

With particulate matter removed from the syngas, additional gas cleanup (including mercury removal) and cooling steps can more easily be performed. The syngas is scrubbed with recycled sour water (water with dissolved sulfur compounds and other contaminants condensed from the syngas) to remove chlorides and trace metals and to reduce the potential of equipment corrosion and formation of undesirable products in the AGR. This is shown in Figure 1.6-8.

Figure 1.6-8. Syngas Scrubbing



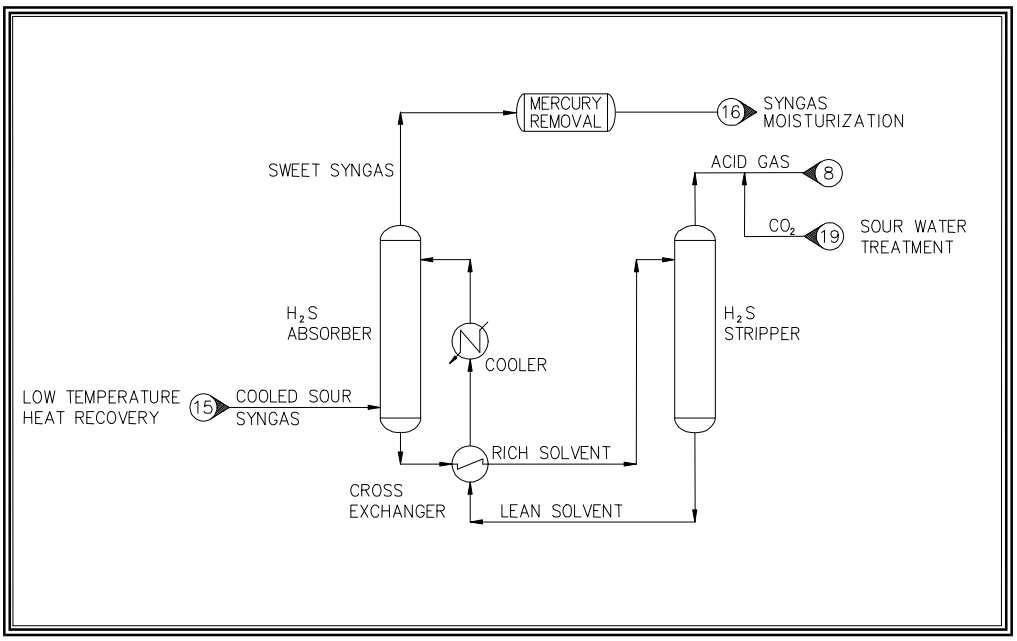
A COS hydrolysis unit is provided to achieve a high level of sulfur removal. The purpose of the COS hydrolysis step is to convert the small amount of COS in the syngas to H_2S, which can then be efficiently removed in the AGR system. After hydrolysis, the syngas is cooled in process heat exchangers to efficiently utilize the available relatively low-temperature heat. Most of the ammonia (NH_3) and a small portion of the CO_2 and H_2S present in the syngas are absorbed in the water condensed by this cooling step. Additionally, some of the trace metals that remained in

their gaseous state during the particulate matter removal process will condense. The water is collected and sent to the sour water treatment unit. The cooled sour syngas is fed to the AGR system where the sulfur compounds are removed to produce a low sulfur product syngas.

1.6.5.3.3 Acid Gas Removal System

The AGR system (shown in Figure 1.6-9) contacts the cool sour syngas with an aqueous solution of MDEA, an amine absorbent that removes the H_2S to produce a clean product syngas. MDEA chemically bonds with H_2S, with a bond that can be easily broken with low level heat in order to regenerate the absorbent. H_2S is absorbed from the syngas by contacting the gas with MDEA solution within the H_2S absorber column. A portion of the CO_2 is also absorbed as well. The H_2S-rich MDEA from the bottom of the absorber flows to a cross heat exchanger to recover heat from the hot lean MDEA coming from the stripper. The heated rich MDEA is then directed to the H_2S stripper where the H_2S and CO_2 are removed at near atmospheric pressure. A concentrated stream of H_2S and CO_2 exits the top of the H_2S stripper and flows either to the carbon-capture system or directly to the SRU. The lean MDEA is pumped from the bottom of the stripper to the heat exchanger. The lean MDEA is further cooled before being stored and then recirculated to the absorber. This unit is a totally enclosed process with no discharges to the atmosphere.

Figure 1.6-9. Acid Gas Removal



1.6.5.3.4 Potential Carbon Capture Retrofit

The Proponent believes that some form of Federal greenhouse gas emissions control will be imposed within the next ten years. To provide the State and consumers with a means to deal with such requirements, the Proponent will design Mesaba One and Mesaba Two to be carbon capture ready. Additionally, the Proponent has contracted with the University of North Dakota Energy and Environmental Research Center ("EERC") to assess CO_2 management options for

Mesaba One and Mesaba Two. This work is part of the Plains CO_2 Reduction Partnership,[4] Phase II efforts EERC is conducting for DOE to validate the most promising sequestration technologies and infrastructure concepts identified during Phase I of the Program.[5] Sink-source pairs, specific to the composition of CO_2 gas streams that can be removed from the syngas produced by Mesaba One and Mesaba Two, will be identified and ranked according to engineering, economic, and public-acceptance considerations.

The carbon capture system that the Proponent will seek to engineer on a preliminary basis can be added after the IGCC plant is in operation. Based on work to date, such CO_2 capture facilities will likely be located within the existing IGCC Power Station Footprint and require an area of approximately 100' X 150' to accommodate necessary equipment. The preferred location for the future plot space would be adjacent to the power block. For PRB coal, the Proponent would expect to capture approximately one third of the carbon (as CO_2) in the solid IGCC feedstock. This capture would likely come at a decrease in capacity and efficiency of the IGCC plant.[6]

1.6.5.3.5 Mercury Removal and Moisturization

Fixed beds of activated carbon will be provided to remove residual mercury from syngas (see Figure 1.6-9 above). Multiple beds specially impregnated to remove mercury are used to obtain optimized adsorption. The activated carbon capacity for mercury ranges up to 20% by weight of the carbon (Parsons, 2002). The mercury removal system will remove enough mercury from the syngas so that the mercury content of the syngas fuel is no more than 10% of the mercury contained in the solid IGCC feedstock. The mercury removal system will be located immediately upstream or immediately downstream of the AGR. The location will be determined during the next engineering phase of the project by working closely with carbon suppliers to identify the optimum location. After acid gas and mercury removal, the product syngas is moisturized, heated, and diluted with nitrogen for control of nitrogen oxides ("NO_x") before being combusted for power generation in the CTGs.

1.6.5.4 Sulfur Recovery Unit

The H_2S carried along in the acid gas from the AGR system is converted to elemental sulfur in the SRU. This technology is based on the industry-standard Claus process involving the conversion of the H_2S to gaseous elemental sulfur and steam. The sulfur is selectively condensed and collected in molten form (see Figure 1.6-10).

The acid gas stream from the AGR units and the CO_2 /H_2S stripped from the sour water are fed to the SRU. One-third of the H_2S is combusted with oxygen to produce the proper ratio of H_2S and SO_2, which are then reacted together to produce elemental sulfur gas in a reaction furnace. A

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[4] The Plains CO_2 Reduction Partnership is one of seven regional partnerships funded by the U.S. Department of Energy's National Energy Technology Laboratory Regional Carbon Sequestration Partnership Program.

[5] Plains CO_2 Reduction ("PCOR") Partnership Phase I Final Report/Quarterly Technical Progress Report for the Period July 1-September 30, 2005; DOE Cooperative Agreement No. DE-PS26-03NT41982 EERC Fund Nos. 4251, 4334, 4406, and 9039, January 2006.

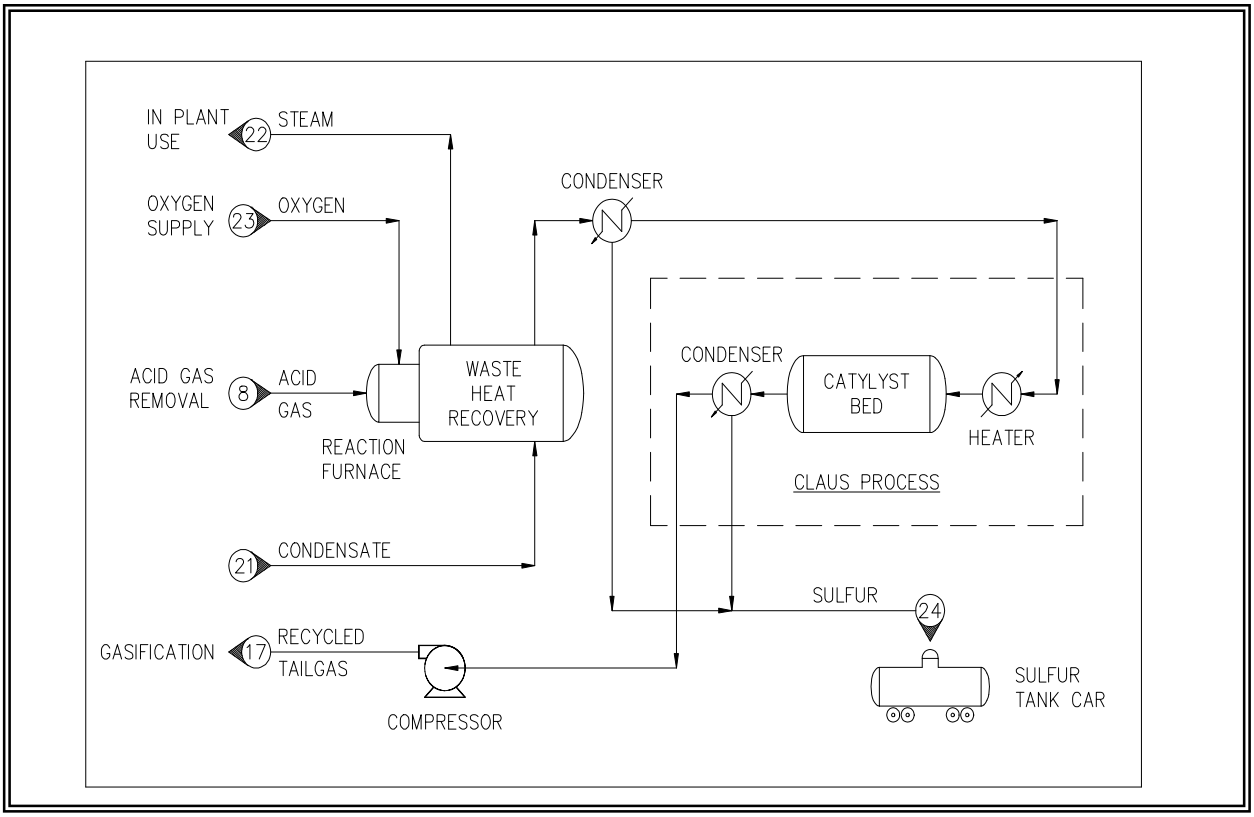
[6] The adverse economic and operational impacts associated with carbon capture are expected to be reduced by research and development initiatives presently underway as part of the DOE's Clean Coal Power Initiative. Future research under that initiative will develop the technological path required to achieve removal of an expected 90% of the total CO_2.

waste heat boiler is used to recover heat before the furnace off-gas is cooled to condense the first increment of sulfur. Gas exiting the first sulfur condenser is fed to a series of heaters, catalytic reaction stages and sulfur condensers where the H_2S is incrementally converted to elemental sulfur. The sulfur is recovered and stored in molten form and may be sold as a by-product raw material for fertilizer and other beneficial uses. If not sold, the sulfur will be stored on site and/or transported to a storage facility.

The tail gas from the SRU is composed mostly of CO_2 and nitrogen with trace amounts of H_2S and SO_2 as it exits the last condenser. This SRU tail gas is catalytically hydrogenated to convert the remaining sulfur species to H_2S and then recycled to the gasifier. Recycling the SRU tail gas allows for a very high overall sulfur removal in the IGCC process and eliminates the need for a conventional tail gas treating unit and the associated SO_2 and NO_x emissions to the atmosphere.

The sulfur production rate is dependent upon the sulfur content of the feedstock, and will vary from about 30 tons per day up to about 165 tons per day for each IGCC unit. The sulfur storage tanks are considered part of the SRU system.

Figure 1.6-10. Sulfur Recovery Unit



Condensed sulfur from the SRU is collected in the sulfur pit. The liquid sulfur drains into the pit which contains a pump well and sulfur pumps. Sweep nitrogen is introduced into the pit to prevent the accumulation of an otherwise potentially explosive mixture of H_2S and air, and to control fugitive emissions. The sweep nitrogen inlet and outlet are located at opposite ends of the pit to ensure proper sweep of the vapor space. The sweep nitrogen outlet is collected and recycled to the second stage of the gasifier. Nitrogen is used instead of air as it is readily

available from the ASU and since it is undesirable to return air back to the gasifier's second stage.

The liquid sulfur is pumped from the sulfur pit to a sulfur degassing unit. The sulfur degassing unit strips dissolved H_2S out of the liquid sulfur. The degassed sulfur is pumped from the degassing unit to the sulfur storage tank. The stripped H_2S stream is routed to the tail gas recycle compressor then on to the gasifier.

Sulfur loading involves pumping liquid sulfur from the sulfur storage to trucks or rail cars. The sulfur loading equipment will have vapor recovery systems to control fugitive emissions by returning displaced vapors to the storage tank.

The SRU is a totally enclosed process with no discharges to the atmosphere.

1.6.5.5 Air Separation Unit

The air separation unit provides oxygen for the gasification process and nitrogen for CTG NO_x control and for purging. The ASU contains an air compression system, an air separation cryogenic distillation system ("cold box"), an oxygen pump system and a nitrogen compression system. Two ASU equipment trains will be provided for each phase of the facility.

A multi-stage, electric motor-driven centrifugal compressor compresses filtered atmospheric air that may be combined with additional compressed air extracted from the gas turbines in the power block. The combined air stream is cooled and directed to the molecular sieve absorbers where moisture, carbon dioxide and atmospheric contaminants are removed to prevent them from freezing in the colder sections of the plant. The dry carbon dioxide-free air is separated into oxygen and nitrogen in the cryogenic distillation system. A stream containing mostly oxygen is discharged from the cold box as a liquid and stored in an intermediate oxygen storage tank, from which it is fed to the gasifier.

The remaining portion of the air is mainly nitrogen and leaves the ASU in three separate nitrogen streams. A small portion of the nitrogen is high purity and is used in the gasification plant for purging and inert blanketing of vessels and tanks. The largest, but less pure, portion of the nitrogen is compressed and sent to the combustion turbines for NO_x emission control. A waste/excess nitrogen stream is vented to the atmosphere. There will be no emission of regulated air pollutants from the ASU.

1.6.5.6 Slag Handling, Storage and Loading

The slag/water slurry from the gasifier (see Figure 1.6-6 above) flows continuously into a dewatering bin. The bulk of the slag settles in the bin while water overflows into a settler in which the remaining slag fines are settled and concentrated. The slurry of fine slag particles from the bottom of the settler is recycled to the slurry preparation area, ensuring maximum carbon utilization. The clear water from the settler is passed through heat exchangers where it is cooled as the final step before being returned to the gasifier quench section.

Dewatered slag is transferred by in-plant trucks to the slag storage area from where it will be loaded into on-road trucks or rail cars for transport to market or storage. The dewatered slag is relatively inert. It is also still very moist, and will therefore not be a source of fugitive emissions.

1.6.5.7 Combined Cycle Power Block

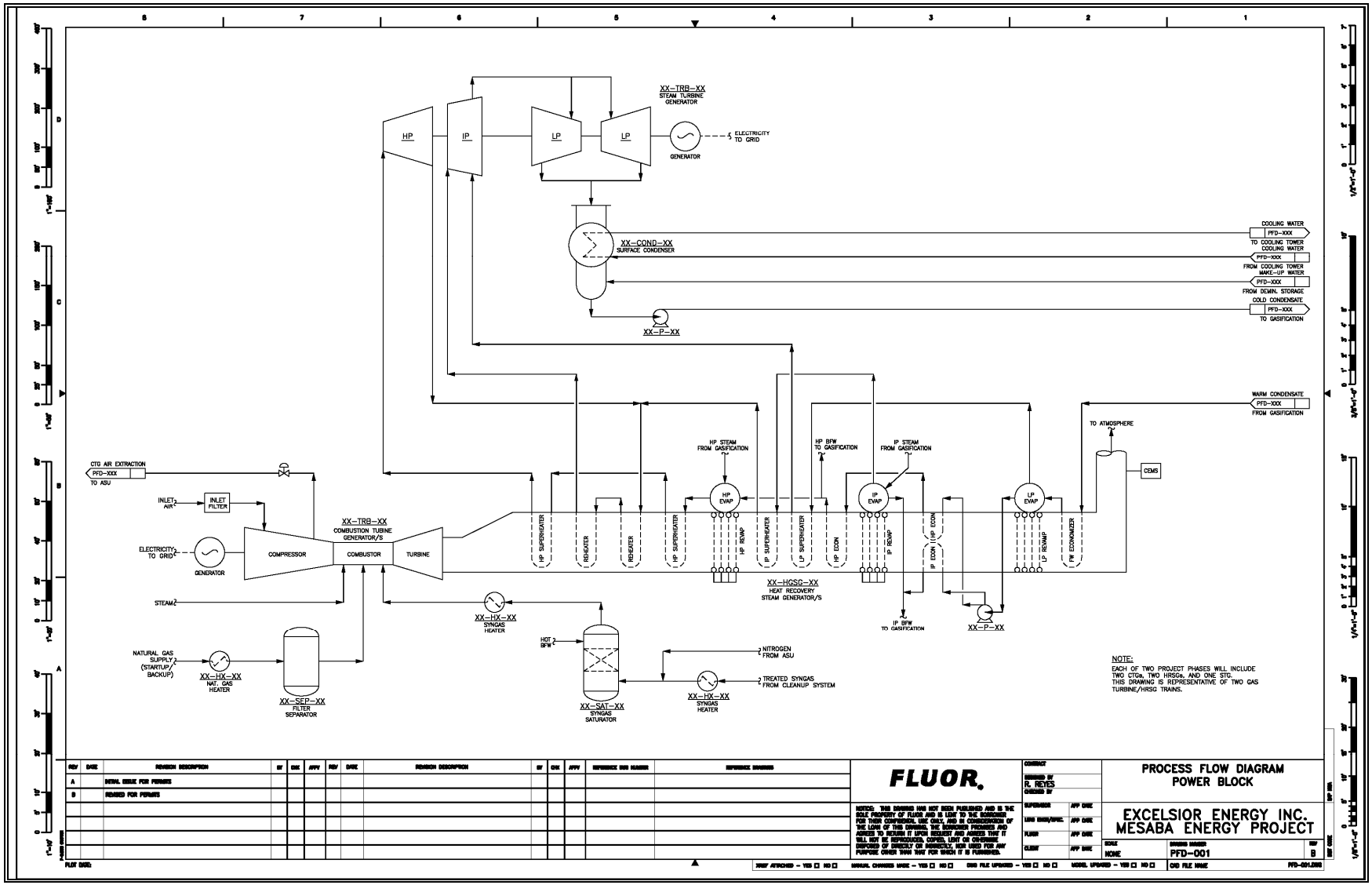
The power generation portion of the IGCC Power Station is similar to a conventional natural gas combined cycle plant. Combined cycle power generation is one of the most efficient commercial electricity generation technologies currently available. Each phase of the Project will include two "F Class" advanced CTGs configured to utilize syngas, two HRSGs, and a single STG. See Figure 1.6-11 below. The CTGs will convert the chemical energy contained in the syngas fuel to electricity both directly through the generators integral to the CTGs, and indirectly through the additional thermal energy contained in the CTG exhaust gas. The exhaust gas is converted to high-energy steam in the HRSGs and subsequently to a significant amount of additional electricity in the STG.

Preheated syngas from the gasification section and compressed air are supplied to the combustion turbine combustor and mixed through diffusion (a diffusion flame combustion turbine). Diluent nitrogen added to the syngas fuel reduces the flame temperature in the combustor and thereby reduces production of nitrogen oxides. The hot exhaust gas exiting the combustor flows to the expander turbine, which drives the generator to produce electricity and also turns the air compressor section of the combustion turbine. Hot exhaust gas from the expander is ducted through the HRSG to generate high-energy steam used to produce additional electricity in the steam turbine generator. Following heat recovery, the cooled CTG exhaust gas is discharged to the atmosphere through the HRSG stacks. The HRSG stacks will be provided with emission monitoring instruments as required to verify compliance with applicable emission standards and permit conditions.

The HRSG generates three pressure levels of steam as well as heating boiler feed water for the syngas cooler in the gasification section. The HRSG also provides additional energy for superheating steam from the gasification section and cold reheat steam from the STG.

The steam turbine generator is comprised of high pressure ("HP"), intermediate pressure ("IP"), and low pressure ("LP") turbine sections, coupled directly to a generator. The LP turbine section exhausts to the surface condenser. Process heat from the gasification plant is used to preheat the condensate from the steam turbine condenser before it is returned to the HRSG to produce steam. STG exhaust steam is condensed in the surface condenser by indirect cooling with circulating cooling water from the cooling tower. The resulting steam condensate is recycled to the HRSG and other heat recovery equipment to once again produce steam for the STG.

Figure 1.6-11. Illustration of Combined Cycle Concept



1.6.6 Plant Utility Systems

1.6.6.1 Tank Vent Collection/Boiler System

A tank vent collection/boiler system is used to convert each off-gas component in the tank vents to its oxidized form (SO_2, NO_x, H_2O, and CO_2) before venting to the atmosphere. The tank vent streams are composed primarily of air purged through various in-process storage tanks, and are routed to the tank vent boiler. This tank purge gas may contain very small amounts of sulfur-bearing components. The high temperature produced in the tank vent boiler thermally converts any H_2S present in the tank vents to SO_2. Heat recovery in the form of steam generation is provided for the hot exhaust gas from the tank vent boiler before it is directed to a stack.

The slag handling dewatering system off-gas contains H_2S which would be a source of relatively significant SO_2 emissions if vented to the tank vent system. In this part of the process, H_2S is released from slag water as the pressure is reduced from approximately 400 pounds per square inch gauge ("psig") to atmospheric conditions. Rather than vent this "flashed" gas to the tank vent boiler, a blower will be provided to combine it with either the tail gas from the SRU for recycle to the gasifier or the SRU feed gas from the AGR, thus eliminating this potential SO_2 emission source.

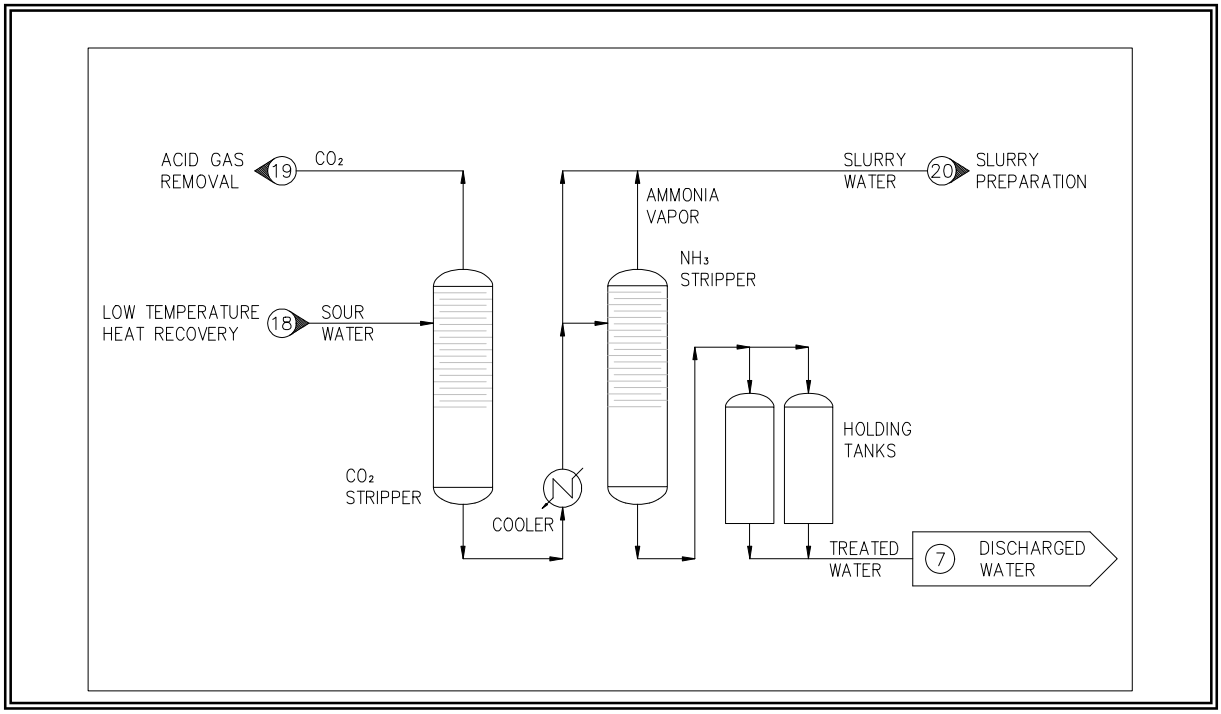
1.6.6.2 Sour Water Treatment

Process water containing dissolved contaminant gases produced within the gasification process must be treated to remove these dissolved gases before being recycled to the feedstock grinding and slurry preparation area or being diverted to the Zero Liquid Discharge ("ZLD") system. The sour water treatment process is illustrated in Figure 1.6-12. The dissolved gases are driven from the water using steam-stripping. The steam provides heat and a sweeping medium to expel the gases from the water, resulting in a water purification level sufficient for reuse within the plant and/or for processing in the ZLD system.

Water condensed during cooling of the sour syngas contains small amounts of dissolved gases (CO_2, NH_3, H_2S and other trace contaminants). The gases are stripped from the sour water in a two-step process. First, the CO_2 and most of the H_2S are removed in the CO_2 stripper column by steam stripping and directed to the SRU. The water exits the bottom of this column, is cooled, and a major portion is recycled to feedstock grinding and slurry preparation. The rest is treated in an ammonia stripper column to remove the ammonia and remaining trace components. The stripped ammonia is combined with the recycled slurry water. A portion of the ammonia stripped water is diverted to the ZLD system, with the rest being reused within the plant. Reuse of the water within the gasification plant minimizes water consumption and discharge.

This unit is a totally enclosed process with no discharges to the atmosphere.

Figure 1.6-12. Sour Water Treatment



1.6.6.3 Zero Liquid Discharge System

1.6.6.3.1 Gasification Island: West and East Range IGCC Power Stations

Water from the bottom of the ammonia stripper is treated in a ZLD unit. The blowdown stream is pumped to a brine concentrator which uses steam or vapor compression to indirectly heat and evaporate water from the wastewater stream. Generated water vapor is compressed and condensed, and the high quality distillate is recycled to the syngas moisturization system or to other water uses in the plant. The concentrated brine is further processed in a heated rotary drum dryer/crystallizer. There the remaining water is vaporized and a solid filter cake material is collected for proper disposal. Use of the ZLD system effectively prevents the contaminants in feedstocks from being discharged to surface waters.

