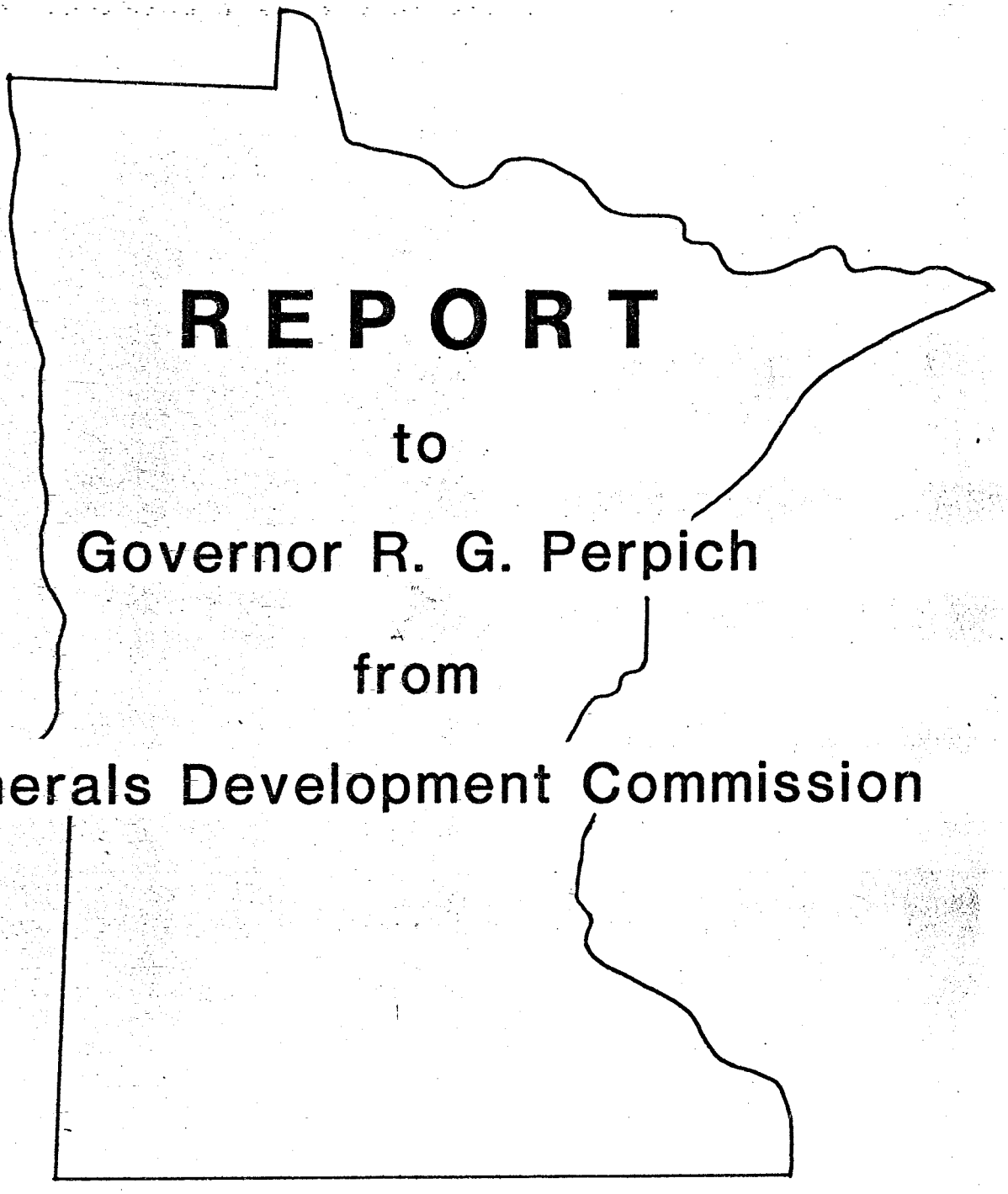

REPORT

to

Governor R. G. Perpich

from

Minerals Development Commission

J. H. DeLuca
Chairman

February 15, 1983

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Governor Rudy Perpich
State of Minnesota
State Capitol
St. Paul, Minnesota 55101

Dear Governor Perpich:

The committee you appointed to review the establishment of the Natural Resource Institute in northeastern Minnesota had met and considered the matter. In preparing our recommendation, we recognize that these are changing times in northeastern Minnesota. The iron ore industry has provided employment to thousands of persons. Now that industry is changing and the probabilities are that it will provide at least four thousand fewer direct jobs than it has in the recent past. The Duluth-Superior Air Base has been closed and no alternative mission has been found. As a result 3,000 persons have lost their jobs. Manufacturing companies employing more than 2,000 persons have been forced to close or relocate in order to better serve distant markets. Notwithstanding the difficulties with which we are now faced, we feel that the prospects are bright because northeastern Minnesota is blessed with abundant natural and human resources, including:

Hundreds of millions of tons of taconite;

Thousands of acres of peat;

Millions of board feet of timber;

Billions of gallons of fresh pure water;

Thousands of well-educated, hard-working people.

If we are to make the maximum use of these natural and human resources, at a minimum we must:

improve the quality of taconite pellets;

reduce the cost of producing taconite pellets;

build mini steel mills on the Iron Range to produce steel products for a regional market;

use peat and biomass to help solve our energy problems and for other purposes;

improve techniques for harvesting, manufacturing and transporting timber and timber products;

add value to our timber products;

find additional economic and environmentally safe uses for our water; and

develop high technology industries that will draw on the strengths of the region.

If we are to accomplish the above goals, it is essential that we establish a comprehensive, well-coordinated research and development program with respect to both our natural and human resources. At the present time, the research and development efforts of the State of Minnesota are divided among various agencies of the state and are not part of a well-planned and coordinated program.

Notwithstanding the fine work that the MRC, affiliated with the Twin Cities campuses of the University of Minnesota, has done over the years, particularly with respect to Dr. Davis' work, in recent years these efforts have been underfunded and poorly supported, with the result that research efforts in minerals are at a minimum and are practically nonexistent with respect to peat and biomass. Moreover, the research with respect to water is related almost entirely to improving the quality of the water. This is an important goal and must be maintained; however, we must go further and find how we can use our abundant water resources in northeastern Minnesota to provide environmentally sound methods of accomplishing this.

In light of the foregoing, it is our preliminary recommendation that a Natural Resource Institute be established as a division of the University of Minnesota, Duluth. In this connection, the following steps must be taken:

The President of the University of Minnesota will appoint the Director of the Institute.

The Governor of the State of Minnesota will appoint a 15 person advisory committee. The committee will advise the Director regarding research and development efforts that should be undertaken, and it will serve as a liason between the Institute and industry, labor, and public agencies.

Research activities relating to minerals currently being conducted at the Twin Cities campuses of the University of Minnesota will be transferred to the Institute.

The Director of the Institute, the President of the University and the Dean of the School of Forestry will coordinate research relating to the timber resources of northeastern Minnesota. The School of Forestry will remain at the Twin Cities campus.

We would note that these efforts will be complimented, particularly with respect to our human resources by establishing a school of electronic and computer engineering on the UMD campus.

We developed a preliminary budget with respect to the cost of the Natural Resource Institute during the next biennium. That estimate is set forth in the attached addendum.

You will note that this program calls for a transfer of the present MRC program from the Twin Cities campuses of the University to Duluth. We feel that this is essential. The mineral related research activities should be in one location. Moreover, they should be located at the same location as the research activities related to peat and water. Finally, they should be located in the region in which the resources are located so that public officials and private citizens will have every opportunity to be aware of the research activities that are taking place and be in a position to put a meaningful input into such research.

We recognize that this transfer will impose some hardships on the personnel at the MRC on the Twin Cities campuses. We would expect that every reasonable step will be taken to alleviate these conditions.

At the present time, your committee is reviewing whether the Natural Resource Institute should be housed in the SAGE missile facility on the abandoned Duluth air base, or in a new building on the UMD campus. Attached hereto is a study by Thomas & Vecchi indicating that the cost of rehabilitating the SAGE missile base will be approximately $1.7 million, and that the cost of purchasing and installing the necessary equipment will be approximately $3.3 million.

We would expect to have additional detailed information on these matters available in the near future. We would also expect to have an estimate as to what it would cost to build a new building on the UMD campus available so the best possible decision can be made as to this matter.

We understand that you, area legislators, and representatives of the various taconite companies are looking into other matters relating to the costs of doing business by the taconite industry, including taxes. Thus, we have not made specific recommendations in those areas. We do, however, have these suggestions:

(1) With a reduction in production taxes from taconite being inevitable over the next decade, we should change the homestead tax credit formula so that the taconite taxes are not deducted in computing the aid that homeowners are entitled to under the Foundation Aid Program. In this way, the entire state will bear a portion of the burden of the natural steel recession, and we will be able to continue to make some contributions to the Environmental Protection Fund and 2002 Fund.

(2) If we are to have any reasonable hope of increasing employment in the taconite industry on the Iron Range, we must find a way to process a portion of our taconite into steel products on the Iron Range. If we are successful in doing this, it will be necessary to make sure that the steel-making facilities are not subject to additional taconite production taxes on occupation. Therefore, the law should be amended to make sure that this will not happen.

(3) The maximum utilization of our natural resources in northeastern Minnesota - minerals, timber, water and peat - is essential if we are to restore prosperity to northeastern Minnesota. We must have a coordinated program of research that will have the wholehearted support of all of the people of northeastern Minnesota. One way to accomplish this is to provide an additional credit of ten cents per ton against the production tax or the occupation tax for research activities by the taconite companies in the Natural Resource Institute.

We commend you for your efforts in revitalizing the important natural resource industries in northeastern Minnesota. We look forward to working with you and sending you additional recommendations from time to time.

