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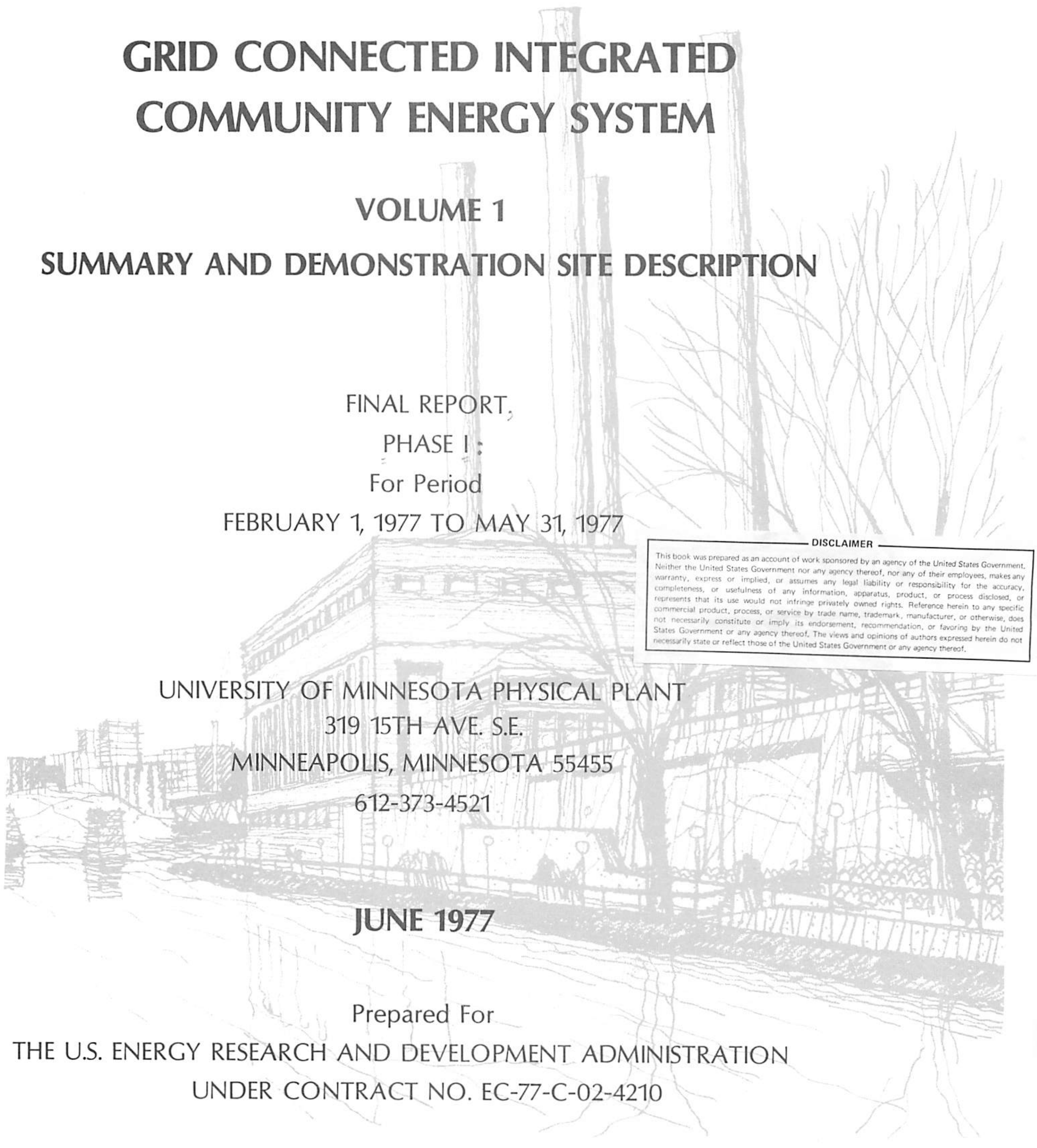

GRID CONNECTED INTEGRATED COMMUNITY ENERGY SYSTEM

VOLUME 1

SUMMARY AND DEMONSTRATION SITE DESCRIPTION

FINAL REPORT,
PHASE I ;
For Period
FEBRUARY 1, 1977 TO MAY 31, 1977

UNIVERSITY OF MINNESOTA PHYSICAL PLANT
319 15TH AVE. S.E.
MINNEAPOLIS, MINNESOTA 55455
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JUNE 1977

Prepared For
THE U.S. ENERGY RESEARCH AND DEVELOPMENT ADMINISTRATION
UNDER CONTRACT NO. EC-77-C-02-4210

DISCLAIMER

DISCLAIMER

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Bailey Meter Company, St. Paul, Minnesota

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Honeywell, Inc., Minneapolis, Minnesota

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The following institutions have furnished documentation or planning reports from which information was extracted for preparation of this report.

University of Minnesota	- Physical Plant
University of Minnesota	- Physical Planning
St. Mary's Hospital	- Administration
Fairview Hospital	- Administration
Augsburg College	- Administration

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St. Mary's Hospital

Fairview Hospital

Augsburg College

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VOLUME 1

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ABSTRACT

The University of Minnesota and its partners--St. Mary's and Fairview Hospitals, Augsburg College, Northern States Power Company, and possibly some small add-on customers--will develop the feasibility of a Grid-Connected Integrated Community Energy System utilizing co-generation of electricity as a byproduct of steam in an educational, residential, hospital and commercial community lying adjacent to the east and west banks of the Mississippi River, just east of the downtown business district of the City of Minneapolis, Minnesota.

The ICES will be formed by employment of production of steam for district heating and cooling, hot water for district heating and cooling, cogeneration of electricity, thermal storage, handling of health care solid waste and improvement of coal handling at an "energy production center" consisting of two central heating plants.

Retrofitting the energy "center" to form ICES will substantially increase fuel and plant efficiency resulting in lower plant fuel and process energy costs. The multiple plant sites which now exist will be interconnected and by implementation of cogeneration of electricity from steam will greatly increase plant utilization efficiency. The recovery of waste heat energy from solid waste slagging, pyrolysis gasifier and waste heat recovery boiler will reduce fossil fuel demand upon the plant. Thermal storage of heat in hot water tanks and/or sandstone strata will offset steam peaking capacity investment and increase cogeneration of electricity.

Environmental effects will be greatly decreased. Plant stack emissions will be greatly reduced by installation of baghouses to control particulates. Coal handling facilities will become cleaner and quieter. The pyrolysis system by operating at 3000° F and double burning of refuse will present far cleaner operation than present incineration facilities and reduce landfill requirements by 97%.

Central Coal handling facilities will be retrofitted to allow the development of "Special Trains" to bring coal to the plants at lower fuel costs.

Visual enhancement and public usage of the central plant areas will be achieved through construction of pedestrian corridors and green park areas. This will not only enhance the use and aesthetics of the riverfront, but also allow for first hand community "inspection" of the generating plant and the suppport facilities.

There are no known adverse effects upon human health, the standards of living or the general well being of the community residents within which ICES will operate. Environmental questions raised by regulatory agencies or the community will be answered.

EXECUTIVE SUMMARY

The development of a Grid-Connected Integrated Community Energy System (ICES) present opportunities for cost savings and multiple use of central plant steam generation facilities in the United States.

Under the right conditions, development of cogeneration techniques will save money and increasingly scarce fuel supplies. With present utility technology, less than 40% of the energy in fuel can be converted into power. The remaining energy (waste heat) is thrown to a colder heat sink for disposal. By utilizing the waste heat, such as in ICES, the amount of energy in fuel put to work can be greatly increased. For ICES this amounts to a 54% increase in fuel utilization as demonstrated on the accompanying Sankey Diagrams.

Multiple use of central plant sites enable planners and engineers to deal more effectively with the complex technical, financial, legal, and environmental tradeoffs which modern central plants have come to involve. At the same time the multiplant and multiuse site, such as ICES, makes quite a difference in planning for expansion and for the community entity. Because ICES is a closed-cycle development as far as energy production processes are concerned, large water requirements required by condensing type operations are eliminated.

The multiuse site can take better advantage of rail, barge and highway transportation for more efficient and economical fuel transportation.

The site can have a beneficial socio-economic impact upon the surrounding community because of its opportunity for progressive planning implementation. The ICES site can become a major link to overall urban District Heating schemes as these are developed. A site such as the University of Minnesota offers substantial opportunity to lead the way for the governmental and private sectors to locate a substantial amount of energy production at the load center of an entire urbanized area. The central site multiuse concept is an attractive alternative to scattered, controversial, single-use developments. A variety of energy production facilities can be incorporated to produce significant cost reduction of the forms of energy to end-users. In addition, multiple use of the site acreage produced better revenue return, and could in fact, even produce better public relations over conventional sites.

This feasibility study presents an opportunity for this Demonstration Community and ERDA to further develop and exploit the advantages of "co-energy" production. Continuing escalation of the needs and concerns of society along with the wide public attention give them will impact strongly upon ICES. We have demonstrated by this report the acceptability of ICES into this region by public regulatory agencies and community organizations. Our study has been as comprehensive and defensible as possible within the limitation of the time frame and scope of work. The ICES is flexible enough to allow for future changes in public regulation or community concerns. We developed the following philosophy to augment the ICES study:

1. We have considered all pertinent environmental, sociological, technical, legal and economic factors.
2. We employed a systematic approach built upon logic and organization.

3. The interdisciplines of professionals involved matched the environmental, engineering, and economic tasks.
4. Data and observations are backed by logical rationale with each step.

As the time for permitting and certications of ICES approaches, special attention will be required in all areas of the feasibility study. The professionalism of the report for Phase I will greatly enhance further efforts during ensuing phases. Problems by others to develop "co-energy" sites will be forseen by the experiences, especially the environmental and institutional aspects, gained here.

The partners to ICES are committed to the District Heating concept and the generation of by-product electricity because of the efficiencies of coupling heat and electrical production. The reduction of existing steam distribution pressure for ICES allows for more cogenerated electrical production in the system while maintaining an efficient and highly reliable District Heating scheme. Optimization techniques illustrated in the report lead to a defensible position for entering Phase II of the ICES program with a 7500 kilowatt straight noncondensing turbine or a 7500 kilowatt single automatic extraction turbine. The primary obstacles to this decision are development of a hot water distribution scheme and capital to demonstrate. Also, money and time during this phase did not allow optimization of the boiler feedwater temperature wherein an increase would allow more regeneration of electricity.

The primary obstacle to implementation of ICES whether it is in Minnesota or elsewhere, we believe, is the breaking down of capital barriers. ICES is highly capital intensive and risky, the effort of mobilization of that capital will affect many groups with substantial conflicts of interest. Only through federal participation in capital outlay for front end and risk capital can the pilot ICES succeed here in Minnesota, and quite possibly elsewhere. The federal government must play a central role in financing. The significant advantages of elimination of use in central plant facilities of oil and natural gas and the use of coal for such facilities must have strong backing by the federal government to convince the environmentalists that ICES is a rational undertaking. By outlays of capital the government must break down the barriers to the use of coal in the United States. These barriers are primarily a reflection of past institutional and not technical barriers. The development of previously unknown barriers must be technically researched.

As part of ICES another important concept will hopefully be demonstrated. In this country, steam more than hot water has been the primary transport medium for heating and cooling district systems. Steam is an efficient and economical system for short transmission distances and can effectively meet the needs of small, high density, urban areas. However, transmission costs and difficulty of transmission and maintainability of steam multiply with distance. This relationship has seriously affected the development of district steam heating systems in this country. As a result there has been little incentive for steam distribution to expand with the expansion of the urban area into the suburban area. We are quickly learning that hot water district heating, that can be demonstrated by ICES, is more economical and can efficiently serve a greater area than steam. Thus a small demonstration system of hot water district heating should be federally funded because this policy will appear to be mandatory for the future development of urban (andeventually suburban) district heating in the United States.

Another area to be addressed by ICES is a specific need for waste management and disposal of solid waste generated by health care industries. The planning for urban solid waste management now typically involves objectives of either or both resource and energy recovery. The ICES program presented offers a definite opportunity for solution to a solid waste management problem specifically related to the Twin Cities Metropolitan Region (TCMR) and we feel nationally, while incorporating energy recovery as a major part of the solution.

The specific problem is the proper collection and disposal of solid waste generated from health care facilities. Historically, hospitals have periodically experienced difficulties in disposing of their solid waste in municipal disposal facilities. Internal processing through incineration has also met with difficulties, due to tight environmental controls, and segregation techniques initiated to limit problematical categories from public concern has met with limited success. Most hospital administrations indicate problems with managing their solid waste in the community, but are usually restricted in alternatives because of economic constraints.

ICES calls for the development of a speciality disposal system designed and integrated into the program to satisfy this urban need. Other TCMR solid waste planning would be free to continue with their otherwise comprehensive programs, according to energy and resource recovery objectives, while the health care industry would gain some economies of scale and specialized handling through a regional management system. Energy recovery from the speciality system is also integrated into the ICES to off-set disposal cost to the health care industry.

High temperature incineration, by vertical-shaft, slagging pyrolysis and secondary high temperature combustion has been selected as the most desirable hardware concept for disposal. It is a simple system in concept, will accept solid waste without front-end processing, and is a positive disposal (output only through inert, sterile slag, or 2500° F gas combustion). It is also flexible enough in operation to accommodate the wide range of organics and moisture found in this type of solid waste. Sensible heat recovery by steam generation is the mode of waste energy recovery.