1.6.6.3.2 Cooling Tower Blowdown: East Range Site

Stringent conditions applying to discharges of mercury in the Lake Superior Basin watershed make it necessary for the East Range IGCC Power Station to eliminate all direct wastewater discharges to receiving waters (the Station will discharge sanitary wastewaters to the Hoyt Lakes POTW). Elimination of cooling tower blowdown (see Section 1.7.4.1 for a description of this non-contact cooling wastewater stream) – the only process wastewater stream to be generated by the IGCC Power Station – will be accomplished via a second ZLD system serving the power block and gasification island cooling towers. The ZLD treatment system for the Station's cooling tower blowdown would consist of three steps to optimize energy consumption: a clarifier for suspended solids removal, a reverse osmosis ("RO") system to concentrate the dissolved solids, and a brine concentrator/crystallizer to remove water from the dissolved solids.

The cooling tower blowdown water and other non-oily water streams will be processed first via a clarifier to remove suspended solids. The sludge generated will be processed through a dewatering system consisting of a thickener/filter press. The 25% dry cake produced will be trucked offsite for disposal. Trace levels of ferric chloride or ferric sulfate would be added to promote flocculation. The sludge is expected to be non-hazardous and will be tested to confirm such condition.

The overflow from the clarifier will be sent via pressure filters to a reverse osmosis system. The permeate or product water will be recycled to the cooling tower basin to reduce makeup water usage (a 75% recovery is expected). The concentrated reject from the RO will be sent to a ZLD comprised of a mechanical vapor recompression ("MVR") evaporator or similar equipment and crystallizer and the concentrated crystals will be disposed offsite and the recovered distillate will be sent to the boiler feed water mixed bed unit for further polishing and reuse in the HRSGs. The crystallized solids are expected to be non-hazardous. Any excess distillate water can be returned to other water users or the cooling tower basin.

The cycles of concentration ("COC") in the cooling towers will be maintained between 8 and 10 cycles because of the high magnesium and sulfate in makeup water from Mine Pit No. 6 (see Section 1.8.1.1.6).

The ZLD system would add about 2 MW to the plant auxiliary load per phase. This would correspond to a change in the net plant higher heating value ("HHV") heat rate from 9,391 to about 9,422 Btu/kWh. Pollutant emissions from the stacks serving the combustion turbines, the flare, and the tank vent boiler are not expected to be materially different between the West and East Range IGCC Power Stations given that the two systems are operating under the same capacity factor (the annual and peak emissions from the listed sources would be identical but the amount of energy produced for export to the electrical grid would be greater at the West Range IGCC Power Station). However, particulate matter emissions from the cooling towers would be expected to be greater for the East Range Power Station (see Section 1.8.1.1.6).

1.6.6.4 Auxiliary Boilers

Two auxiliary boilers, one for each phase of the IGCC Power Station, will provide steam for pre-startup equipment warm up and for other miscellaneous purposes when steam from the gasifiers or HRSGs is not available. These boilers will provide steam in addition to, or in lieu of, the steam that can be generated from the tank vent boilers. Each boiler will produce a maximum of about 100,000 lb/hr of steam and will be fueled by pipeline natural gas. Annual operation of each boiler will be equivalent to or less than 25% of the year at maximum capacity. Boilers will be equipped with low NO_x burners to minimize emissions.

1.6.6.5 Flare

The gasification island elevated flare is utilized to burn partially combusted natural gas and scrubbed/desulfurized off-specification syngas during unit startup or on-specification syngas during short-term combustion turbine outages. Syngas sent to the flare during normal planned flaring events will be filtered, water-scrubbed and further treated in the AGR and mercury removal systems to remove regulated contaminants prior to flaring. Flaring of untreated syngas or other streams within the plant would only occur as an emergency safety measure during

unplanned plant upsets or equipment failures. The elevated flare is estimated to be approximately 185 feet in height.

1.6.6.6 Emergency Diesel Engines

One 2 MW emergency diesel generator will be used for the gasification island and one 350 kW emergency diesel generator will be used for the power block. One or two nominal 300 horsepower ("hp") diesel-driven firewater pumps will be provided for each phase (emission estimates are based on having two firewater pumps per phase). These engines will burn very low sulfur distillate oil. Other than plant emergency situations, the engines will be operated less than five hours per month per engine for routine testing, maintenance, and inspection purposes.

1.6.7 Major Process Equipment

The major functional process equipment provided for the inside-the-battery-limit ("ISBL") facilities for the IGCC Power Station are identified below. The number of trains and percentage train capacity for each of the functions/components are also identified. Capacities for some of the major components are identified.

1.6.7.1 Air Separation Unit (2x 50%)

- ASU (2,507 tons per day/train, based on PRB1 coal operation)
- N_2 Booster Compressor for CTG Injection
- Liquid Oxygen and Liquid Nitrogen storage

1.6.7.2 Feedstock (Coal/Petroleum Coke) Handling (1 x 100%)

- Feedstock Active Storage (20 days based on PRB1 coal)/Conveying/Reclaiming (based on 8,550 tons/day, as received)
- Feedstock Inactive Storage (45 days based on PRB1 coal)
- Flux Storage (silos)/Conveying/Reclaiming (250 tons/day based on 50:50 blend of PRB2:PRB3 coals)
- Rotary Railcar Unloading Facilities and Thaw Shed (Feedstock)
- Dust Collectors for enclosed feedstock storage areas
- Truck Unloading Facilities (Flux)

1.6.7.3 Gasification Island (3 x 50%)

- Feedstock Grinding and Slurry Preparation (2 x 60%)
- Gasification (4,275 tons per day design coal, as received, per gasifier, based on PRB1 coal)
- High Temperature Heat Recovery
- Dry Char Removal
- Particulate Matter Removal
- Slag Grinding (1 x 100%)
- Slag Dewatering (1 x 100%)

- Slag Storage and Loading System (1 x 100%) (800 tons per day (wet basis), based on 50:50 blend of PRB2:PRB3 coals)

1.6.7.4 Syngas Treating (2 x 50%)

- Syngas Scrubbing
- Low Temperature Syngas Cooling
- COS Hydrolysis
- Recycle Gas Compression
- Acid Gas Removal
- Acid Gas Enrichment (1 x 100%)
- Mercury Removal
- Syngas Moisturization
- Sour Water System (1 x 100%)

1.6.7.5 Sulfur Recovery and Tail Gas Recycle (2 x 50%)

- Claus Plant Sulfur Recovery (O_2-Blown), (Up to 83 tons per day/train, based on high sulfur Illinois No. 6 operation)
- Molten Sulfur Storage
- Molten Sulfur Truck/Rail Loading Facilities (1 x 100%)
- Tail Gas Recycle (1 x 100%)
- Tank Vent Gas Incineration (1 x 100%)

1.6.7.6 Power Block

- CTG (2 x 50%) (220 MW nominal each, based on Siemens-Westinghouse SGT6-5000F combustion turbine assumed for environmental permitting)
- HRSG and Exhaust Stack (2 x 50%)
- STG (1 x 100%), (Up to 300 MW nominal)
- Surface Condenser (1 x 100%)
- Vacuum, Condensate and Boiler Feedwater Systems (1 x 100%)
- Power Block Circulating Water System
- Raw Water/Demineralizer Water Tankage/Pumps
- Demineralizer System
- Filtered Raw Water, Firewater/Tankage/Pumps
- Wastewater Collection/Wastewater Separation
- Plant and Instrument Air
- Step-up Transformers

1.6.7.7 General Facilities (1 x 100%)

- Gasification/ASU Cooling Water/Tower System
- ZLD Unit (for Process Condensate Blowdown)
- Process Condensate Blowdown Holding Tank
- Gasification Unit Flare
- Emergency Diesel Generator

- Natural Gas Distribution
- Plant Drains
- Nitrogen Distribution
- Potable and Utility Water
- Sanitary Sewage System
- Storm Water Collection and Treatment

1.6.7.8 Dominant Structures and Other Buildings Associated With The IGCC Power Station

From a visual perspective, the dominant structures on site include the following:

- CTG Building (230 ft. x 180 ft. x 75 ft. high)
- STG Building (170 ft. x 140 ft. x 90 ft. high)
- ASU Building (375 ft. x 140 ft. x 70 ft. high)
- HRSG (110 ft. x 55 ft. x 90 ft. high)
- Rod Mill Feed Bins (155 ft. x 25 ft. x 150 ft. high)

These structures and their proximity to the IGCC Power Station's point and fugitive emission sources are identified in Figure 1.5-3 and shown in an artist's visualization in Figure 1.5-4. The finished grade elevations of the West Range IGCC Power Station Footprint are provided in Figure 1.5-8; the East Range grade elevations are provided in Figure 1.5-11.

Other buildings associated with the IGCC Power Station include the control room, administration building, warehouse/maintenance shop, combustion turbine and steam turbine buildings, weather enclosures for the ASU compressors, slurry preparation, water treatment/lab, railcar thaw shed, switchyard control room, several power distribution centers, and a visitor's center.

1.6.8 Expected Process Operating Characteristics

The IGCC Power Station will be designed to process a relatively wide variety of feedstocks, including sub-bituminous coal, bituminous coal and petroleum coke. As noted previously in Section 1.6.3, feedstock variability has been considered along with critical equipment components and operating conditions known to influence plant performance (for example, the combustion turbine selected, its operating mode, the operating mode of the gasifier, and ambient conditions) to identify the operating conditions which would provide a reasonable upper limit or "worst case" scenario for potential pollutant emissions/discharges. Table 1.6-1 quantifies such conditions assuming operation of the gasifier in PSQ mode while Table 1.6-2 assumes operation of the gasifier in FSQ mode. Pollutant emissions, discharges, and waste products are quantified assuming the conservative PSQ conditions (see Section 1.8).

Table 1.6-1 Key Performance Indicators Used to Assess Worst Case Environmental Impacts Of IGCC Power Station (Phase I, PSQ Mode)

Performance Parameter	Estimated Range	Comments
CTG gross power, MW	440	Total for two CTGs
STG gross power, MW	265 – 300	Varies depending on quantities of steam generated by Gasification Island and HRSGs
Net plant generation, MW	580 – 606	Output from CTGs plus STG, less internal consumption and losses
Coal/coke feed rate, tons/day (as received)	5,300 – 8,550	Feed rate to gasifiers
Coal/coke feed energy, million Btu/hr (HHV)	5,280 – 5,910	Energy content of gasifier feedstock
Product syngas energy, million Btu/hr (HHV)	4,190 – 4,368	Energy content of syngas fuel delivered to CTGs
Coal conversion efficiency	0.71 – 0.80	Fraction of solid feedstock energy in syngas feed to CTGs
Net overall heat rate, Btu/kW-hr (HHV)	8,900 – 9,500	Solid feedstock energy used per unit of net electricity to grid
Flux feed, tons/day	0 – 250	Conditioning agent for gasifier feedstock
Slag by-product production, tons/day	500 – 800	Varies depending on feedstock composition and flux use
Sulfur by-product production, tons/day	30 – 165	Varies depending on feedstock composition

Table 1.6-2 Expected IGCC Power Station Operating Characteristics (Phase I, FSQ Mode)

Feedstock	PRB-1	PRB-1	PRB-1	50/50 Wt% PRB2/PRB3	Illinois No. 6	Sizing Basis
Ambient Temperature:	38°F	80°F	-20°F	38°F	38°F	
Power Generation						
SW SGT6-5000F CTG (x2)	440 MW	440 MW	440 MW	440 MW	440 MW	440 MW
STG	300 MW	300 MW	288 MW	N/A	N/A	300 MW
Gross Power	740 MW	741 MW	728 MW	N/A	N/A	741 MW
Less ASU Auxiliary Load	- 98 MW	-106 MW	- 97 MW	N/A	N/A	N/A
Less Internal Consumption	- 37 MW	- 37 MW	- 35 MW	N/A	N/A	N/A
Net Power (for Export to Grid)	606 MW	598 MW	596 MW	N/A	N/A	606 MW
Coal Feed (as received), tons/day	8225	8119	8136	7397	5477	8225
Coal Feed (dry), tons/day	5716	5643	5655	5461	4957	5716
Coal Feed (HHV), MMBtu/hr	5688	5616	5627	5592	5288	5688
Plant Heat Rate (HHV), Btu/kWh	9391	9397	9439	9412	9033	N/A
Oxygen Feed (contained), tons/day	5014	4950	4960	5005	3894	5014
Flux Feed, tons/day	0	0	0	233	0	
Design capacity, tons/day						233
Slag Produced, tons/day	501	495	496	774	772	

Feedstock	PRB-1	PRB-1	PRB-1	50/50 Wt% PRB2/PRB3	Illinois No. 6	Sizing Basis
Design capacity, tons/day						774
Sulfur Produced, tons/day	30	29	29	45	162	
Design capacity, tons/day						162

The composition and properties of the product syngas will vary depending on the solid feedstocks processed and Power Station operating conditions. Table 1.6-1 shows the expected range of syngas composition and fuel heating value.

Table 1.6-3
Estimated Product Syngas Composition Multiple Feedstock Plant (Phase Independent)

Component [1]	Range
Hydrogen, vol %	30 – 40
Carbon monoxide, vol%	35 – 50
Carbon dioxide, vol%	13 – 26
Methane, vol%	1 – 5
Nitrogen plus argon, vol%	2 – 3
Higher heating value, Btu/scf [2]	240 – 305

[1] Parameters shown for dry syngas fuel (water excluded), prior to nitrogen dilution.

[2] Standard conditions defined as 60 degrees Fahrenheit ("^{o} F"), one atmosphere pressure.

1.7 Resource Inputs

1.7.1 Feedstocks

1.7.1.1 Delivery

Coal and petroleum coke feedstocks will normally be received by rail in dedicated unit trains from the mine (or refinery). Rail access into the West Range IGCC Power Station is from existing Burlington Northern Santa Fe Railway ("BNSF") and CN tracks; rail access to the East Range IGCC Power Station is limited to the CN Railroad. The rail loop at either location will be designed to accommodate unit trains up to 135 cars in length with the average unit train shipment expected to be comprised of 115 cars. Each unit train car will carry on average about 119 tons of feedstock (BNSF, 2005).

Each phase of the IGCC Power Station, under the maximum feedstock input case and assuming gasifier operations in FSQ mode, will require a maximum of 8,225 tons of feedstock per day on an as-received basis. Assuming PSQ operation of the gasifiers, the daily maximum would increase to 8,550 tons on an as-received basis.

One 135 car unit train can deliver about 16,100 tons of coal and each 115 car unit train about 13,700 tons. With Mesaba One and Two operating at full load with the gasifiers in FSQ mode, a maximum 16,460 tons of coal feedstock per day will be consumed, requiring the delivery of about five 115 car unit trains every four days (slightly more than one 115 car unit train per day). With the gasifiers operating in PSQ mode, Mesaba One and Two would require under full load operations a maximum of about 17,100 tons of feedstock per day, thus not substantively changing the worst case, short term fuel delivery schedule. Approximately four hours time will be required to unload one unit train. Three unit trains per day (midnight to midnight) is the maximum feedstock shipment that could be received and unloaded at the Station, but such a schedule would not normally occur.

Mesaba One will utilize approximately 2.7 million tons of feedstock annually assuming operation at a 90 percent capacity factor. Feedstock selection throughout the lifetime of the IGCC Power Station is expected to be made pursuant to a competitive solicitation process, with selection based upon the terms offered by various suppliers and transportation rate considerations.

The availability of multiple rail transportation modes at a site will enhance the long-term benefits of the feedstock-flexible plant design. An important element in the site selection process addressed whether a site could be served by more than one rail provider via their own trackage. This capability introduces competition into the feedstock supply equation and should result in lower feedstock costs over the life of a project relative to feedstock costs with such rail competition absent. The West Range Site offers two major coal transportation alternatives, the BNSF and CN, each having direct access to the IGCC Power Station by the construction of short spurs to the Station Footprint. The East Range Site has the CN within the immediate vicinity of the IGCC Power Station Footprint, and also has the potential physical capability to receive shipments of fuel via water at Taconite Harbor, with transportation to the Site via CE's 70 mile rail line which served the former LTV Mining operations. This alternative is not considered to be cost competitive with the CN rail alternative under current market conditions.

1.7.1.2 Receiving and Storage

The feedstock handling system will include facilities necessary to unload solid feedstock materials, convey them to storage areas, store them until required, reclaim them from storage, blend them as necessary, and convey the blended materials to the slurry preparation system. On-site storage facilities will be provided for two feedstock materials, coal and petroleum coke. Storage facilities will also be provided for flux, a feedstock conditioning material. The feedstock storage facilities will include, for each phase of the facility, approximately 20 days of active storage and approximately 25 days of inactive storage. The storage areas will incorporate dust suppression systems (including covered conveyers and other enclosures, dust suppression sprays, and vent filters) and will be paved, lined, or otherwise controlled to enable collection and treatment of storm water runoff and prevent infiltration to ground water of chemical species leached from feedstock materials and/or flux.

Unloading facilities will include a thawing shed to loosen frozen cargo during the winter season, and a partially enclosed rotary car dumping system. After the locomotive on a unit train positions the first car in the rotary dumper, subsequent cars are placed in the dumping position by an automatic electro-hydraulic positioner. Such rail car positioning systems reduce the run time of the locomotive or switch engine and the emissions that would otherwise occur if engines were required to run during the entire unloading process (the rail car unloading system allows all but one engine to be shut down, that engine being operated at a reduced load to maintain air pressure in the brakes). Feedstock falls from the rotated cars into an enclosed pit from which such materials are transferred via a feeder/conveyor system to active storage pile stackers. Four active storage piles for each phase of the IGCC Power Station will provide working feedstock storage. Additional inactive storage will be located on the opposite side of the rail sidings to provide a reserve source of feedstock material in the event normal deliveries of unit trains are interrupted. If needed, feedstock from the inactive pile will be moved by mobile equipment (bulldozers, scrapers, and/or front-end loaders) to the rail unloading pit to access the automated plant feed system. Reclaimers and conveyors will move feedstock from the active piles to the slurry feed preparation area.

The feedstock handling/storage systems and their associated emission controls are further reviewed in Sections 1.8.1.1.5 and 1.8.1.1.6 where annual estimates of fugitive particulate matter emissions attending operation of the IGCC Power Station are provided.

1.7.1.3 Feedstock and Feedstock Characteristics

Mesaba One and Mesaba Two are designed to be “feedstock flexible” throughout their economic lifetime. While conventional pulverized coal (“PC”) fired power plants can sometimes use a limited range of fuels, they must be designed for a specific performance fuel. When using other fuels, the performance and output of these PC plants typically deteriorate. Feedstock flexibility will allow the Project to operate at or near maximum capacity using:

- 100% bituminous coal (for example, Illinois No. 6 coal)
- 100% sub-bituminous coal (for example, PRB coal)
- Up to a 50:50 coal/petroleum coke (“pet coke”) blend
- Other blends of these feedstocks

This feedstock flexibility, made possible by the use of IGCC technology and the design parameters for Mesaba One and Mesaba Two, will provide ongoing future cost benefits because it allows the Station to adapt its feedstock mix over the life of the facility to minimize the cost of power. Feedstock flexibility provides Mesaba One and Mesaba Two a hedge against physical dependency upon a single feedstock supplier or transportation provider, and against supply disruptions from any mine or carrier. Table 1.7-1 shows the feedstock design specifications being utilized to design the Station's unique feedstock flexibility.

Although the primary fuel source for electric power production will be syngas produced from the feedstocks specified above, the IGCC Power Station will also be capable of operating on pipeline natural gas. The power island is a combined-cycle unit, optimized for operation on syngas. This ability to operate on natural gas provides an additional source of available generating capacity (and reliability for periods when the gasification island is unavailable). In addition, it offers the option of installing the combined-cycle power island early in the construction process (that is, ahead of the gasification island), thereby allowing for electricity production from natural gas until the gasification island is installed and the unit begins full base load operation on syngas. Although not currently planned for Mesaba One and Mesaba Two, the ability to come online early using natural gas is a very useful resource planning option for subsequent units. The Proponent will propose permits to allow for natural gas firing at capacity factors of 30%, 20%, 10% and 5% for years 1, 2, 3, and thereafter, respectively.

Table 1.7-1
Feedstock Design Specification Basis

Feedstock	Bituminous Illinois No.6 Coal		Sub-Bituminous PRB Coal		Petroleum Coke	
	Dry Basis	As Rcvd.	Dry Basis	As Rcvd.	Dry Basis	As Rcvd.
HHV, Btu/lb	12,802	11,586	11,942	8,300	15,204	13,699
Ultimate Analysis, Wt %						
Carbon	70.79	64.06	69.9	48.58	87.32	78.71
Hydrogen	4.81	4.35	4.8	3.34	3.67	3.31
Nitrogen	1.51	1.37	0.9	0.63	1.31	1.18
Sulfur	3.32	3.00	0.53	0.37	6.27	5.65
Oxygen	6.92	6.26	16.77	11.66	0.72	0.65
Chlorine	0.14	0.13	<0.01	0.01	0.01	0.01
Ash	12.51	11.32	7.1	4.93	0.7	0.63
Total	100.00	90.50	100.0	69.50	100.00	90.10
Moisture, %		9.5		30.5		9.9
Ash Mineral Analysis, Wt%						
SiO_2	49.57	NA	31.2	NA	20.55	NA
Al_2O_3	19.32	NA	13.9	NA	9.11	NA
TiO_2	0.96	NA	1.1	NA	0.8	NA
Fe_2O_3	19.32	NA	6.3	NA	5.44	NA
CaO	3.81	NA	24.3	NA	11.77	NA
MgO	1.01	NA	6.1	NA	3.64	NA
Na_2O	0.46	NA	1.7	NA	1.68	NA
K_2O	2.40	NA	0.2	NA	0.66	NA
P_2O_5	0.35	NA	0.5	NA	0.52	NA

Feedstock	Bituminous Illinois No.6 Coal		Sub-Bituminous PRB Coal		Petroleum Coke	
	Dry Basis	As Rcvd.	Dry Basis	As Rcvd.	Dry Basis	As Rcvd.
SO_3	2.07	NA	13.6	NA	23.75	NA
NiO	NA	NA	NA	NA	4.68	NA
V_20_5	NA	NA	NA	NA	16.11	NA
Other	0.73	NA	1.1	NA	1.29	NA
	100.0		100.0		100.0	
Ash Fusion Temp. (Reducing), ^oF						
Initial Deformation	2000	NA	2170	NA	2440	NA
Softening (H=W)	2150	NA	2180	NA	2500	NA
Hemispherical (H=1/2w)	2185	NA	2190	NA	2550	NA
Fluid	2370	NA	2200	NA	2600	NA
Hardgrove Grindability Index	50-65	NA	80	NA	53	NA

1.7.2 Flux Receiving and Storage

The E-Gas™ gasifier will operate at high temperatures. At such temperatures, ash in feedstock material will normally melt and drain to the bottom of the gasifier where it will be removed. The molten ash – known as slag – will be cooled in a water bath outside the gasifier until it solidifies.

Mineral matter in the ash determines the temperature at which ash in the gasifier would melt and the slag viscosity at a specific operating temperature. If the slag is too viscous, it will not easily flow from the gasifier, or could plug the bottom. Flux, typically silica/sand, limestone, iron oxide or a mixture of these, would be blended with the feed as necessary to control the slag melting point and fluidity. A slag that is too fluid could be excessively erosive to the refractory in the gasifier, so the amount and composition of flux, if used, must be carefully monitored and controlled.

Flux would normally be received by truck (or railcar) and pneumatically conveyed to enclosed storage silos equipped with fabric filters for dust control. Flux from storage silos would be automatically blended with feedstock by a weigh belt feeder system. The required quantity of flux would be a small fraction of the total feed, typically less than 250 tons per day per phase.

1.7.3 Natural Gas Supply Pipeline and Metering Station

As noted in Section 1.5.1.3 natural gas will be used to start up the facility and as a backup fuel. When operating on natural gas, the Power Station cannot achieve the nominal 606 $MW_{(net)}$ output attainable when operating on syngas. This is due, in part, to the lack of nitrogen that would otherwise be available for nitrogen dilution and power augmentation when operating the ASU to supply oxygen to the gasifiers.

If the West Range Site is approved by the MPUC, natural gas will be supplied through a direct connection with the GLG pipeline located about 12 miles due south of the IGCC Power Station or from NNG's tapping point located in La Prairie, Minnesota, about 10 miles west southwest of the Station. This access to multiple pipeline infrastructure alternatives is beneficial. The Proponent will contract with either or both entities for natural gas transportation capacity for quantities and at pressures sufficient to operate the IGCC Power Station at its limited capability (see above paragraph) when firing its backup fuel.

As noted in Section 1.5.3.4, the East Range Site has only one natural gas supply option, the NNG Pipeline. An existing branch pipeline (known as the Erie Branch line) from NNG's main pipeline originating at a tap of the GLG pipeline in Carlton, Minnesota, directly abuts the eastern boundary of the Buffer Land. Up to 32 miles of "looped" 16-inch pipe (that is, new pipeline laid along an existing pipeline, in this case the 10-inch Erie Branch pipeline) and a 2,500 horsepower compressor expansion is required to provide natural gas to the East Range IGCC Power Station in sufficient quantity and pressure to operate at limited capability when firing its backup fuel. Only one easement is required (from NNG) to access the pipeline ROW. The Proponent would contract with NNG to provide gas transportation and other entities to supply natural gas.

The Proponent will purchase natural gas through a series of contracts with gas suppliers in order to obtain the lowest overall fuel price and best contract conditions for this commodity. Due to the volumes of natural gas required to fuel the IGCC Power Station, the Proponent will install and operate accurate metering equipment to confirm the extent of such purchases. Typical natural gas composition is shown in Table 1.7-2.

Table 1.7-2
Typical Natural Gas Constituents

Constituent	Percent By Volume
Methane	96.9
Ethane	2.00
Propane	0.50
n-Butane	0.10
i-Butane	0.10
n-Pentane	0.00
i-Pentane	0.00
Hexane+	0.10
Oxygen	0.00
Carbon dioxide	0.00
Nitrogen	0.30
TOTAL	**100.00**
Sulfur, ppmv	14.8
Specific Gravity (air = 1.00)	0.57-58
Net Heating Value (Btu per scf)	935

Btu = British thermal units.
scf = standard cubic foot.

1.7.4 Water Supply

Water is needed by the IGCC Power Station in significant quantities for the steam cycle, cooling, and introducing feedstock into the gasifier. Water supplies for the West Range and East Range Sites will come from different sources and be required in slightly different quantities. The sources and quantities of water required at each site are discussed in detail in Section 1.12.4. Section 1.12.4 confirms that the water supply sources for each Site are sufficient to provide the quantities of water required by Mesaba One and Mesaba Two for the specific uses outlined in the subsections below.