ADDENDUM

OPERATING COSTS

	Year 1	Year 2
The Director's Office	$ 120,000	$ 120,000
Heat and Utilities[1]	$ 25,000	75,000
Peat Division:		
New Funds	$ 250,000	$ 550,000
Present Funds	$ -0-	$ -0-
Mineral Division:		
New Funds	$ 500,000	$1,000,000
Present Funds[2]	$ 800,000	$ 800,000
Water Division:		
New Funds	$ 200,000	$ 500,000
Present Funds:		
Sea Grant[3]	$ 575,000	$ 575,000
Lake Superior Basin[4]	$ 600,000	$ 600,000
	$3,070,000	$4,220,000
Total Present Funds	$1,975,000	$1,975,000
Total New Funds	$1,095,000	$2,245,000

Total New Funds Needed:

Capital Costs	$6,000,000[5]
Operating Year 1	$1,095,000
Operating Year 2	$2,245,000
Total	$9,640,000

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[1] Oil is the present energy source. Conversion to peat as a part of research efforts obviously will have to be considered.

[2] Includes $200,000 in federal and state funds.

[3] Includes $451,000 in private and federal funds.

[4] Includes $475,000 in private and federal funds.

[5] A request will be made to EDA to fund approximately one-half of these costs.

PROJECT DESCRIPTION - NORTHEASTERN MINNESOTA NATURAL RESOURCE RESEARCH INSTITUTE

I. INTRODUCTION

The continued rise in unemployment, lack of investment capital, emigration of the work force, and general decline in the state of the economy in northeastern Minnesota demands that action be taken to develop a plan to stimulate the economy in this depressed area. Although some revival in the economy is forecast for the coming year, the extent of this rebound is unlikely to attain the employment levels of the past ten years. However, despite the relatively gloomy outlook in the short term, the long term prospects are optimistic by virtue of the abundant natural resources that exist in northeastern Minnesota.

The program outlined here is a description of a Natural Resource Research Institute which will be associated with the University of Minnesota-Duluth. The main objective of the Institute will be to develop the natural resources of northeastern Minnesota into economically viable products. Subsequently, the economic status of northeastern Minnesota would be revived through the development of these new products. Although the mainstays of the northeastern Minnesota economy will continue to be taconite and timber products, the Institute is envisioned to be an innovative program to develop or expand the use of other resources such as copper-nickel, peat, or water. The most

critical end-product of the Institute will be the creation of new jobs. The applied research shall be prioritized such that those projects most relevant to the current situation in northeastern Minnesota shall receive the highest priority with more futuristic projects accorded lower priorities.

The activities of the Institute are not envisioned to be in basic research (e.g., theory-oriented), but primarily to focus on using the technology derived from basic research and developing the applied technology for the production of marketable products. To achieve this goal, Institute personnel will be selected who have an applied orientation and interest. It is anticipated that the SAGE building and associated facilities on the now-abandoned Duluth Air Force Base will be remodeled to house the Institute.

Although research is being performed on problems related to northeastern Minnesota, it is geographically dispersed, essentialy uncoordinated, and often the emphasis is upon basic rather than applied research and product development. This is not to deny the importance of basic research but immediate problems normally are solved through application of existing research results. With regard to the current geographical dispersal of research efforts, it is critical that the necessary studies, those relevant to a particular region, be carried out as a centralized research and development effort in the affected region where the research staff are intimately acquainted with the problem and the implications of any possible solution to other factors in the environment surrounding this problem.

Applied research at a distance can easily generate solutions which are inappropppriate to the area or which are unacceptable to the population which would be affected by the proposed solution.

II. PROGRAM ORGANIZATION

The Institute is divided into three major divisions which were defined by three of the most important classes of natural resources available in northern Minnesota: (1) minerals, (2) water and (3) biomass. The organizational framework of the Institute (Figure 1) is headed by a Director who reports directly to the Provost of the University of Minnesota-Duluth. In addition, an Advisory Board will be established to provide input and consultation to the Director regarding the plans of the Institute. The Director will be responsible for administration, planning, fund raising, and overall efficient management of the Institute. Under the Director will be one Division Chief for each of the three major resource areas. Each will be responsible for administration, planning, grant writing, and overall management of their respective divisions.

It is anticipated that the Director will be a full-time administrator who has considerable research and management experience in a wide variety of resource areas. In contrast, the Division Chiefs will have responsibilities both in program administration, and also will be in research activities. Considerable flexibility should be allowed in activities for both the Director and Division Chiefs in order to attract some of the best people in these fields, and also to enable a variety of viable possible production lines to be explored. The Director

and Division Chiefs in consultation with the University of Minnesota-Duluth campus administration and the Advisory Board will develop the structure and personnel composition of the respective units.

III. FUNCTIONAL SUPPORT WITH OTHER UNIVERSITY PROGRAMS

The Natural Resource Research Institute will form a new unit within the University of Minnesota-Duluth. However, both personnel and functions of the Institute will receive support from a variety of programs currently within the university (see Figure 1). For instance, the Lake Superior Basin Studies Center (LSBSC) of the University of Minnesota-Duluth has Water Chemistry and Geo-Chemistry Laboratories which can provide technical assistance and support capabilities to the Institute. Similarly, the Bureau of Business and Economic Research (BBER) at the University of Minnesota-Duluth can provide support in areas such as evaluation of the economic viability of products developed at the Institute. Furthermore, it is plausible that many of the personnel hired at the Institute will have capabilities which could foster an expansion of the teaching and research mission of the University.

The Institute staff are not expected to have any continuing instructional commitment at UMD but the interaction between UMD faculty and students and the Institute staff shall provide strong enrichment to both populations. Both undergraduate and graduate students from UMD should create a trained, readily trainable source of inexpensive assistants from the Institute viewpoint while the students will gain invaluable experience. The professional level interactions with UMD reserch faculty

consulting or even directly involved in projects and the corresponding resource support provided UMD by Institute staff will complement and enhance the effectiveness and productivity of both groups.

IV. FINANCIAL SUPPORT FROM OTHER PROGRAMS

Although base funding is required to remodel the SAGE building and to initiate the Institute, it is highly likely that a large proportion of funds can be secured from a variety of state and federal agencies as well as from private businesses, which traditionally support applied research activities (see Figure 1). Potential sources of support for at least one of the resource divisions include the Iron Range Resources and Rehabilitation Board (IRRRB), the U.S. Environmental Protection Agency (EPA), Sea Grant, U.S. Department of Energy (DOE), U. S. Department of Agriculture (USDA), U.S. Economic Development Administration (EDA), the Bureau of Mines and especially private industry. In the latter case, it would be especially encouraging and beneficial for private industries to cooperate in the development of the Institute and its functions because private industry stands to benefit significantly from the activities of the Institute.

V. DIVISION OBJECTIVES

Minerals Division

This will be the largest unit within the Institute because it is associated with the resources that have greatest potential for economic benefit to northern Minnesota. Although the

technologies associated with taconite development are relatively advanced, it is anticipated that the Institute personnel will explore the possibilities for the use of low grade ores which are abundant yet not economically feasible at the current time. Northeastern Minnesota is also known to have deposits of copper and nickel which are obvious possibilities for further development. In essence, the Minerals Division will be expected to work with private industry and University personnel to develop technology for extraction, reduction, production, and marketing of the most economically viable mineral products available in northeastern Minnesota. The scope of the research activities will be to expand or refine existing operations to whatever extent possible, but also shall explore and develop other potential resource possibilities.

Water Division

One of northeastern Minnesota's most visible and distinctive natural resource is its water. The abundance of lakes and rivers provides innumerable opportunities and support for the recreation and tourism industry. Therefore, the pressures for the protection of this resource are substantial. In contrast, the potential for the development of prudent schemes for use of the water resources of northern Minnesota is substantial, but has not been explored to a significant degree. The potential areas to be considered with respect to this resource include the use of water for irrigation or for consumption not only locally but also regionally or nationally. Other possibilities include the areas of aquaculture, fisheries development, and energy production.

Biomass Division

Northeastern Minnesota has extensive deposits of decayed organic matter (peat) and extensive areas of standing crops in the form of trees, shrubs, cattails, and a variety of other vegetational life forms. Although northeastern Minnesota has an active timber industry which produces lumber, construction materials, and paper products among other goods, the present forestry resources are under-utilized. In the National Forests, for instance, extensive stands are over-mature because of a lack of more demand for these goods or because of access problems. A variety of potential uses for these biomass products have been identified but the development of technology for the expanded use of these products in northern Minnesota is limited. Among the most readily identifiable possibilities for exploration and expansion of the economic use of these resources are energy production such as in the gasification of peat, the use of wood chips, and the production of gasohol.

VI. BUDGET

The proposed costs for converting the existing SAGE building on the abandoned Air Force Base in Duluth for the Natural Resource Research Institute are estimated to be _____ million for the first year of the biennium. It is expected that costs will be highest during the first year when remodeling and laboratory development will occur. The progression of hiring personnel will first include the Director who will then develop the Institute in conjunction with the Provost and the Advisory Board. It is especially critical that the Director have flexibility and authority to develop the most-efficient operation that he/she sees fit. Therefore, the Director will need to be hired in conjunction or preferably before most remodeling and laboratory development plans are finalized. Hiring of additional personnel will then lag behind the construction phase and likely will be primarily completed during the second year.