As with other concepts in the candidate ICES program, federal financial support will be considered paramount in this projects initiation, and it will very likely not become a reality without it.

Regulation of the solid waste is currently governed by the Minnesota Health Department, Minnesota Pollution Control Agency, the respective County of the facility, and the Metropolitan Council presenting several institutional barriers that will be investigated. Aside from these institutional barriers that must be bridged, the economics to the respective health care facility must present a favorable advantage to their existing system of disposal, otherewise the administrators will have reluctance to participate "in-the-face" of other escalating administrative cost.

The special waste collection and disposal system, integrated into the ICES, gaining credits through energy recovery, through fuel credits and offering a positive solution to a substantial community need, must be considered an important part of the ICES program.

Specifically, ICES focuses on modifications to the University of Minnesota, Minneapolis Campus central heating plant, wherein the capability of generating additional steam and by-product electricity will be established by retrofitting a retired Northern States Power generating plant, Southeast Steam Plant. The plant will be brought back on coal and the generating cycle will be changed from condensing to noncondensing. The generating amount of by-product electricity will be controlled by heating and cooling requirements of the Community. The maximum amount of cogeneration fed only into the Power Company's Grid will occur when all the off-heat from the generation of electricity can be gainfully utilized by the Community's established heating and cooling system. River water or cooling towers, which represent significant heat loss, will not be utilized in the ICES concept. We project an energy reduction of 5,270 BTU per kilowatt of generation by ICES when compared to the Utility Company's large fossil fuel-fired plants. This is a 54% reduction.

The second area of importance in the proposed ICES involves the installation of a pyrolysis system for the safe disposal of infectious and hazardous waste, which will represent approximately 10% by weight of the total waste collected. In addition to furnishing a long-term method for disposing of this type of waste, a low BTU gas will be generated, which will be burned in the Southeast plant as a supplement to its fossil fuel requirements.

A third area of importance is the adding on of a Community gas/oil committed loads to the University of Minnesota coal-fired system. For several years, the two Hospitals--St. Mary's and Fairview--have had deep concern about the future availability of natural gas and oil. The St. Mary's Hospital plant, as well as others, (such as the plant at Augsburg College) will be decommissioned by ICES.

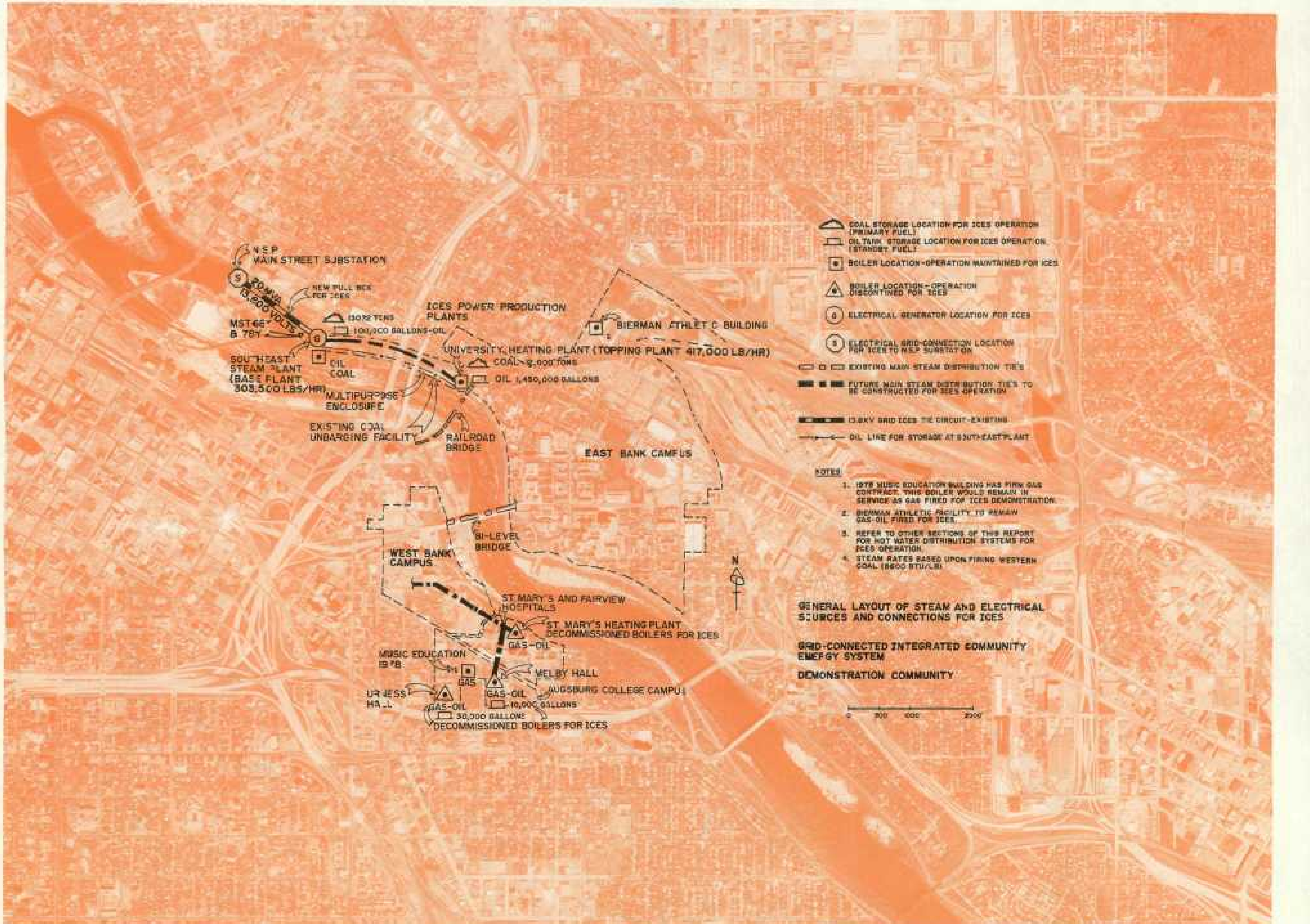
A fourth area being investigated is the conversion of part of our steam distribution to variable flow and variable temperature hot water district heating. Economics and urban spread as energy and construction costs escalate indicate that hot water will most likely be the distribution system of the future. Along with the distribution studies, thermal storage of cogeneration off-heat is being investigated.

The acquisition of Southeast Steam will require the present coal unloading (barge and rail) facilities to be upgraded for economical and environmental reasons. Presently, it takes 12 hours to unload a barge and involves 70 to 140 truck loads to transport the coal from the unbarging dock to storage bunkers. The study includes the costing and environmental improvements of converting to an automated, totally enclosed transfer system, or as an alternative development of special trains from the Montana coal fields. These changes could result in a savings of up to $5 per ton of delivered coal ($22 to $17 per ton).

Because of the complexity and diversity of ICES and concerns of environmentalists, regulatory agencies and other special interest groups, the above areas should be given equal weight in judging the qualifications of ICES respondents. Not only capital and technical criteria impact upon its successful development, but also the institutional and socio-economics will play equal roles. The University has demonstrated its capacity to manage and solve the problems associated with all areas of ICES. It has developed a rational policy that can be used nationally for future "co-energy" production facilities.

The residents of the Twin City area are deeply concerned about their environment, but they are also willing to accept rational, judicious tradeoffs to develop a more efficient use of primary resources. This could not be amplified more adequately than by ERDA's selection of the Twin Cities for studies of urban District Heating by a Swedish consultant.

Stating again, the University has met the objectives of ICES selection that will be acceptable to the public, the environmentalists, the regulatory agencies, and the partners, Northern States Power, St. Mary's and Fairview Hospitals and Augsburg College.


N.S.P. MAIN STREET SUBSTATION
20 MVA 13,800 VOLTS
NEW PULL BOX FOR ICES
MST 66 B 787
ICES POWER PRODUCTION PLANTS
13072 TONS
100,000 GALLONS-OIL
SOUTHEAST STEAM PLANT (BASE PLANT 303,500 LBS/HR)
OIL COAL
MULTIPURPOSE ENCLOSURE
EXISTING COAL UNBARGING FACILITY
RAILROAD BRIDGE
UNIVERSITY HEATING PLANT (TOPPING PLANT 417,000 LB/HR)
COAL - 2,000 TONS
OIL 1,450,000 GALLONS
BIERMAN ATHLETIC BUILDING
EAST BANK CAMPUS
WEST BANK CAMPUS
BI-LEVEL BRIDGE
ST. MARY'S AND FAIRVIEW HOSPITALS
ST. MARY'S HEATING PLANT DECOMMISSIONED BOILERS FOR ICES
GAS-OIL
MUSIC EDUCATION 1978
GAS
MELBY HALL
AUGSBURG COLLEGE CAMPUS
GAS-OIL
10,000 GALLONS
URNESS HALL
GAS-OIL
30,000 GALLONS
DECOMMISSIONED BOILERS FOR ICES
N
COAL STORAGE LOCATION FOR ICES OPERATION (PRIMARY FUEL)
OIL TANK STORAGE LOCATION FOR ICES OPERATION (STANDBY FUEL)
BOILER LOCATION-OPERATION MAINTAINED FOR ICES
BOILER LOCATION-OPERATION DISCONTINUED FOR ICES
ELECTRICAL GENERATOR LOCATION FOR ICES
ELECTRICAL GRID-CONNECTION LOCATION FOR ICES TO N.S.P. SUBSTATION
EXISTING MAIN STEAM DISTRIBUTION TIE'S
FUTURE MAIN STEAM DISTRIBUTION TIE'S TO BE CONSTRUCTED FOR ICES OPERATION
13.8KV GRID ICES TIE CIRCUIT-EXISTING
OIL LINE FOR STORAGE AT SOUTHEAST PLANT
NOTES
1. 1978 MUSIC EDUCATION BUILDING HAS FIRM GAS CONTRACT. THIS BOILER WOULD REMAIN IN SERVICE AS GAS FIRED FOR ICES DEMONSTRATION.
2. BIERMAN ATHLETIC FACILITY TO REMAIN GAS-OIL FIRED FOR ICES.
3. REFER TO OTHER SECTIONS OF THIS REPORT FOR HOT WATER DISTRIBUTION SYSTEMS FOR ICES OPERATION.
4. STEAM RATES BASED UPON FIRING WESTERN COAL (8600 BTU/LB)
GENERAL LAYOUT OF STEAM AND ELECTRICAL SOURCES AND CONNECTIONS FOR ICES
GRID-CONNECTED INTEGRATED COMMUNITY ENERGY SYSTEM
DEMONSTRATION COMMUNITY
0 300 600 2000