1.7.4.1 Non-Contact Cooling (Cooling Tower Operation)[7]

Heat must be rejected from the IGCC Power Station's condenser in order to maintain proper steam cycle characteristics. Large volumes of water are required for this purpose (a typical 600 MW PC power plant would require about 300,000 gallons per minute (gpm) for a once-through cooling system). The IGCC Power Station will use cooling towers to reduce - relative to a once-through cooling system - the amount of water required to be withdrawn from the Water Resources. In a cooling tower, warmed cooling water from the IGCC Power Station's condenser is cooled by the evaporation of a portion of the water as it passes through the cooling tower. In addition to evaporation, a very small amount of entrained water, called drift (water droplets that are entrained in the exhaust air stream carrying heat away from the towers), will also be lost. As evaporation continues, salts dissolved in the remaining cooling liquid become more concentrated. When the concentrations of dissolved salts near their solubility limit, scale formation may occur on the condenser tubes and hinder heat transfer. Although addition of certain chemicals can inhibit scale formation, a portion of the cooling water, called cooling tower blowdown, must be removed and discharged.

Cooling tower blowdown will be permitted under an NPDES discharge permit. The amount of cooling tower blowdown generated, its characteristics, and how its discharge is managed are discussed in Section 1.8.2.2.2.

1.7.4.2 Process Water

1.7.4.2.1 Steam Cycle

Raw water must be treated to ultra purity standards to be used in the heat recovery steam generators ("HRSG") for steam production. The steam produced in the HRSGs is delivered to the steam turbine and condensed for reuse.

1.7.4.2.2 Contact Cooling

Water is used in numerous enclosed vessels to cool and clean the syngas. This is generally accomplished by routing the syngas through a countercurrent flow of water, with the syngas generally being introduced into the bottom of a tower and water at the top. The water, by virtue of its physical contact with the contaminated syngas, picks up soluble and insoluble contaminants, becomes contaminated itself, and thereafter is treated. In Mesaba One and Mesaba Two, such contact process waters will be segregated from cooling tower blowdown and routed through a ZLD system, thereby ensuring that no trace elements carried over from the feedstock will be discharged to ambient receiving waters. Systems included in the sour water treatment process will remove mercury from this wastewater stream prior to sending it through the brine concentrator and ZLD system. The ZLD system is discussed in further detail in Sections 1.6.6.3 and 1.8.2.1.2.

[7] Black & Veatch, 1996, "Power Plant Engineering," Page 525-26.

1.7.4.2.3 Feedstock Slurry and Source of Hydrogen

Water serves a critical role in the IGCC Power Station, both as a slurrying agent for introducing feedstocks into the gasifier and as a source of hydrogen to enhance the reducing atmosphere inside the gasifiers.

1.8 PROJECT DISCHARGES AND PRODUCTS

1.8.1 Air Emissions

Discharges of air emissions will meet all required State and Federal standards, with analysis demonstrating that emission levels are largely independent of the Site. The block flow diagrams presented in Figures 1.6-1 and 1.6-2 enumerate air emission sources and their associated control equipment. The spatial location of the major air emission points on the IGCC Power Station are identified on the layout plan in Figure 1.5-3. Maximum and average emission quantities from each point have been estimated using:

- Equipment supplier data
- BACT as proposed in the Part 70/New Source Review Construction Authorization Permit Application
- Test results for similar equipment at other IGCC facilities, especially the existing Wabash River (which also uses E-Gas™ gasification technology)
- Engineering calculations, experience, and judgment
- Published and accepted average emission factors, such as the U.S. Environmental Protection Agency (EPA) Compilation of Air Pollutant Emission Factors (AP-42)

The following sections describe these estimates and the calculation basis for both criteria and non-criteria pollutants. Detailed calculation descriptions and examples are presented in the West Range IGCC Power Station application for a Part 70/New Source Review Construction Authorization Permit attached to the Joint Application as Appendix 5. With the exception of PM_{10} emitted from the cooling towers, the calculations are independent of the Site and, therefore, can be applied to the East Range IGCC Power Station (PM_{10} emissions from the cooling towers are increased at the East Range IGCC Power Station due to higher concentrations of total dissolved solids in the pit waters relative to the pit waters accessible at the West Range Site)

1.8.1.1 Criteria Pollutants

Table 1.8-1 presents the normal and maximum short-term emission rates for each source. Table 1.8-2 shows the proposed maximum annual criteria pollutant emission rates for each emission source in the facility.

Table 1.8-1
Short-Term Emission Summary
(Phase I and II)

Emission Source	Normal Emission Rate (lb/hr)[1]					Maximum Emission Rate (lb/hr)[1]				
	NO_x	SO_2	CO	PM_{10}[2]	VOC	NO_x	SO_2	CO	PM_{10}[2]	VOC
Combustion Turbines	624	270	380	100	35	792	732	10,960[3]	100	1,052[3]
Tank Vent Boilers	12	7.2	3.6	0.4	0.2	39	17	12	1.4	0.6
Flares[4]	0.3	negl[5]	2.2	negl	negl	478	2,080	11,400	60	45
Auxiliary Boilers	9.4	0.8	19	1.3	1	9.4	0.74	19	1.3	1

Emission Source	Normal Emission Rate (lb/hr)[1]					Maximum Emission Rate (lb/hr)[1]				
	NO_x	SO_2	CO	PM_{10}[2]	VOC	NO_x	SO_2	CO	PM_{10}[2]	VOC
Cooling Towers				9/58					9/58	
Fugitive PM_{10}				8.6					8.6	
Fugitive VOC					3.8					3.8
Emergency Generators	158	4.1	36	5.8	6.1	158	4.1	36	5.8	6.1
Emergency Fire Water Pump Engines	37	2.5	8.0	2.6	3.0	37	2.5	8.0	2.6	3.0
Total	**841**	**285**	**449**	**128[6]/177[7]**	**49**	**1,513**	**2,836**	**22,435**	**189[6]/238[7]**	**1,112**

[1]See following text for description of normal and maximum short-term emissions.
[2]PM10 includes filterable plus condensable fractions.
[3]Peak startup emission rate for four CTGs; normally startup for these engines will not occur simultaneously.
[4]Normal flare emission rates are for natural gas pilots only.
[5] negl = negligible emissions.
[6] West Range IGCC Power Station
[7] East Range IGCC Power Station

Table 1.8-2
Annual Emission Summary
(Phase I and II)

Emission Source	Emission Rate (ton/year)				
	NO_x	SO_2	CO	PM_{10}	VOC
Combustion Turbines	2,772	1,332	1,928	440	176
Tank Vent Boilers	53	32	16	1.8	0.8
Flares	27	25	572	3.4	2.6
Auxiliary Boilers	10	0.8	21	1.4	1.2
Cooling Towers				39[1]/255[2]	
Fugitive PM_{10}				6.7	
Fugitive VOC					17
Emergency Generators	7.9	0.20	1.8	0.29	0.31
Emergency Fire Water Pump Engines	1.9	0.12	0.40	0.13	0.15
Total	**2,872**	**1,390**	**2,539**	**493[1]/709[2]**	**197**

[1] West Range IGCC Power Station
[2] East Range IGCC Power Station
See following text for explanation of annual emission basis.

1.8.1.1.1 Combustion Turbine Generators

Emissions from the IGCC Power Station are primarily controlled through the inherently lower polluting IGCC technology. Specifically, this means production of syngas at relatively high pressure allows efficient and cost-effective syngas cleanup prior to combustion in the CTGs to

produce electricity. As discussed in the preceding process description in Section 1.6.5, the following treatment steps will be applied to the syngas:

- Hot gas particulate matter filtration via cyclone and ceramic filter to achieve more than 99.9% particulate matter removal
- Water scrubbing to remove soluble contaminants, condensable materials, and suspended particulate matter
- Amine treatment combined with COS hydrolysis
- Carbon adsorption for removal of mercury and other trace contaminants
- Moisturization (water saturation) for NO_x control and improved power production

In addition to the syngas treatment measures discussed above, the moisturized product syngas fuel is diluted by about 100 percent (one-to-one) with ASU nitrogen for additional NO_x reduction. Steam injection, in lieu of nitrogen dilution and moisturization, will be used for NO_x control when operating on natural gas. Finally, each CTG will be equipped with inlet air filters to minimize particulate matter emissions potentially caused by the entry of suspended atmospheric materials contained in the combustion air.

Emissions from the CTGs are based on the following gas concentrations as emitted at the HRSG stack (or, in the case of particulate matter, the stack emission rate):

Syngas

- SO_2, based on 50 ppmvd, as H_2S in the undiluted, unsaturated syngas, rolling 30-day average and assuming 100% conversion of H_2S to SO_2
- NO_x, 15 ppmvd (@ 15% O_2)
- CO, 15 ppmvd (@ 15% O_2)
- PM_{10}, 25 lb/hr/CTG
- Volatile Organic Compounds ("VOC"), 2.4 ppmvd (@15% O_2)

Natural Gas

- SO_2, based on pipeline-quality natural gas (assumed 1.0 grain/100 scf total sulfur) and assuming 100% conversion of sulfur to SO_2
- NO_x, 25 ppmvd (@ 15% O_2)
- Other criteria pollutants, equal to or less than syngas emission rates

As is the case with many types of internal combustion engines, CTG emissions of one or more pollutants during startup can exceed the normal operating emission rates for short periods. This temporary higher emission rate is caused by reduced combustion efficiencies during initial operation at low temperatures and low loads, as well as the delay necessary to achieve minimum specified combustor conditions prior to commencement of steam injection for NO_x control.

Table 1.8-3 shows the maximum short-term CTG emission rates for four operating conditions. The emission rates shown in this table reflect the maximum values for potentially available commercial CTGs under consideration for use.

Table 1.8-3
Maximum CTG Short-Term Emission Rates (Phase I and II)

Operating Mode	Emission Rate (lb/hr)				
	NO_X	SO_2	CO	PM_{10}	VOC
Normal syngas operation[1]	624	270	380	100	35
Maximum syngas operation[2]	624	732	380	100	35
Maximum natural gas operation	792	24	288	72	26
Worst-case startup[3]	484	<24	10,960	44	1052

[1] 30-day rolling average fuel sulfur.
[2] Peak 1-hour average fuel sulfur.
[3] Worst-case startup for four CTGs; normally all four would not start up simultaneously.

The maximum annual CTG emission rates and bases are summarized in Tables 1.8-4 and 1.8-5 for the first four years of operation and years 5-30, respectively.

Table 1.8-4
Maximum CTG Annual Emissions Years 1 – 4 (Phase I and II)

	Yr. No. 1 TPY	Yr. No. 2 TPY	Yr. No. 3 TPY	Yr. No. 4 TPY	Basis[1]
Hrs/Yr	2630	1750	880	440	Peak natural gas per year
NO_x	2954	2880	2807	2770	Balance of year on syngas at full load
SO_2	964	1088	1210	1271	Balance of year on syngas at full load, 50 ppmvd annual average sulfur in fuel
CO	1808	1848	1888	1909	Plus 50 hr/yr startup/shutdown, balance of year on syngas at full load
PM_{10}	401	414	426	432	Balance of year on syngas at full load
VOC	167	171	174	176	Plus 50 hr/yr startup/shutdown, balance of year on syngas at full load

[1] Indicated hours of natural gas full load operation plus additional operation described for each pollutant.

Table 1.8-5
Maximum CTG Annual Emissions Years 5 – 30 (Phase I and II)

	Tons/Year	Basis
NO_x	2,772	440 hours (approx 5% of the year) on full-load natural gas operation; 8,320 hours on full load syngas operation.
SO_2	1,332	Full year (8,760 hours) on full-load syngas operation; 50 ppmvd average H_2S in undiluted, unsaturated sulfur in syngas
CO	1,928	50 hours startup/shutdown per CTG, balance of year (8,710 hours per CTG) on full-load syngas operation
PM_{10}	440	Full year (8,760 hours) on full load syngas operation
VOC	176	50 hours startup/shutdown per CTG, balance of year (8, 710 hours per CTG) on full load syngas operation

1.8.1.1.2 Tank Vent Boilers

The tank vent boilers ("TVBs," one for each phase) will be designed to safely and efficiently dispose of recovered process vapors from various process tanks and vessels associated with the gasification process. The TVBs prevent the emission of reduced sulfur compounds and other gaseous constituents to the atmosphere that could cause nuisance odors and other undesirable environmental consequences. The TVBs may also be operated on natural gas to produce steam for the IGCC Power Station during gasifier shutdowns. The estimated maximum short-term and annual emission rates, based on supplier estimates for similar equipment, are shown in Tables 1.8-6 and 1.8-7.

Table 1.8-6
Tank Vent Boiler Short-Term Emissions
(Phase I and II)

Operating Mode	Emission Rate (lb/hr)				
	NO_x	SO_2	CO	PM_{10}	VOC
Normal syngas operation[1]	9	7	2.6	0.3	0.1
Maximum syngas operation[2]	39	17	12	1.4	0.6
Maximum natural gas operation[3]	24	0.2	7.2	0.8	0.3

[1] Assumes 30 MMBtu/hour heat input rate.
[2] Assumes 130 MMBtu/hour heat input rate.
[3] Assumes 80 MMBtu/hour heat input rate.

Table 1.8-7
Maximum Tank Vent Boiler Annual Emissions
(Phase I and II) [1]

	Tons/Year
NO_x	53
SO_2	32
CO	16
PM_{10}	1.8
VOC	0.8

[1] Based on approximately 280 trillion (10^{12}) Btu/yr, syngas plus tank vent vapors and about 37 trillion Btu/yr natural gas combusted. Assumed sulfur in tank vapors averages 1.5 lb/hr (each phase) on annual basis.

1.8.1.1.3 Flares

The elevated flares for Mesaba One and Mesaba Two will be designed for a minimum 99 percent destruction efficiency for CO and G_2S. As discussed previously, the flares are normally used only to oxidize treated syngas and natural gas combustion products during gasifier startup operations. The flares will also be available to safely dispose of emergency releases from the IGCC Power Station during unplanned upset events or outages.

The estimated maximum short-term and annual emission rates, based on agency guidance and equipment supplier specifications, are shown in Table 1.8-8.

Table 1.8-8
Flare Short-Term Emission Rates (Phase I and II)

Operating Mode	Emission Rate (Lb/Hr)				
	NO_x	SO_2	CO	PM_{10}	VOC
Normal Operation[1]	0.3	0.01	2.2	0.03	.02
Normal Startup Operation[2]	230	370	5,350	28	21
Maximum Flaring Operation[3]	480	2,080	11,400	60	45
	Emission Rate (Tons/Year)				
Maximum Annual[4]	26.8	24.6	572	3.4	2.6

[1] Natural gas pilot, only.
[2] Start-up flaring of syngas for two gasifiers and two flares.
[3] Maximum flaring capacity for two flares, based on flaring syngas production from two gasifiers for each flare and a worst case upset sulfur content of 400 ppmv in syngas.
[4] Maximum annual emission based on combustion of approximately 700 billion Btu of syngas and 136 billion Btu of natural gas during startup, plant upsets, and normal operating conditions.

1.8.1.1.4 Fugitive Equipment Leaks

VOC and hazardous air pollutants ("HAPs") emissions associated with normal equipment leakage have been estimated using standard U.S. EPA fugitive emissions factors for valve seals, pump and compressor seals, pressure relief valves, flanges, and similar equipment. For the case of VOC, only the amine handling system is included in the estimate since MDEA would be the only VOC handled in significant quantity at the facility. Fugitive emission estimates of HAPs are based on the estimated concentration of each HAP in various syngas streams multiplied by the calculated leakage rates. The estimated fugitive emissions are summarized in Table 1.8-9.

Table 1.8-9
Fugitive Emission Estimate
(Phase I and II)

Emission Type	Emission Rate	
	lb/hr	ton/yr
Federal HAPs	0.06	0.3
Ammonia	0.2	1.3
Hydrogen sulfide	4.0	17
MDEA	3.2	14
VOC	3.8	16
TRS	4.0	17

[1] VOCs include MDEA, benzene, carbon disulfide, carbonyl sulfide, ethyl benzene, hexane, hydrogen cyanide, naphthalene, toluene, xylenes, and waste oil.

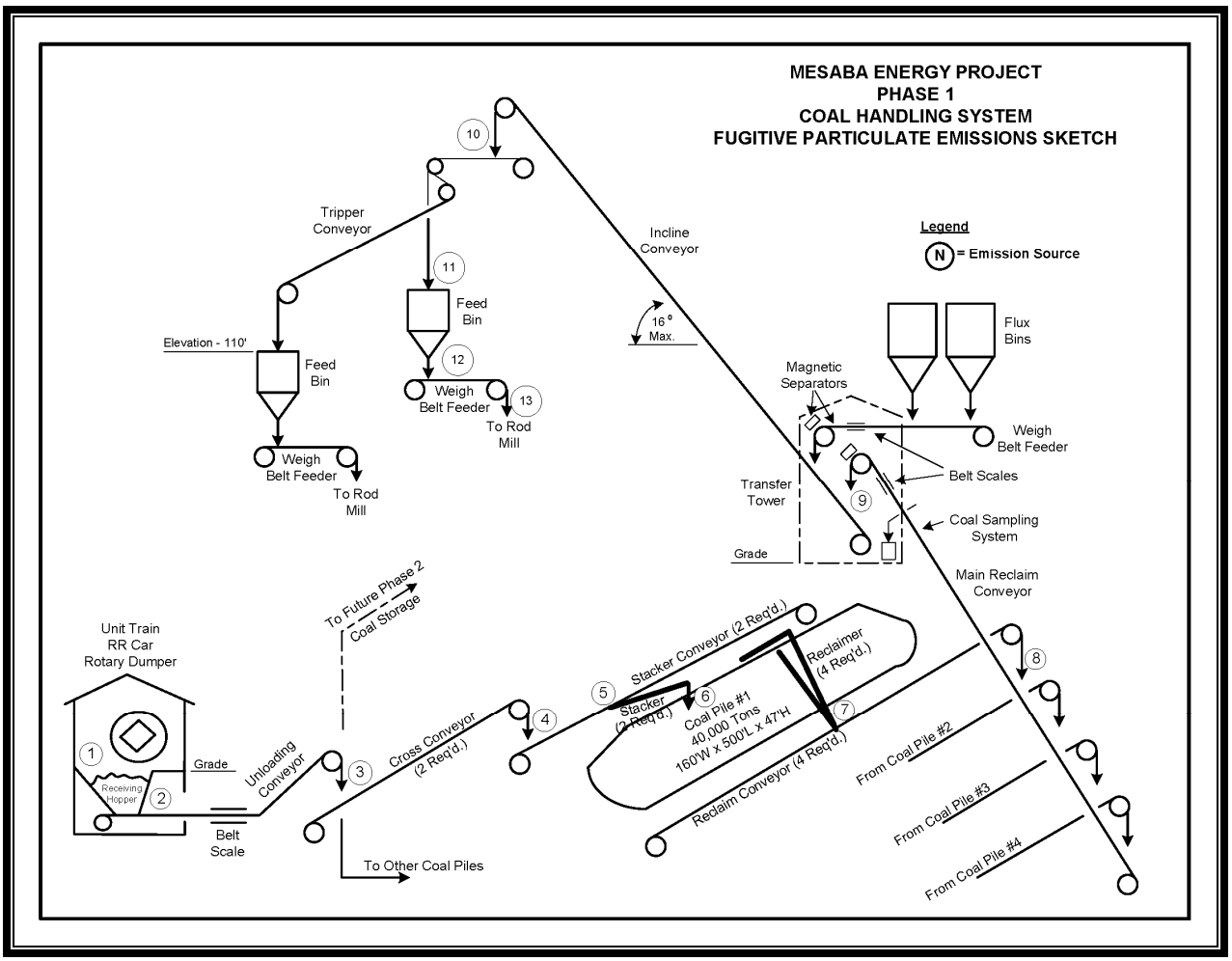
[2] Total reduced sulfur (TRS) includes carbon disulfide, carbonyl sulfide, and hydrogen sulfide.

1.8.1.1.5 Material Handling Systems

Fugitive particulate matter emissions (fugitive dust) will be generated by coal/coke and slag handling, preparation, and storage during the operational phase of the IGCC Power Station. Sources of these emissions include the active and inactive coal/coke storage piles, conveyors/transfer points, slurry preparation area, and the slag storage area. Estimated emissions

of total suspended particulate matter (particulate matter with an aerodynamic diameter no greater than 30 microns) and PM_{10} (particulate matter with an aerodynamic diameter no greater than 10 microns) for these sources are summarized in Table 1.8-10 for Phase I operations (fugitive particulate matter emission rates for Phase I and II would be twice the values shown). A schematic diagram of the material handling system is shown in Figure 1.8-1. Detailed calculations are presented in Appendix 5 of the Joint Application (the West Range IGCC Power Station application for a Part 70/New Source Review Construction Authorization Permit); material handling emission calculations are independent of the Site and, therefore, can be applied to the East Range IGCC Power Station.

Figure 1.8-1
Material Handling System for Phase I IGCC Power Station



The estimates of particulate matter emission rates (lb/hr, tons/year) are based on methodologies developed by the U.S. EPA and documented in AP-42 ("Compilation of Air Pollutant Emission Factors, Volume 1: Stationary Point and Area Sources", 5th Edition). Specific portions of AP-42 utilized in the current analysis include Section 13.2.4 ("Aggregate Handling and Storage Piles"), Section 13.2.5 ("Industrial Wind Erosion"), and Section 13.2.2 ("Unpaved Roads"). These sections were used to estimate emission factors for the various coal/slag handling and moving

components, windage losses from the coal and slag piles, and emissions resulting from on-site truck traffic movement of slag from process units to the slag storage pile.

The emission factor for rail car unloading of feedstock was developed from the Electric Power Research Institute (EPRI) report CS-3455, published in June 1984. The peak hourly throughput for this system, as well as for conveyors and transfer points up to the storage pile, is based on unloading approximately 36 unit train cars per hour (approximately 4,300 tons/hr).

The emission factors (expressed in lb/ton) for aggregate handling systems derived from AP-42 are multiplied by the maximum material throughput to estimate an uncontrolled particulate matter emission rate. Peak values are expressed on an hourly basis and represent the maximum system throughput requirements. For the materials handling facilities upstream of the coal pile, this rate is as described above. For materials handling facilities downstream of the storage pile, the peak rate is based on 120 percent of the average rate required for the nominal plant output. The annual throughput is based on the average material throughput requirement for the plant at full load conditions based on 8,760 hours per year. The AP-42 methodology correlates the aggregate handling particulate matter emission factor inversely with coal moisture content. Because of this, the maximum plant fugitive particulate matter emission rates were found to be higher on operation with Illinois No. 6 coal versus the significantly higher moisture content (and higher as-received throughput rate) for PRB-1 coal. The maximum slag generation and throughput rates are also based on operation with Illinois No. 6 coal – the slightly higher slag generation rate based on operation with a blended feedstock had an insignificant impact on the emissions from the slag handling systems. However, in practice, PRB coal is known to be dusty. To account for this experience and to derive more conservative "worst case" estimates, the surface moisture content in PRB coal was assumed to be 4% and the fugitive particulate matter emission rates were recalculated. The fugitive emissions from PRB coal using the revised assumptions are provided in Table 1.5-10.

Uncontrolled particulate matter emissions estimates were modified as appropriate by a control efficiency multiplier. Control efficiencies used in these estimates include:

1.	No control method	0%
2.	Railcar/Feedstock storage pile load-in	50%
3.	Partial enclosure of transfer point	70%
	3a. Partial enclosure w/dust suppression spray	75%
4.	Full enclosure of transfer point	90%
	4a. Full enclosure w/dust suppression spray	95%
	4b. Full enclosure with baghouse filter	99%
5.	Roadway w/watering and cleaning	80%

The control efficiency for railcar unloading and storage pile load-in using an adjustable stacker are based on engineering judgment for the partial containment systems planned. References to items 3 and 4 (above) are identified in EPA 450/3-81-005b (Sept. 1982) and Environmental Progress (Feb. 1984). The control efficiencies for items 3a, 4a, and 4b are based on engineering judgment and preliminary discussions with dust suppression system vendors (to assess enhanced particulate matter suppression and/or capture using the systems identified relative to the control efficiency for an enclosed system alone). The reference for the control efficiency provided for item 5 is found in Section 13.2.2 of AP-42.

The wet spray dust suppression systems require that water be supplied to the various injection points. This water may be blended with glycol for freeze point suppression, and/or surfactants (wetting agents) or chemical binding or encrusting agents. Because of such chemical additions, any free water draining from the solids will be captured and treated as required before re-use on-site or off-site disposal.

Determination of particulate matter emissions resulting from wind erosion of the storage piles requires information on pile geometry and wind velocities at the plant site. As shown on the IGCC Power Station plot plan and visual renderings (see Figures 1.5-3 and 1.5-4, respectively), rectangular storage piles with rounded ends have been assumed. Lengths, widths, angles of repose and heights have been determined to provide the required storage volumes in one or more piles. These values were used to estimate the pile surface areas exposed to winds, as required by the AP-42 procedure. Historical wind velocity profiles (speed and annual frequency of occurrence) were obtained from University of Minnesota Technical Bulletin AD-TB1955 for the local Hibbing, Minnesota area. The reported wind velocities are relatively low, and only infrequently exceed the threshold friction velocity needed to generate quantifiable emissions as defined by the AP-42 procedure. Hence, at these conditions, the piles were not significant contributors to overall plant particulate matter emissions.

In-plant trucks will be used to transport dewatered by-product slag from the gasifier slag handling area to the slag storage pile or bins to await shipment by rail or truck to offsite locations. A truck traffic emission factor from AP-42 is used to estimate fugitive road dust from this internal slag transfer operation. A control efficiency of 80% has been applied to this emission source based on watering of the roadway near the pile to suppress dust and periodic removal/cleanup of dust-producing material.