NATURAL RESOURCE RESEARCH INSTITUTE

AND RELATED

LEGISLATIVE SPECIAL REQUESTS

BUDGET ESTIMATE SUMMARY

(in thousands $)

	EXISTING	NEW FUNDS			
INSTITUTE PROGRAM SUPPORT	FY83	FY84	FY85	FY86	FY87
Directors Office		150	150	175	175
Mineral Division	350	800	800	1100	1100
Water Division		150	225	300	300
Biomass Division		200	375	450	450
Building Maintenance		?	?	?	?
Laboratory Expansion		-	250	250	250
STRUCTURE COST					
Remodeling		?			
Laboratory Development		3500			
Relocation of existing facilities		?			
TOTAL COSTS	350	4800	1800	2275	2275
TOTAL COSTS(LESS FIRST YEAR STRUCTURE COSTS)		- 3500 1300			
(LESS EXISTING LEGISLATIVE FUNDS)		- 350	- 350	- 350	- 350
NEW NET FUNDS FOR INSTITUTE OPERATION		950	1450	1925	1925

ADDITIONAL FUNCTIONAL SUPPORT REQUEST

	EXISTING FY83	FY84	FY85	FY86	FY87
BUREAU OF BUSINESS AND ECONOMIC RESEARCH	31	160	160	180	180
LAKE SUPERIOR BASIN STUDIES CENTER	124	555	555	625	625
TOTAL COSTS	155	715	715	805	805
(LESS EXISTING LEGISLATIVE SPECIAL FUNDS)		-155	-155	-155	-155
NET NEW FUNDS - FUNCTIONAL SUPPORT UNITS		560	560	650	650

February 11, 1983

Proposed Northern Minnesota Natural Resources Research Institute, Conversion and Renovation of Sage Building Duluth Air Base, Minnesota

Report on Viability and Implementation of Existing Sage Building - Duluth Air Base into Northern Minnesota Natural Resources Research Institute

Evaluation of Existing Facility

We have made an evaluation of the existing Sage Building at the Duluth Air Base to determine the viability and related costs for the implementation of the proposed Northern Minnesota Natural Resources Research Institute into this facility.

Several on site inspections of the building and grounds were made, as well as review of building plans and equipment manuals, by Thomas A. Vecchi, AIA, Architect; E.L. Hemenway, P.E., Electrical Engineer; and Jon Ohman, P.E., Mechanical Engineer.

This facility was constructed in 1955/1956. We found the building and equipment to be in very good condition. The basic building structure consists of reinforced concrete floor slabs, columns, beams, and exterior walls. Exterior walls are constructed of 10 inch thick reinforced concrete with one inch rigid insulation, faced with 4 inch concrete block on the interior. Interior partitions are generally demountable type units with concrete block walls enclosing mechanical equipment rooms, stairways, elevator, toilet rooms, and special areas.

The building and grounds compound is enclosed with security cyclone fencing and electronic gates. The entire area within the compound is paved providing ample parking and storage of materials. The building has a loading dock at the elevator as well as overhead doors providing access to the building for vehicles.

homas and Vecchi

The elevator has a 16,000 pound capacity with a 10' x 16' cab which has the capability to transport forklifts and other motor vehicles.

The Power House portion of the building, first floor, has a rolling crane which runs the full length of the building.

The clear floor to structural ceiling heights in building are as follows:

22'-0" at the Power House Area, First Floor
17'-0" First Floor
13'-0" Second Floor
19'-0" Third Floor
16'-0" Fourth Floor

The existing electrical systems are in very good condition and consist of: 500 kVA transformer, three generator switchgear units, power supply system, two power panels on each floor, and associated circuits for lighting panels and convenience outlets as well as electrical system supplying the refrigeration and air handling. (See attached Electrical Systems Report by E.L. Hemenway, P.E., Electrical Engineer, Exhibit 1)

The existing mechanical systems were also found to be in good condition. They consist of building ventilation, water chiller, air conditioning, air distribution system, two oil-fired low pressure steam boilers, automatic temperature control, underground fuel oil storage tanks, plumbing and heating piping systems. (See attached Mechanical Systems Report by Jon Ohman, P.E., Mechanical Engineer, Exhibit 2)

Reuse Conclusions

In appraising the Sage Building and site as a reuse facility for the proposed Northern Minnesota Natural Resources Research Institute, we believe the building and site, including the electrical and mechanical systems, are very adaptable; and the implementation of this proposed reuse could be accomplished with minor renovations and modifications.

The site is adjacent to a major trunk highway and routes to targeted resource areas as well as being in proximity to UMD, the airport, and other areas of the city.

Security of the complex is already built in, and ample parking, loading, and storage areas are provided.

The building would be renovated and modified, ready for implementation of laboratory equipment, pilot plants, and support facilities, as follows:

Building Exterior
Would be wrapped in an envelope of two inch rigid insulation board faced with reinforced resin/portland cement and exposed aggregate finish.

Building Interior
Demolition of certain partition walls and related patching.
Patch and fill in existing duct openings in ceiling and floors.
New floor covering.
New suspended ceilings.
Minimal - new concrete walls, doors, frames and hardware.
Painting and refinishing of interior surfaces.

All existing entrances, stairways, toilet rooms, janitor's rooms, and certain mechanical equipment rooms are to remain as they exist.

Modification of ventilating, air conditioning, heating and plumbing systems.

Note: The heating system will be used as part of the ongoing biomass research activities.

Modification of electrical systems.
New lighting, electrical panels, and convenience outlets as required.

Project Description

See attached project description report as prepared by Dr. Tom Woods and Dr. Don Harris.

Assignment of Areas Within the Complex

First Floor

42,548 gross sq. ft.
33,000 net renovated sq. ft.

Minerals & Biomass Handling Facilities

Bulk handling
Pilot plants
Energy conversion
Field laboratories
Storage
Heavy equipment
Power plant and electrical power source

Second Floor

23,256 gross sq. ft.
21,000 net renovated sq. ft.

Applied Research & Experimental Laboratories

Minerals
Timber
Peat
Water

Third Floor

23,256 gross sq. ft.
6,000 net renovated sq. ft.

Office & Clean Laboratories

Note: Most of the existing rooms and partitions on this floor will be used as they presently exist.

Fourth Floor
23,256 gross sq.ft.
21,000 assignable sq.ft.

This floor is unassigned.

Available for future related uses.
No renovation will be done on this floor at this time.

Preliminary Renovation Cost Analysis

Exterior Building Wall Area -------- 52,300 sq.ft.
To receive new insulation and
stucco finish.

Interior Renovated Areas ---------- 60,000 sq.ft.
First Floor 33,000 sq.ft.
Second Floor 21,000 sq.ft.
Third Floor 6,000 sq.ft.

Estimated General, Mechanical & Electrical
Construction Cost ---------- $1,700,000

Note: The furnishing and installation of the laboratories, pilot plants, equipment, furnishing, etc, are not included in the above prices but are included as part of the attached project description report - $3,500,000

Architectural & Engineering Fees ---------- $ 136,000

Contingencies ---------- $ 100,000

Acquisition Costs (Land & Buildings) -------- $ 100,000

Maintenance Cost (Per Year) ---------- $ 300,000
Utilities, fuel, electricity, water,
sewer, janitorial, and ongoing maintenance.

New Building Comparison

Note: The first, second, and third floors of the Sage Building contain 89,000 gross sq. ft.

A new building of comparative size is estimated to have a construction cost of ---------- $6,500,000

This cost does not include the $3,500,000 laboratory equipment costs, architectural/ engineering fees, contingencies, or land acquisition.

Sage Building Reuse, Madison, Wisconsin

Dr. Don Harris	University of Minnesota - Duluth
Dr. Tom Wood	University of Minnesota - Duluth
Frank Altman	Governor's Staff
Tom Vecchi	Thomas & Vecchi Architects

The above group traveled to Madison, Wisconsin, January 27, 1983, to have a first hand view and tour of a similar Sage Building facility which was purchased and converted in 1971 by the University of Wisconsin Aluminum Research Foundation into a Biological & Chemical Sciences Research Center. The research center was later sold to the Ralston Purina Company and is presently owned and operated by Hazelton Raltech Inc.

The basic building along with the electrical and mechanical components were maintained and reused. The building exterior was refinished, and windows were incorporated. A new entrance with drive up ramp was installed. The building interior partitions and suspended ceiling systems were removed and open landscaped laboratories with a minimal amount of movable partitioned offices were incorporated, along with new and modified lighting and mechanical systems. The end result is a very functional, practical, and attractive research center.

Respectfully submitted,

Thomas A. Vecchi

Thomas A. Vecchi, AIA
Architect

February 11, 1983 Exhibit 1

SAGE BUILDING ELECTRICAL SYSTEM

Proposed Northern Minnesota Natural Resources Research Institute
Conversion and Renovation of Sage Building
Duluth Air Base, Minnesota

The Sage Building consists of the Power House and the Operations Building. The electrical system of the complex remains largely unchanged from the days it was generating power for the computer system.

In the Power House, the six diesel driven generators have been removed and a 500 kVA transformer has been installed to supply power from Minnesota Power. Three of the generator switch gear units have been deactivated and the remaining three units have the capability to supply power to the Operations Building and the Power House utility systems.

The power supply system within the Operations Building remains intact. There are generally two power panels on each of the four floors and associated circuits radiate from there to the various lighting panels and convenience circuits. The principal power load of the Operations Building was on the second floor where the computer main frames were located. The circuits to the second floor area remain intact (power is supplied from two substations of 500 kVA each).

The electrical system supplying the refrigeration and air handling units of the air conditioning systems remains intact.

In appraising the Sage Building for a research laboratory, I believe that the electrical system can be adapted to this use with only minor modification. The metallurgical laboratory would probably impose the greatest electrical load as it may contain electric furnaces and rock crushing and grinding machinery.

The peat laboratory may contain electric drying equipment and some form of pelletizing machinery. The water lab may contain laboratory desks and equipment such as found in an analytical laboratory. The electrical load imposed by the above facilities would be well within the 1000 kVA capability of the two existing substations.