GRID-CONNECTED INTEGRATED COMMUNITY ENERGY SYSTEM FOR UNIVERSITY COMMUNITY

GENERATION OF BYPRODUCT ELECTRICITY

PLANT UTILIZATION INCREASED BY 54%

UTILITY BENEFITS GAINED BY PEAKING CAPACITY

HEALTH CARE INDUSTRY WASTE DISPOSAL

HEALTH CARE INCINERATORS ARE MARGINAL

PYROLYSIS PROCESS IS 70% EFFICIENT

ENERGY RECOVERY FROM WASTES PROVIDES 2 LBs STEAM PER POUND OF WASTE

LANDFILL REDUCTION - 97% BY VOLUME

THERMAL DISTRIBUTION

STEAM - GENERATION OF BYPRODUCT ELECTRICITY AND COMMUNITY HEATING

HOT WATER - REGENERATION OF ELECTRICITY AND COMMUNITY HEATING

THERMAL STORAGE

DIURNAL - DEGRADATION ENERGY CONSERVING, INCREASE IN BYPRODUCT GENERATION

SEASONAL - REDUCTION IN PLANT CAPACITY AND INVESTMENT

CENTRAL PLANT SITE

REDUCED PLANTS IN COMMUNITY

TRANSFER OF CRITICAL RESOURCES (OIL, GAS) TO COAL

IMPROVED USE OF PRIMARY RESOURCE-COAL

ENVIRONMENTAL QUALITY

PUBLIC FACILITIES AND USEAGE

IMPROVED COAL HANDLING

IMPROVED AIR QUALITY

ONE CENTRAL PLANT

CLOSED SYSTEM CYCLE

SOCIO-ECONOMIC

IMPROVED UTILIZATION OF NATURAL RESOURCES

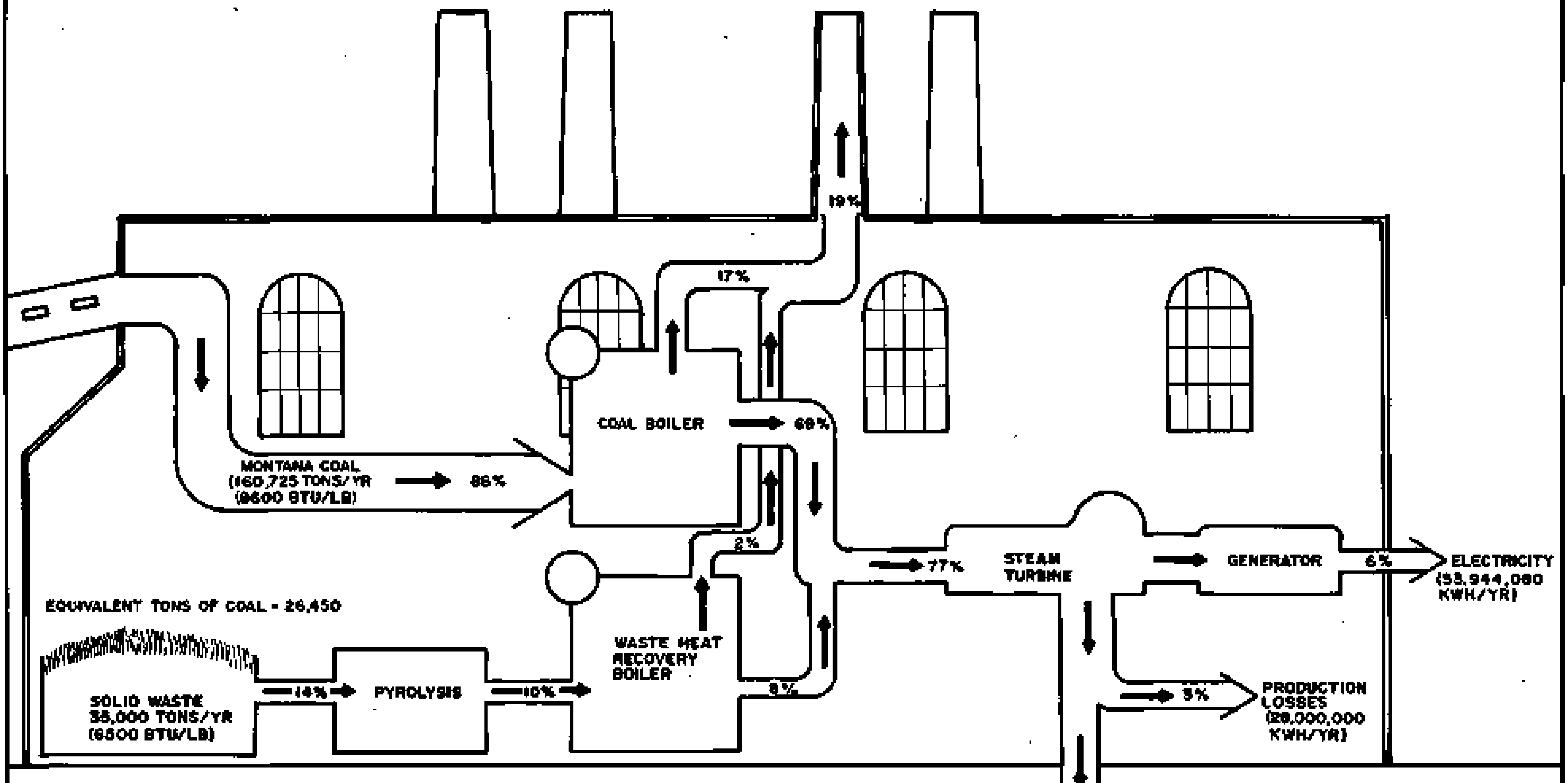
IMPROVED ENVIRONMENT

REDUCED HEATING COSTS AS DEREGULATION OF GAS AND OIL AND CURTAILMENT OF NATURAL GAS - OIL SUPPLIES OCCURS

MODEL SYSTEM READY FOR INTEGRATION INTO URBAN

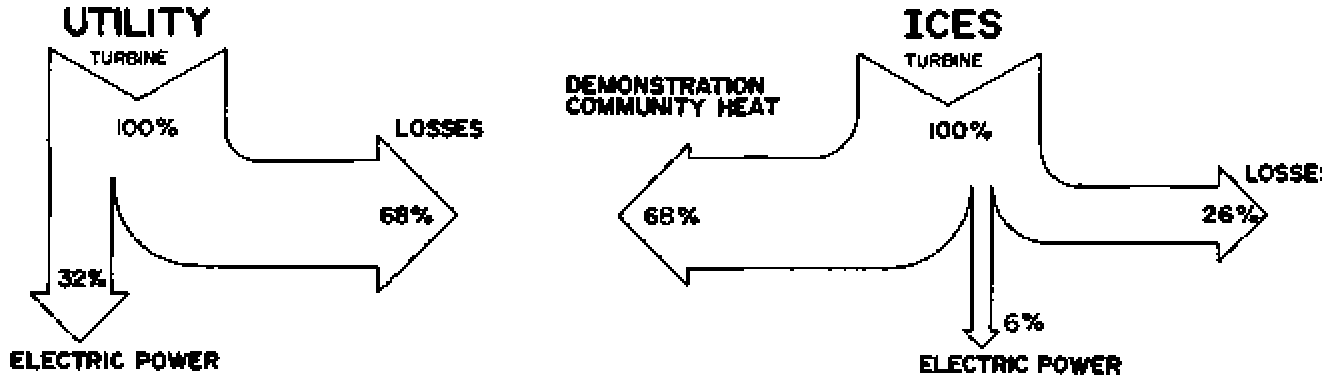
DISTRICT HEATING SYSTEM

PROVIDES ECONOMICAL SITE FOR FUTURE STUDY



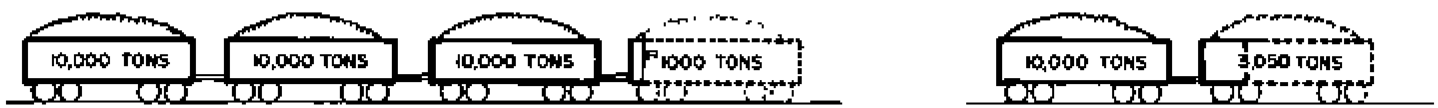
ANNUAL ICES PLANT CAPACITY UTILIZATION = 81.54%
ICES FUEL EFFICIENCY WITHOUT PYROLYSIS = 77% = 4430 BTU/KWH
ICES FUEL EFFICIENCY WITH PYROLYSIS = 74.00%
TYPICAL UTILITY FUEL EFFICIENCY = 32.00% = 10,662 BTU/KWH

UNIVERSITY OF MINNESOTA	GRID ICES FUEL UTILIZATION EFFICIENCY SCHEMATIC	BY G.D.M.	BUILDING	SCALE	SHEET
		CHECKED J.O.	DATE 4-29-77	REVISED 6-22-77	DRAWING 50



FUEL NEEDED TO PRODUCE 50,000,000 KWH OF ELECTRICITY

UTILITY | ICES



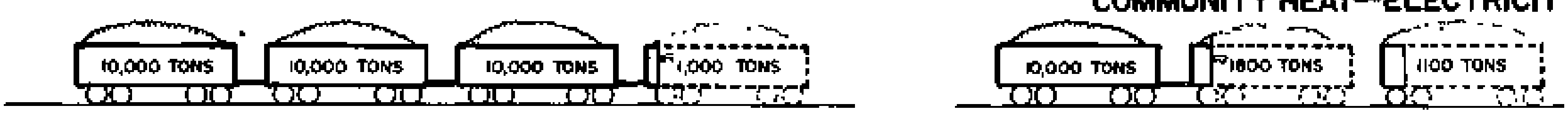
UTILITY: EQUIVALENT TONS OF COAL 31,000 TONS

ICES: EQUIVALENT TONS OF COAL 13,050 TONS

FUEL NEEDED TO PRODUCE EQUAL AMOUNTS OF USEFUL ENERGY

UTILITY (ELECTRICITY ONLY) | ICES

COMMUNITY HEAT—ELECTRICITY

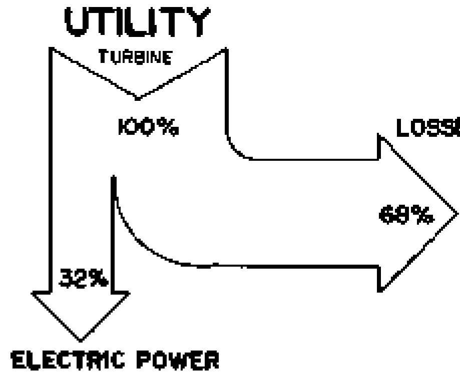


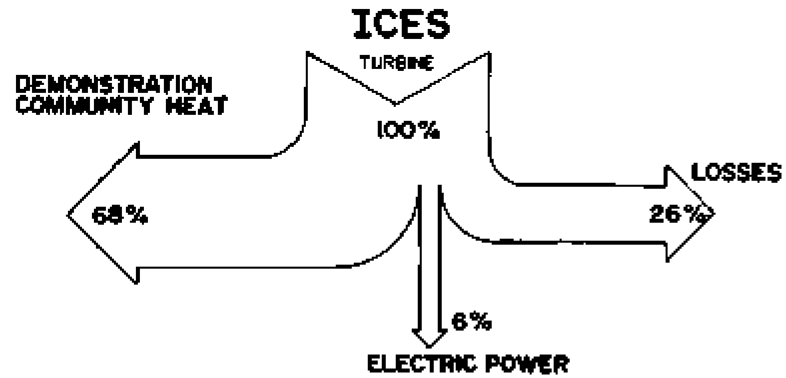
UTILITY: EQUIVALENT TONS OF COAL 31,000 TONS

ICES: EQUIVALENT TONS OF COAL 12,900 TONS

NOTE: NORMAL CARLOADS ARE 100 TONS

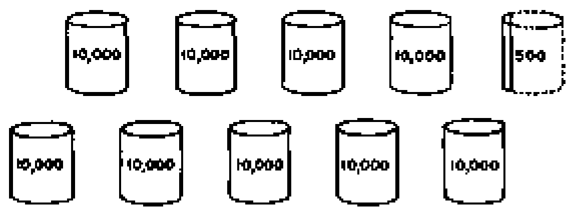
UNIVERSITY OF MINNESOTA	GRID ICES SANKEY AND FUEL COMPARISION DIAGRAMS: UTILITY VS ICES	BY GDM	BUILDING	SCALE	SHEET
		CHECKED J.O	DATE 5/5/77	REVISED 6-22-77	DRAWING 55





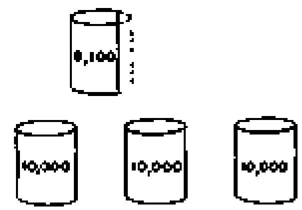
FUEL NEEDED TO PRODUCE 50,000,000 KWH OF ELECTRICITY

UTILITY



EQUIVALENT BARRELS OF OIL
90,500

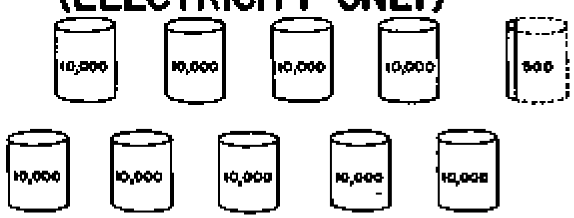
ICES



EQUIVALENT BARRELS OF OIL
38,100

FUEL NEEDED TO PRODUCE EQUAL AMOUNTS OF USEFUL ENERGY

UTILITY (ELECTRICITY ONLY)



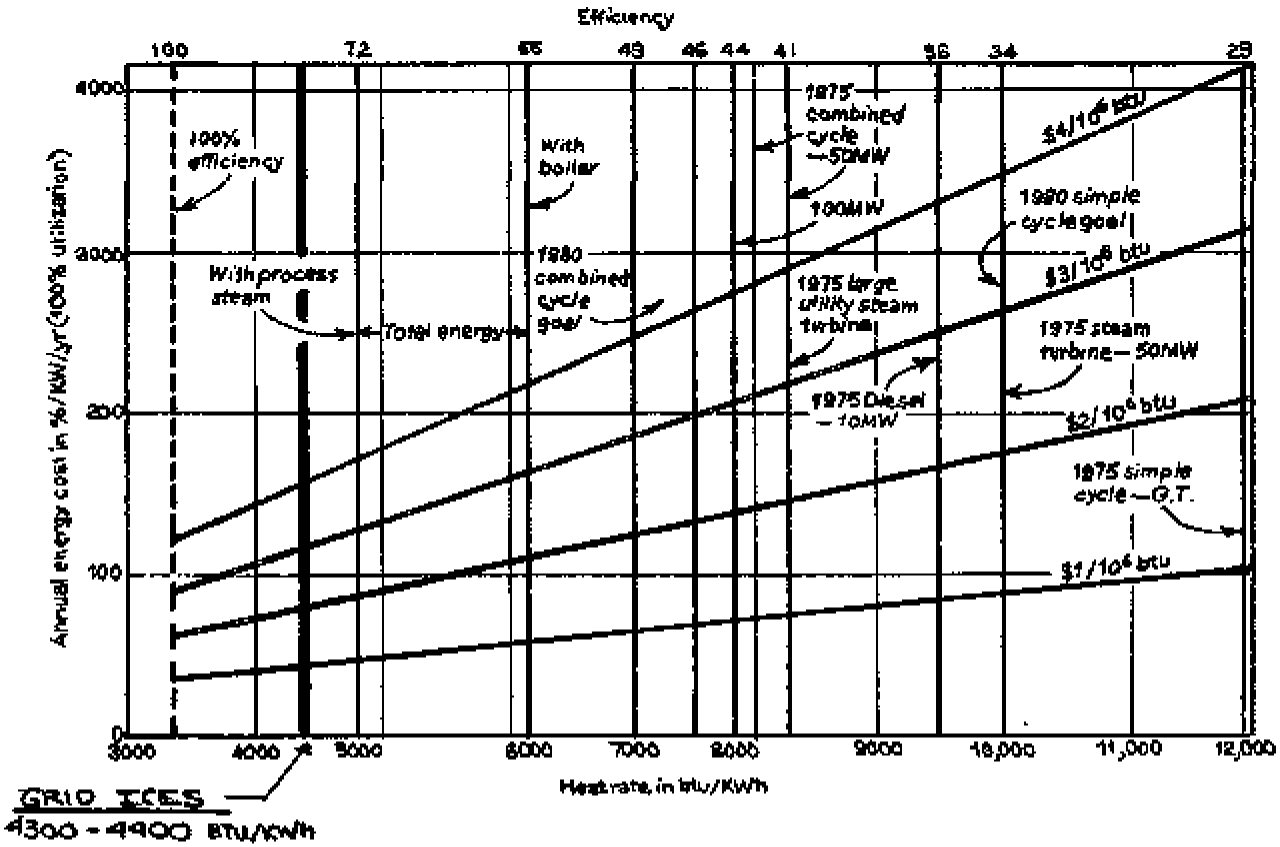
EQUIVALENT BARRELS OF OIL
90,500

ICES

COMMUNITY HEAT — ELECTRICITY

EQUIVALENT BARRELS OF OIL
37,700

UNIVERSITY OF MINNESOTA	GRID ICES SANKEY AND FUEL COMPARISION DIAGRAMS: UTILITY VS ICES	BY GOM	BUILDING	SCALE	SHEET
		CHECKED J.O	DATE 5/5/77	REVISED 6-27 77	DRAWING 51