Table 1.8-10 Fugitive Particulate Emission Estimate (Phase 1 Operation)

Emission Source Description		Notes	PM30 Emission Factor (lb/ton)	PM10 Emission Factor (lb/ton)	Maximum Hourly Throughput (ton/hr)	Maximum Annual Throughput (ton/yr)	Control Method	Control Efficiency (%)	Controlled PM30 Maximum Hourly Emission Rate (lb/hr)	ControlledPM30 Maximum Annual Emission Rate (ton/yr)	Controlled PM10 Maximum Hourly Emission Rate (lb/hr)	Controlled PM10 Maximum Annual Emission Rate (ton/yr)
COAL HANDLING AND STORAGE												
1	Railcar Unloading	1,9	0.00174	0.00087	4,300	3,100,000	Partially Enclosed Shed with dust suppression sprays	75	1.871	0.674	0.935	0.337
2	Unloading hopper to Unloading Conveyor	2,9	0.0020	0.0010	4,300	3,100,000	Fully enclosed transfer point with dust suppression sprays	95	0.432	0.156	0.204	0.074
3	Unloading conveyor to Cross-Conveyor	2,9	0.0020	0.0010	4,300	3,100,000	Fully enclosed transfer point with dust suppression sprays	95	0.432	0.156	0.204	0.074
4	Cross-Conveyor to Stacker Conveyor	2,9	0.0020	0.0010	4,300	3,100,000	Fully enclosed transfer point with dust suppression sprays	95	0.432	0.156	0.204	0.074
5	Stacker Conveyor to Stacker	2,9	0.0020	0.0010	4,300	3,100,000	Fully enclosed transfer point with dust suppression sprays	95	0.432	0.156	0.204	0.074
6	Stacker to Coal Pile	2,9	0.0020	0.0010	4,300	3,100,000	Ring-type dust suppression sprays at discharge point; Adjustable height stacker	50	4.323	1.558	2.044	0.737
7	Reclaimer to Reclaim Conveyor	2,8	0.0020	0.0010	430	3,100,000	Partially Enclosed transfer point with dust suppression sprays	75	0.216	0.779	0.102	0.368
8	Reclaim Conveyor to Main Conveyor	2,8	0.0020	0.0010	430	3,100,000	Fully enclosed transfer point with dust suppression sprays	95	0.043	0.156	0.020	0.074
9	Main Conveyor to Incline Conveyor	2,8	0.0020	0.0010	430	3,100,000	Fully enclosed transfer point with dust suppression sprays inside building	95	0.043	0.156	0.020	0.074
10	Incline Conveyor to Tripper Conveyor	2,8	0.0020	0.0010	430	3,100,000	Fully enclosed transfer point with dust suppression sprays	95	0.043	0.156	0.020	0.074

Emission Source Description		Notes	PM30 Emission Factor (lb/ton)	PM10 Emission Factor (lb/ton)	Maximum Hourly Throughput (ton/hr)	Maximum Annual Throughput (ton/yr)	Control Method	Control Efficiency (%)	Controlled PM30 Maximum Hourly Emission Rate (lb/hr)	ControlledPM30 Maximum Annual Emission Rate (ton/yr)	Controlled PM10 Maximum Hourly Emission Rate (lb/hr)	Controlled PM10 Maximum Annual Emission Rate (ton/yr)
11	Tripper Conveyor to Feed Bin	2,8	0.0020	0.0010	430	3,100,000	Fully enclosed transfer point with baghouse dust collector	99	0.009	0.031	0.004	0.015
	Windage from Coal Storage	3,5	--	--	--	--	None	0	--	0.104	--	0.052
	SUBTOTAL								**8.28**	**4.24**	**3.97**	**2.02**
COAL SLURRY FACILITY SOURCES												
12	Feed Bin to Weigh Belt Feeder	2,8	0.0020	0.0010	430	3,100,000	Fully enclosed transfer point with dust suppression sprays	95	0.043	0.156	0.020	0.074
13	Weigh Belt Feeder to Rod Mill Feed Chute	2,8	0.0020	0.0010	430	3,100,000	Fully enclosed transfer point with dust suppression sprays	95	0.043	0.156	0.020	0.074
	SUBTOTAL								**0.09**	**0.31**	**0.04**	**0.15**
SLAG TRANSPORT AND STORAGE												
	Slag Disposal Truck Traffic	4	8.5	2.26	0.40	3,500	Apply dust suppressant	80	0.680	2.975	0.181	0.791
	Slag Storage Load-in		Nil	Nil			Wet slag	100	0.000	0.000	0.000	0.000
	Windage from Slag Storage	3,6	--	--	--	--	None	0	--	0.027	--	0.013
	Slag Storage Load-out	7	0.0053	0.0025	39	281,780	None	0	0.207	0.748	0.098	0.354
	SUBTOTAL								**0.89**	**3.75**	**0.28**	**1.16**
	TOTAL								**9.25**	**8.30**	**4.28**	**3.33**

1. Emission Factor from EPRI CS-3455 (6/84).
2. Coal emission factors for transfer points from AP-42 Section 13.2.4); U=9.3 mph, M=4%; Emission factor E = k*0.0032*{(U/5)^1.3/(M/2)^1.4}; k=0.74 for PM and = 0.35 for PM10.
3. Windage emissions from AP-42 (Section 13.2.5); wind speeds from AD-TB1955 University of Minnesota "Climate of Minnesota".
4. Emission factor for onsite truck traffic (slag transfer) from AP-42 (Section 13.2.2) in lb/VMT (vehicle miles traveled); Hourly throughput units are VMT per hour; assumed 0.2 mile/round trip between process units and slag pile; approximately 2 truck/hr required (20 ton truck); Approx 0.4 VMT/hr.
5. Coal active storage pile based on 4 oval piles, providing 20 day capacity (~ 160,000 tons for PRB-1).
6. Slag storage pile based on 1 oval pile, providing ~ 50 day capacity (~ 37,000 tons for bituminous coal or PRB2 – PRB3 blend).
7. Slag emission factors for transfer points from AP-42 Section 13.2.4); U=9.3 mph, M=2%; = k*0.0032*{(U/5)^1.3/(M/2)^1.4};k=0.74 (PM)/ = 0..35 (PM10).
8. Facilities between coal pile and slurry prep based on hourly throughput rate of 120% of average capacity at full plant output.
9. Maximum hourly feed rate based on unloading of thirty-six cars (119 tons per car) of unit train per hour; enables unloading of full unit train in about 3.2 hours.

1.8.1.1.6 Particulate Matter and Mercury Releases from Cooling Tower Drift

The high concentration of TDS found in pit waters in the vicinity of the East Range Site is the source of increased PM_{10} emissions from the East Range IGCC Power Station cooling towers relative to such emissions from the West Range IGCC Power Station. TDS in pit waters in the vicinity of the East Range Site have been shown to be present at concentrations up to 1,800 milligrams per liter ("mg/L"), whereas peak concentrations of TDS in pit waters in the vicinity of the West Range Site are on the order of 340 mg/L. The West Range IGCC Power Station cooling towers will operate at or below eight cycles of concentration; the East Range IGCC Power Station cooling towers are expected to operate up to a maximum of ten cycles of concentration.

Table 1.8-11 shows the expected maximum particulate matter emissions from the cooling towers as a result of drift. Alternate feedstock cases have shown slightly different conditions for the two cooling towers, which would affect the emissions rates. The emission estimates below are based on 100 percent PRB-1 coal feed to the plant, and the Siemens-Westinghouse CTG power block (606 MW net nominal output at the bus bar of the IGCC Power Station's high voltage switchyards) and are indicative of the maximum combined particulate matter release. The drift rate is based on 0.001% of the tower recirculation rate as provided by equipment suppliers and reflects the use of high efficiency drift eliminators. The TDS content of the drift is the maximum value estimated from water quality measurement data for the makeup water (the water quality data from which such maxima were derived are provided in the West Range NPDES Permit Application attached to the Joint Application as Appendix 6 and in the results of water quality data for the East Range Site attached to the Joint Application as Appendix 7). Table 1.8-11 shows emissions from a single phase. The emissions for the combined Phase I and II operations would be double those shown.

Table 1.8-11
Particulate Matter (PM_{10}) Emissions From Cooling Tower Drift
(Per Phase)

	West Range		East Range	
	Power Block Cooling Tower	Gasification/ ASU Cooling Tower	Power Block Cooling Tower	Gasification/ ASU Cooling Tower
Duty (MMBtu/hr)	1,740	690	1,740	690
Recirculation Rate (10^6 lb/hr)	116	46	116	46
Drift (lb/hr)	1,160	460	1,160	460
TDS (ppmw)	2,720	2,720	18,000	18,000
PM_{10} Emission (lb/hr/tower)	3.2	1.3	21	8.3
PM_{10} Emission (lb/hr/cell)	0.3	0.3	1.7	1.7
PM_{10} Emission (TPY)	14	5.5	91	36

The Power Block cooling tower is currently configured with 12 cells, and the smaller Gasification/ASU cooling tower with 5 cells. Key performance data related to the cooling tower cells are presented in Table 1.8-12.

Table 1.8-12
Cooling Tower Characteristics (per cell)

Characteristic	Value
Exhaust Flow, 10^6 acfm (wet)	1.37
Exhaust Temperature, ^oF	104
Outlet Elevation (above grade), ft	48
Outlet Diameter, ft	33

The cycles of concentration in a cooling tower relate how much the dissolved solids are allowed to concentrate in the cooling water system. Assuming i) the IGCC Power Station is operating on eight cycles of concentration; ii) the total amount of water recirculated in the power block and gasification/ASU cooling towers is approximately 320,000 gpm; iii) drift constitutes approximately 0.001% of the water being recirculated; iv) the plant operates at a 92% capacity factor year around; and v) the concentration of mercury in the raw make-up water is 0.9 nanograms per liter, releases of mercury via drift could be expected to be on the order of 0.04 grams per year per phase of the Project. At ten cycles of concentration, the amount of mercury released via drift would be 0.05 grams per year. Annual releases on this order are not considered to be environmentally consequential.

1.8.1.1.7 Auxiliary Boilers

The auxiliary boilers will normally operate only when no steam is available from the gasifiers or HRSGs. The annual capacity factor for these boilers will be 25% or less. The auxiliary boilers will be provided with low NO_x burners for emission control. Emission rates based on supplier guarantees for similar equipment are shown in Table 1.8-13.

Table 1.8-13
Maximum Auxiliary Boiler Short-Term and Annual Emission Rates
(Phase I and II)

	lb/hr	Ton/Year*	Basis
NO_x	9.4	10	Low NO_x burner, 30 ppmvd (@ 3% O2)
SO_2	0.74	0.82	1 grain/100 scf in pipeline gas
CO	19	21	100 ppmvd (@ 3% O2)
PM_{10}	1.3	1.4	0.005 lb/million Btu, HHV
VOC	1.0	1.1	10 ppmvd (@ 3% O2)

*Annual emission based on 25% maximum annual capacity factor.

1.8.1.1.8 Emergency Diesel Engines.

Other than the emergency uses for which they are intended, each of the diesel engines driving the emergency generators and fire protection pumps will be operated no more than 100 hours per year. Emissions for each engine are estimated using accepted agency-published factors (AP-42) and very low sulfur diesel fuel. Table 1.8-14 shows the maximum short term and annual non-emergency emissions for each engine.

Table 1.8-14
Emergency Diesel Engines Emissions
(Phase I and II)

Diesel Engine	Approx Capacity, Each	Total No. Of Engines - Phases I & II	Short-Term Emission (Lb/Hr)					Annual Emission (Ton/Yr)				
			NO_X	SO_2	CO	PM_{10}	VOC	NO_X	SO_2	CO	PM_{10}	VOC
Emergency generators – gasification island	2 MW	2	129	2	30	4	4	6.4	0.1	1.5	0.2	0.2
Emergency generators – power block	350 kW	2	29	2	6	2	2	1.5	0.1	0.3	0.1	0.1
Fire pumps	300 hp	4	37	2.5	8.0	2.6	3.0	1.9	0.1	0.4	0.1	0.1

1.8.1.2 Non-Criteria Pollutant Emissions and Lead

1.8.1.2.1 Lead Emissions

Plant emission rates for trace amounts of lead were estimated from published information for a similar IGCC facility.[8] These estimates are shown on Table 1.8-15 included in the hazardous air pollutants emission discussion below.

1.8.1.2.2 Sulfuric Acid Emissions

Sulfur trioxide ("SO_3") emissions, expressed as sulfuric acid ("H_2SO_4"), for the CTGs and other plant emission sources were estimated based on supplier information and measurements at Wabash River. These estimates are also shown on Table 1.8-15 in the hazardous air pollutants emission discussion below.

1.8.1.3 Hazardous Air Pollutant Emissions

Emission rates for HAPs, as identified by the MPCA, have been estimated for the project using the following sources (listed in order of significance):

- Results of regulatory test programs at Wabash River - adjusted, as appropriate, for the expected worst-case feeds to the Mesaba Energy Project.
- Equipment supplier information.
- Published emission factors and reports applicable to IGCC facilities.
- Engineering calculations and judgment.
- U.S. EPA emission factors (AP-42) for coal combustion.

[8]National Energy Technology Laboratory, U.S. Dept of Energy, *Major Environmental Aspects of Gasification-based Power Generation Technologies, Final Report*, December 2002.

HAP emissions at the IGCC Power Station will be reduced by the inherently low polluting IGCC technology and many of the same process features that control criteria emissions. A large portion of the heavy metals and other undesirable constituents of the feed will be immobilized in the non-hazardous vitreous slag by-product and thereby prevented from causing adverse environmental effects. Gaseous and particle-bound HAPs that may be contained in the raw syngas exiting the gasifiers will be totally or partially removed in the syngas particulate matter removal system, water scrubber, and AGR systems described above. In addition, the mercury removal carbon absorption beds will ensure that mercury emissions from the IGCC Power Station will be less than 10 percent of the mercury present in the feedstock as received.

Table 1.8-15 presents a summary of estimated HAPs emissions for the Phase I and Phase II IGCC Power Station. The application for a Part 70/New Source Review Construction Authorization Permit for the West Range Site is attached to the Joint Application as Appendix 5 and contains in an appendix therein the methodology used to estimate HAP emissions, shows example calculations, and identifies the sources of HAPs data used.

Table 1.8-15
Annual Hazardous Air Pollutant Emissions (Phase I and II)

CAS # or MPCA #	Compound	Annual Average HAP Emission (ton/yr)				Total Phase I	Phase I & Phase II
		CTGs	TVB	Flare	Fugitive		
75-07-0	Acetaldehyde	0.044	1.6E-04	3.9E-04		0.045	0.089
98-86-2	Acetophenone	0.022	7.9E-05	2.0E-04		0.022	0.045
107-02-8	Acrolein	0.43	1.5E-03	3.8E-03		0.43	0.87
7440-36-0	Antimony	0.027	2.8E-04	7.0E-04		0.028	0.056
7440-38-2	Arsenic	0.059	1.5E-03	3.7E-03		0.064	0.128
71-43-2	Benzene	0.061	0.028	0.071	0.0063	0.167	0.333
100-44-7	Benzyl chloride	1.03	3.7E-03	9.2E-03		1.0	2.1
7440-41-7	Beryllium	0.0064	7.9E-06	2.0E-05		0.0064	0.0128
92-52-4	Biphenyl	0.0025	9.0E-06	2.2E-05		0.0025	0.0051
117-81-7	Bis(2-ethylhexyl)phthalate (DEHP)	0.11	3.9E-04	9.6E-04		0.109	0.218
75-25-2	Bromoform	0.06	2.0E-04	5.0E-04		0.057	0.114
7440-43-9	Cadmium	0.24	5.7E-05	1.4E-04		0.24	0.47
75-15-0	Carbon disulfide	1.13	4.0E-03	1.0E-02	0.034	1.18	2.35
463581	Carbonyl sulfide				0.058	0.058	0.116
532-27-4	Chloroacetophenone, 2-	0.0103	3.7E-05	9.2E-05		0.0104	0.0208
108-90-7	Chlorobenzene	0.032	1.1E-04	2.8E-04		0.032	0.065
67-66-3	Chloroform	0.088	3.2E-04	7.9E-04		0.089	0.179
0-00-5	Chromium, total (1)	0.013	1.1E-03	2.6E-03		0.016	0.033
18540-29-9	Chromium, (hexavalent)	0.0038	3.2E-04	7.9E-04		0.0049	0.0099
7440-48-4	Cobalt (1)	0.0064	1.2E-03	3.0E-03		0.011	0.021
98-82-8	Cumene	0.0078	2.6E-05	6.6E-05		0.0079	0.0159

CAS # or MPCA #	Compound	Annual Average HAP Emission (ton/yr)				Total Phase I	Phase I & Phase II
		CTGs	TVB	Flare	Fugitive		
57-12-5	Cyanide (Cyanide ion, Inorganic cyanides, Isocyanide)	0.140	4.6E-03	1.2E-02	0.0088	0.16	0.33
77-78-1	Dimethyl sulfate	0.071	2.5E-04	6.3E-04		0.072	0.144
121-14-2	Dinitrotoluene, 2,4-	4.2E-04	1.5E-06	3.7E-06		4.2E-04	8.4E-04
100-41-4	Ethyl benzene	0.14	0.032	0.079	5.4E-06	0.25	0.50
75-00-3	Ethyl chloride (Chloroethane)	0.061	2.2E-04	5.5E-04		0.062	0.124
106-93-4	Ethylene dibromide (Dibromoethane)	0.0018	6.3E-06	1.6E-05		0.0018	0.0036
107-06-2	Ethylene dichloride (1,2-Dichloroethane)	0.059	2.1E-04	5.3E-04		0.060	0.119
50-00-0	Formaldehyde	0.42	1.5E-03	3.7E-03	1.1E-06	0.42	0.84
110-54-3	Hexane	0.10	3.5E-04	8.8E-04	1.5E-06	0.10	0.20
7647-01-0	Hydrochloric acid	0.096	3.0E-04	7.4E-04	0.034	0.13	0.26
7664-39-3	Hydrogen fluoride (Hydrofluoric acid)	1.2	5.3E-05	1.3E-04		1.2	2.5
78-59-1	Isophorone	0.86	3.1E-03	7.6E-03		0.87	1.73
7439-92-1	Lead	0.014	6.3E-05	1.6E-04		0.014	0.028
7439-96-5	Manganese	0.025	2.4E-03	5.9E-03		0.034	0.068
7439-97-6	Mercury	0.012	6.6E-04	1.6E-03		0.015	0.029
74-83-9	Methyl bromide (Bromomethane)	1.23	0.011	0.029		1.3	2.5
74-87-3	Methyl chloride (Chloromethane)	0.78	6.0E-03	1.5E-02		0.80	1.61
71-55-6	Methyl chloroform (1,1,1 - Trichloroethane) (4)	0.029	1.1E-04	2.6E-04		0.030	0.060
78-93-3	Methyl ethyl ketone (2-Butanone)	0.58	2.1E-03	5.1E-03		0.58	1.17
60-34-4	Methyl hydrazine	0.25	9.0E-04	2.2E-03		0.25	0.51
80-62-6	Methyl methacrylate	0.029	1.1E-04	2.6E-04		0.030	0.060
1634-04-4	Methyl tert butyl ether	0.051	1.8E-04	4.6E-04		0.052	0.104
75-09-2	Methylene chloride (Dichloromethane)	0.056	5.5E-04	1.4E-03		0.058	0.117
91-20-3	Naphthalene	0.064	8.1E-04	2.0E-03	2.6E-05	0.067	0.133
7440-02-0	Nickel	0.0096	4.2E-03	1.0E-02		0.024	0.048
108-95-2	Phenol	0.95	1.2E-02	3.0E-02	7.8E-08	0.99	1.98
123-38-6	Proprionaldehyde	0.561	2.0E-03	5.0E-03		0.568	1.136
7784-49-2	Selenium	0.014	2.4E-04	5.9E-04		0.015	0.029
100-42-5	Styrene	0.037	1.3E-04	3.3E-04		0.037	0.075
127-18-4	Tetrachloroethylene (Perchloroethylene)	0.063	2.3E-04	5.7E-04		0.064	0.129
108-88-3	Toluene	0.00081	0.0112	0.0280	6.6E-04	0.041	0.081

CAS # or MPCA #	Compound	Annual Average HAP Emission (ton/yr)				Total Phase I	Phase I & Phase II
		CTGs	TVB	Flare	Fugitive		
108-05-4	Vinyl acetate	0.011	4.0E-05	1.0E-04		0.011	0.023
1330-20-7	Xylenes	0.055	0.013	0.032	1.0E-05	0.10	0.20
	Total federal HAPs	***11.4***	***0.2***	***0.4***	***0.1***	***12.0***	***24.1***
	Other Emissions						
56-55-3	Benz[a]anthracene	5.6E-05	2.0E-07	5.0E-07		5.7E-05	1.1E-04
207-08-9	Benzo(k)fluoranthene	1.6E-04	5.8E-07	1.4E-06		1.6E-04	3.3E-04
50-32-8	Benzo[a]pyrene	5.6E-05	2.0E-07	5.0E-07		5.7E-05	1.1E-04
218-01-9	Chrysene (Benzo(a)phenanthrene)	1.5E-04	5.3E-07	1.3E-06		1.5E-04	3.0E-04
193-39-5	Indeno(1,2,3-cd)pyrene	9.1E-05	3.2E-07	8.1E-07		9.2E-05	1.8E-04
3697-24-3	Methylchrysene, 5-	3.2E-05	1.1E-07	2.8E-07		3.2E-05	6.5E-05
7664-93-9 14808-79-8	Sulfuric acid and sulfates	62.0	0.2	0.6		62.8	125.6
	Other VOC				8.3	8.3	16.6
	Hydrogen sulfide				8.6	8.6	17.2
	Total Volatile Organic Compounds (VOC)	9.6	0.1	0.4	8.4	18.6	37.1
	Total Reduced Sulfur (TRS) Compounds	1.1	0.004	0.010	8.7	9.8	19.7

1.8.1.3.1 Mercury

The volume of pre-combustion syngas present at the time of its clean-up in the E-Gas™ process is about one hundred times less than the volume of the post-combustion gas handled in a typical conventional pulverized coal-fired boiler. An inherent advantage that IGCC technology has over such conventional systems is that gas clean up equipment can be much smaller in size and the residence time for allowing contact between a chemical (like mercury) and an absorbent (like activated carbon) can be increased, thereby providing for greater pollutant removal efficiency. This pre-combustion gas clean-up process allows for highly effective mercury removal rates, which in the case of Mesaba One and Mesaba Two will be at least 90 percent of the as-received combustion concentration present in its incoming fuel. For Mesaba One and Two, this translates to maximum annual mercury emissions of only 54 pounds on a twelve month rolling average. Figure 1.8-2 Figure 1.8-2 shows how mercury is expected to partition throughout the IGCC Power Station.

1.8.1.3.2 Carbon Dioxide

Carbon dioxide emissions from the IGCC Power Station are a function of the feedstock consumed and the Station's net heat rate (a measure of the overall efficiency under which the energy in the feedstock is converted to electricity). The characteristics of the feedstock that dictate the rate at which CO_2 is emitted are its carbon content and higher heating value. Figure 1.8-3 illustrates the rates at which CO_2 will be produced by Mesaba One and Mesaba Two when using 100% bituminous coal and 100% subbituminous coal as a feedstock. The CO_2 emission rates shown in

Figure 1.8-3 do not account for any CO_2 removal that would occur as a result of the equipment additions described in Section 3.1.5.3.5. For purposes of comparison, the CO_2 generation rate of Sherco 3 (a pulverized coal-fired electric generating unit using western subbituminous coal) is also shown in Figure 1.8-3.

Emissions of CO_2 from other large coal-fired electric generating units in Minnesota are shown in comparison with Mesaba One and Mesaba Two in Figure 1.8-4. For those units shown in Figure 1.8-4 that use wet limestone scrubbers (for example Boswell Energy Center and Sherburne County Unites 1 and 2) CO_2 emissions will be underestimated as CO_2 is produced as a consequence of removing SO_2 from the combustion gases. For those units that use lime spray dryers to remove SO_2 from their combustion gases (for example, Sherburne County Unit 3), CO_2 is produced as a consequence of producing lime (CaO) from limestone ($CaCO_3$). Some SO_2 will be removed by soluble oxides present in coal ash, thereby lowering the quantity of CO_2 produced as a result of reacting SO_2 and limestone slurry added for such reason.

Figure 1.8-2 Expected Mercury Partitioning in the IGCC Power Station (Mesaba One and Mesaba Two)

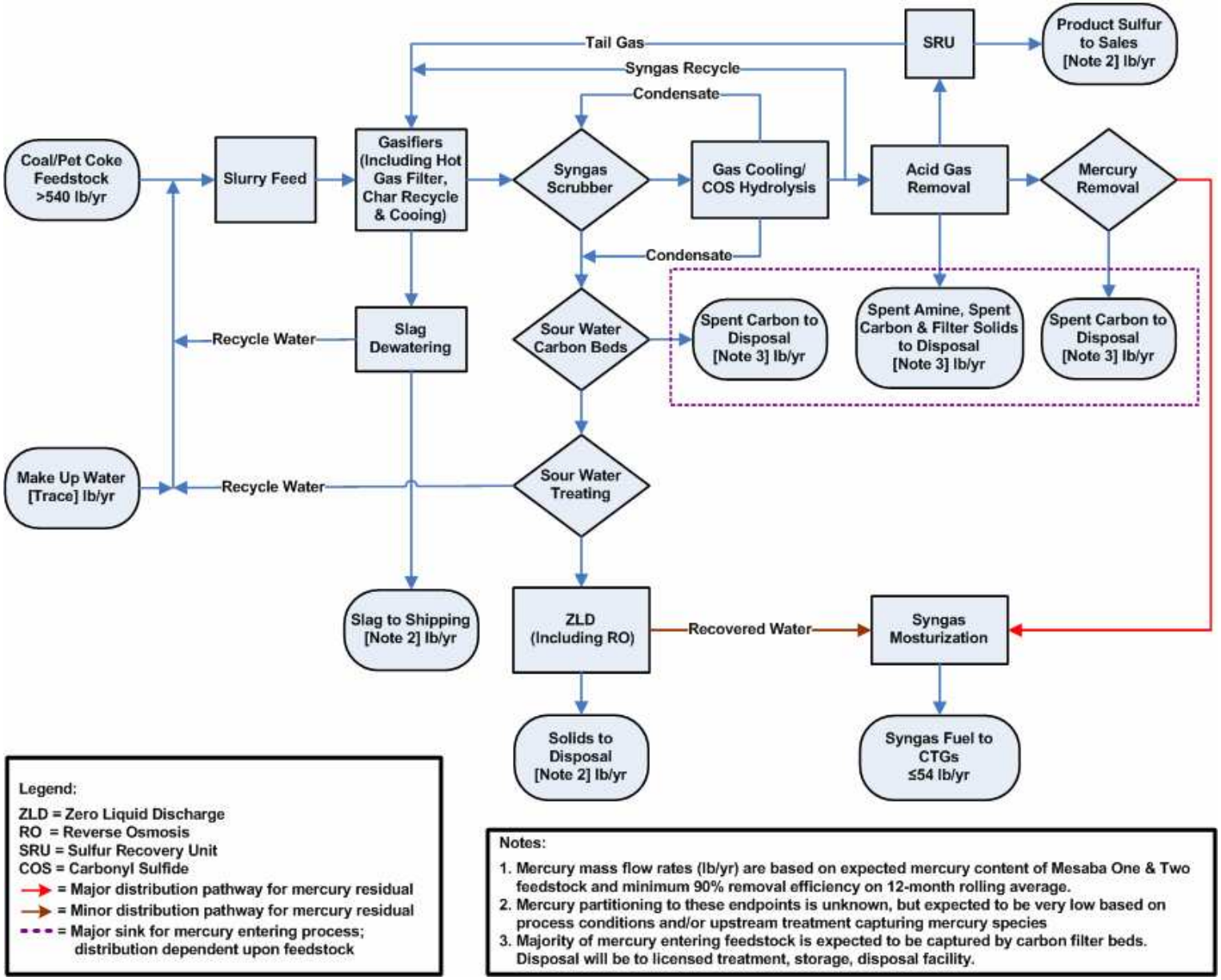


Figure 1.8-3 Carbon Dioxide Emissions From Mesaba Energy Project vs. Sherco Unit 3