If the total connected load on the system was to increase above 500 kVA, it would be necessary to increase the size of the Minnesota Power service transformer; the connecting circuitry is okay for 1500 kVA.

The lighting on the first, second, and third floors is high intensity fluorescent and adequate for the intended use. Some rearrangement of fixtures may be necessary to adapt to the occupancy.

The writer was in charge of the Sage utilities system for nine years prior to retirement as Supervisory General Engineer and is completely familiar with all aspects of the electrical and mechanical systems.

Respectfully submitted,

E. L. Hemenway P.E.

E. L. Hemenway, P. E.
Electrical Engineer

pm

2395 MOUNTFIELD ST. • DULUTH, MINN. 55803

February 11, 1983 Exhibit 2

SAGE BUILDING MECHANICAL SYSTEM

Proposed Northern Minnesota Natural Resources Research Institute
Conversion and Renovation of Sage Building
Duluth Air Base, Minnesota

After touring the Sage Building and reviewing its equipment handbook, I have gained a good understanding of the facility's mechanical systems. I have arrived at the opinion that the mechanical systems are very adaptable to the requirements of a research center.

The building's ventilating and air conditioning systems are very large and complex, designed to offset the tremendous amount of heat released by the electronic systems. The ventilation air distribution system can be easily revised to deliver the proper amounts of air to the new spaces. Some of the air handling systems will have to be dismantled and existing fan speed slowed to the proper speeds. Two of the three air conditioning water chillers have been removed from the facility; however, the remaining chiller has ample capactiy (400 tons of refrigeration) to handle future cooling requirements.

The heating system consists of two oil-fired low pressure steam boilers. Each boiler's capacity is 150 boiler horsepower which, by my calculations, will be more than enough to offset the building's heating requirements. Alternate fuels will no doubt want to be studied for their adaptability to this system and/or fuel research projects. Minor changes in automatic temperature controls will be required, as well as modifications designed to improve the energy efficiency of the systems.

The plumbing systems appear to be sufficient to handle the requirements of a laboratory, although the cost of plumbing modifications may be more than heating or ventilating modifications.

Respectfully submitted,

Jon Ohman/pm

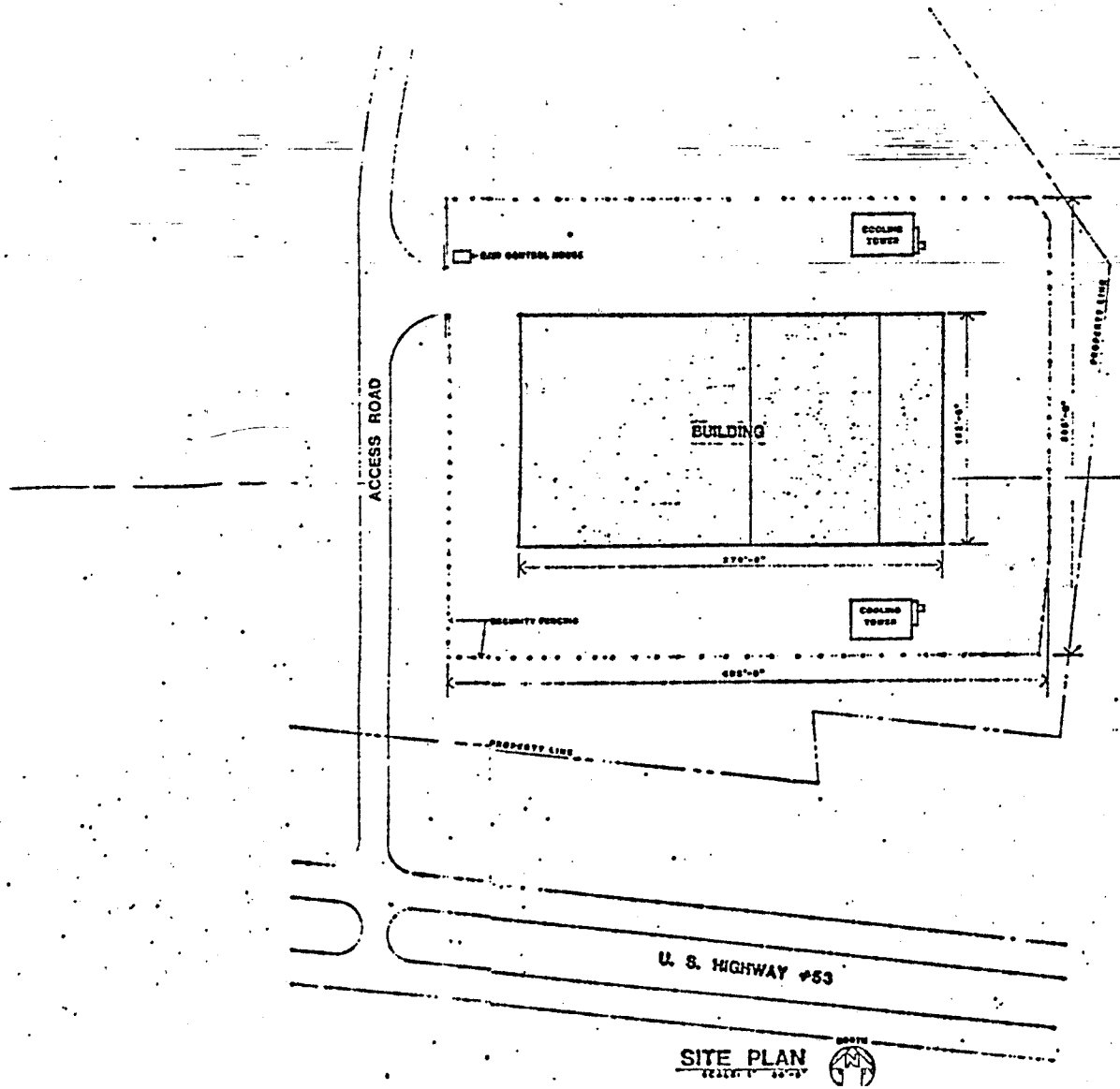
Jon Ohman, P.E.
Mechanical Engineer
Building Energy Consultant

pm

NORTHERN MINNESOTA NATURAL RESOURCES RESEARCH INSTITUTE

CONVERSION AND RENOVATION OF SAGE BUILDING

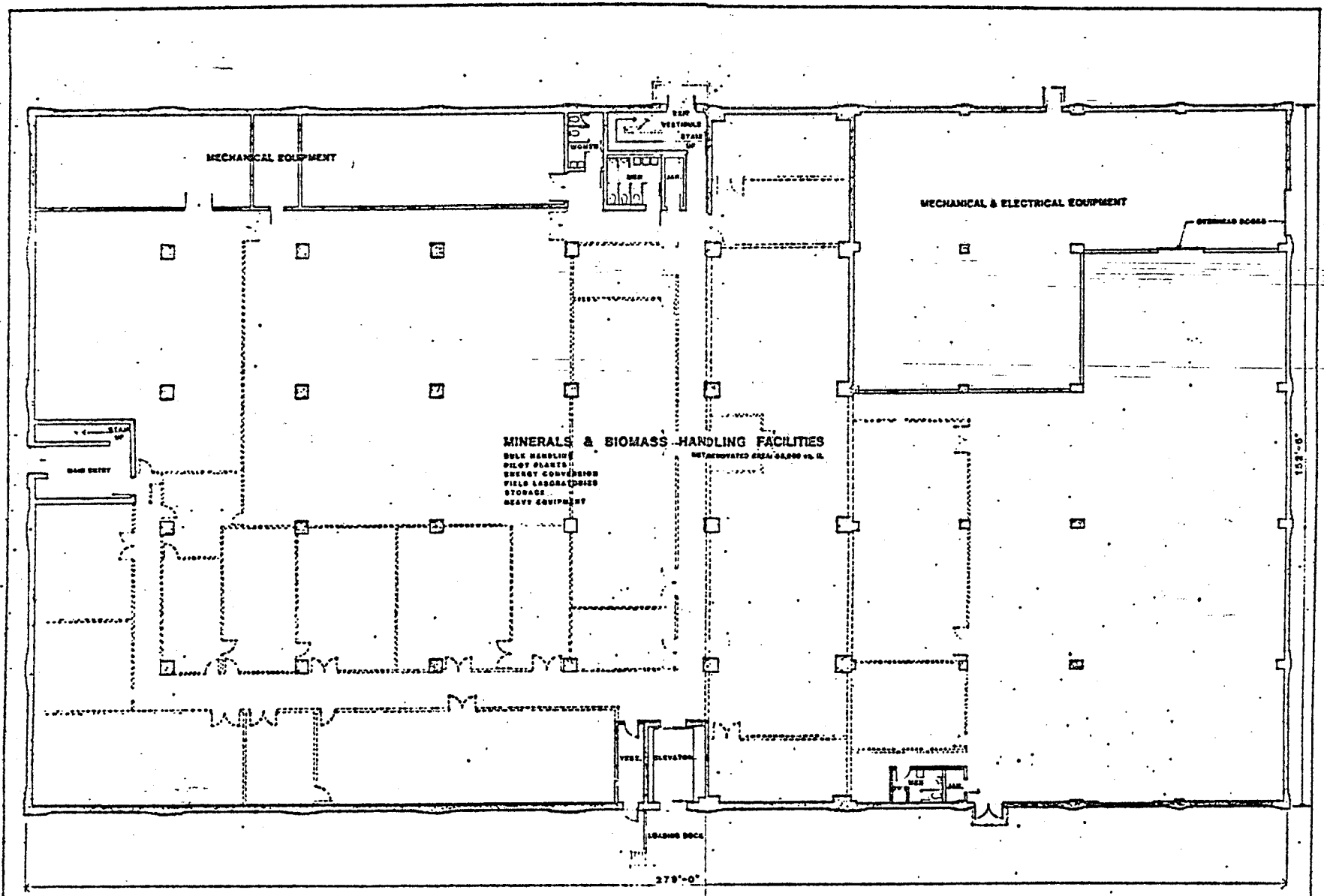
DULUTH AIR BASE, MINNESOTA



SITE PLAN

Thomas and Vecchi
AIA Architects

John Ley Thomas/Thomas A Vecchi Inc 166 East Superior Street Duluth Minnesota 55802 (218)724-8802
PROPOSED NORTHERN MINNESOTA NATURAL RESOURCES RESEARCH INSTITUTE
CONVERSION AND RENOVATION OF SAGE BUILDING
DULUTH AIR BASE
MINNESOTA