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UNIVERSITY OF MINNESOTA	COMPARISON OF ENERGY COST AND HEAT RATE FOR TYPICAL ENERGY - CONVERSION SYSTEM COMPARED TO ICES.	BY A.E.A	BUILDING	SCALE N.S.	SHEET
		CHECKED J.O	DATE 3/25/77	REVISED	DRAWING 40

1.0 SITE OVERVIEW

As shown on the site maps and schematics, the Demonstration Community is located on the Mississippi River, a major transportation artery, in an urban residential, educational, commercial and industrial area of the City of Minneapolis, located in the mid-central eastern edge of Minnesota. The river flows southeasterly through the ICES Community.

Changes in weather are frequent, both summer and winter, because of high and low pressure systems moving across the Northern United States from west to east. In general, there is a tendency to extremes in all climatic features.

Prevailing winds are from the northwest. Average temperatures range from a mean of 70° F in July to 16° F in January. Extremes ranges from -34° F to 102° F. Relative humidity is high winter and summer. Annual mean precipitation is 17 inches with a mean snowfall of 45 inches.

The ICES Community is situated on bluffs above the river and is connected by a two-level pedestrian-traffic bridge across the river, the upper level being owned by the University.

St. Mary's and Fairview Hospitals and Augsburg College are located approximately two city blocks from the West Bank Campus.

The campuses and the hospital system are typical of large university campuses and metropolitan hospital systems.

The community adjacent to the Demonstration Community consists of residential, educational and small commercial facilities. The campuses and the hospital systems are ringed by three interconnecting major freeway systems: (1) Interstate 94, (2) Interstate 35W, (3) State 280.

The Demonstration Community is connected to the surrounding community by common pedestrian and traffic thoroughfares.

The Demonstration Community has an occupancy space of 12,150,000 gsf and will expand to 13,300,000 gsf by 1980.

The steam distribution networks are existing except for the extensions which will interconnect the systems of the partners and the two central plants. Hot water distribution will be placed in existing tunnel systems and will be utilized by the University initially.

As will be shown in the report, climatic conditions are relatively stable on a diurnal basis, but vary considerably from season-to-season. Reasonable demands for cooling in the summer and heating in the winter, and a year round operation of the Community create an annual thermal capacity utilization factor of 81%.

The environmental quality of the Community and the surrounding area will not be depreciated, but will be enhanced by lower air pollution, development of a pedestrian corridor along the river, and clean-up of a landmark on the Mississippi River, the so called "Four Stacker" Southeast Steam Plant.

1.1 GEOGRAPHICAL LOCATION

The University of Minnesota, Minneapolis Campuses (East and West Bank Campuses), St. Mary's and Fairview Hospitals, and Augsburg College comprises an area of some 282 acres (12,283,920 sq. ft.) located on high bluffs along the Mississippi River approximately 1 mile east from the downtown business district of Minneapolis.

As shown on the accompanying "metro location" map the Demonstration Community is located at the heart of a seven county metropolitan area surrounding the cities of Minneapolis and St. Paul, the so called Twin Cities of Minnesota.

The Demonstration Community is located entirely within the City of Minneapolis, Minnesota. The University is the largest city campus university in the United States with an enrollment of 55,000 full-time day students. It also operates extension classes for 25,000 students.

The convenient location of the Community within the metro area has allowed the partners to ICES to conveniently and economically offer centralized educational and health care services to the region and the state.

The Community is connected by freeway bridges, and a two-level pedestrian traffic bridge across the river; the upper pedestrian level being owned by the University. The Mississippi River and its bluffs have recently been designated a critical area by the State of Minnesota. The bluffs along the west bank have been reserved for open space even though they are generally inaccessible especially below the hospitals.

The river flats below the West Bank Campus are being returned gradually to open space uses from their current commercial coal, oil and sand storage operations. The east bank of the river just below the East Bank Campus is generally inaccessible except for a large city park area below University Hospitals. The east bank of the Mississippi River upstream of the University Heating plant has also been designated a critical area but is designated a thermal and electrical power production area. Various community interests, the University, and the Minneapolis Park Board have established some pedestrian corridors which ICES will enhance. The development of the ICES will answer to these park needs and will in part be handled by development of a multi-purpose overhead enclosure or tunnels for transport of people, oil, coal, and energy products of steam and hot water.

St. Mary's and Fairview Hospitals, and Augsburg College are located approximately 2 city blocks southeast from West Bank Campus. The West Bank Community (West Bank Campus, St. Mary's and Fairview Hospitals, Augsburg College) are located in the midst of one of the older communities in the Twin Cities. This area, known as the Cedar-Riverside area is undergoing a revitalization and redevelopment involving the cultural, living and business communities.

The West Bank Community is primarily made up of the University, St. Mary's and Fairview Hospitals, Augsburg College, some commercial space, and a mixture of low and medium density housing. Until a few years ago housing had been primarily single family or low density. Very recently, however, Cedar-Riverside West was constructed as a high density apartment tower. Cedar-Riverside was initially one of seven H. U. D. new communities in the nation. It was projected to house and service a population of 30,000 by the development of five urban neighborhoods. This development has bee marked by financial problems the past few years and any further development beyond the present complex is highly questionable at this time. Any business venture regarding sale of steam or hot water via ICES with Cedar-Riverside at this time would not be in the best interest of ICES.

East Bank Campus is located in a primarily residential-small commercial-industrial section of the city. The general character of single family residential is gradually changing to multi-family units.

Adjacent to the University's East Bank Campus are three distinct neighborhoods: Como, University District Improvement Area/Holmes, and Motely/Prospect Park Community.

The Como neighborhood is somewhat removed from the area of direct campus influence. It is comprised mainly of people who work at the University, the Como Research and Service Center, a support facility of the University, and some light commercial service such as neighborhood stores and shops.

The U.D.I.A./Holmes neighborhood is uniformly residential with the exception of a small commercial area, Dinkytown. Efforts are now underway to restrain private construction of additional rental units. The Holmes portion of U.D.I.A. has been selected as an urban renewal area. Within the area the University operates a dormitory, Sanford Hall; faculty housing, Pillsbury Court; and the Chateau, a student non-profit apartment.

Bordering on the southeastern edge of the East Bank Campus is a predominantly residential neighborhood referred to as Motely/Prospect Park. Some fraternities and rental housing coexist with owner-occupied family housing. Adjacent to Motely/Prospect Park the University leases space along the University Avenue edge of this neighborhood.

Aerial photographs and area maps are presented at the end of this section to show the Demonstration Community as it exists in 1977. Land areas and design communities will be dealt with in Volume 5 of this report.

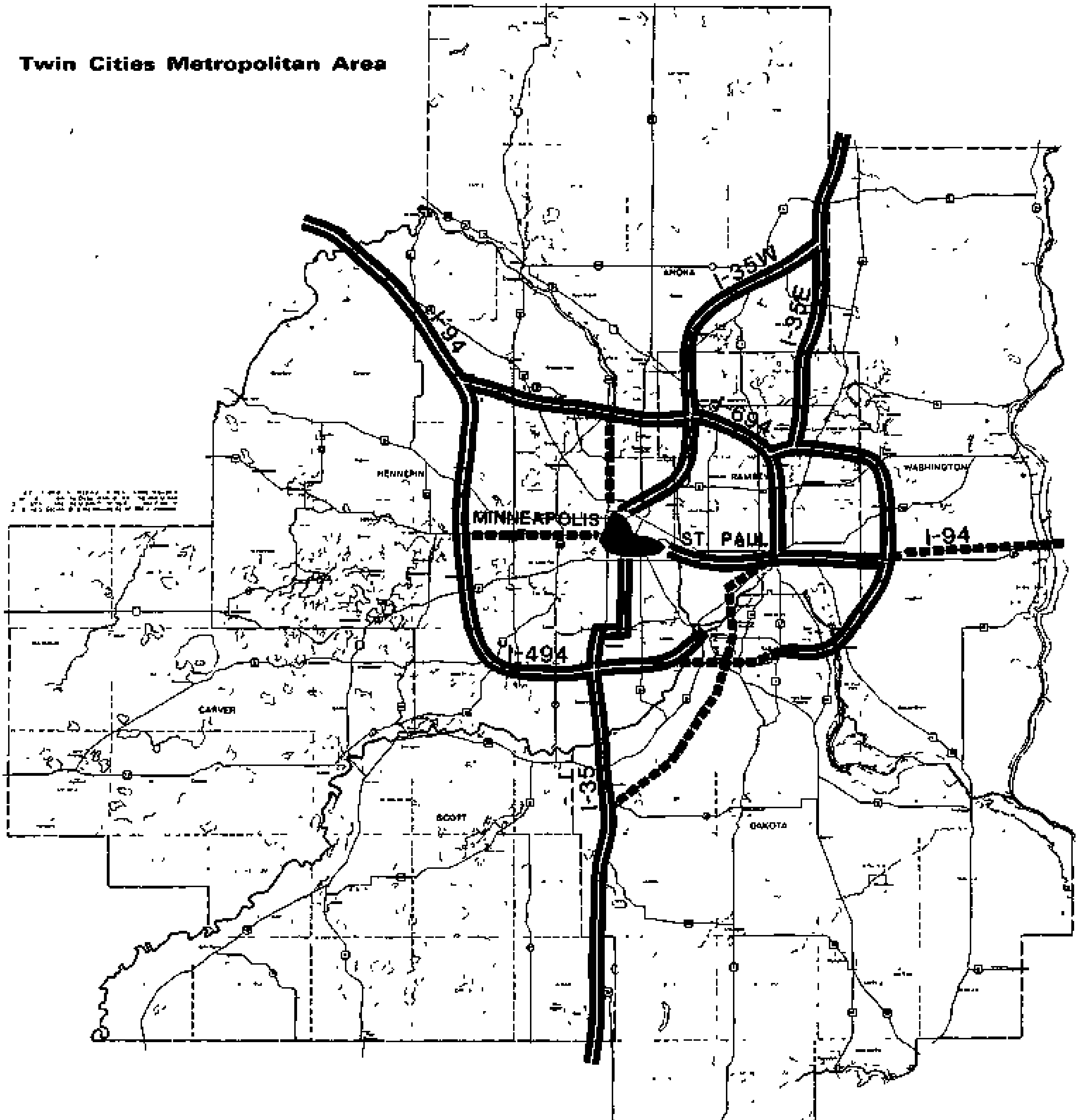
The aerial photograph entitled "land Areas" also gives the location of the University Heating Plant, Southeast Steam Plant and Main Street Substation which will form the heart of the ICES thermal and electrical production. All aerials open so that north is the top of the page.