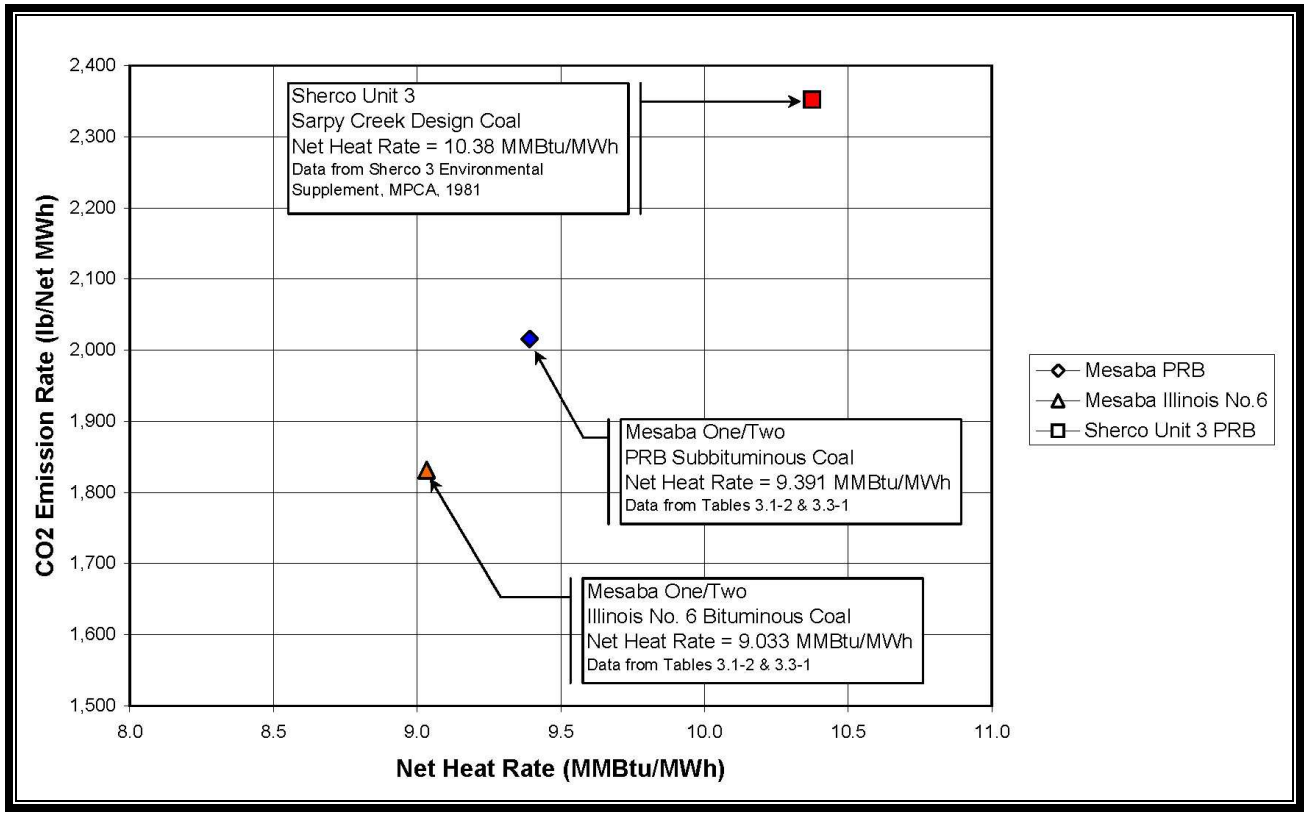
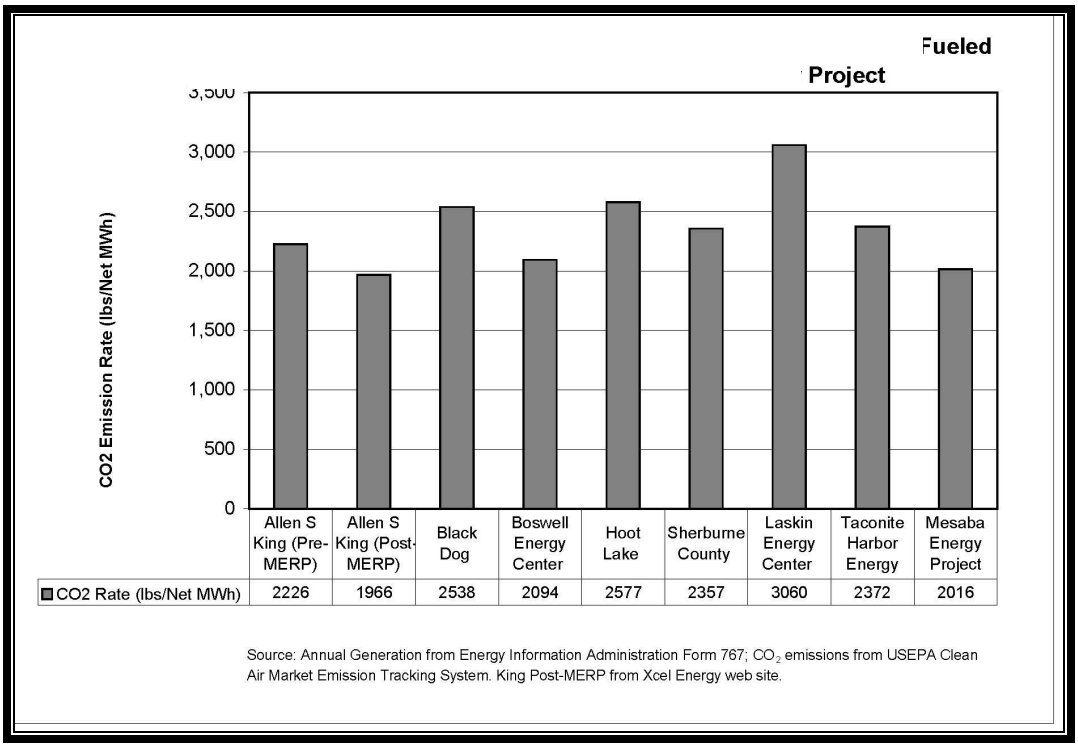


Figure 1.8-4 2004 Carbon Dioxide Emission Rates From Large Coal-Fueled Minnesota Generating Plants vs. Mesaba Energy Project



1.8.2 Water Effluents

The allowable quantity and concentration of chemical species in wastewater discharges from the IGCC Power Station are dependent in large part on the characteristics of potential receiving waters in the Project's vicinity. In the case of the West Range and East Range Sites, the receiving waters are located in different watershed basins that have greatly different water discharge standards. The nature and extent of the differences are discussed in detail in Section 1.12.5.

Importantly with respect to wastewater discharges, the East Range Site is located within the Lake Superior Basin watershed and the standards that apply to discharges of bioaccumulative chemicals of concern ("BCCs") in the Basin effectively preclude wastewater discharges from Mesaba One and Mesaba Two. The principal reason for such discharge prohibition is that mercury – a BCC – is found in the source waters for the East Range Site at concentrations nearly equal to the water quality criteria standard applied to end-of-the-pipe discharges. See Section 1.12.5 for a discussion of the impact of the Lake Superior Basin watershed on the East Range IGCC Power Station design.

1.8.2.1 Site Independent Features of IGCC Power Station

1.8.2.1.1 Commonalities: Introduction

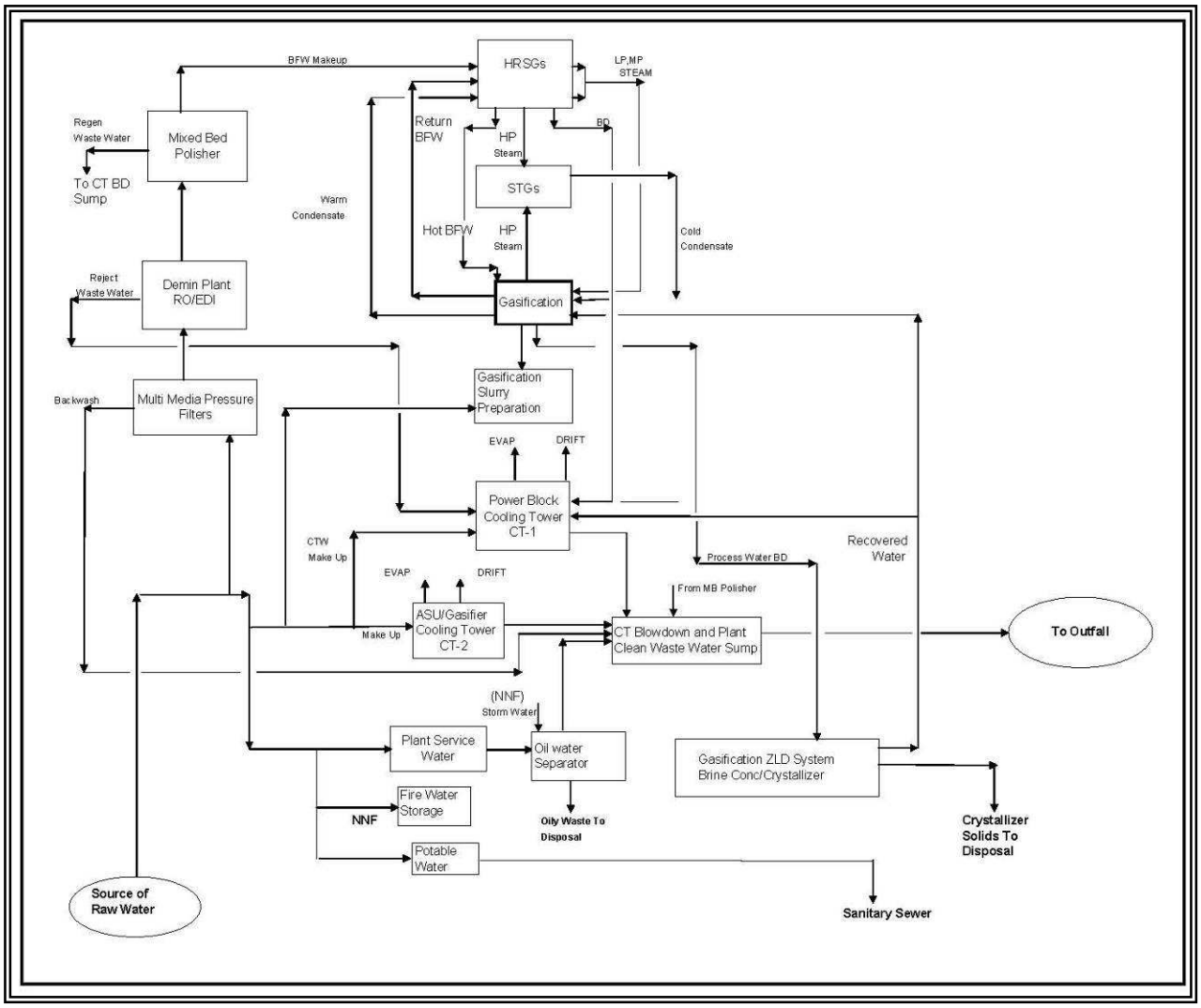
Although differences in the amounts of water appropriated, consumed, and discharged will vary between the West and East Range Sites, the general requirements for water will be the same as

those specified in Section 1.7.4. A generalized water balance diagram that will apply to each of the sites is shown in Figure 1.8-5.

1.8.2.1.2 Zero Liquid Discharge System: Gasification Island

The gasification island will incorporate a significant environmental feature to protect the quality of local streams and lakes. That is, wastewater (generated from gasification and slag processing operations) containing certain levels of heavy metals and other contaminants from the feedstocks will be treated in a state-of-the-art ZLD system. This system will recover distilled water for reuse in the power plant, reducing fresh water consumption, and, more importantly, concentrate heavy metals and other contaminants of concern into a solid waste stream (see Section 1.8.5.1). This solid waste will be effectively disposed of in approved waste management facilities. Therefore, no wastewater streams from the ZLD system serving the gasification island will require disposal at either site (see Figure 1.8-5).

Figure 1.8-5. Water Balance Diagram Showing Integration of ZLD System into Gasification Island in Mesaba One and Two Design*



*In the case of the East Range IGCC Power Station, cooling tower blowdown is routed to a second ZLD system to avoid discharges to surface waters in the Lake Superior Basin watershed.

1.8.2.1.3 Storm Water Management

1.8.2.1.3A Pre-Construction

Environmentally sensitive areas on the West and East Range Sites will be identified prior to the start of construction. These locations will be clearly delineated and will not be disturbed during site preparation activities. Best Management Practices ("BMPs") for storm water runoff will be identified, adopted and implemented during this time period.

1.8.2.1.3B Construction

Initial Project Site preparation activities will include building access roads, clearing brush and trees, leveling and grading the site, bringing in necessary utilities, and undertaking dewatering activities that may be required. Construction of temporary parking, offices and material storage

areas at this time will involve the use of earthmoving and logging equipment to clear and prepare the site for construction of the plant. Trucks will be required to bring fill material for roadways and the plant, remove harvested timber, remove debris from the site, and stockpile fill material. Gravel and road base will be utilized for the temporary roads, material storage, and parking areas as noted in Figure 1.5-5.

In accordance with 40 C.F.R. Part 122.26(b)(14)(x), the Proponent will develop and submit to the MPCA prior to undertaking any construction activities a SWPPP that identifies erosion prevention and sediment BMPs. The plan will include specific identification of foreseeable conditions and proposed practices to properly address all such identified conditions during the various stages of construction and post construction. The plan will include a description of the nature of the construction activity and address the following:

- Potential for discharging sediment and/or other potential pollutants from the site.
- Location and type of all temporary and permanent erosion prevention and sediment control BMPs, along with procedures to be used to establish additional temporary BMPs as necessary for the site conditions during construction.
- Site maps with existing and final grades, including dividing lines and direction of flow for all pre and post-construction storm water runoff drainage areas located within the project limits. The site map must also include impervious surfaces and soil types.
- Locations of areas not to be disturbed.
- Location of areas where construction will be phased to minimize duration of exposed soil areas.
- All surface waters and existing wetlands, which can be identified on maps such as USGS 7.5 minute quadrangle maps or equivalent maps within one-half mile from the project boundaries, which will receive storm water runoff from the construction site, during or after construction.
- Methods to be used for final stabilization of all exposed soil areas.

1.8.2.1.3C Operation

Storm water generated during operation of the IGCC Power Station will be managed in three ways. Storm water with potential to become contaminated with process solids/liquids will be segregated from process equipment by curbs, elevated drain funnels and other means and returned as make-up to the feedstock slurrying system or for other process water use.

Storm water that could become contaminated with oil (such as water runoff from parking lots) will be routed through an oil/water separator and then to the cooling tower blow down sump prior to discharge off-site.

Storm water from other areas not associated with industrial activity will be routed to the storm water detention pond where settling can occur and initial rainfall ("first flush") can be contained, checked, and released in a controlled manner to a permitted outfall.

1.8.2.1.4 Sanitary Discharges

Sanitary wastewaters produced during operation of the IGCC Power Station will be relatively small (about 30 gallons per person per day) and will be discharged to a nearby POTW. In the case of the West Range Site, the closest POTW is the Coleraine – Bovey – Taconite regional

wastewater treatment facility ("WWTF") located in Bovey. This system would be accessed via the City of Taconite's sanitary sewer system. In the case of the East Range Site, the closest wastewater treatment facility ("WWTF") is the Hoyt Lakes POTW. The Hoyt Lakes POTW would be accessed in the vicinity of the Laskin Energy Center, the City being responsible for constructing a satellite WWTF there or constructing a new pipeline from that point to the City's existing WWTF. As an alternative, sanitary wastewaters from plant activities could be managed on site via a septic system or stand alone wastewater treatment system.

1.8.2.2 West Range (Preferred Site)

In the case of the West Range IGCC Power Station, the chemistry of the water effluent streams are inextricably linked to the chemistry of the Station's source waters. The reason for this strong link is due to the fact that the only discharge to West Range receiving waters will be cooling tower blowdown (see Section 1.7.4.1).

1.8.2.2.1 Introduction: Water Requirements, Water Use Flow Diagram and Receiving Waters

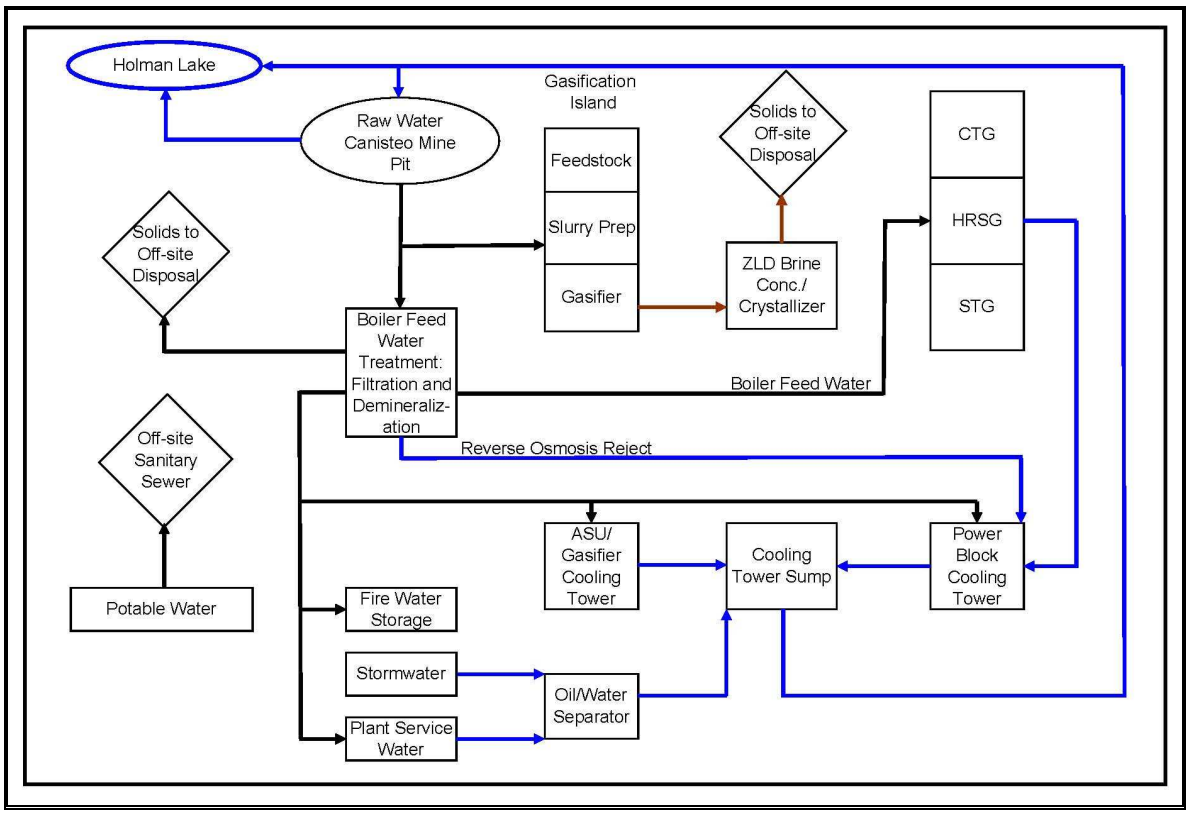
Information regarding water requirements and a generalized water use for the West Range IGCC Power Station is presented in Table 1.8-16 and Figure 1.8-6, respectively.

Table 1.8-16
Water Appropriation Requirements

Phase	Average Annual Appropriation (GPM)	Peak Appropriation (GPM)
I	4,000[a]-4,400[b]	6,500
I and II	8,800[b]-10,300[c]	15,200

[a]Based on 8 COC in the gasification island and the power block cooling towers
[b]Based on 5 COC in the gasification island and the power block cooling towers
[c]Based on 3 COC in the gasification island and the power block cooling towers

Figure 1.8-6. Generalized Water Use Block Flow Diagram for West Range IGCC Power Station



As shown in Figure 1.8-6 and Figure 1.8-7, the receiving waters for the West Range IGCC Power Station will be the Canisteo Mine Pit ("CMP") and Holman Lake. The location of these waters relative to the IGCC Power Station is shown on Figure 1.8-8.

Figures 1.8-7 and 1.8-8 show that the CMP would also serve as the source of water for the IGCC Power Station. The Proponent's water management plan calls for other sources of water to be pumped into the CMP to provide for sufficient water supplies and to maintain water levels and appropriate water chemistry. A general introduction to the water management plan is provided in Section 1.8.2.2.4. A detailed discussion of the water management plan is provided in Section 1.12.4

Figure 1.8-7. Water Management Plan Elements for West Range IGCC Power Station

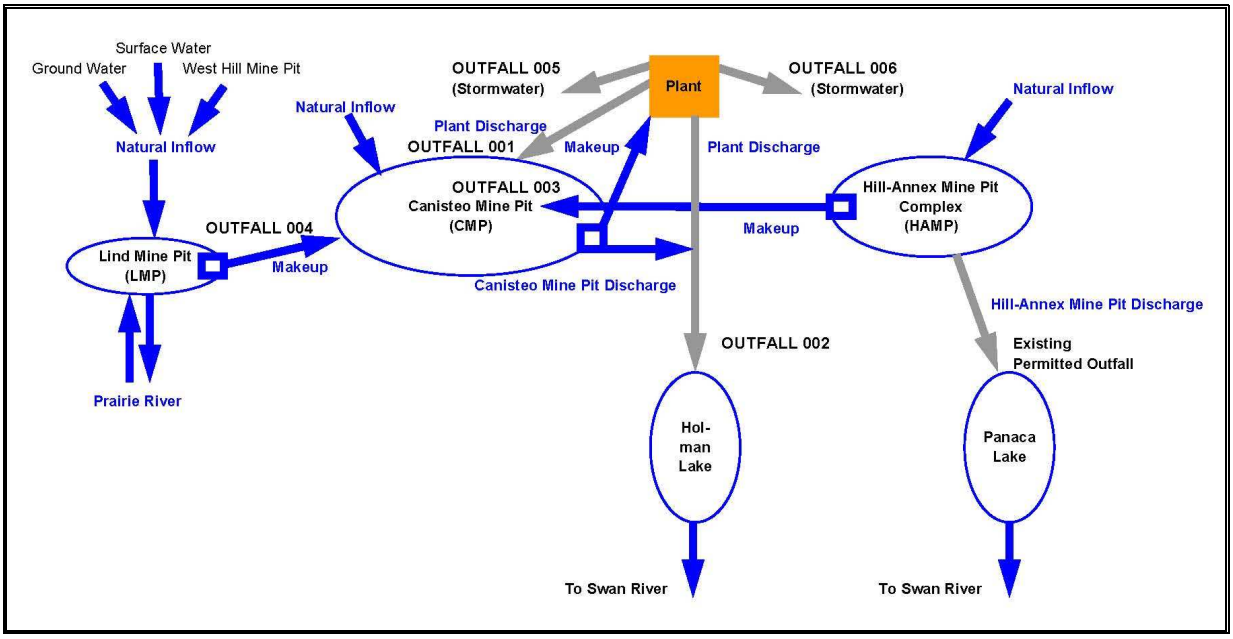
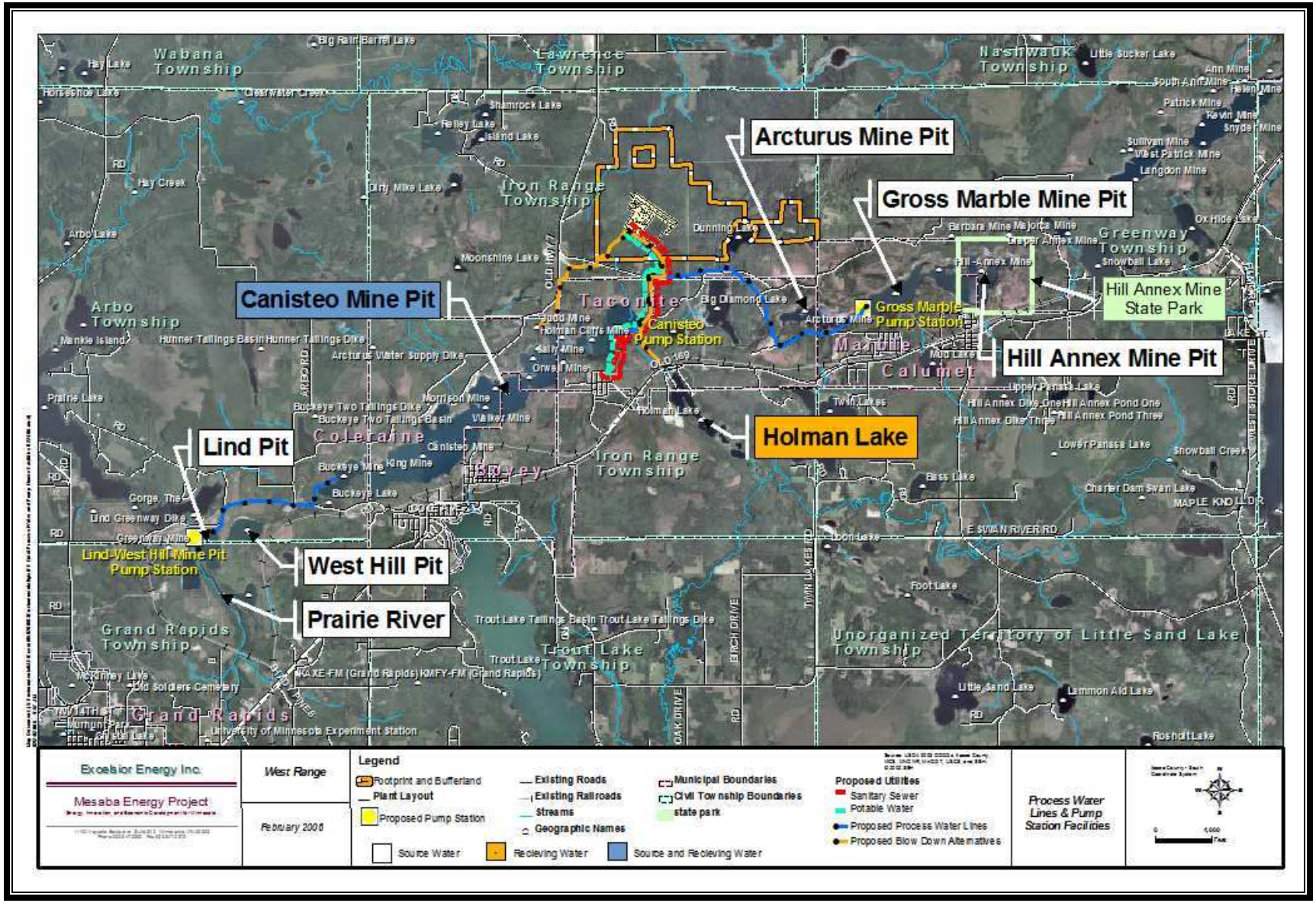


Figure 1.8-8. West Range Site Source and Receiving Waters



1.8.2.2.2 Cooling Tower Blowdown

Because almost all of the wastewater discharged from the IGCC Power Station operations is due to the need to remove a portion of the condenser cooling water for control of dissolved solids (as noted previously in Section 1.7.4.1, this wastewater stream is referred to as "cooling tower blowdown"), the constituents in the discharge are essentially the same materials present in the water supply to the plant, but more concentrated. Based on the IGCC Power Station equipment operating requirements and source water quality, the plant cooling towers are expected to be limited to between approximately three to eight COC. Therefore, the contaminants in the cooling water blowdown could be concentrated (due to evaporation in the cooling tower) by about three to eight times the concentration in the water supply.