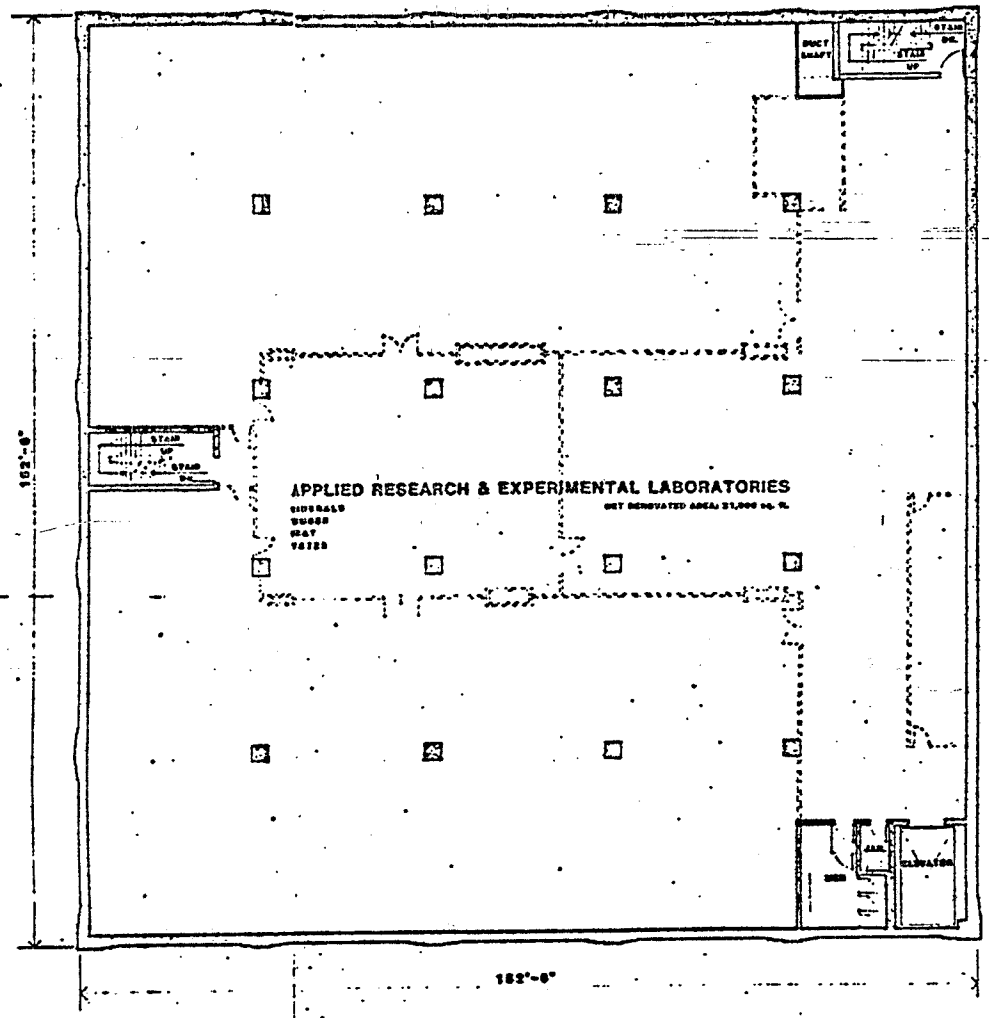
FIRST FLOOR PLAN

GROSS AREA: 43,848 sq. ft.

Thomas and Veach AIA Architects

John Ivey Thomas/Thomas A Veach Inc. 595 East Sycamore Street Duluth Minnesota 55812 (218) 724-8002

PROPOSED NORTHERN MINNESOTA NATURAL RESOURCES RESEARCH INSTITUTE
CONVERSION AND RENOVATION OF SAGE BUILDING
DULUTH AIR BASE
MINNESOTA

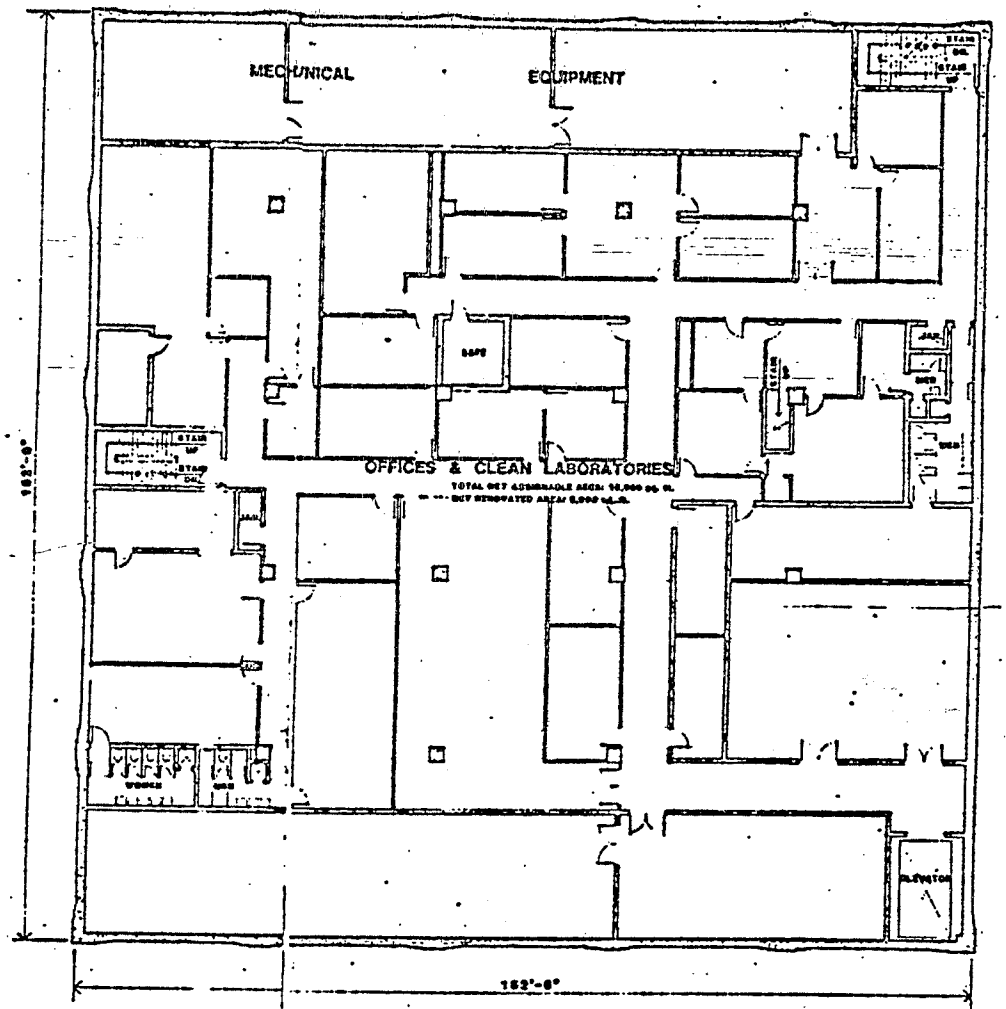


SECOND FLOOR PLAN

GROSS AREA: 23,255 sq. ft.

AIA Architects

PROPOSED NORTHERN MINNESOTA NATURAL RESOURCES RESEARCH INSTITUTE
CONVERSION AND RENOVATION OF SAGE BUILDING
DULUTH AIR BASE
MINNESOTA