Land Areas - 1977

Facility	Acreage Owned	*Gross Square Feet Owned
East Bank - West Bank	232	10,105,920
St. Mary's Hospital	20	871,200
Fairview Hospital	11	479,160
Augsburg College	25	1,089,000
Total	288 acres	12,545,280 gsf

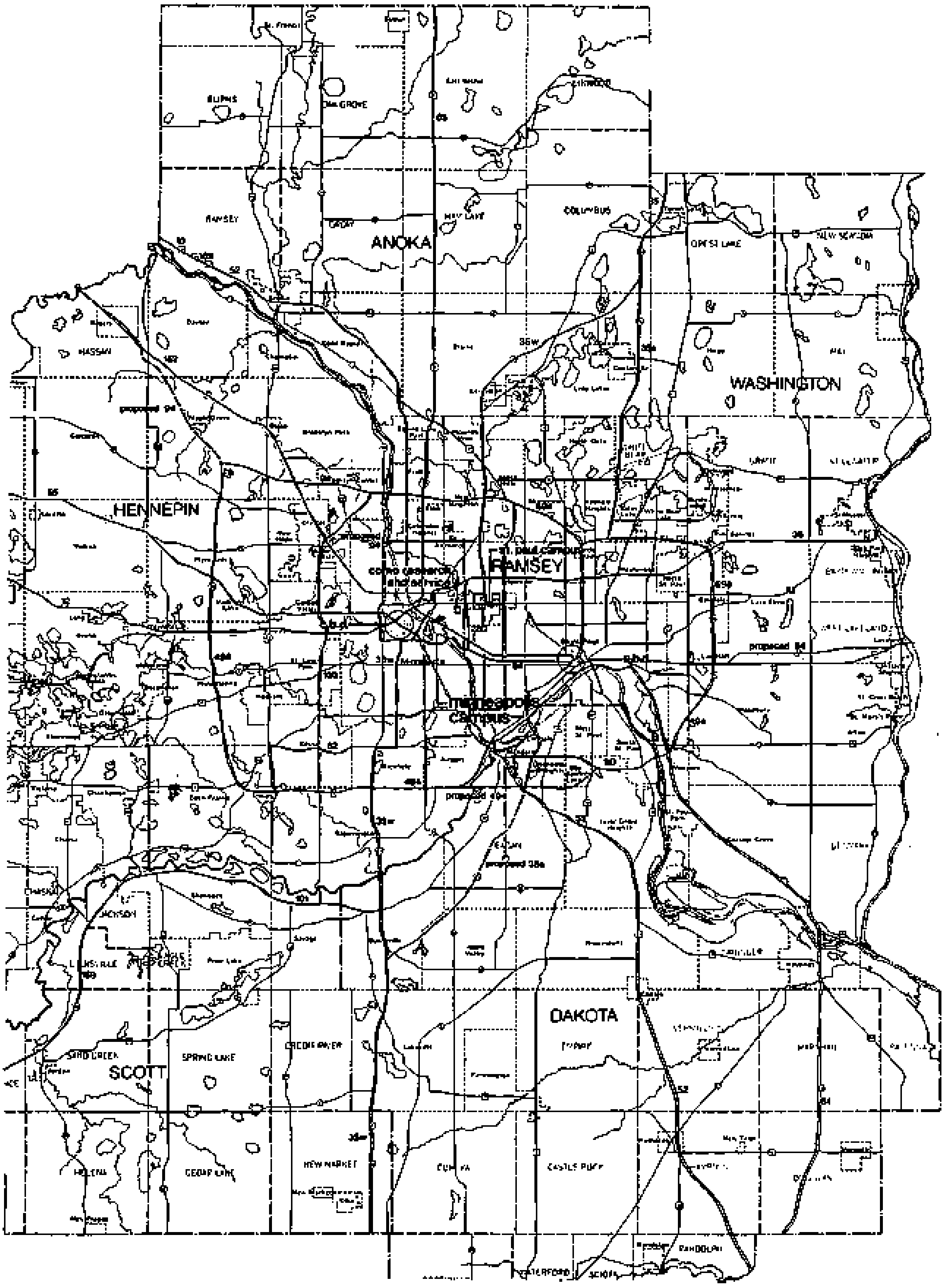
*1 acre = 43,560 square feet

Twin Cities Metropolitan Area



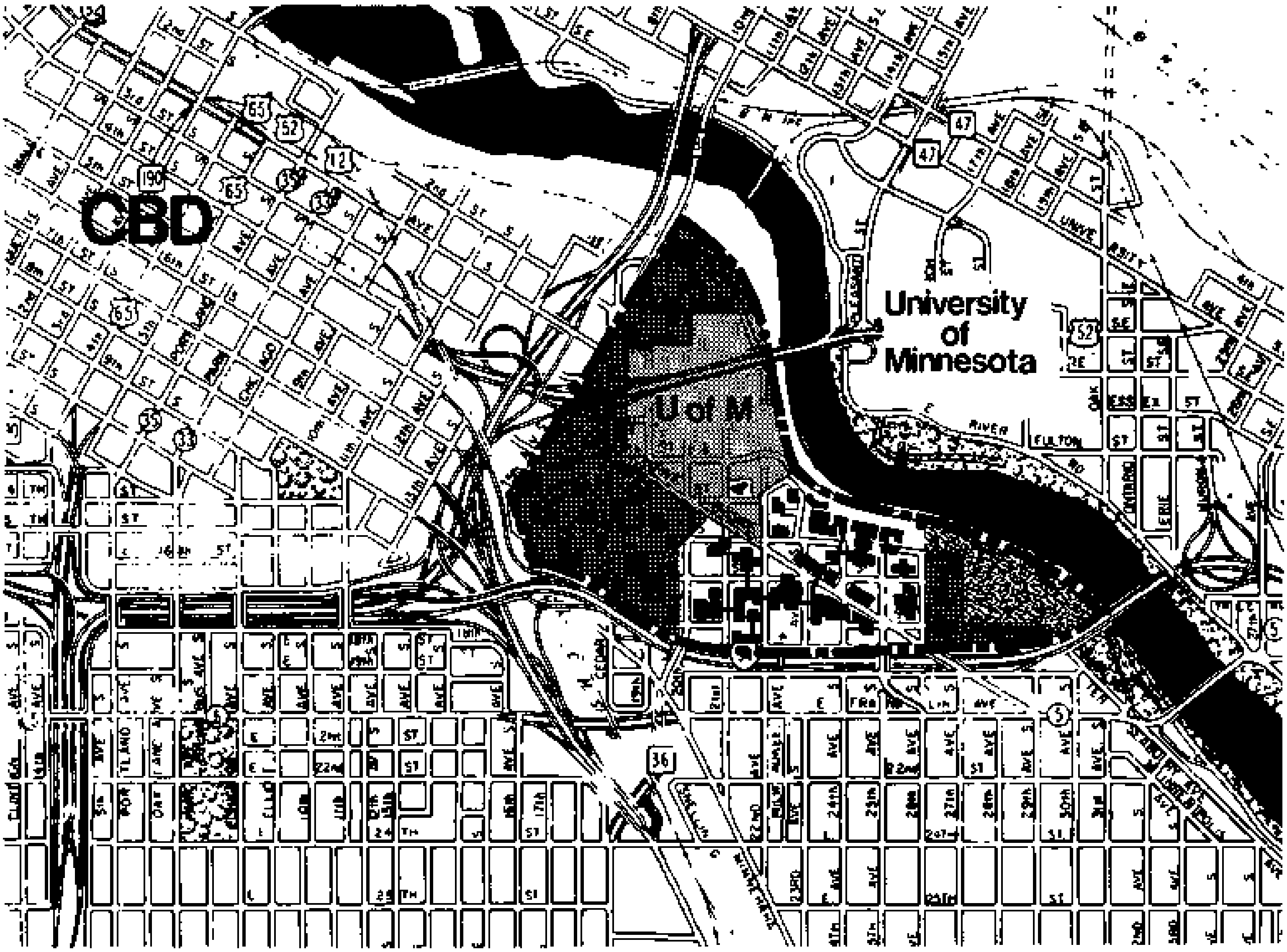
base map by Metro Council

me ro location

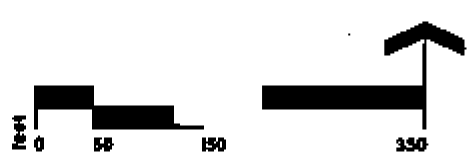


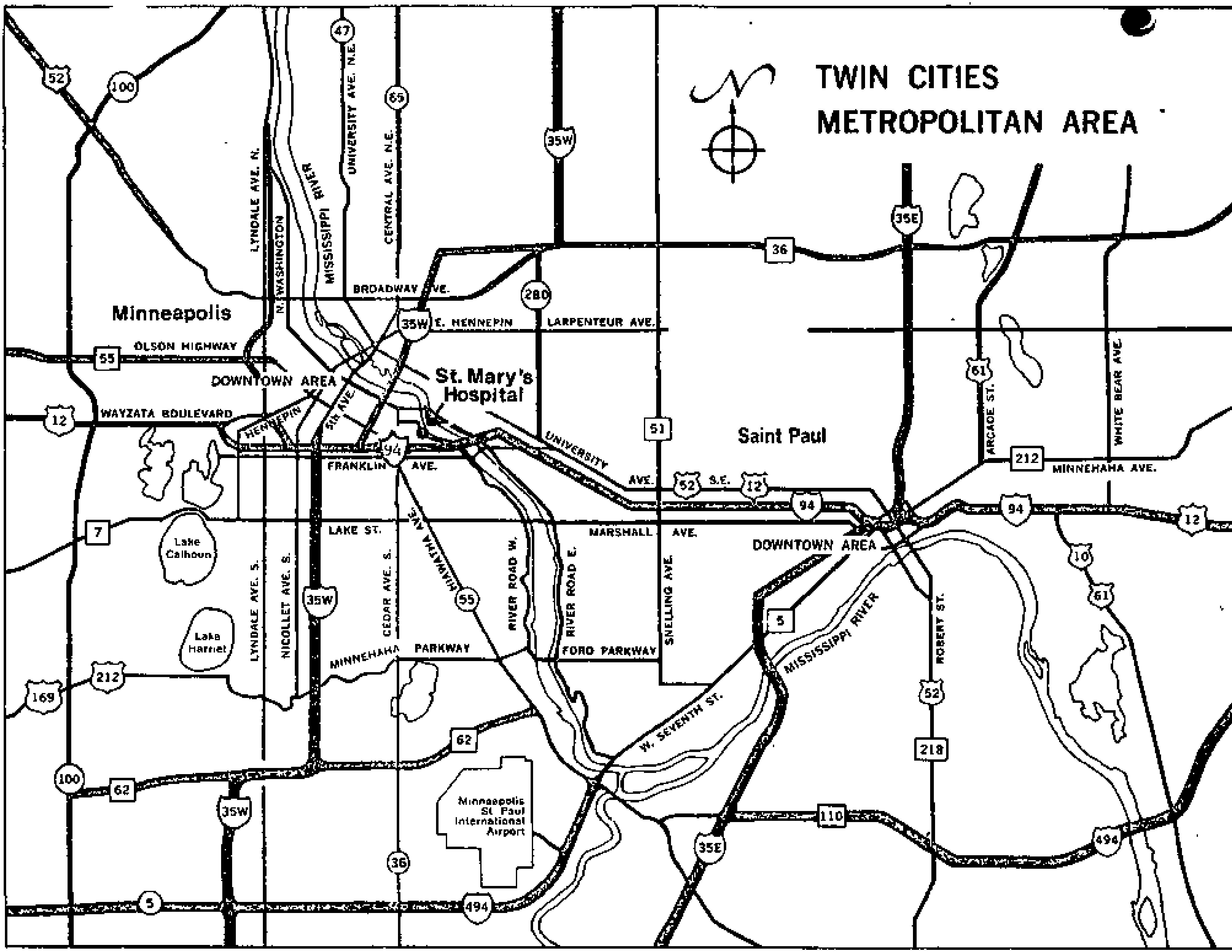
campus location within the metropolitan area

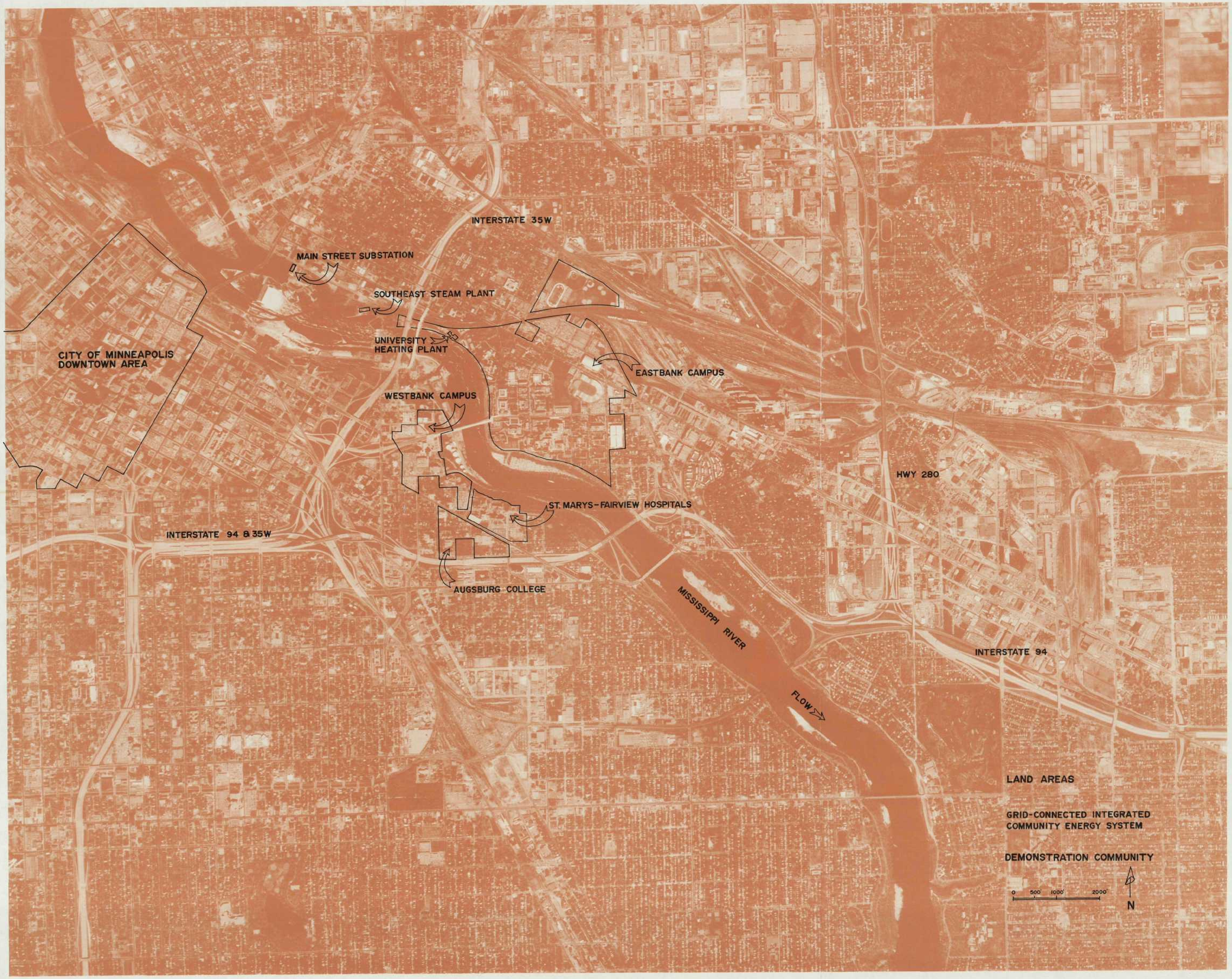
university of minnesota
minneapolis campus