In general, the amount of cooling tower blowdown requiring discharge to receiving waters is calculated as follows[9]:

$$\text{Blowdown} = \frac{\text{Evaporation}}{\text{Cycles - 1}} - \text{Drift}$$

As determined by this formula, wastewater discharge rates to the CMP and Holman Lake will be inversely proportional to the cycles of concentration at which the cooling towers are operated. The number of cycles of concentration in the IGCC Power Station will be determined in large part by the concentration of mercury in the CMP waters, the water quality criteria standards for mercury, TDS and hardness, and the total mass of mercury discharged to Holman and Panasa Lake as allowed under conditions of an NPDES permit issued to Mesaba One and Two.

The following outlines Proponent's methodology for operating Mesaba One and Two (the methodology is fully discussed in the NPDES Permit Application at Section 5.2.2.1 and Appendix D the NPDES Permit Application is attached to the Joint Application as Appendix 6). The IGCC Power Station will operate at five cycles of concentration during Phase I and at three cycles of concentration for Phase I and II. A portion of the IGCC Power Station effluent will be discharged to the CMP and a portion will be discharged to Holman Lake. The volume of water discharged directly to Holman Lake from the IGCC Power Station will be controlled such that the total mass of mercury discharged to the Swan River watershed (the sum of any future discharge from the Hill-Annex Mine Pit to Panasa Lake and the IGCC Power Station discharge directly to Holman Lake) will be no greater than the mass currently permitted to be discharged to the watershed from the Hill-Annex Mine Pit Complex ("HAMP Complex"). Importantly, the outcome of this operating scenario is no net increase in the mass of mercury permitted to be discharged to the Swan River watershed under the existing NPDES Permit (No. MN0030198) currently held by the MDNR. The volume of water discharged directly to Holman Lake will be adjusted about every five years, or as needed during Phase I and II operation, to limit the mass of mercury discharged. The expected peak and annual average wastewater discharge rates for the IGCC Power Station are summarized in Table 1.8-17.

[9] Black & Veatch, 1996, "Power Plant Engineering," Page 525-26.

Table 1.8-17
Estimated Wastewater Discharge Rates to West Range Site Receiving Waters

	Cycles of Concentration	Peak Discharge (GPM)	Average Annual Discharge (GPM)
I	5	1,300	550-900
I and II	3	5,140	2,200-3,500

The estimated average annual consumptive and non-consumptive uses and flows contributing discharge to the CMP during operation of a single phase, based on five cycles of concentration in the gasification island and the power block cooling towers, are shown in Figure 1.8-9a. The flows for combined Phase I and Phase II operation and three cycles of concentration in the cooling towers are shown in Figure 1.8-9b. Specific water uses related to the gasification island and the power block are described below.

Figure 1.8-9a
Mesaba One - Water Uses Contributing to IGCC Power Station Discharge

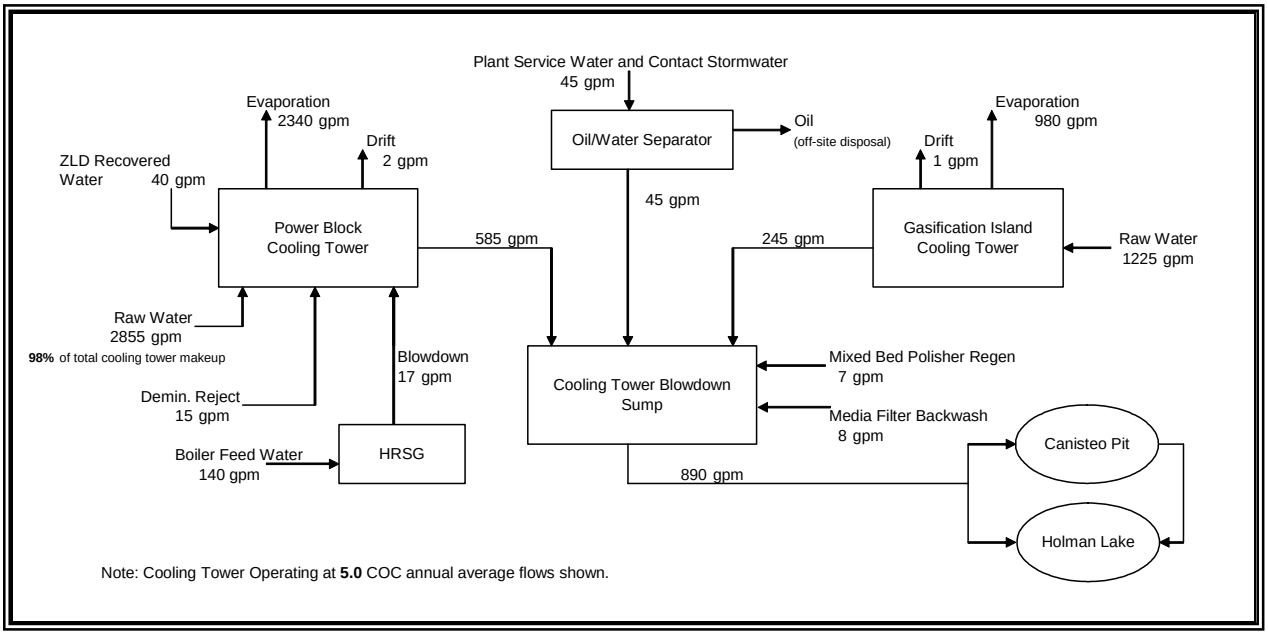
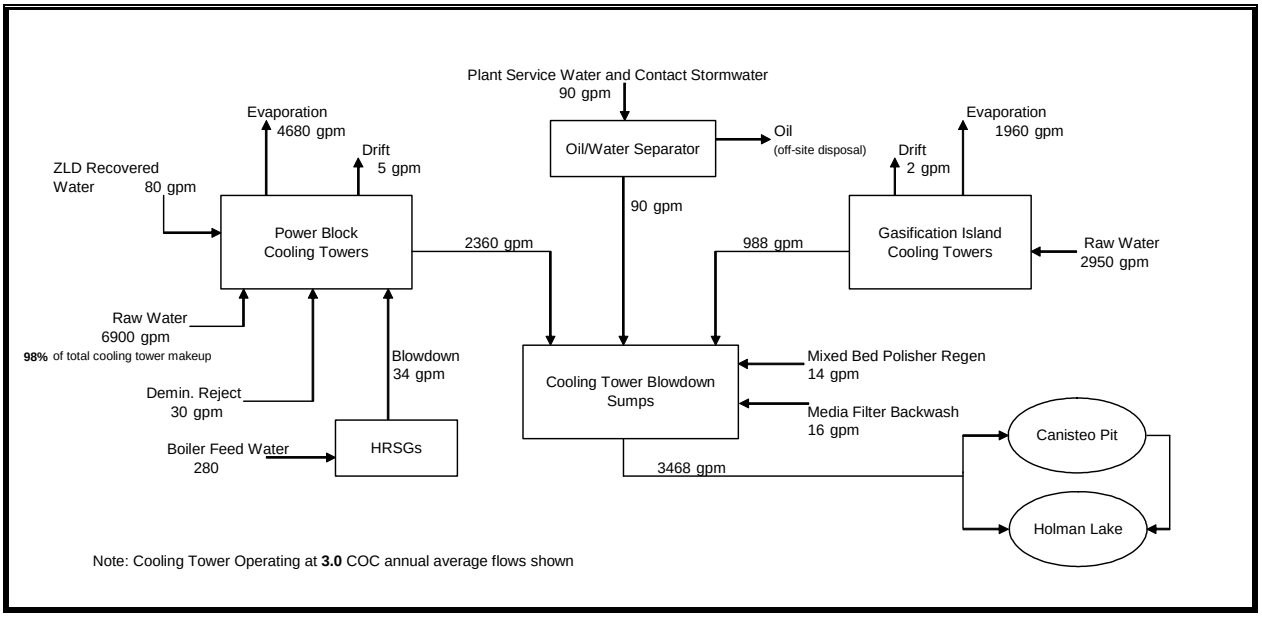


Figure 1.8-9b
Mesaba One and Mesaba Two -
Water Uses Contributing to IGCC Power Station Discharge



As shown in Table 1.8-18, the wastewater from the IGCC Power Station will consist mostly of cooling tower blowdown, blended with relatively low-flow additional wastewater streams from other plant systems, including HRSG blowdown, reject water from the boiler feed water demineralizers, and treated storm water (processed through an oil/water separator) from plant drains isolated from contamination by process solids/liquids (see Figure 1.8-5).

Table 1.8-18
Wastewater Discharge Rate From Systems In The Phase I IGCC Power Station

Wastewater Component	Cycles of Conc.	Expected Discharge (GPM)	
		Ann. Avg.	Peak
Power Block Cooling Tower Blowdown	8	335	498
HRSG Demineralizer /RO Reject Water*	8	15	15
HRSG Blowdown*	8	17	17
Gasifier/ASU Cooling Tower Blowdown	8	140	209
Plant Service Water	8	45	45
Mixed Bed Polisher Regen./Backwash	8	15	15
Power Block Cooling Tower Blowdown	5	585	873
HRSG Demineralizer /RO Reject Water*	5	15	15
HRSG Blowdown*	5	17	17
Gasifier/ASU Cooling Tower Blowdown	5	245	366
Plant Service Water	5	45	45
Mixed Bed Polisher Regen./Backwash	5	15	15

Wastewater Component	Cycles of Conc.	Expected Discharge (GPM)	
		Ann. Avg.	Peak
Power Block Cooling Tower Blowdown	3	1,180	1,750
HRSG Demineralizer /RO Reject Water*	3	15	15
HRSG Blowdown*	3	17	17
Gasifier/ASU Cooling Tower Blowdown	3	494	732
Plant Service Water	3	45	45
Mixed Bed Polisher Regen./Backwash	3	15	15

*The HRSG Demineralizer/RO Reject Water stream and HRSG Blowdown stream both discharge directly to the Power Block Cooling Tower and, therefore, would be reflected in the discharge from the Power Block Cooling Tower. For example, the average annual discharge from the IGCC Power Station assuming 8 cycles of concentration would be 535 gpm (335+140+45+15), not 567 (335+15+17+140+45+15).

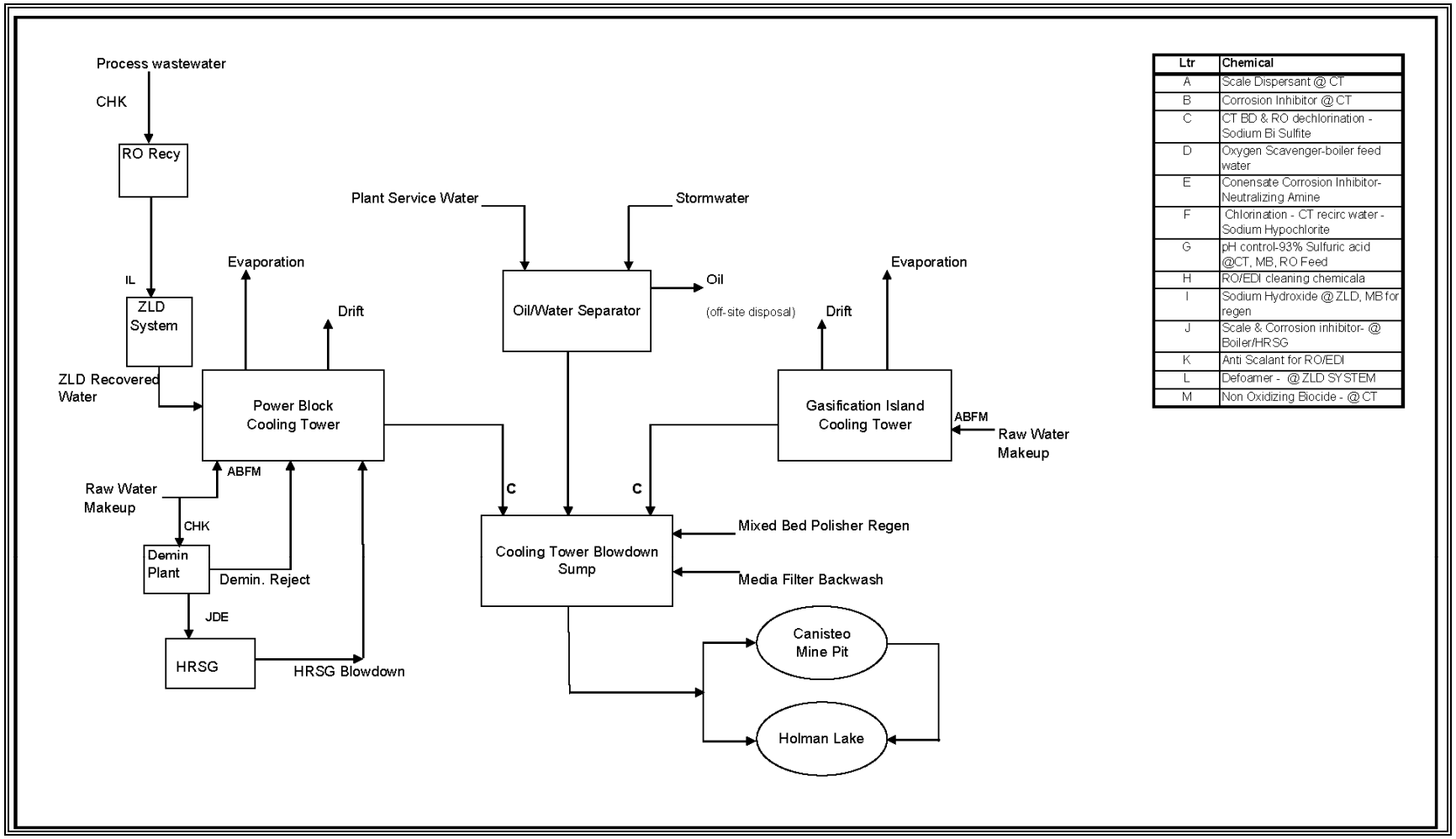
The chemicals that are expected to be added to the circulating water system and the residual amounts that ultimately would be discharged from Mesaba One and Mesaba Two to receiving waters are identified and listed in Table 1.8-19. The Proponent has screened the chemicals identified in this table for phosphorous-containing compounds and will establish in the design basis for the IGCC Power Station that use of such chemicals is to be avoided. These chemicals are primarily needed to control cooling water corrosion and fouling, and to neutralize certain undesirable constituents in the plant discharge stream. The point of introduction for each of the chemicals is indicated in the table and in Figure 1.8-10. Material Safety Data Sheets ("MSDS") representative of the chemical additives are provided in Appendix C of the NPDES Permit Application (attached to the Joint Application in Appendix 6). The estimated chemical usage for Mesaba One and Mesaba Two is also listed (half the indicated amount would be used for Mesaba One). However, the majority of the chemicals would be consumed in the plant processes and only residual amounts would be present in the water ultimately discharged to the CMP and/or Holman Lake. These quantities are preliminary estimates only and are subject to revision when the specific water chemistry program for the facility is developed.

Table 1.8-19
Chemical Additives Used Per Year (Phase I and II)

Chemical	Point(s) Of Introduction	Estimated Usage (lbs/Year)	Estimated Residual In Discharge	Basis, % In Discharge
Scale Dispersant	Cooling Towers	75,000	750	1%
Corrosion Inhibitor	Cooling Towers	300,000	3000	1%
Dechlorination – Sodium Bisulfite	Cooling Tower Blowdown Sump, Reverse Osmosis System	15,000 7500	150 75	1%
Oxygen Scavenger	Boiler Feed Water	6600	66	1%
Condensate Corrosion Inhibitor-Neutralizing Amine	Boiler Feed Water	2200	22	1%
Chlorination - Sodium Hypochlorite	Cooling Towers	300,000	1500	0.5%

Chemical	Point(s) Of Introduction	Estimated Usage (lbs/Year)	Estimated Residual In Discharge	Basis, % In Discharge
pH control-93% Sulfuric Acid	Cooling Towers, Reverse Osmosis, Mixed Bed	18,000 3000 11,000	36 6 22	0.2%
Sodium Hydroxide	Mixed Bed regeneration	11,000	0	(totally neutralized)
Scale and Corrosion Inhibitor	Boiler/HRSG	13,000	130	1%
Anti-Scalant	Reverse Osmosis, Deionizer	150 200	2 2	1%
Non-Oxidizing Biocide	Cooling Towers	11,000	22	0.2%

Figure 1.8-10. Points of Chemical Addition in the IGCC Power Station Circulating Water System



Ltr	Chemical
A	Scale Dispersant @ CT
B	Corrosion Inhibitor @ CT
C	CT BD & RO dechlorination - Sodium Bi Sulfite
D	Oxygen Scavenger-boiler feed water
E	Conensate Corrosion Inhibitor-Neutralizing Amine
F	Chlorination - CT recirc water - Sodium Hypochlorite
G	pH control-93% Sulfuric acid @CT, MB, RO Feed
H	RO/EDI cleaning chemicala
I	Sodium Hydroxide @ ZLD, MB for regen
J	Scale & Corrosion inhibitor- @ Boiler/HRSG
K	Anti Scalant for RO/EDI
L	Defoamer - @ ZLD SYSTEM
M	Non Oxidizing Biocide - @ CT

1.8.2.2.3 Source Water Quality

The water needs of the West Range IGCC Power Station will be met by withdrawing water from nearby abandoned mine pits, including: the CMP, the HAMP Complex, and the Lind Mine Pit ("LMP"). The Prairie River will also serve as a source of water supply and will be integrated into the mine pit water plan. These sources are shown on Figure 1.8-8. The current quality of each water source is summarized in Table 1.8-20. In general, the current concentration of each constituent is based on the median concentration of available qualified water quality analyses. Water quality data is provided in an appendix to the NPDES Permit Application provided in Appendix 6.

Table 1.8-20
Current Source Water Quality

Constituent	Water Source				
	Units	CMP	HAMP Complex	LMP	Prairie River
Hardness	mg/l	308	229	--[b]	--[b]
Alkalinity	mg/l	180	163	178	76
Calcium	mg/l	55.3	58.6	73.2	50
Magnesium	mg/l	40.8	20.5	--	22
Iron	mg/l	<0.05	<0.05	--	--
Manganese	mg/l	<0.02	<0.02	--	--
Chloride	mg/l	5.15	5.2	4.9	1.3
Sulfate	mg/l	103.5	59.5	--	<5
TDS	mg/l	337	254	402	--
pH	mg/l	8.4	8.3	7.7	7.4
Aluminum	ug/l	<25	<25	--	91
Barium	ug/l	28.6	29.7	--	--
Cadmium	ug/l	<10	<10	--	--
Chromium (6+)	ug/l	<5	<5	--	--
Copper	ug/l	<10	<10	--	--
Fluoride	mg/l	--	--	--	--
Mercury	ng/l	0.9	0.9	0.8[a]	0.59
Nickel	ug/l	<5	<5	--	--
Selenium	ug/l	<2	<2	--	--
Sodium	mg/l	6.6	6.2	5.0	2.5
Specific Conductivity	umhos/cm	476	418	--	171
Zinc (3)	ug/l	<10	<10	--	--
BOD	mg/l	<2	<2	--	--
COD	mg/l	<2	<2	--	--
TOC	mg/l	1.9	1.9	--	--
TSS	mg/l	1.5	1.5	--	--
Ammonia (as N)	mg/l	<0.1	<0.1	0.1	0.018
Phosphorus	mg/l	<0.1	<0.1	0.01	0.029

[a] For the mass balance computations presented in Section 5, it was conservatively assumed that the mercury concentration in the LMP is identical to that in the HAMP Complex and the CMP.
[b] --Indicates that no data was collected.

1.8.2.2.4 West Range Outfalls and Discharge Rates

For the West Range Site, the direct receiving water bodies for discharges of cooling tower blowdown from the IGCC Power Station will be the CMP and Holman Lake.

Holman Lake will receive discharges from the CMP for purposes of water level control in the CMP and/or to maintain water quality within that Pit (to keep the concentration of solids from building up).

Figures 1.8-11a and 1.8.11b show the expected discharge outfalls for Mesaba One and the combined Mesaba One and Mesaba Two, respectively. The combination of surface flow/infiltration of water to the CMP, the input of excess water from the HAMP Complex, and the discharge of water from the CMP (or directly from the IGCC Power Station) to Holman Lake would act to reduce the concentration of mineral constituents in the CMP. The locations of the discharge outfalls are shown on Figure 1.8-12.

Figure 1.8-11a. Phase I Water Operations Flow Rates: West Range IGCC Power Station

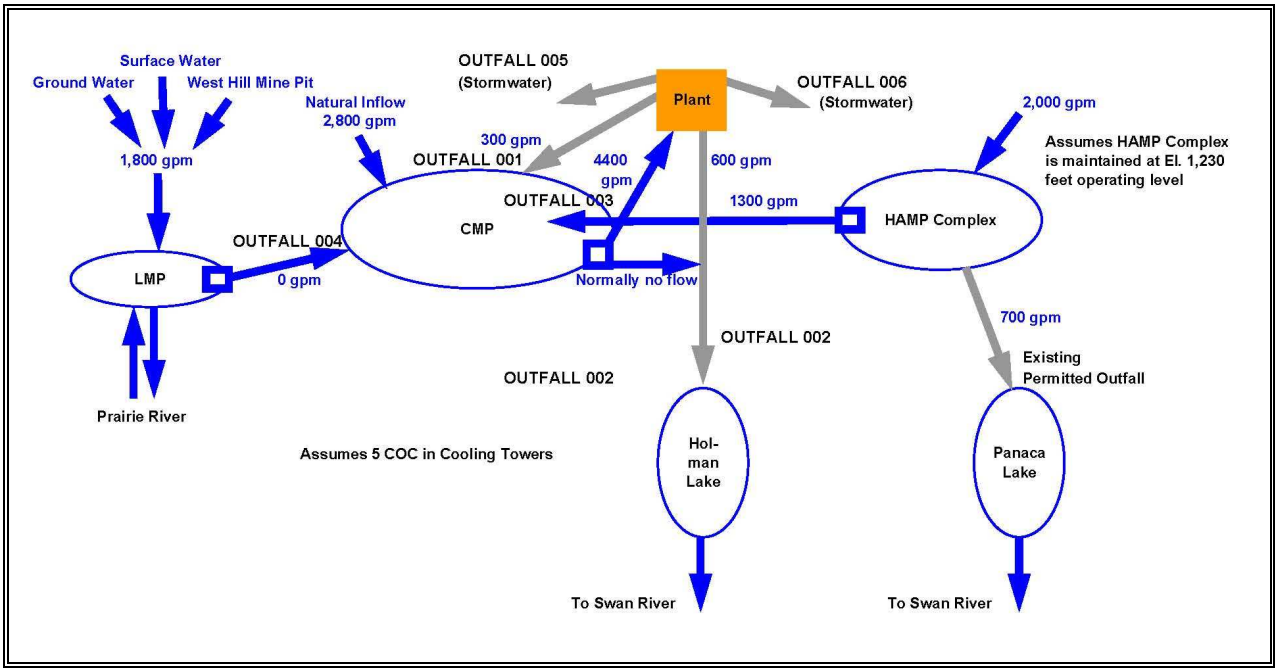


Figure 1.8-11b. Phase I and II Water Operations Flow Rates: West Range IGCC Power Station

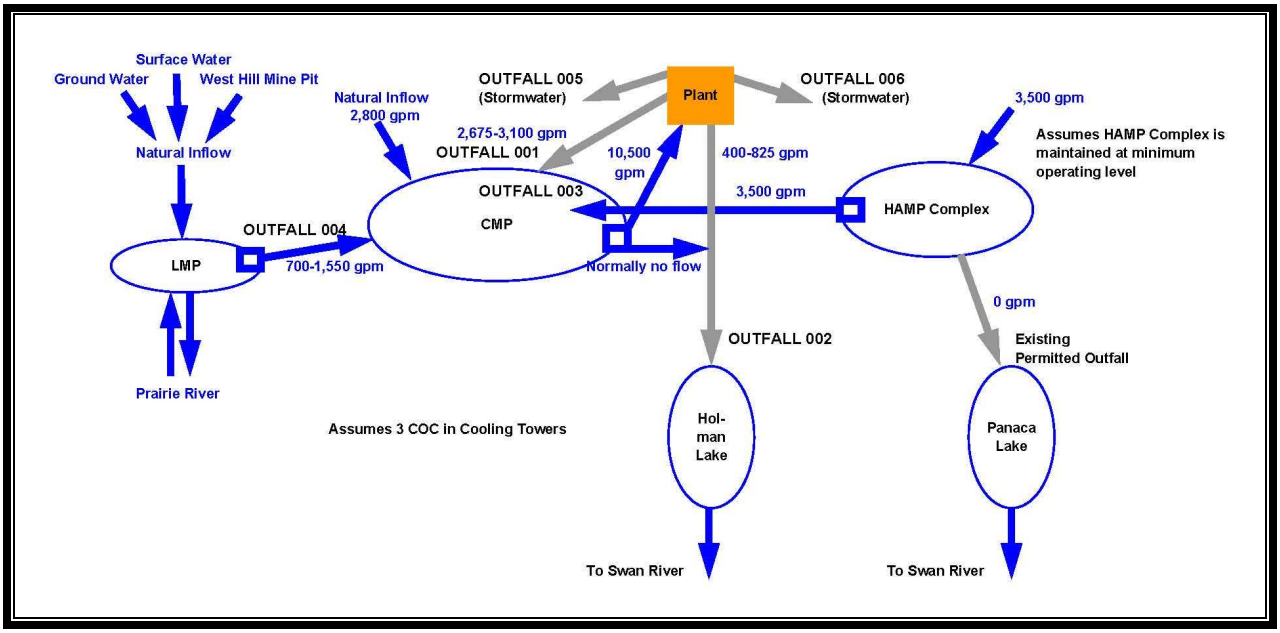
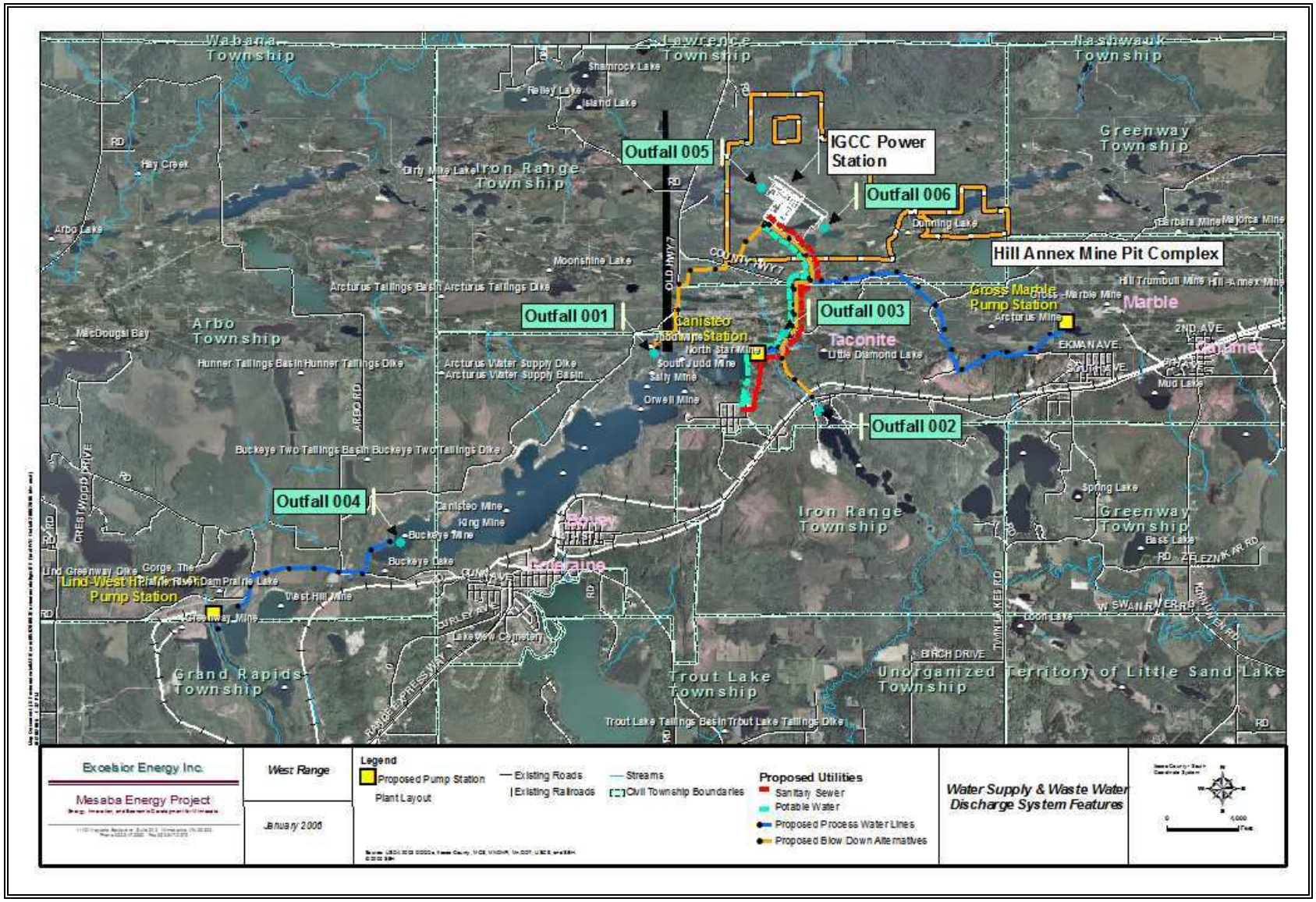


Figure 1.8-12. NPDES Outfall Locations: West Range IGCC Power Station



The expected average annual flow rate and proposed permitted peak flow rate for each outfall for Phase I and Phase I and II operation are summarized in Table 1.8-21. The expected average annual discharge rates are based on the water balances presented in Figures 1.8-9a and 1.8-9b. The proposed peak discharge rates are typically based on modeled peak rates plus some additional capacity to provide operational flexibility.