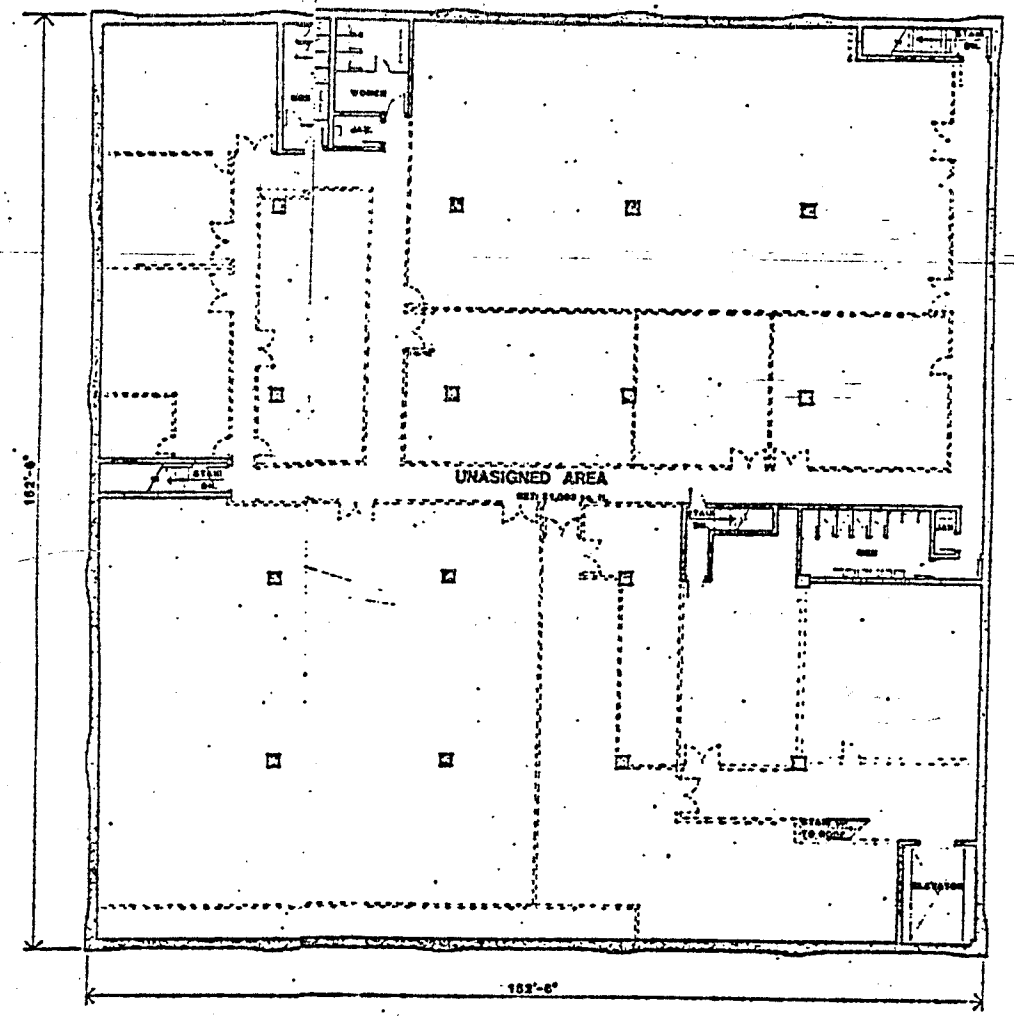
THIRD FLOOR PLAN

GROSS AREA: 23,250 sq. ft.

Thomas and Veach
AIA Architects

John Ivey Thomas/Thomas A Veach Inc 56 East Superior Street Duluth Minnesota 55802 (218) 724-8802

PROPOSED NORTHERN MINNESOTA NATURAL RESOURCES RESEARCH INSTITUTE
CONVERSION AND RENOVATION OF SAGE BUILDING
DULUTH AIR BASE
MINNESOTA



FOURTH FLOOR PLAN

GROSS AREA: 33,250 sq. ft.

Thomas and Veach AIA Architects

John Ley Thomas/Thomas & Veach Inc. 66 East Superior Street Duluth Minnesota 55802 (218)724-8802

PROPOSED NORTHERN MINNESOTA NATURAL RESOURCES RESEARCH INSTITUTE
CONVERSION AND RENOVATION OF SAGE BUILDING
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MINNESOTA

A NEW PLAN FOR MINERALS IN MINNESOTA

Minnesota is one of the leading non-fuel minerals producing states and over the years has made an outstanding contribution to the growth of our great nation. Throughout the history of the country more than half of all the iron ore consumed by the U. S. steel industry has been extracted from the iron ranges of Minnesota. We can proudly claim that the majority of the vast structure of the nation as we know it today is fabricated from steel that had its origins in the northern part of our state. However, in recent times those Minnesotans who rely on our mineral industry for their livelihood have been subjected to undue stress and hardship caused principally by unfavorable national and international economic forces but also aggravated by a historical lack of foresight and systematic planning for the future of minerals in Minnesota by the state itself.

A new MINERALS PROGRAM is therefore proposed with four major thrusts that will initiate an aggressive approach to our current problems and fully recognize our responsibilities for the future. It is also of critical importance to our survival as a leading mineral producing state that we develop a sound working relationship between labor, industry and government based on cooperation and mutual respect. The days for confrontation are over and we must now plan for a future which can be seen to be dramatically different from that forecast as little as four years ago and in which full utilization of the installed capacity of our taconite pellet plants cannot be expected for several years.

The four areas of activity are:

- IRON ORE RAW MATERIALS,
- NOVEL IRON AND STEELMAKING,
- DIVERSIFICATION OF OUR MINERAL BASE, and
- STABLE LONG-TERM MINERAL RESEARCH

This new initiative will require appropriate funding and in reaching decisions on the necessary levels it should be remembered that since 1914 Minnesota tax receipts from iron ore activities have amounted to over 2.5 billion dollars. Although these taxes have been put to good use in developing the Iron Range community infrastructure of which we can be justifiably proud, it can also be seen now that a totally inadequate proportion of these taxes was used as an insurance for the future. That future is upon us now and we have been caught unprepared. We must develop responsible plans for the use of mineral tax funds currently available and also review the distribution of mineral tax revenues so that we can begin a more appropriate program for investing in the future of minerals in Minnesota.

In considering potential Minnesota mineral developments, it is necessary to bear in mind that there are few areas in the world that can compete with the sheer magnitude of operations on the Mesabi Range and that the taconite industry, albeit in a reduced form, will comprise the major component of any mineral activity in Minnesota for many years to come. The first two parts of this program therefore relate to our known iron ore resources.

The first major thrust is for applied research in the area of iron ore raw materials since this is the area of our historic strengths and is also a focal point of the current crisis. At this time there is a large international oversupply of pellets which is likely to persist for several years. This creates a strongly competitive market and under these circumstances the most successful products will be those with the best combination of cost and quality. The state and the nation will benefit from such research since improved raw material quality leads to improved blast furnace productivity and ultimately to steel products which are more able to withstand economic pressures from imports. Higher quality feed materials will therefore increase U. S. domestic production relative to imports and keep jobs open in both the steel and the iron ore industries. Research to lower operating costs or to develop new raw material formulations also has the potential to provide similar benefits. This part of the program will require close cooperation between state research activities, related programs in the U. S. Bureau of Mines, and the iron ore and steel industries.

The second major thrust involves research to identify potentially economic routes for the production within Minnesota of iron based products with higher added value. Studies over the last two years have indicated that although conventional direct reduction processes are not economically viable in Minnesota, production of raw steel or higher value products could have significant job and economic impacts. The problem facing the state is to identify technically and economically viable routes to achieve these goals and to create the required incentives to encourage commercial developments. This will require technical and economic analysis of many different possible process routes, evaluation and development of novel direct smelting routes for the production of molten metal and demonstration plants on the Iron Range to effect the transition from research results to commercial applications. Since peat represents a potential local energy resource, appropriate evaluation of the commercial and technical possibilities of using peat for the further processing of our iron ore resources should also be included.

This phase of the program will depend on industry involvement in demonstration projects in Northeastern Minnesota and it will be necessary to encourage industrial cooperation on an international basis from both steel producers and developers of new direct smelting or other novel technologies. Any major project initiated in Northeastern Minnesota will require significant capital investments by the state and will consequently require careful project cost evaluation. However, if these projects are imaginatively developed, it should be possible to create a funding package with contributions from industrial, banking and community groups. The state should aim to commit itself to at least one such major project before the end of 1983.

An important aspect of the mineral economics activity will be the evaluation of taxation and incentive strategies to achieve development objectives set by the state. This phase of the program will require close interaction with state agencies and legislative committees, particularly with the minerals division of DNR. Recongnizing this interaction, an increased funding level for the minerals division of DNR will be needed to establish personnel and programs that will form part of this overall minerals effort. This funding should be on the order of $1 million per year.

The third major thrust will begin a rational program seeking the development of a broader base for the mineral industry of the state.

Minnesota has a unique geological setting and the extensive cover of glacial drift has hidden most of the base rock geology from classical mineral exploration activites.

The existing geological mapping programs within the Minnesota Geological Survey should therefore be accelerated and a comprehensive program for the interpretation and publication of this information should be developed within a relatively short time frame. The aim is to provide detailed basic geological information that will stimulate commerical exploration programs. Funding for this activity will require an increment of approximately $1 million per year to the current state special support for the Geological Survey and the necessary additional funding for geophysical data gathering activities. At the same time as this mapping program is tackled, forward looking fundamental research must be developed to tackle the technical aspects of mineral processing and metal extraction for nonferrous metals which are known to exist in the rock structures of Minnesota.

In the current distressed times when industry is closing down both its operating plants and its research activitles, the fundamental responsibility of the state for long-term research becomes more clearly apparent. An appropriate insurance policy for the future needs to be established in the form of a stable research organization with a skilled staff that can develop innovative research in normal times and provide a powerful core of expertise when needed in times of crisis.

Since any applied research can only succeed if it is based on sound fundamental principles the final thrust of the program aims to create a stably funded long-term research effort in the Mineral Resources Research Center at the University of Minnesota. This effort must also be integrated with the teaching function so that strong programs can be maintained in the mining, mineral and metallurgical engineering disciplines which are vitally necessary for providing the skilled human resources on which the mineral industry of the state relies. This fourth stage of the new Minerals program will cover both basic disciplinary topics and research in commodity areas of current or potential interest to the state and will be fully integrated with the first three phases.

The fourth stage can be achieved by re-establishment of the MRRC state special at the funding level required to support the level of activity carried out in the peak years of 1972/73. This will provide an initial base for the state's long-term minerals program which should expand over the next four years to approximately $5 million per year, a level appropriate to support the first three phases and the longer term needs of the state. As part of this expansion the needs for local training and research in minerals in Northeastern Minnesota should be fully recognized and a practical plan to meet these needs should therefore be developed and implemented. Such a plan could provide for close liaison with Iron Range activities and problems at both the community and industry levels and also provide a focal point for coordinating state interests in any joint commercial demonstration projects that evolve in relation to the search for further processing of our iron ore resources, thereby playing an important role in the first two parts of this program outlined above.