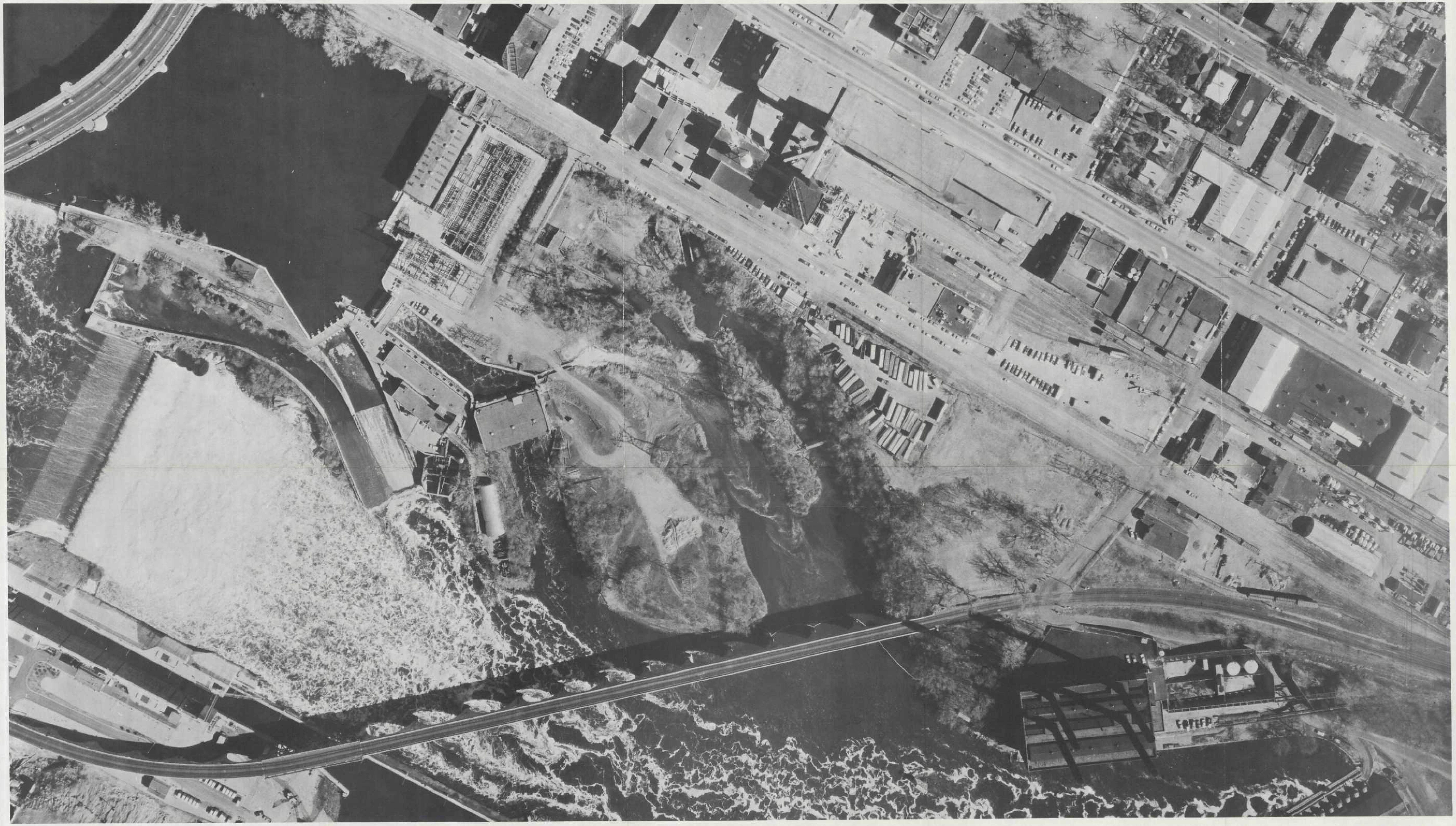
area loca ion




TWIN CITIES
METROPOLITAN AREA
Minneapolis
Saint Paul
St. Mary's Hospital
DOWNTOWN AREA
DOWNTOWN AREA
OLSON HIGHWAY
WAYZATA BOULEVARD
BROADWAY AVE.
E. HENNEPIN
LARPENTEUR AVE.
HENNEPIN
5th AVE.
FRANKLIN AVE.
UNIVERSITY AVE. S.E.
MINNEHAHA AVE.
LAKE ST.
MARSHALL AVE.
LYNDALE AVE. N.
N. WASHINGTON
MISSISSIPPI RIVER
UNIVERSITY AVE. N.E.
CENTRAL AVE. N.E.
LYNDALE AVE. S.
NICOLLET AVE. S.
CEDAR AVE. S.
HIAWATHA AVE.
RIVER ROAD W.
RIVER ROAD E.
SNELLING AVE.
ROBERT ST.
ARCADE ST.
WHITE BEAR AVE.
MINNEHAHA PARKWAY
FORD PARKWAY
W. SEVENTH ST.
MISSISSIPPI RIVER
Lake Calhoun
Lake Harriet
Minneapolis St Paul International Airport


INTERSTATE 35W
MAIN STREET SUBSTATION
SOUTHEAST STEAM PLANT
UNIVERSITY HEATING PLANT
CITY OF MINNEAPOLIS DOWNTOWN AREA
EASTBANK CAMPUS
WESTBANK CAMPUS
HWY 280
ST. MARYS-FAIRVIEW HOSPITALS
INTERSTATE 94 & 35W
AUGSBURG COLLEGE
MISSISSIPPI RIVER
INTERSTATE 94
FLOW
LAND AREAS
GRID-CONNECTED INTEGRATED COMMUNITY ENERGY SYSTEM
DEMONSTRATION COMMUNITY
0 500 1000 2000
N


SOUTHEAST
STEAM PLANT
EXISTING MINNEAPOLIS
CAMPUS HEATING PLANT
INT 35W
10th AVE
EXISTING VIEW LOOKING NORTH



Mark Hurd
AERIAL SURVEYS, INC.
MINNEAPOLIS, MINN.
SANTA BARBARA, CALIF. · SAN JUAN, P.R.

DATE OF PHOTOGRAPHY
APRIL 19, 1974

SCALE 1" = 100'

N

MINNEAPOLIS
HENNEPIN COUNTY
MINNESOTA
METROPOLITAN AREA

SHEET 56B

Mark Hurd
AERIAL SURVEYS, INC.
MINNEAPOLIS · MINN.
SANTA BARBARA · CALIF · SAN JUAN · P.R.

DATE OF PHOTOGRAPHY
APRIL 19, 1974

SCALE 1" = 100'

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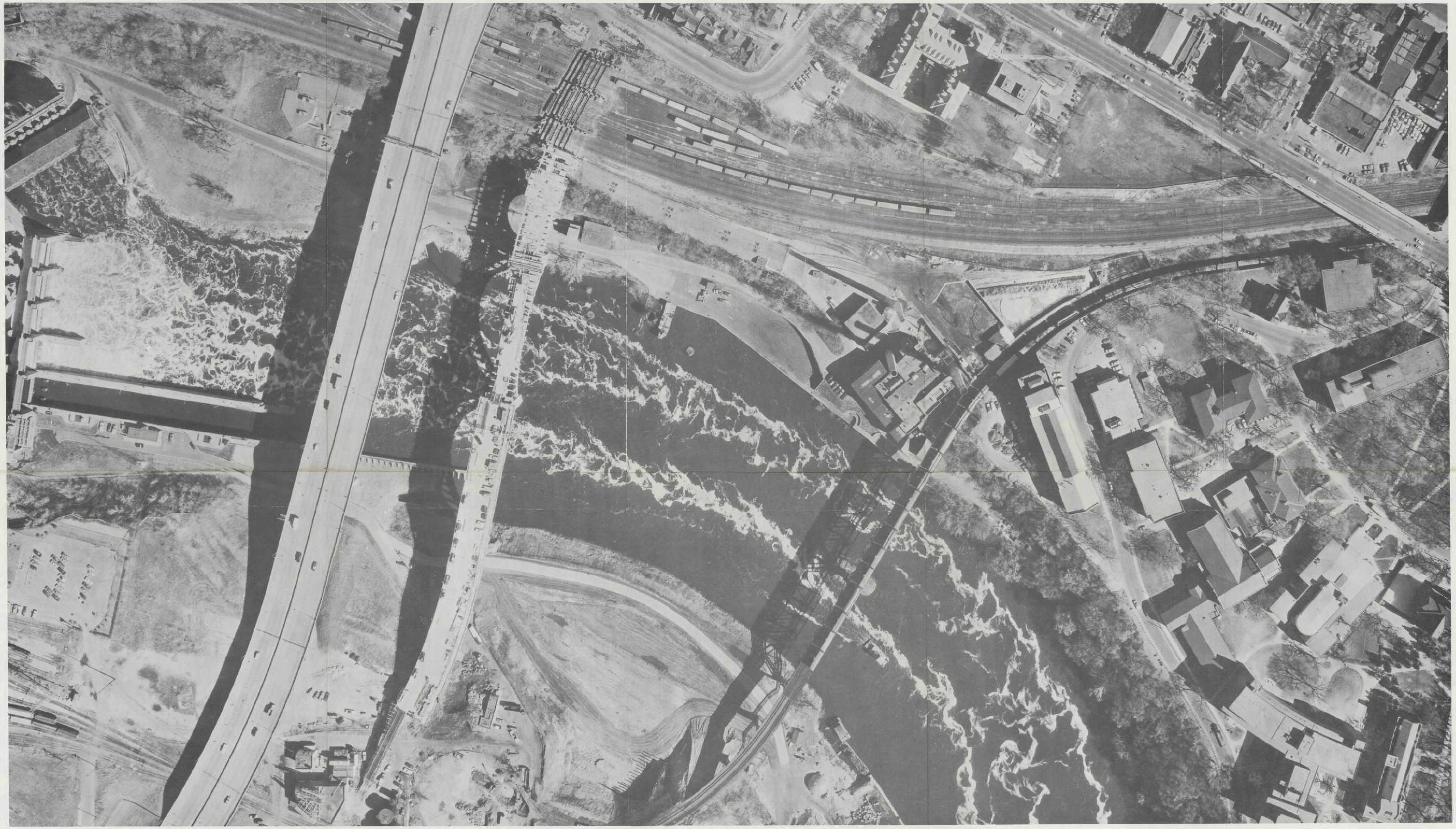
MINNEAPOLIS
HENNEPIN COUNTY
MINNESOTA
METROPOLITAN AREA