Table 1.8-21
Discharge Flow Rates

Outfall	Phase I		Phase I and II	
	Average (gpm/MGD)	Peak (gpm/MGD)	Average (gpm/MGD)	Peak gpm/MGD)
001	900/1.3	3,000/4.3	3,500/5.0	6,000/8.6
002	600/0.9[a]	3,000/4.3	825/1.2[a]	6,000/8.6
003	2,000/2.9	7,000/10.1	3,500/5.0	7,000/10.1
004	0	0	1,800/2.6	7,000/10.1
005	To be determined	To be determined	To be determined	To be determined

[a] Limited by mercury mass discharge.

The current water quality of the receiving water is provided in Table 1.8-22

Table 1.8-22
Current Water Quality of Receiving Waters

Constituent	Units	CMP	Holman Lake
Hardness	mg/l	308	--[a]
Alkalinity	mg/l	180	186
Calcium	mg/l	55.3	50.2
Magnesium	mg/l	40.8	--
Iron	mg/l	<0.05	0.75
Manganese	mg/l	<0.02	0.04
Chloride	mg/l	5.15	8.4
Sulfate	mg/l	103.5	10.1
TDS	mg/l	337	236
pH	mg/l	8.4	7.9
Aluminum	ug/l	<25	--
Barium	ug/l	28.6	--
Cadmium	ug/l	<10	--
Chromium (6+)	ug/l	<5	--
Copper	ug/l	<10	--
Fluoride	mg/l	n/a	--
Mercury	ng/l	0.9	<4.0
Nickel	ug/l	<5	--
Selenium	ug/l	<2	--
Sodium	mg/l	6.6	7.4

Constituent	Units	CMP	Holman Lake
Specific Conductivity	umhos/cm	476	--
Zinc (3)	ug/l	<10	--
BOD	mg/l	<2	--
COD	mg/l	<2	--
TOC	mg/l	1.9	--
TSS	mg/l	1.5	--
Ammonia (as N)	mg/l	<0.1	<0.1
Phosphorus	mg/l	<0.1	0.01

[a] – Indicates that no data was collected.

A comparison of expected IGCC Power Station discharges and applicable state numerical water quality standards (Minn. R. 7050.0222) is summarized in Table 1.8-23. None of the abandoned mine pits is listed on the PWI or are published in rules that Class 2B water standards are applicable (Minn. R. 7050.0430). Holman Lake is listed on the PWI, but not in Minnesota Rules, so Class 2B water standards apply. In the absence of formal guidance with respect to the "classification of the West Range Water Resources, the Proponent has determined that the Class 2B water standards are applicable (Min. R. 7050.0430).

Table 1.8-23
Expected IGCC Power Station Discharges and Applicable State Numerical Water Quality Standards

Constituent	Units	Class 2 WQ Standard	Anticipated Effluent Water Quality – Phase II (5 COC)	Anticipated Effluent Water Quality – Phase II (3 COC)
Hardness	mg/l	250	0 .07	0.03
Alkalinity	mg/l	n/a	--	--
Calcium	mg/l	n/a	--	--
Magnesium	mg/l	n/a	--	--
Iron	mg/l	n/a	--	--
Manganese	mg/l	n/a	--	--
Chloride	mg/l	230	38	16
Sulfate	mg/l	n/a	470	280
TDS	mg/l	700	2,317	1,039
pH	mg/l	6 - 9	6 - 9	6 - 9
Aluminum	ug/l	125	73	31
Arsenic	ug/l	53	Note 4	Note 4
Barium	ug/l	n/a	--	--
Cadmium	ug/l	2.0[1]	Note 3	Note 3
Chromium (6+)	ug/l	32[1]	Note 3	Note 3
Copper	ug/l	15[1]	Note 3	Note 3
Fluoride	mg/l	n/a	--	--
Mercury	ng/l	6.9	6.6	2.8
Nickel	ug/l	283[1]	37	16
Selenium	ug/l	5	Note 3	Note 3

Constituent	Units	Class 2 WQ Standard	Anticipated Effluent Water Quality – Phase II (5 COC)	Anticipated Effluent Water Quality – Phase II (3 COC)
Sodium	mg/l	n/a	--	--
Specific Conductivity	umhos/cm	1000	12,380	1,400
Zinc (3)	ug/l	191[1]	Note 3	Note 3
Phosphorus	mg/l	1[2]	0.07	0.03

[1] indicates a hardness based standard. It is assumed hardness in the receiving water is >200 mg/L based on available data.
[2]phosphorus standard is an effluent limit and not a water quality standard.
[3]results below detection limit.
[4]not analyzed.

A mass balance model was constructed to estimate the IGCC Power Station effluent water quality over various periods of operation of the IGCC Power Station and under various operating scenarios. The model is described and detailed study results are presented in Appendix D of the NPDES Permit Application attached as Appendix 6 to this Joint Permit Application. The model calculates the anticipated water quality from the IGCC Power Station discharge and that anticipated in the CMP as a result of various inflows from the HAMP Complex and the LMP, and discharges from the IGCC Power Station.

The modeling results indicate that key water quality constituents associated with Outfall 001 and 002 discharges will be mercury, total dissolved solids (TDS), and hardness. As shown below, mercury will be addressed by operating the IGCC Power Station such that the concentration of mercury in its effluent discharges will not exceed the water quality standard of 6.9 ng/L. In addition, operation of the system will be such that the mass of mercury discharged to Holman Lake through Outfall 002, combined with the mass of mercury discharged to Panasa Lake from the continued pumping of the HAMP Complex, will not exceed the mass of mercury currently permitted to be discharged to Panasa Lake under existing NPDES Permit No. MN0030198. Both Holman Lake and Panasa Lake are tributary to the Swan River. Therefore, this system will not contribute additional pollutants to the Swan River watershed. TDS and hardness discharge concentrations will be acceptable with the inclusion of a mixing zone as allowed under Minn. R. 7050.0210, subp. 5.

The volume of water discharged directly to Holman Lake will be adjusted approximately every five years, or as needed during Phase I and II operation, to limit the mass of mercury discharged to Holman Lake.

Similarly, it is anticipated that the concentration of sulfate in the IGCC Power Station discharge water will also increase over time and concern has been raised regarding the link between sulfate and methyl mercury. However, as with mercury, no additional mass of sulfate will be discharged to the Swan Lake watershed from the IGCC Power Station. While it has been demonstrated that the addition of sulfate may stimulate the formation of methyl mercury in peatlands (Branfireun et al. 1999; 2001)[10], the relationship may depend on several variables in addition to sulfate. These

[10] Branfireun BA, Roulet NT, Kelly CA & Rudd JWM (1999) In situ sulphate stimulation of mercury methylation in a boreal peatland: toward a link between acid rain and methylmercury contamination in remote environments. Global Geochemical Cycles 13: 743-750.

include organic carbon, the fraction of bioavailable mercury, and the microbial community structure (not all sulfate reducing bacteria methylate mercury) (Porvari and Verta 1995; Branfireun et al. 1999; Macalady et al. 2000).[11] In addition, the thermal modeling presented in Section 5.3 below has demonstrated that the discharge water from the IGCC Power Station is anticipated to remain at or near the surface of the receiving water and will have limited mixing with the bottom waters.

The reader is referred to Appendix 6 for a complete discussion of the mass balance conducted in support of demonstrating that there will be no increase in the mass discharges to the Swan Lake watershed above those that are presently permitted.

1.8.2.3 East Range (Alternate Site)

The East Range Site is located in the Lake Superior Basin watershed (see Section 1.12.5.3.1). The challenges for new or expanded discharges sources located within this watershed are described in Section 1.12.5.3. The Proponent has deemed the most feasible option for permitting Mesaba One and Mesaba Two on the East Range Site (or anywhere within the Lake Superior Basin watershed without the benefit of an existing NPDES permit having evidence of historical discharges to the same water body) is to avoid discharging cooling tower blowdown. This represents an aggressive solution considering that the constituents of cooling tower blowdown mostly consist of dissolved solids originally present in the water, but concentrated due to the removal of water by evaporation. The Proponent has chosen to design the East Range IGCC Power Station in a manner that eliminates process water discharges altogether (see Section 1.6.6.3.2). To accomplish this, the East Range IGCC Power Station would incorporate a ZLD system to eliminate discharges of cooling tower blowdown from the power block and gasification cooling towers. Although significant quantities of solids will be removed in this process and require landfill disposal, such solids are expected to be non-hazardous. The quantity of solids requiring disposal would be on the order of 109 tons per day at peak flows and about 73 tons per day on an annual average. These estimates are based on the maximum TDS concentration observed in samples taken from Pit No. 6. Of note, samples analyzed from other East Range mine pits show TDS concentrations on par with those from the Canisteo and Hill-Annex Mine Pits. Figure 1.8-13 is a schematic diagram showing how the ZLD system would be incorporated into the design of the East Range IGCC Power Station.

CE has constructed a demolition landfill north-northwest of the Station Footprint that would be about a 4.75 mile drive over a combination of Power Station roads and CR 666. The Proponent has initiated discussions with CE about that company's willingness to entertain converting part of its demolition landfill to an industrial solid waste landfill to accept the salts produced by the ZLD system handling cooling tower blowdown (solids produced in the ZLD system serving the

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Branfireun BA, Bishop K, Roulet NT, Granberg G & Nilsson M (2001) Mercury cycling in boreal ecosystems: The long-term effect of acid rain constituents on peatland pore water methylmercury concentrations. Geophys. Res. Lett. 28: 1227-1230.

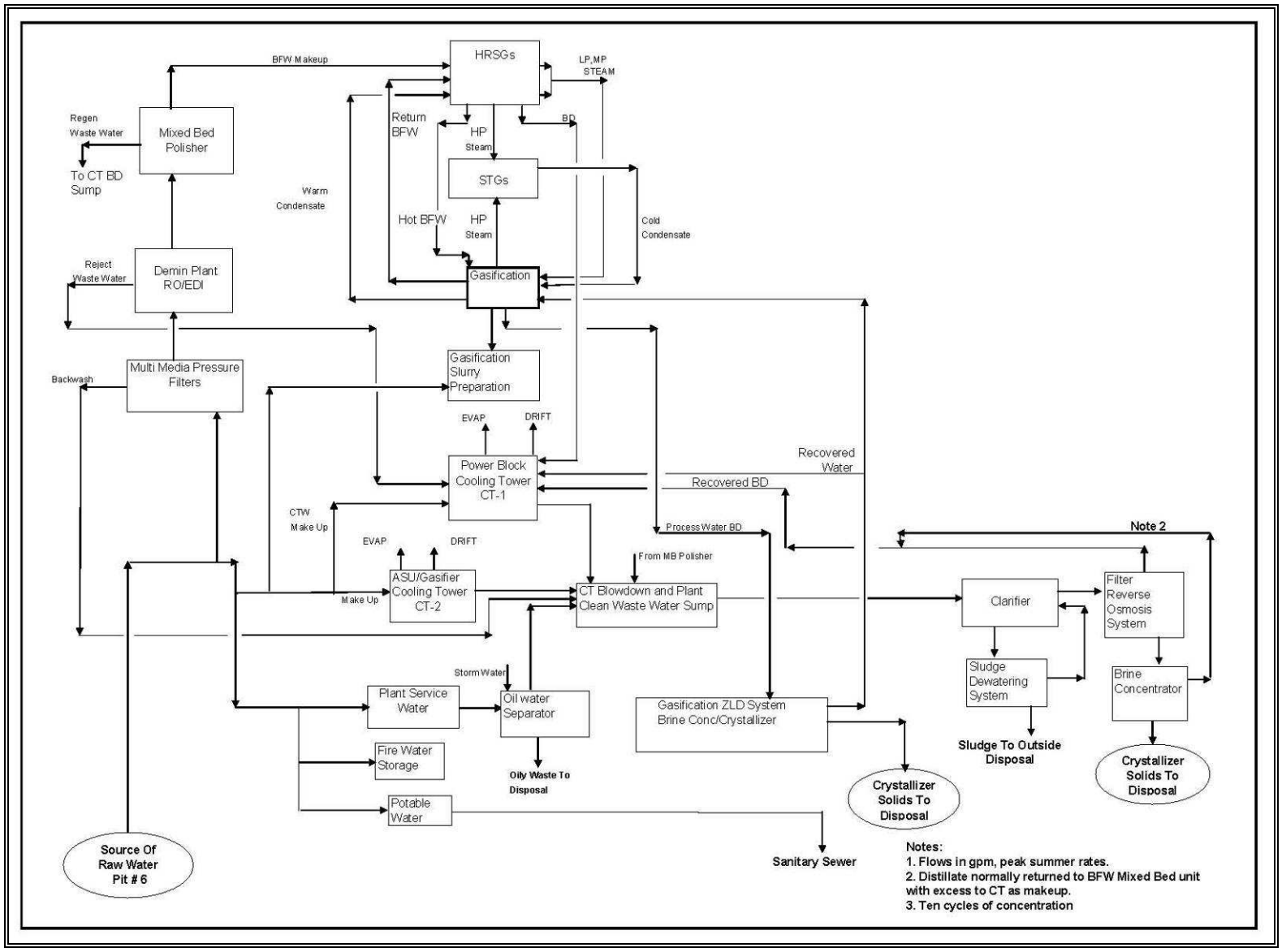
[11] Macalady JL, Mack EE & Scow KM (2000) Sediment Microbial Community Structure and Mercury Methylation in Mercury-Polluted Clear Lake, California. Appl. Environ. Microbiol. 66: 1479.

Porvari P & Verta M (1995) Methylmercury production In flooded soils - a laboratory study. Water, Air, and Soil Poll. 80: 765-773.

gasification island are expected to be hazardous and therefore not suitable for disposal in an industrial solid waste landfill). CE has responded affirmatively regarding its interest in considering the Proponent's proposal. The quantity of solid wastes produced as a result of operating the ZLD system to eliminate discharges of cooling tower blowdown is presented in Section 1.8.5.1.3.

Use of a ZLD system to eliminate process water discharges from the IGCC Power Station has special benefits that could be integrated with other projects seeking to locate in the same general area of the East Range IGCC Power Station. Such benefits include using as a partial source of water for the IGCC Power Station the wastewater effluents produced by those projects. This pollution prevention opportunity is discussed more fully in Section 1.8.3.3.

Figure 1.8-13 East Range ZLD System Design to Eliminate Discharges of Cooling Tower Blowdown



1.8.3 Pollution Prevention, Recycling and Reuse Plans

1.8.3.1 Site Independent Features

The IGCC Power Station will be designed to minimize process-related discharges to the environment and will represent a significant step toward demonstrating state-of-the-art industrial ecology in the use of coal for power generation. Mesaba One and Mesaba Two will stand out as a state-of-the-art example of incorporating pollution prevention concepts into practically every aspect of the IGCC Power Station's design and operation. The following are the key pollution prevention, recycling, and reuse features that will be employed and that are not Site dependent:

1.8.3.1.1 Spill Prevention Control and Countermeasure (SPCC) Plan

The SPCC Plan will anticipate contingency spill events, thereby insulating environmental media from the effect of accidental releases. All above ground chemical storage tanks will be lined or paved, curbed/diked, and have sufficient volume to meet all regulatory requirements.

Each Project Site will have a drainage plan that isolates routine, process-related operations from affecting the surrounding environment.

1.8.3.1.2 Feedstock Handling

The feedstock storage area will be paved or lined so that runoff can be collected, tested, and treated as necessary. The storage area will contain facilities to control fugitive dust emissions. Coal conveyors will be covered.

1.8.3.1.3 Feedstock Slurry Preparation

The grinding equipment will be enclosed and any vents will be collected and routed to the tank vent boiler/auxiliary boiler. The water used to prepare the coal will be stripped process condensate (recycled).

1.8.3.1.4 Gasification, High Temperature Heat Recovery, Dry Char Removal and Slag Grinding

The char produced in gasification is removed and recycled to the first stage of the gasifier. This improves carbon conversion in the gasifier and reduces the amount of carbon contained in the gasifier slag.

1.8.3.1.5 Slag Handling

The slag dewatering system generates some flash gas (gas released as a result of a rapid and significant drop in pressure to which a material is exposed) that contains H_2S. The flash gas will be recycled back to the gasifier via the syngas recycle compressor. Water that is entrained with the slag will be collected and sent to the sour water stripper for recycle.

1.8.3.1.6 Sour Water System

Sour water will be collected from slag dewatering and the low temperature heat recovery system, and the NH_3 and H_2S will be stripped out and sent to the SRU. The stripped condensate will be used to prepare coal slurry. Surplus stripped condensate will be sent to the ZLD Unit.

1.8.3.1.7 Zero Liquid Discharge Unit

The ZLD unit concentrates and evaporates the process condensate. The ZLD unit produces high purity water for reuse and a solid filter cake for disposal off site (the ZLD unit concentrates heavy metals and other contaminants into this filter cake). The ZLD is also a recycle unit since the recovered water is reused, reducing total plant water consumption.

1.8.3.1.8 COS Hydrolysis

The gasifier produces small quantities of COS that cannot be absorbed in the AGR system. The COS hydrolysis unit converts COS to H_2S so that it can be removed in the AGR unit. The COS hydrolysis unit improves the sulfur recovery efficiency of the Power Station and reduces the total amount of sulfur in the syngas, and ultimately, the release of SO_2 from the HRSG stacks.

1.8.3.1.9 Mercury Removal Features

The mercury removal unit uses specially formulated activated carbon to capture trace quantities of mercury that remain in the syngas. Mercury in the sour water handling system is captured via activated carbon filters strategically located ahead of potential release points.

1.8.3.1.10 Acid Gas Removal

The AGR system removes H_2S from the raw syngas and produces a low sulfur syngas for use in the combined cycle power block. The AGR system also produces concentrated H_2S feed for the SRU.

1.8.3.1.11 Sulfur Recovery Unit (SRU)

The SRU converts the H_2S to elemental sulfur which will be marketed for use as a fertilizer additive or for production of sulfuric acid. The tail gas from the SRU is recycled back to the gasifier eliminating tail gas emissions commonly found in Claus plants.

1.8.3.1.12 Syngas Moisturization

The syngas moisturization system improves the recovery of low level heat from the gasification process and serves as a diluent for the syngas used in the combustion turbines. Nitrogen from the ASU is also used as a diluent. Dry, clean syngas typically has a heating value in the range of 250 to 300 Btu/scf. If the dry syngas was used directly in the combustion turbines, the thermal NO_x formed would be too high. Earlier IGCC plants used steam injection for NO_x control, which is less efficient at reducing NO_x than using fuel moisturization and nitrogen.

1.8.3.1.13 Integration of the ASU and Power Block

The ASU produces nitrogen as a by-product and this nitrogen is an effective diluent for NO_x control. The ASU also requires large amounts of electrical power for air compression. Part of

the air compression requirements will be provided by the combustion turbine compressors, further integrating the gasification and combined cycle power block portions. This integration reduces the ASU auxiliary power requirement and increases the Power Station's net electric output.

1.8.3.1.14 Other Reuse Plans

Boiler blowdown and steam condensate will be recovered from the combined cycle power block and gasification facilities, and will be reused as cooling tower makeup water.

1.8.3.1.15 Training and Leadership

All corporate and plant personnel will be trained in a culture focused on continuous improvement in operations and environmental performance. Training and programs will include setting, measuring, evaluating and achieving performance and waste reduction goals.

1.8.3.2 West Range IGCC Power Station

One of the most important site dependent pollution prevention features the West Range Site offers is the long term role the IGCC Power Station will play as a flood control mechanism for Hill-Annex State Park and the communities, highways, and railroad facilities located south of the CMP. Although there are other means to control the flooding threat in these locations, none offers the IGCC Power Station's capability for water reuse and its attendant socio-economic benefits.

1.8.3.3 East Range Site

Eliminating cooling tower blowdown discharges from the IGCC Power Station that would be constructed on the East Range Site (via the ZLD system described in Section 1.8.2.3) provides significant pollution prevention opportunities and operational synergies with nearby projects that either have acquired construction permits or are in the environmental review/permitting process. The other nearby projects must cope with similar issues regarding stringent regulations for process water discharges in the Lake Superior Basin watershed. Further, the MPCA must cope with the existing rules to license and permit such projects, realizing the socio-economic benefits they will bring. The IGCC Power Station equipped with the ZLD system to eliminate cooling tower blowdown may allow Mesaba One and Mesaba Two to utilize as source water the process wastewaters released by nearby projects. This feature could integrate well with the proposed industrial mining facilities to be located on CE properties by eliminating wastewaters that would otherwise represent new discharges to impaired waters downstream.

The IGCC Power Station's delayed in-service date relative to the other local projects' start up dates need not pose a fatal flaw to an otherwise acceptable idea. The Proponent plans to use the 2West Extension Mine Pit ("2WX") as a reservoir from which to supply water to the IGCC Power Station. Until the IGCC Power Station is ready to take water from the 2WX Mine Pit, other projects could potentially direct their effluent waters there for intermediate storage.

1.8.4 Waste Treatment Plans

As described in the previous section, waste treatment requirements for the IGCC Power Station are significantly reduced by substantial internal recycling, reuse of potential waste streams within the process areas, the use of the ZLD system to eliminate trace elements and other minerals in solid feedstocks from being discharged to the environment, and the production of potentially marketable slag and elemental sulfur as end products of the pre-combustion treatment process.

The following paragraphs describe the treatment plans for the remaining permanent facility waste streams that are presently envisioned to be discharged from the plant. Construction waste treatment plans are described in Section 1.8.5.2.

1.8.4.1 Site Independent Treatment Plans

1.8.4.1.1 Gasification Wastes

The ZLD system incorporated into the Proponent's design of the IGCC Power Station at either site represents the only treatment that will be necessary for gasification-related wastes. The solid waste produced by the ZLD system is discussed in Section 1.8.5.1.3 and Table 1.8-24.

1.8.4.1.2 Sanitary Waste Water

Sanitary waste water generation for the IGCC Power Station is expected to be quite low during operation, on the order of 30 gallons per person per day (the same generation rate is assumed during the construction period to be conservative). The possibilities for treating sanitary wastes include connecting to the local/regional POTW onsite treatment in a package sewage treatment system and discharge with cooling water blowdown, or on-site septic tanks coupled to a leach field. The preferred alternative, discussed in Section 1.12.6, is to hook up to the local/regional POTW.

1.8.4.1.3 Storm Water

Storm water management and treatment is described in Section 1.2.2.

1.8.4.2 West Range (Preferred Site)

1.8.4.2.1 Cooling Tower Blowdown

Cooling tower blowdown is the most significant wastewater stream released from the IGCC Power Station. The characteristics of this stream and the need for discharging it have been discussed previously in Section 1.8.2.2.2. The blowdown constituents are essentially the same background compounds present in the source waters, but in concentrated form. Provided that a reasonable mixing zone is allowed beyond the end-of-the-pipe, only minimal treatment of this stream is expected to be needed to meet acceptable water discharge limits. This treatment will consist of temperature control, pH adjustment, de-chlorination, and the intermittent addition of anti-foaming additives as required. Addition of chemicals used in the circulating water system to prevent corrosion is done so at points to properly coat metallic surfaces with such substances without loss of such treatments to the environment. The residual materials associated with operation of the cooling towers are discussed in Section 1.8.2.2.2.

1.8.4.3 East Range Site

The East Range IGCC Power Station Site will effectively eliminate all process water discharges, including cooling tower blowdown. This mode of operation will make the Mesaba One and Mesaba Two, and potentially other industrial complexes in the vicinity of the East Range Site, zero discharge facilities. The integration of the IGCC Power Station into the operation of the mining projects as described would be an example of water reuse (wastewaters in the case of Mesabi Nugget and PolyMet Mining becoming a water resource in the case of Mesaba One and Two).