It is also important to send out a strong signal indicating that Minnesota is serious in its intentions both to stabilize the minerals economic base and to support alternative mineral related developments. It would therefore be appropriate to initiate a comprehensive review of current minerals management and policy and to establish a new clearly outlined Minnesota Minerals Policy designed to maximize mineral development and regional economic stability while maintaining realistic objectives for environmental protection.

Minnesota is standing at a major crossroad and the significance of minerals in Minnesota in the second century of mineral activity will be strongly influenced by the direction taken now. Although the immediate problems cannot be solved in the short term, longer term developments in minerals can be influenced and encouraged by todays actions.

The road that leads straight ahead, that continues the policy of the past hundred years is no longer acceptable.

The message conveyed in the current economic crisis on the Iron Range must be fully understood and the appropriate forces within the state assembled to focus clearly on our mineral future. The Minerals Plan for Minnesota outlined above points us in the right direction. Any further progress requires a legislative mandate. The 1983 legislative session holds the key to the future of minerals in Minnesota.

Minnesota Business Partnership Suggestions for Public Policy Measures to Encourage Mineral Exploration and Development

Access to Minerals

1. Offer leases for exploration on a regular twice yearly schedule upon state lands except where development of a discovery would clearly be foreclosed by environmental considerations.

2. Allow access to non-leased state-owned surface and minerals on a non-exclusive basis for non-destructive geological, geophysical, and geochemical surveys (but not drilling) without requiring public disclosure of data obtained.

3. In concert with federal policy currently being considered, encourage long-term leasing of state and county lands for mining accessory uses (tailing ponds, plant sites, buffer zones, etc.) instead of requiring land exchanges.

4. Permit leasing of private lands for mineral exploration without local government intervention where the knowledge to be gained has area-wide or state-wide significance, while retaining local government's participation in reviewing proposals for mineral development.

Environmental Review and Permitting Procedure

1. Streamline and consolidate the environmental review process to reduce costs, delays and duplication of effort for applicants seeking permits for small and medium size projects, e.g. industrial minerals, non-ferrous metals, and scram iron ore operations.

2. Modify mine land reclamation rules to facilitate development of small and medium size projects. (Currently, small and medium size projects exceeding 80 acres are subject to criteria appropriate for large developments but impractical for smaller scale activities.)

3. Modify recently adopted EQB regulations governing petition requirements, appeals, time allowed for agency response, generic EISs and EISs on resultant actions to simplify procedures for small operations. (There should be a closer relationship between the stringency of regulations and the potential environmental significance of a proposed project.)

Taxation and Royalties

1. Minnesota should promptly undertake a study to design a mineral tax policy that is:

   -Attractive to explorers and developers,

   -A predictable component of mining costs, and

   -Based on profitability or rate of return,

   while providing the citizens of Minnesota and the affected area adequate compensation for governmental services required as a result of development.

2. Minnesota should revise its royalty system to prevent discrimination against metals with high smelting and refining costs by allowing deduction of such costs from gross metal value. (Present royalty, based on gross metal value, does not allow for deduction of smelting and refining costs, which are highly variable.)

Research

1. Fund basic applied geological programs for topographic and geologic mapping and regional-scale geophysical mapping by the Minnesota Geological Survey.

2. Rely on private sector exploration activity to provide information on occurrences or targets of geologic interest, obviating duplication by state prospecting programs.

3. Fund basic applied mineral processing research by the Mineral Resources Research Center to increase emphasis on and assist development of Minnesota's metallic and industrial minerals.

4. Fund economic research into problems of the iron ore industry in seeking methods to improve the marketability of Minnesota ores and pellets.

5. Fund research to determine practical ways to prevent adverse effects on air and water quality by mineral development.

Seminar for the Minnesota Legislature on Technology. Based on Issues in Minnesota's Economic Development.

Presented by D. J. Enochs

January 6, 1983

COMMENTS ON MINNESOTA IRON

Thank you Mr. Chairman:

Distinguished Guests, Ladies, Gentlemen:

One hundred and fifty years ago, the German philosopher Hegel concluded: "we learn from history that men learn nothing from history."

Yet we know that when men are sufficiently stimulated to find answers to help them shape the future, they often take a hard look at the successes and defeats of the past. Hopefully, we can disclaim Hegel's conclusion in our search for the answers to the future of Minnesota iron. We learned that low taxes and reasonable costs encouraged development, and that cooperation produced results. We have also learned that high taxes drives business away and that without cooperation between government and business, little is done.

The story of Minnesota iron spans more than 100 years of determined men finding answers to tough problems.

Minnesota taconite is a flint-hard rock formed two billion years ago. It's a low-grade ore containing 20 to 25% iron. The iron is present as specs of magnetic iron oxide which are liberated by crushing, grinding and magnetic separation. Taconite concentrates containing 62 to 65% iron are then made into 1/2" pellets for charging into blast furnaces.

Mining and processing taconite take a lot of capital--operations chew up steel, supplies, energy and money. It took 90 years from the time Christian Wieland stepped on it in 1865 to the first commercial pellets from Silver Bay in 1955.

An extraordinary persistence and cooperative effort between government and industry started in 1912, and intensified in the 1940's.

The crucial steps in building Reserve Mining Company, the first commercial taconite operation, were the work done by the University of Minnesota Mines Experiment Station; the Armco pilot plant in Ashland, Kentucky; the prototype production plant at Babbitt; and finally, the commercial pellet plant at Silver Bay. The business was built soundly, step by step, with many of the contributors staying with the new industry for 30 years or more.

The advent of commercial pellets brought consumers much better quality, lower cost, and higher blast furnace productivity than with conventional red ore.

By the 1940's, an end was seen to the three billion tons of red ore, which was formed in pockets along the outcrop of the lower grade iron formation.

With the depletion of red ore foremost in the minds of the planners, a series of events transformed the industry.

- The Paley Report of 1952, commissioned by President Truman, stated that the nations's iron ore reserves were depleting and that we had to depend on foreign sources for our supply.

- Bethlehem and U.S. Steel built blast furnaces on the United States East Coast to accept foreign ore in the early 1950's.

- The St. Lawrence Seaway, built in part to accommodate Labrador/Quebec ore, was opened in 1959.

- The Taconite Amendment limiting future tax increases on taconite to the same level applied to other Minnesota manufacturing firms was approved with a 7:1 margin by voters in 1964. Following approval of the amendment billions of industry dollars were committed to taconite development.

  (In my mind, if the amendment had not passed, the taconite industry in Minnesota would not have developed as we know it today.)

Now let's look at what has happened recently.

In 1973 and 74 the demand for world steel peaked. Economic forecasters were universally confident of substantial growth in steel demand. Steelmakers frantically searched for iron ore, determined not to be caught short, they dedicated themselves to self sufficiency. Low grade iron ore properties in remote regions were investigated and acquired as a hedge against future shortfalls. I found myself swept up in the spirit of the times and visited iron ore prospects and operations on five continents.

Consumers enthusiastically took highly-leveraged equity participation in new or expanded pellet facilities, or signed long term take-or-pay contracts. Ironically, there was little increase in blast furnace capacity to accommodate the new pellets.

The forecasters were wrong. Their curves started downward in 1977 instead of cooperatively climbing as predicted. By 1980 pellet capacity utilization dipped to 70%, and today it's 40%.

Producers' problems have been compounded by rising costs in every sector at rates much higher than their foreign competitors. Employment costs today are 24 to $25 per hour, and supply and energy costs are high. Of particular interest to the legislators present should be the rise in taxes. In 1970 pellet companies paid state and local taxes of $.32/ton; in 1980 it was $2.72--an 8 1/2 fold increase. Today it is as high as 6 to $7/ton. Pellet prices increased less than three-fold from 1970 to 1980 ($.27 to $.74/unit). The inordinate tax increase brings to mind the spirit of the Taconite Amendment. In 1964 the people of Minnesota guaranteed taconite developers favorable taxes for 25 years. The "guarantee" was forgotten in 10 years.

Last year the consequence of high costs and underutilization was that nearly all North American steel producers tried to sell or give away their pellet ownership positions. Some companies who lost over $100 million on iron ore commitments during the year, could have saved $50 million or more with foreign purchases. Brazilian ore reached consumers in the midwest for 10 to $15 per ton less than Minnesota ore. When we compare Minnesota's flint-like taconite grading 23% iron with the easy to dig Brazilian ore at 68% iron, the picture starts to clear up. What about the 5,000 mile haul from Brazil? Total freight and transfer charges for a ton of ore from Tuberao, Brazil to an Ohio River blast furnace is $15.32 vs. $24.77 from Minnesota.

Without radical adjustments, the steel companies simply won't be around. McLouth Steel Corporation is an example. Last year the company filed for Chapter 11 bankruptcy protection, was purchased and restructured with lower employment costs and no ore commitments. Other companies are in the same kind of trouble. Restructured steel companies become the low cost producers. Steel and pellet producers are concerned with survival--they need cash. Layoffs and early retirements are occuring at all levels; research and exploration budgets have been drastically cut or eliminated.

Only a portion of Minnesota's pellet capacity is expected to be required in the next two to three years, and if Minnesota pellets can somehow regain a competitive position, demand is still not expected to exceed supply until the turn of the century. The outlook is dismal.

Producers are independently studying, intensively, which plants to cut back or shut down. While collective studies by two or more groups could result in optimal savings, until now few companies have shown any interest in working with others on mutual problems. Ownership complexities, concerns for possible violation of anti-trust laws and polarization among producers, owners, consumers, employees, government and special interests are serious obstacles.

But, the case for optimization studies is a good one. National and individual economic interests are at stake.

Looking to the future, iron ore and steel producers may radically depart from today's conventional raw material and steelmaking practice. New practices could conceivably be researched, designed and installed to serve the best interests of the sponsors. It will take a lot of cooperation--something like the teamwork in the development of pellets or the passing of the Taconite Amendment.