SHEET 58A



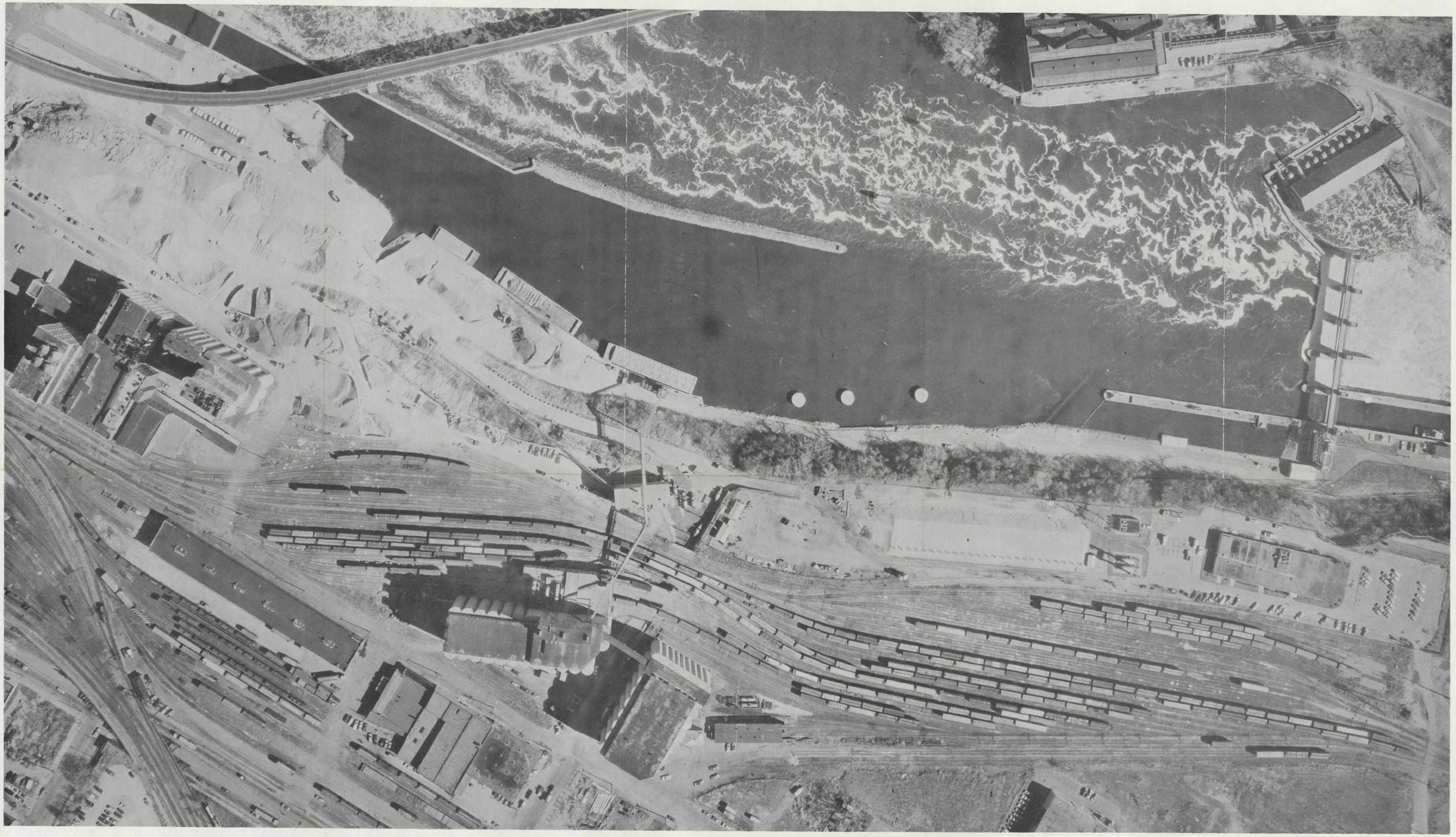
Mark Hurd
AERIAL SURVEYS, INC.
MINNEAPOLIS, MINN.
SANTA BARBARA, CALIF. SAN JUAN, P.R.

DATE OF PHOTOGRAPHY
APRIL 19, 1974

SCALE 1"=100'

MINNEAPOLIS
HENNEPIN COUNTY
MINNESOTA
METROPOLITAN AREA

SHEET58C



Mark Hurd
AERIAL SURVEYS, INC.
MINNEAPOLIS, MINN.
SANTA BARBARA, CALIF. SAN JUAN, P.R.
DATE OF PHOTOGRAPHY
APRIL 19, 1974

SCALE 1" = 100'

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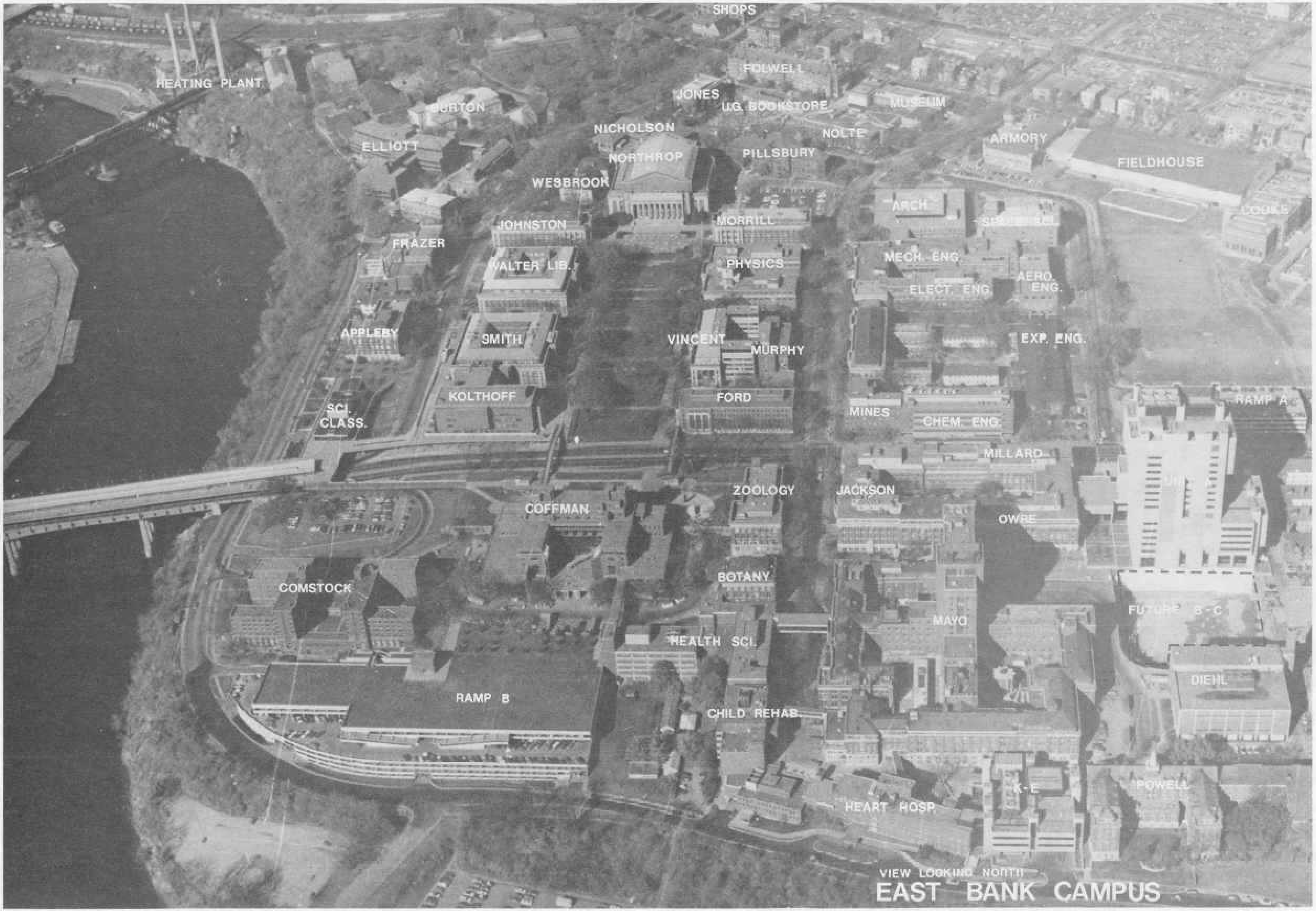
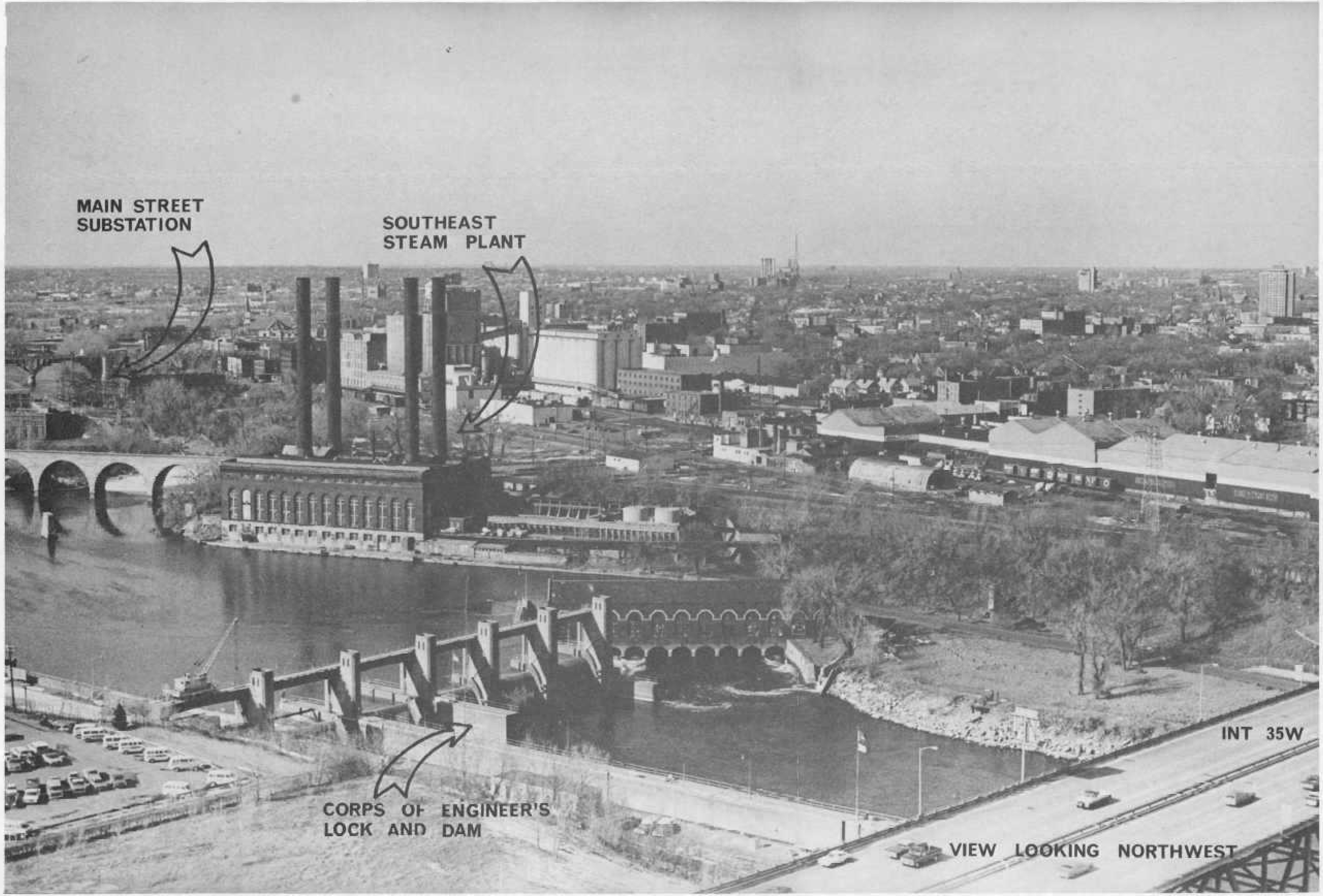
MINNEAPOLIS
HENNEPIN COUNTY
MINNESOTA
METROPOLITAN AREA