1.8.5 Solid Waste Generation and Disposal

Solid wastes produced at either Site will include miscellaneous janitorial streams associated with clean-up of the IGCC Power Station, commercial waste paper, spent activated carbon beds, and spent catalyst materials (associated with the COS hydrolysis and SRU systems). The solid waste stream produced by the ZLD system is discussed in Table 1.8-24 and Section 1.8.5.1.3 below. Off-site disposal of solid wastes that cannot otherwise be recycled or reused on-site will be conducted in compliance with all local, State and Federal rules and regulations.

Slag and elemental sulfur produced as a result of the mineral matter and sulfur contained in the feedstocks utilized are considered to be potential revenue producing streams that will be actively marketed.

1.8.5.1 Operational Wastes

1.8.5.1.1 Site Independent Listing of Operational Wastes

Table 1.8-24 summarizes the expected waste streams that will be generated during operation of the Phase I and II IGCC Power Station. These estimates are based on experience gained at Wabash River (which also uses E-Gas™ technology) and adjusted for differences in capacity and configuration. Operational wastes generally include the following process wastes:

- Spent catalysts, adsorbents, and process solvents
- Used oils and fluids
- Cleaning and maintenance wastes
- Miscellaneous materials

1.8.5.1.2 West Range Site

The West Range Site has no additional operational wastes to add to the list in Table 1.8-24.

1.8.5.1.3 East Range Site

Residual solids from the ZLD system serving the power block and gasification island cooling towers will be produced in addition to the materials listed in Table 1.8-24. The worst case amount of solids produced is based upon the highest TDS levels measured in any of the mine pit waters, which in this case were measured in Mine Pit No. 6 (1,800 mg/L, see Section 1.8.1.1.6). At a peak make-up rate of 5,060 gpm for each of the Phase I and II Developments, and assuming worst case water quality, the peak solids produced by this system would total about 109 tons per day:

Solids = 5,060 gal/min-phase*2 phases*8.33 lb/gal*1,440 min/day*1,800 lbs/10^6 lbs water*1 ton/2000 lbs ≈ 109 tons/day

On an annual average basis, make up to the cooling towers is projected to be 3,400 gpm. Using the same worst case water quality conditions noted above, the solids production rate would be about 73 tons per day:

Solids = 3,400 gal/min-phase*2 phases*8.33 lb/gal*1,440 min/day*1,800 lbs/10^6 lbs water*1 ton/2000 lbs ≈ 73 tons/day

Assuming a 92% capacity factor, total solids production from the ZLD system would be about 24,500 tons per year.

Table 1.8-24
Estimated Operational Waste Streams (Phase I and II)

Waste Description	Comments	Annual Quantity	H/NH*	Likely Disposition
Used Catalysts and Sorbents				
COS hydrolysis catalyst	Proprietary composition	42 tons	NH	Non-hazardous landfill
Hydrolysis catalyst support balls	Alumina silicate	14 tons	(NA)	Recycle
Claus sulfur recovery catalyst	Activated alumina	28 tons	NH	Non-hazardous landfill
Claus catalyst support balls	Activated alumina	10 tons	(NA)	Recycle
Hydrogenation catalyst	Cobalt Molybdenum	6 tons	(NA)	Metals reclaim
Hyd. catalyst support balls	Alumina silicate	2 tons	(NA)	Recycle
Amine regenerator carbon filter	Activated carbon	26 tons	H	Stabilize, hazardous waste landfill
Syngas treatment carbon	Activated carbon	60 tons	H	Stabilize, hazardous waste landfill
Mercury removal carbon	Impregnated carbon	14 tons	H	Stabilize, hazardous waste landfill
Sour water carbon	Activated carbon	48 tons	H	Stabilize, hazardous waste landfill
MDEA reclaim ion exchange	Ion exchange resin	0.4tons	NH	Non-hazardous waste landfill
Other Process Wastes				
ZLD filter cake (Gasification Island)	Inorganic and organic salts	4400 tons	H	Stabilize, hazardous waste landfill
Refractory brick and insulation	Gasifier repairs	360 tons	NH	Non-hazardous waste landfill
MDEA sludge	Reclaimer bottoms	10,000 gal	H	Incinerate or hazardous waste landfill
Sour water sludge	Char carryover in syngas	30 tons	H	Incinerate
Waste char and ash	Maintenance cleaning	160 tons	N	Non-hazardous waste landfill
Amine absorber residues	Iron and salts	20 yd^3	N	Non-hazardous waste landfill
Metallic filter elements		60 yd^3	H	Stabilize, hazardous waste landfill
Spent citric acid	Cleaning solution	40 drums	H	Approved disposal facility

Waste Description	Comments	Annual Quantity	H/NH*	Likely Disposition
Spent soda ash	Cleaning solution	40 drums	H	Approved disposal facility
Spent sulfuric acid	Line cleaning solution	14,000 gal	H	Approved disposal facility
Off-line combustion turbine wash wastes	Detergent and residues	15,000 gal	Probably NH	Characterize, dispose as non-hazardous or hazardous wastes
HRSG wash water (infrequent)	Detergent, residues, neutralized acids	100,000 gal	Probably NH	Characterize, dispose as non-hazardous or hazardous wastes
Raw water treatment sludge and used water filter media	Solids removed from makeup water to plant	TBD	Probably NH	TBD
Miscellaneous Streams				
Used oil	Lube oils, oil from oil/water separator	8000 gal	(NA)	Send to reclaimer
Spent grease		16 drums	NH	Blend to gasifier feed
Miscellaneous solvents, coal tars		2 drums	H	Solvent reclaimer
Flammable lab waste		2 drums		Blend to gasifier feed
Scrap metal	Steel, aluminum, etc.	200 yd^3	NH	Recycle
Waste paper and cardboard	Office, shops, packing, etc.	320 yd^3	NH	Recycle
Combined industrial waste	Used PPE, materials, small amounts of refractory, slurry debris, etc.	320 yd^3	NH	Non-hazardous waste landfill

***Legend:** NH = Non-Hazardous; H = Hazardous; NA= Not Applicable

The environmental features of E-Gas™ technology avoid two significant solid waste streams – flue gas desulfurization (FGD) solids and ash – associated with other types of coal-based power generation:

- Conversion of mineral materials in the feedstock to a non-hazardous, marketable slag by-product eliminates the need to dispose of fly ash and bottom ash waste streams.[12] The properties of the slag product are described in Table 1.8-25.[13]
- Removal of sulfur from IGCC syngas in a relatively concentrated form and the subsequent production of elemental sulfur, another marketable by-product, eliminate the significant solid wastes that could result from the flue gas desulfurization process needed for other types of coal-based plants.

The use of a ZLD process will prevent the discharge of heavy metals and other gasification wastes with the plant wastewater effluent (Sections 1.6.6.3 and 1.8.2.1.2 present a description of the ZLD process). The solid waste stream from this process, consisting mainly of crystallized solids in a "filter cake," will likely be classified as a hazardous waste due to metals content and will be disposed in an approved hazardous waste landfill or other licensed facility. Table 1.8-26 presents a typical composition of ZLD filter cake from the system serving the gasification island, based on data from Wabash River.

Other wastes resulting from the operation and maintenance of the IGCC facility include:

- Worn and broken internal refractory from the gasifier vessel that is periodically removed and replaced.
- Spent activated carbon used for purification of syngas fuel, process solvents, and other purposes.
- Sludge resulting from internal amine solvent recycling.
- Detergents and used chemicals from cleaning of the power generation equipment and other facilities.

The Proponent will manage operational wastes in accordance with applicable regulations, good industry practices and established internal company procedures. Waste minimization and pollution prevention programs will be implemented (see Section 1.8.3). Hazardous and non-hazardous wastes will be properly collected, segregated, and recycled or disposed at approved waste management facilities within regulatory time limits and in accordance with requirements. Plant staff will be adequately trained in proper waste handling procedures. Waste manifests and other records and reporting will be maintained as required by regulations and company procedures.

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[12] In some plants that use wet limestone FGD or lime spray dryer FGD systems, a cost cutting step is to remove fly ash along with SO_2 in the post combustion flue gases and place the combined calcium sulfate/sulfite and ash mixture in an on-site landfill

[13] Trace metals such as arsenic, chromium, lead, nickel, vanadium, etc., are captured in the impervious glassy matrix of the slag. The slag is non-hazardous, and will pass EPA's Toxicity Characteristics Leaching Procedure (TCLP) leachate test for metals, semi-volatile and volatile organics listed under RCRA.

Table 1.8-25

E-Gas™ Slag Properties

Mesh Size	Wt. %
+8	28
+12	20
+16	20
-16	32

TCLP Metals	RCRA Regulatory Level, mg/l	Leachate from E-Gas Slag, mg/l
Arsenic	5	<0.1
Barium	100	<0.5
Cadmium	1	<0.5
Chromium	5	<0.1
Lead	5	<1
Mercury	0.2	<0.002
Selenium	1	<0.1
Silver	5	<0.1

TCLP Organics	RCRA Regulatory Level, mg/l	Leachate from E-Gas Slag, mg/l
Pyridine	5	<0.05
1,4-Dichlorobenzene	7.5	<0.05
o-Cresol	200	<0.05
m- & p- Cresol	200	<0.05
Hexachloroethane	3	<0.05
Nitrobenzene	2	<0.05
Hexachloro-1,3-butadiene	0.5	<0.05
2,4,6-Trichlorophenol	2	<0.05
2,4,5-Trichlorophenol	400	<0.05
2,4-Dinitrotoluene	0.13	<0.05
Hexachlorobenzene	0.13	<0.05
Pentachlorophenol	100	<0.05

TCLP Volatile Organics	RCRA Regulatory Level, mg/l	Leachate from E-Gas Slag, mg/l
Vinyl Chloride	0.2	<0.005
1,1-Dichloroethylene	0.7	<0.005
Methyl Ethyl Ketone	200	<0.005
Chloroform	6	<0.005
1,2-Dichloroethane	0.5	<0.005
Benzene	0.5	<0.005
Carbon Tetrachloride	0.5	<0.005
Trichloroethylene	0.5	<0.005
Tetrachloroethylene	0.7	<0.005
Chlorobenzene	100	<0.005
1,4-Dichlorobenzene	7.5	<0.005

Table 1.8-26
Typical Estimated ZLD Solids Composition

COMPONENT	Wt. % (dry)
Calcium	0.02
Sodium	35.31
Magnesium	0.00
Potassium	0.04
Silica	0.06
Chloride	27.94
Total Sulfur	0.19
Sulfate	0.19
Fluoride	4.46
Total Inorganic Carbon	0.27
Ammonia Nitrogen	0.50
Sulfide	0.01
Thiosulfate	0.16
Thiocyanate	0.18
Total Phosphorus	0.01
Total Organic Carbon	6.02
Volatile Organic acids	21.34
Aluminum	0.01
Arsenic	0.04
Barium	0.00
Boron'	3.10
Cadmium	0.00
Chromium	0.00
Copper	0.00
Iron	0.01
Lead	0.00
Manganese	0.00
Nickel	0.00
Selenium	0.12
Silver	0.00
Strontium	0.00
Zinc	0.00
Total	100.00

1.8.5.2 Construction Wastes

The construction activity associated with the IGCC Power Station will generate certain amounts of wastes. A preliminary estimate of hazardous and non-hazardous construction wastes is presented in Table 1.8-27. More significant temporary waste streams may include: site clearing vegetation, soils, and debris, hydrostatic pressure-testing (hydrotest) water, used equipment lube oils, surplus materials, and empty containers.

Surplus and waste materials will be recycled to the extent practical. If feasible, removed site vegetation will be salvaged for pulp and paper production, or recycled for mulch. Hydrotest water will be reused for subsequent pressure tests if practical. Prior to disposal, used hydrotest water will be checked for contaminants and hazardous characteristics. Potential hydrotest water disposal methods, depending on the quality of the wastewater, include discharge to surface waters via the detention basin (pursuant to NPDES permits), trucking to a local POTW, or disposal at some other approved facility. Scrap and surplus materials and used lube oils will be recycled or reused to the maximum practical extent, or otherwise properly disposed.

Table 1.8-27 Estimated Construction Waste Streams (Phase I and II)

Waste Description	Comments	Approx Quantity Per Period	Likely Disposition
Hazardous or Non-hazardous Liquids			
Used lube oils, flushing oils		10 drums/mo	Recycle
Hydrotest water	One time during commissioning, reuse as practical, test for hazardous characteristics	1.2 million gallons (total Phase I and 2)	Hazardous – approved disposal facility Non-hazardous – drain to detention basin and release (need permit)
Steam turbine and HRSG cleaning wastes	Chelates, mild acids, TSP, and/or EDTA - one time during commissioning	700,000 gallons (total Phase I and 2)	Approved hazardous or non-hazardous disposal facility
Hazardous Liquids			
Solvents, used oils, paint, adhesives, oily rags	Containerize	200 gal/mo	Recycle or approved hazardous waste disposal facility
Hazardous Solids			
Spent welding materials	Containerize	400 lb/mo	Hazardous waste landfill
Used oil filters	Containerize	100 lb/mo	Hazardous waste landfill
Fluorescent/mercury vapor lamps		30 units/yr	Recycle
Misc oily rags, oil adsorbents	Containerize	1 drum/mo	Recycle or Hazardous waste landfill
Empty hazardous material containers		1 yd^3/wk	Hazardous waste landfill
Used lead/acid and alkaline batteries	Separate and containerize	1 ton/yr	Recycle
Non-hazardous Liquids			
Sanitary waste from workforce	Portable chemical toilets	400 gal/day	Pumped and disposed by contractor
Non-hazardous Solids			
Site clearing - vegetation	Salvageable (?) timber and waste wood, brush, leaves and vegetative wastes	See Land Use/Land Cover Impacts for West and East Range Power Station Footprint	Sell salvageable timber for pulp and paper production, sell or donate waste wood for use as fire wood, mulch for recycle, or dispose in non-hazardous landfill.

Waste Description	Comments	Approx Quantity Per Period	Likely Disposition
Site clearing – excavation of non suitable soils, misc. debris clearing	Stockpile soils on site	See Grading Plan Cut and Fill Estimates for West and East Range Grading Plans in Figure 1.5-8 and 1.5-11	Reuse soils for berms and landscaping, mulch and recycle organic debris, recycle or landfill inorganic debris.
Scrap materials, debris, and trash	Wood, metal, plastic, paper, packing, office wastes, etc.	40 yd^3/wk	Recycle or non-hazardous waste landfill

Construction management, contractors, and their employees will be responsible for minimizing the amount of waste produced by construction activities and will be required to fully cooperate with project procedures and regulatory requirements for waste minimization and proper handling, storage, and disposal of hazardous and non-hazardous wastes. Each construction contractor will be required to include waste management and waste minimization components in their overall project health, safety, and environmental site plans. Typical construction waste management measures will include:

- Dedicated areas and a system for waste management and segregation of incompatible wastes, with waste segregation occurring at time of generation.
- A waste control plan detailing waste collection and removal from the site. The plan will identify where waste of different categories will be collected in separate stockpiles or bins, and appropriate signage provided to clearly identify the category of each collection stockpile.
- Hazardous wastes, as defined by the applicable regulations, will be stored separately from non-hazardous wastes (and other, non-compatible hazardous wastes) in accordance with applicable regulations, project-specific requirements, and good waste management practices.
- Periodic construction supervision inspection to verify that wastes are properly stored and covered to prevent accidental spills and releases.
- Appropriately labeled waste disposal containers.
- Good housekeeping procedures. Work areas will be left in a clean and orderly condition at the end of each working day, with surplus materials and waste transferred to the waste management area.
- Appropriate waste management training for the construction workforce.

1.8.6 Liquid Waste Generation and Disposal

Information on liquid wastes is presented in Tables 1.8-23 and 1.8-26 above.

1.8.7 Primary and Secondary Products

The primary product of the IGCC Power Station is electric power. The project will also produce elemental sulfur and a vitreous inert slag. A world-wide market already exists for elemental sulfur, although its value will vary considerably with location, purity, and end use. No large scale market exists for slag at this time. It is expected that slag can be marketed for asphalt aggregate, construction backfill, or landfill cover applications. Slag with a carbon content of less than 5% by weight should be marketable as a higher value product such as roofing shingle applications. There is also a potential to market the slag produced from petroleum coke gasification for metals recovery.

The Proponent conducted a preliminary market analysis for slag and sulfur the results of which are attached to the Joint Application as Appendix 8

1.8.8 Storage Requirements and Locations

Storage areas and requirements for the major process feedstocks and byproducts are shown in Table 1.8-28. The numbers presented are for each phase, with the total storage for both phases being double that reported below.

Table 1.8-28
Feedstocks and Byproduct Storage Requirements (Each Phase)

Material	Location	Storage Requirements
Coal Pile	Refer to Plot Plan	395,000 tons (5/45 day active/inactive storage based on maximum PRB-1 coal usage); Dust control; Water run-off control
Pet Coke Pile	Refer to Plot Plan	111,000 tons (5/45 day active/inactive storage); Dust control; Water run-off control
Flux Silo	Refer to Plot Plan	1,120 tons (5 day active storage)
Sulfur Tanks	Refer to Plot Plan	~ 165 tons/day generated (based on Illinois No.6 coal)
Slag Pile	Refer to Plot Plan	32,265 tons (45 day storage, wet basis, using Illinois #6 coal)

1.8.9 Toxic and Hazardous Materials

Hazardous materials that will be used or stored for project operations include relatively small quantities of petroleum products, liquid oxygen and nitrogen, molten sulfur, catalysts, flammable and compressed gases, amine replacement and reclamation chemicals, water treatment chemicals, and minor amounts of solvents and paints. Materials and estimated quantities for the gasification/ASU blocks are based on experience at Wabash River. Power block requirements are estimated from similar combined cycle units. Catalyst materials such as those used in the COS Hydrolysis system and the SRU are discussed in Sections 1.6.4.2 and 1.6.4.4, respectively. Spare catalyst may be selectively stored on-site.

Table 1.8-29 provides a list of potentially hazardous materials to be utilized and/or stored on-site. For the major bulk items, the approximate quantities expected to be stored on site are estimated, and may be adjusted as the frequency and methods of re-supply (e.g., railcar or truck) are optimized. Quantities shown are for Mesaba One and Mesaba Two, with individual phase quantities approximately one-half of the total.

Table 1.8-29
ON-SITE TOXIC AND HAZARDOUS MATERIALS (TOTAL FOR PHASE I and II)

Material	Form	Quantity (Phases I and II)	General Location On-Site	Use
GASIFICATION/AIR SEPARATION UNIT AREAS				
BULK CHEMICALS				
Chlorine or Sodium Hypochlorite	Gas or Liquid	TBD		Cooling Towers
Sodium Hydroxide	Liquid	60,000 gal	Outdoor	Amine Reclamation and Sour Water Treatment
Potassium Hydroxide	Liquid	2,000 gal	Indoor	Dry Char Filter Cleaning
Water Treatment Chemicals	Liquid	Typ. Small (55 gal) Drums to less than ~ 500 gal tank	Indoor	Pump Bldg, Slurry Prep Bldg, Cooling Towers
Oxygen (95%)	Liquid	1,800 tons	Outdoor	ASU Backup Supply
Nitrogen	Liquid	5,000 tons	Outdoor	ASU Backup Supply
Molten sulfur	Liquid	200,000 gal	Outdoor	By-product for Sale
Ammonium lignosulfonate	Liquid	??	Indoor	Slurry Prep Bldg for maintaining % solids in slurry
MISC/DISTRIBUTED MATERIALS				
Paint/Thinners/etc.	Liquid	Minimal	Indoor	Shop/Warehouse
Lubrication Grease/Oils	Solid/Liquid	Minimal	Indoor	Pump Bldg, Slurry Prep Bldg., Shop/Warehouse
Compressed Gases (Ar, He, H_2)	Pressurized Gas	Minimal	Indoor	Lab
Chemical Reagents (acids/bases/standards)	Liquid	Minimal	Indoor	Lab
OTHER HAZARDOUS MATERIALS				
Flammable/Toxic Gases (H_2, CO, H_2S, SO_2)	Pressurized SynGas Mixture		Distributed	Process Piping/Vessels
Acetylene, Oxygen, other welding gases	Gas	Minimal (approved cylinders)		Welding
Natural Gas	Gas (high pressure)		Supply piping only	Startup/Backup Fuel
Diesel Fuel	Liquid	2,000 gal	Outdoor	Emergency generator/fire water pump fuel

Material	Form	Quantity (Phases I and II)	General Location On-Site	Use
POWER BLOCK AREA				
MISC/DISTRIBUTED CHEMICALS				
Sulfuric Acid	Liquid	12,000 gal	Outdoor	Cooling water and BFW pH control; battery acid
Sodium Hypochlorite	Liquid	20,000 gal	Outdoor	Cooling Tower biological control
Circulating Water Chemical Additives (e.g., Magnesium nitrate, magnesium chloride, 2-bromo-2-nitropropane-1,3-Diol, 5-chloro-2-Methyl-4-Isothizaoline-3-one) (Note 1)	Liquids	Typ. Small (55 gal) Drums to less than 500 gal tank	Indoor	Corrosion Inhibitor/ Biocides
Boiler Feedwater Chemicals, e.g., Carbonic Dihydrazide, Morpholine, Cyclohexamine, sodium sulfite (Note 1)	Liquids	Typ. Small (55 gal) Drums to less than 500 gal tank	Indoor	Boiler feedwater pH/Corrosion/ Dissolved Oxygen/Biocide control
Mineral Insulating Oil	Liquid	30,000 gal (estimated, to be confirmed)	Indoor	Electrical Transformers
Lubricating Oil	Liquid	21,000 gal (estimated, to be confirmed)	Indoor	Combustion Turbine/Steam Turbine/Misc. Equipment Lube Oils
Combustion turbine wash chemicals	Liquids	Intermittent use/ Chemicals not stored onsite/ cleaning by contractor		Combustion Turbine Generator cleaning
HRSG Cleaning Chemicals (e.g., HCl, Citric acid, EDTA Chelant, Sodium Nitrite) (Note 1)	Liquids	Multiyear cleaning requirement/ Temp storage only		HRSG Chemical Cleaning
Carbon Dioxide	Pressurized Gas	50,000 scf	Outdoors	Generator purging
Hydrogen	Pressurized Gas	29,000 scf	Outdoors (Assumes use of multi-tube trailer. Active volume based on 1 of 10 tubes per trailer)	Generator cooling (To be verified - Assumes use of H_2-cooled generators – dependent on selected manufacturer)

Notes: “Typical” chemicals for the application are identified.

Natural gas and syngas, which are flammable, will be used in the power block. Natural gas will be used as a startup or auxiliary fuel and will be utilized directly from the on-site pipeline (which connects to the off-site main pipeline). Natural gas will not be stored on site. Syngas will be the primary fuel for the combustion turbines. The syngas is a mixture of carbon monoxide, hydrogen, carbon dioxide, and water vapor. Gaseous H_2 will be used as a generator coolant. Hydrogen will be stored in pressurized gas tubes on a multi-tube trailer. The tube trailer will be stored outside near the turbine-generators and meet required building and fire codes. Carbon dioxide will be stored and utilized for purging of the generators after normal and emergency shutdowns.

Bulk quantities of liquid oxygen and nitrogen will be stored in tanks in the ASU to provide capacity for startups and continued plant operation during short-duration ASU system outages.

Other gases stored and used at the facility include those typically used for maintenance activities, such as shop welding, emission monitoring, and laboratory instrument calibration. These gases will be stored in approved standard-sized portable cylinders, and in appropriate locations.

Water treatment chemicals will be required and stored onsite. Bulk chemicals, such as acids and bases for pH control, will require storage in appropriately designed tankage with secondary containment and monitoring. Gaseous chlorine (used/stored in compliance with all applicable regulatory requirements) or hypochlorite bleach may be used for biological control of the various circulating water and cooling tower streams.

Other water treatment chemicals will be required and used as biocides, pH control, dissolved oxygen removal, and corrosion control for boiler feed water ("BFW"), cooling tower and cooling water treatment. For raw water treatment, coagulants and polymers may also be used. Chemicals used for these purposes are generally specified by the water treatment provider, and are available under a number of trade names. Typical chemicals are identified in Table 1.8-19. Stored quantities of these materials are relatively small, ranging from 55 gal drums to 500 gal tanks.

Combustion turbine and HRSG washes are performed by contractors on an intermittent basis. Combustion turbines are cleaned by injecting wash water into the turbine for three to five minutes while running at full speed just prior to shutting down. The wash water is allowed to soak on the blades for required periods of time. Following the soak, the turbine is accelerated and rinse water is injected for 15 to 20 minutes. The turbine is then allowed to drain and dry. The process is repeated until rinse water exiting the drains is clear. The waste water is collected for disposal. HRSG finned tubes are cleaned with high pressure water jets. Waste water and deposits are drained from the bottom of the HRSG and collected for disposal. The chemicals required for the washes are typically provided by the contractors and are typically not stored long-term on site.

Diesel fuel will be used for the emergency generator and for the fire water pumps. The stored quantity is currently based on approximately 8 hours of operation of the diesel generator at full output (about 3 MW). This limited storage would require the Proponent to have contracts with fuel providers specifying that deliveries of diesel fuel could be provided in less than 8 hours in the case of an emergency. Appropriate containment and monitoring for spillage control will be provided.

Other petroleum-containing hazardous materials include the CTG and STG lube oils, steam turbine hydraulic fluid, transformer oils and miscellaneous plant equipment lube oils. These

materials will be delivered in approved containers, stored in areas with appropriate secondary containment, and used within curbed areas that only drain to internal drains connected to an oil-water separator system. Oil reservoirs, containment areas, and the separators will be checked regularly to identify potential leakage issues and initiate appropriate actions.

1.8.10 Health and Safety Policies and Programs

Facility design features and management programs will be established to address hazardous materials storage locations, emergency response procedures, employee training requirements, hazard recognition, fire control procedures, hazard communications training, personal protection equipment training and accidental release reporting requirements. Significance criteria will be determined on the basis of federal, state and local guidelines, and on performance standards and thresholds adopted by responsible agencies. For example, the Project will comply with all applicable Occupational Safety and Health Administration ("OSHA") hazardous material requirements including the following specific OSHA regulations:

- 1910.120(q)(1) (Emergency Response Plan)
- 1910.120(q)(2) (Elements of Emergency Response Plan)
- 1910.120(q)(2) (Elements of Emergency Response Plan Decontamination)
- 1910.120(q)(2) (Elements of Emergency Response Plan: Personnel Roles)
- 1910.120(q)(2) (Elements of Emergency Response Plan, Critique of Response)
- 1910.120(q)(3) (Skilled Support Personnel)
- 1910.120(q)(6) (Training)
- 1910.120(q)(6) (Training – Hazardous Materials Technician)
- 1910.120(q)(6) (Training – Hazardous Materials Technician – Implementation of Employer's Emergency Response Plan)

Basic approaches to prevent spills to the environment include the initial design of the IGCC Power Station Footprint, comprehensive containment structures, and worker training and safety programs. The comprehensive containment program ensures that appropriate tanks, walls, dikes, berms, curbs, etc. are used to accomplish effective containment. Worker training and safety programs will be established to ensure that workers are aware and knowledgeable about spill containment procedures and related health and environmental protection policies.