It's been a source of curiousity and anger for me through the years to witness the various stages of combat between industry and government, and management and labor. Consumers always end up with the problem.

As a start, representatives of industry and government could sit down together and look at the cost features of area and foreign competition (not direct reduction) to determine what steps by local producers are necessary for them to compete effectively. Next, they should undertake the investigation of a new direct smelting technology and system for the best utilization of Mesabi ore and Minnesota's logistical advantage with respect to shipping, energy, and markets. Uniting the university's scientific resources with the facilities at Silver Bay or elsewhere to design and build a new prototype steel facility is a possiblity worthwhile discussing.

Remembering the past, we can avoid unpleasant repetition and focus on the achievable. Pellets were developed after orchestrating significant amounts of energy, time, and money with a lot of cooperation. A new ore/steel system could be launched today using the same formula. In addition to having a barely-scratched reserve of 50 billion tons of iron formation amounting to 15 billion tons of concentrate, today there is the added benefit of a modern fully-developed mining and processing complex. Deciding to do something about it is the real challenge.

For the past few minutes, we have dealt with Minnesota's competitive position in iron ore and conclude that it needs improvement, but let me offer a caveat. Foreign iron ore reaching the U.S. is competitive -- not to be confused with the steel we permit to be imported at distress prices. To disturb fair competition with embargoes is like trying to repeal the law of gravity -- you will fall and get hurt. The interdependence of the U.S. and Canada is an excellent example. If we were so foolish as to try to restrict Canadian imports, our fall would be immediate. We are net exporters to Canada, and Brazilian or other offshore suppliers are ready to step in. That situation, incidently, is another excellent reason for Minnesota to get back into competition -- and soon.

There is very little foreign ore entering our heartland today even though the price is right. At the moment, we are contracturally locked into Lake Superior District ore, but can only use a fraction of our commitment. Most of the foreign ore consumed in the U.S. keeps the East Coast blast furnaces going. Furnaces on the Gulf and West Coasts and many more inland are down indefinitely -- not because of our failure to meet competition, but because we permit or encourage our valued foreign trading partners to dump their surplus steel on our shores -- thus killing the goose that lays the golden egg.

In closing, 12 years ago Jeno Paulucci funded a 170 page report by the Stanford Research Institute entitled: "The Effect of Higher Production Taxes on The Minnesota Taconite Industry." The report stated that Minnesota pellets were competitive, but that unbriddled taxation could hurt the industry. Today Minnesota Taconite is not competitive.

Today, it is not just taxes, but all segments of operating and transportation costs that need study and improvement--and government and industry must work together if the Mesabi --"The sleeping Giant" is to survive.

Presented by D. J. Enochs in a seminar for the Minnesota Legislature on Technology - Based Issues in Minnesota's Economic Development.

Sponsored by the Science Museum of Minnesota and the Science and Technology Council St. Paul, MN.

January 6, 1983.

MINNESOTA IRON

In northeastern Minnesota, about two billion years ago, the right combination of rocks, physical forces and chemistry resulted in the precipitation of iron and silica in the bottom of large, deep lakes--the beginning of iron formation. More sediments came and the earth was tormented and contorted to change the iron/silica sediments into 50 billion tons of iron-bearing rock. About half ot it formed magnetic taconite, a flint-hard material containing 20 to 25% iron in tiny specs of magnetic iron oxides that could be freed by crushing, grinding and magnetic separation. In places where the iron formation reached the surface, three billion tons of richer ore were formed in pockets after silica had been leached away.

Eons later, nature brought two other valuable resources to the area--white pine forests and beaver. In the middle 1600's, the Chippewa were in place when the voyagers arrived. After 150 years, high U.S. taxes encouraged the Frenchmen to move their fur trading headquarters from Grand Portage to Ft. William, Ontario.

In 1859, four years after the first regular iron ore shipments from Marquette, Michigan, the Wieland family started a sawmill in Beaver Bay, primarily to serve the copper and iron mines of northern Michigan.

George A. Stuntz first discovered ore in Minnesota in 1865 near Tower. In the same year, Christian Wieland found magnetic taconite near Babbitt while guiding a gold exploration party headed by H. H. Eames, the first State Geologist. Peter Mitchell, a prospector from Michigan, became involved and dug the first test pit on the Eastern Mesabi in 1871.

From those beginnings, the following events occurred:

1882	Mesabi Iron Company organized in Duluth - First iron mining company in the state - Later bought the taconite holdings near Babbitt
1884	Railroad completed Tower to Two Harbors. Uncovered Mesabi iron formation in a road cut. First shipment of Minnesota ore from Soudan Mine (Vermillion Range).
1890	Merritt brothers found ore at Mountain Iron on the Mesabi.
1892	First ore shipment from the Mesabi.
1893	John D. Rockefeller acquired the Merritt and other Mesabi holdings in the panic of 1893.
1905	Rockefeller sold Mesabi holdings to U.S. Steel.
1912	First experiments with magnetic separation of taconite by University of Minnesota, Mines Experiment Station.

1915	D. C. Jackling and other notables formed Mesabi Syndicate (later Mesabi Iron Co.) to lease the Babbitt taconite from Mesaba Iron Company.
1916	Steel mill built in Duluth (shut down in 1972)
1919	Work started on the first taconite plant at Babbitt.
1922/24	Sintered taconite concentrates produced and shipped from Babbitt. High costs ($7.00/ton) and low prices ($5.40/ton) closed the plant.
1929	Armco and Oglebay Norton investigated Eastern Mesabi taconite.
1939	Reserve Mining Company organized.
1941	Taconite Tax Law (5¢/ton prod.), in lieu of Ad Valorem and property tax to encourage development of taconite.
1939-50	Crisis in ore expected with fast growing demand and rapid depletion of direct shipping ore. Eastern Mesabi researched for concentratability, pelletizing and blast furnace use. Tests and developmental work by Mines Experiment Station, Minneapolis, Reserve at Babbitt, Erie at Aurora, Armco in Ashland, Kentucky, and Bethlehem in Lebanon, Pennsylvania.
1950's (early)	New blast furnaces built by U.S. Steel at Fairless Hills, Pennsylvania, and by Bethlehem Steel at Sparrows Point, Maryland, to receive South American and African ores.
1950/51	Armco and Republic became 50/50 owners of Reserve.
1952	The Paley Report, commissioned by President Truman, stated that the Nations's iron ore resources were depleting and that we had to depend on foreign sources for our supply.
1954	First shipment of ore from Quebec/Labrador.
1955	First production of commercial pellets at Silver Bay--shipped April, 1956.
1959	Opening of the St. Lawrence Seaway.
1964	Taconite Amendment limiting future tax increases on taconite to the same level applied to other state manufacturing operations--approved by voters, 7:1 margin. Billions of dollars committed to taconite development 1964 through mid-1970's.
1968-77	Reserve Mining Company tailings disposal controversy ending with permits granted to Reserve for an on-land disposal system.

1973/74 - Worldwide steel demand peaked.

- Steelmakers frantically searched for raw materials--determined not to be caught short--dedicated themselves to self-sufficiency.

- Economic forecasters universally confident of substantial growth in steel demand.

- Multi-billion dollar construction of pellet operations continued--with little increase in blast furnace capacity to accommodate new pellet production.

1977-80 - Forecasters were wrong. Pellet capacity utilization diminished to 70% by 1980.

- Minnesota taxes on pellets increased from 32¢/G.T. in 1970 to $2.72/G.T. in 1980--a factor of 8 1/2. In the same period, pellet prices increased by a factor of less than 3.

1982 - North American blast furnaces required about 60M tons of ore and pellets in 1982--50% of 124M tons rated capacity. Minnesota shipped 25M tons or 40% of 63M tons capacity.

- Nearly all North American steel producers sought ways to divest themselves of pellet ownership positions. Some companies who lost over $100M on iron ore commitments, could have saved $50M or more with foreign purchases. Brazilian ore reached consumers in the midwest for $10 to $15/ton less than Minnesota ore.

- Steel and iron mining employment costs reached $24 to $25/hour.

- Steel and mining companies needed cash. Layoffs, terminations and early retirements occurred at all levels. Research and exploration budgets were drastically cut or eliminated.

- McLouth Steel Corporation filed for Chapter 11 bankruptcy protection, was purchased and restructured with lower employment costs and no ore commitments. Other companies were in trouble. Restructured companies could be among the most competitive in the industry.

1983 and beyond:

- The steel industry is currently operating at 40% capacity.

- World steel and iron ore demand through the 1980's is expected to grow by 1 1/2 to 2 1/2% per year. The growth will have little impact on the use of Lake Superior pellets. Only 50% of Minnesota's pellet capacity is expected to be required over the next two years--if it is competitive. Improved demand from 1985 to 1988 will be gradual.

- Forecasters predict weak prices for iron ore until 1985. Demand in North America is not expected to exceed supply until the late 1990's or turn of the century.

- Steel and pellet producers are concerned with survival. Most of them are intensely studying which plants to cut back or shut down. While collective studies by two or more companies could result in optimal savings, until now few companies have shown any interest in working with others on the problems. There are many ownership complexities and polarization problems among producers, owners, consumers, employees, government and special interests.

- In the more distant future, iron ore and steel producers may radically depart from conventional raw material and steel making practices. New practices could conceivably be researched, designed and installed to optimally serve the best interests of the sponsors.

- Nearly three billion tons of Minnesota direct-shipping ore (non-taconites) have been mined and shipped over the past 100 years. The significant volume is gone.

- Fifty billion tons of low-grade iron formation, representing 15 billion tons of concentrates or pellets, remain in northeastern Minnesota. Properly handled, this amounts to several hundred years of reserves.

David J. Enochs
December 28, 1982

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