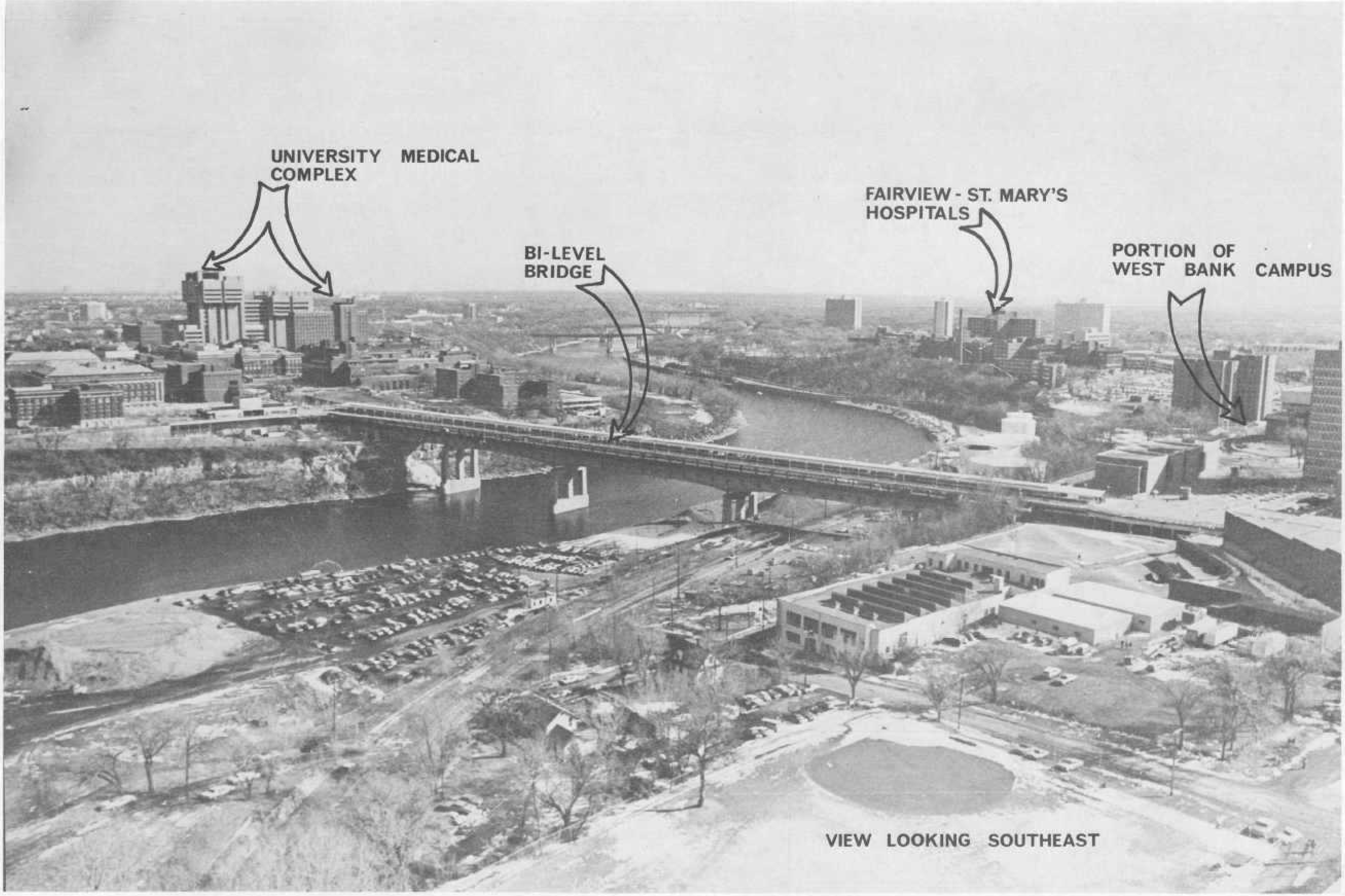
SHEET 56D


SHOPS
HEATING PLANT
FOLWELL
JONES
U.G. BOOKSTORE
MUSEUM
BURTON
NICHOLSON
NOLTE
ARMORY
FIELDHOUSE
ELLIOTT
NORTHROP
PILLSBURY
WESBROOK
MORRILL
ARCH
JOHNSTON
FRAZER
MECH. ENG.
PHYSICS
WALTER LIB.
AERO. ENG.
ELECT. ENG.
APPLEBY
SMITH
VINCENT
MURPHY
EXP. ENG.
KOLTHOFF
FORD
SCI. CLASS.
MINES
CHEM. ENG.
RAMP A
MILLARD
ZOOLOGY
JACKSON
COFFMAN
OWRE
COMSTOCK
BOTANY
FUTURE B-C
MAYO
HEALTH SCI.
RAMP B
DIEHL
CHILD REHAB.
K-E
POWELL
HEART HOSP.
VIEW LOOKING NORTH
EAST BANK CAMPUS

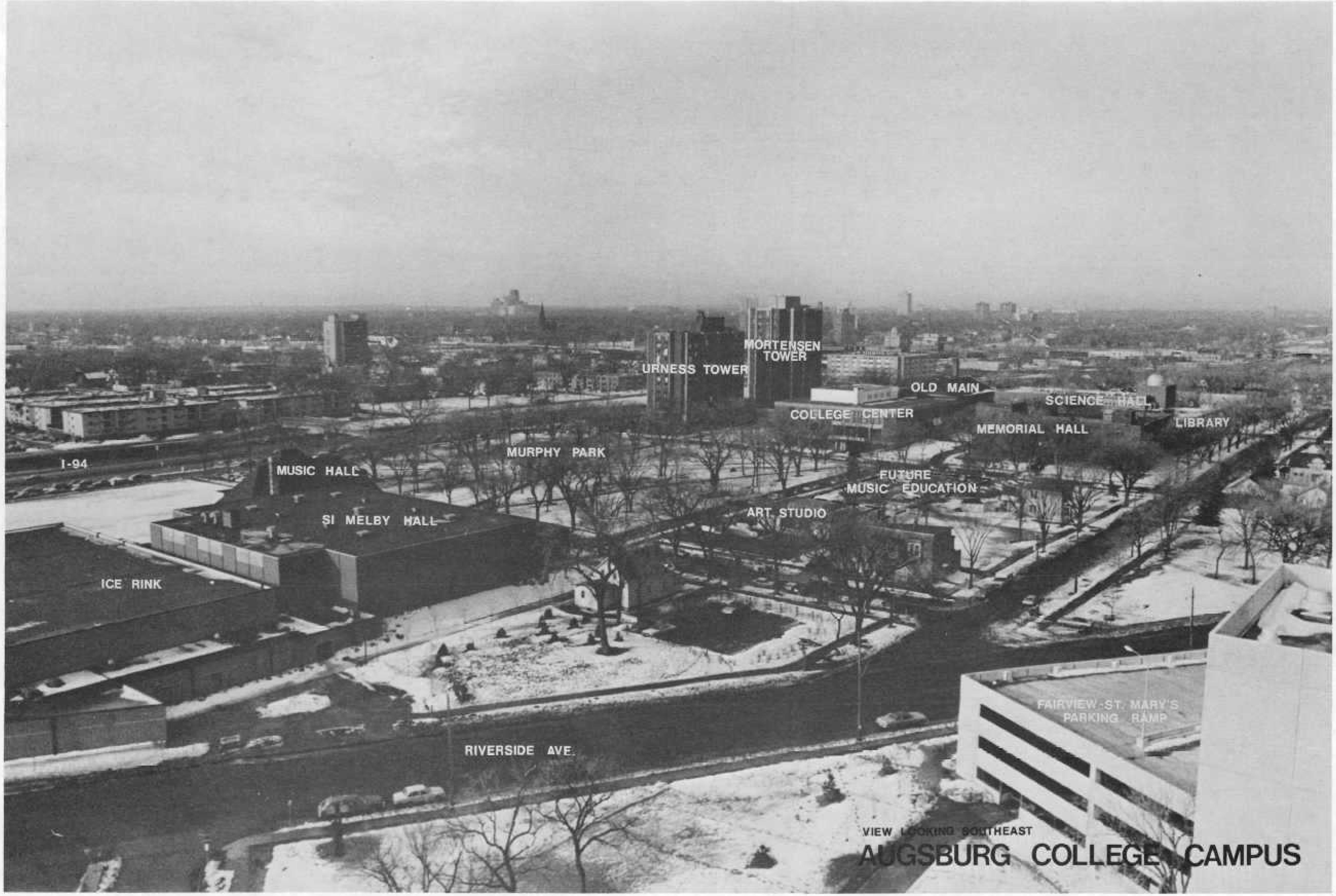

MAIN STREET SUBSTATION
SOUTHEAST STEAM PLANT
CORPS OF ENGINEER'S LOCK AND DAM
INT 35W
VIEW LOOKING NORTHWEST


WILLIAMS ARENA
MEMORIAL STADIUM
STATE BOARD OF HEALTH
VFW
VIEW LOOKING NORTHWEST
EAST BANK CAMPUS


STUDIO ARTS
AUD. CLASSROOM
LAW SCHOOL (FUTURE)
ANDERSON
SOC. SCI.
BUS. ADM.
BLEGEN
WILSON LIBRARY
PERFORMING ARTS
MIDDLEBROOK HALL
VIEW LOOKING NORTHWEST
WEST BANK CAMPUS


UNIVERSITY MEDICAL COMPLEX
FAIRVIEW - ST. MARY'S HOSPITALS
BI-LEVEL BRIDGE
PORTION OF WEST BANK CAMPUS
VIEW LOOKING SOUTHEAST


PORTION OF
EAST BANK CAMPUS
PARK BOARD PROPERTY
ST. MARY'S
JUNIOR
COLLEGE
ST. MARY'S
ECC
ST. MARY'S HOSPITAL
FAIRVIEW HOSPITAL
DOCTOR'S
OFFICE
BLDG.
DOCTOR'S
PARKING RAMP
AUGSBURG
ICE RINK
AUGSBURG
MELBY HALL



VIEW LOOKING SOUTHEAST
AUGSBURG COLLEGE CAMPUS

1.2 SPATIAL DESCRIPTION

Listed below are the existing spaces as of January 1, 1977, that will become a part of the Demonstration Community. Building space on the University Minneapolis Campuses total 10,969,707 gross square feet as shown in the ICES proposal, Section A-7, with funded and proposed additional space by 1980 of 1,167,317 gross square feet. The St. Mary's-Fairview group has a building space of 1,173,432 gross square feet as of July 1, 1976, as indicated in Section A-8 of the proposal. With addition of 494,800 gsf of Augsburg College, the total building space in the Demonstration Community is 12,637,939 gross square feet in 1977. An additional 1,617,317 gross square feet of expansion by 1980 will bring the total space to 14,254,956 gsf.

The University and its partners are using existing facilities located within the "Demonstration Community". All of the land to be included in the Community is wholly owned by the partners.

The total building space comprising the existing Community is as follows:

University East and West Bank Campus	10,969,707 gsf
St. Mary's Hospital	822,432
Fairview Hospital	351,000
Augsburg College	494,800
Total Space - 1977	12,637,939 gsf

Planned building expansion and construction now in progress is dealt with in Section A-14 of the ICES proposal document and Volume 5.

As previously described, Section 1.1, the Demonstration Community occupies approximately 12,545,280 gross square feet of land. This gives a spatial density in 1977, equal to:

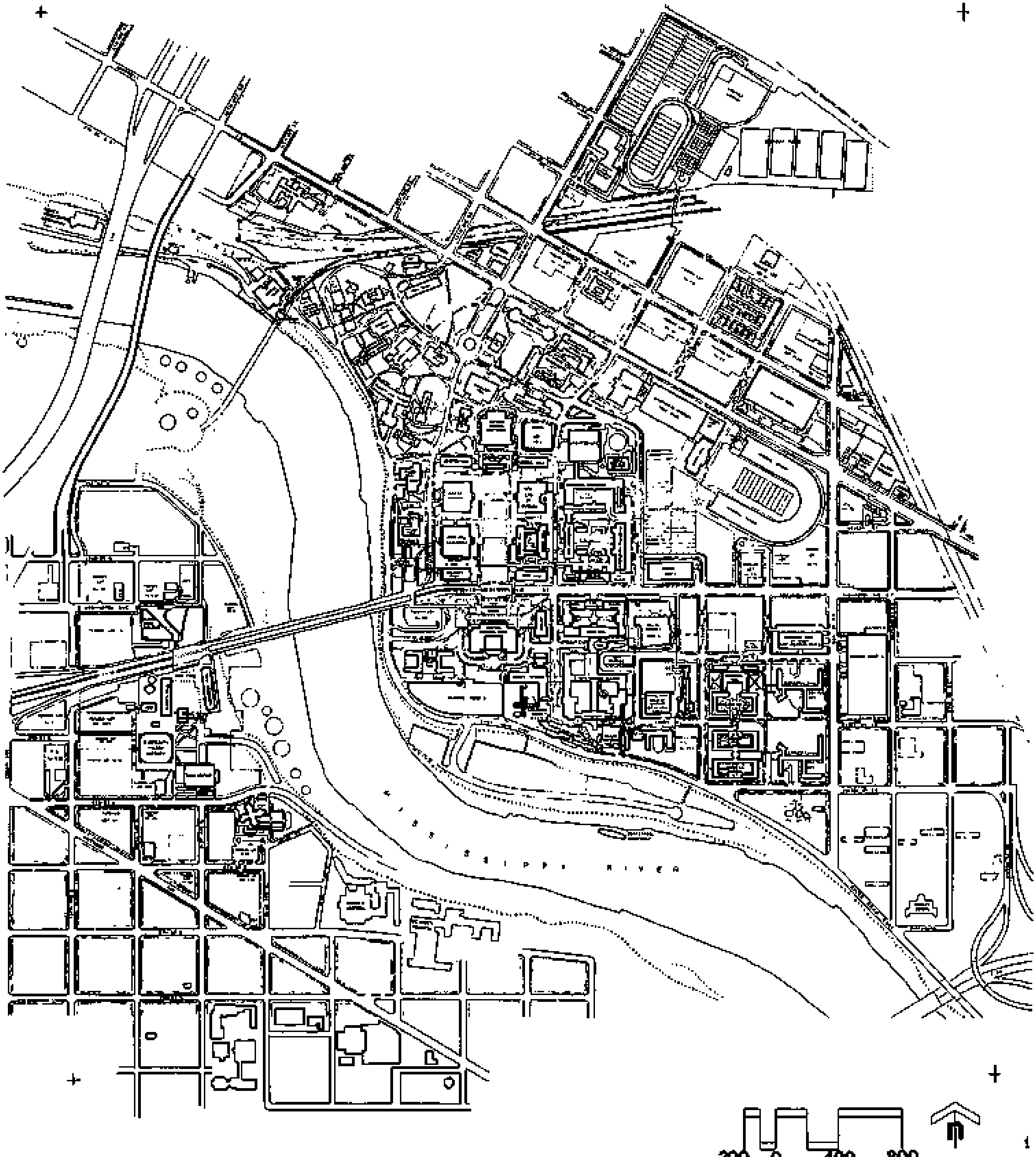
$$\text{Spatial Density} = \frac{\text{Gross Square Feet of Plant}}{\text{Gross Square Feet of Land}}$$

$$= \frac{12,637,939}{12,545,280}$$

$$\text{1977 Spatial Density} = 1.0074$$

Various space summaries are included at the end of this section and in the ICES proposal Sections A-7, A-8, and A-14. The space occupancy is given in this section for Augsburg College because it was not a part of the proposal.

Of the total land space owned, approximately 1,750,000 square feet is dedicated to parking in 1977.

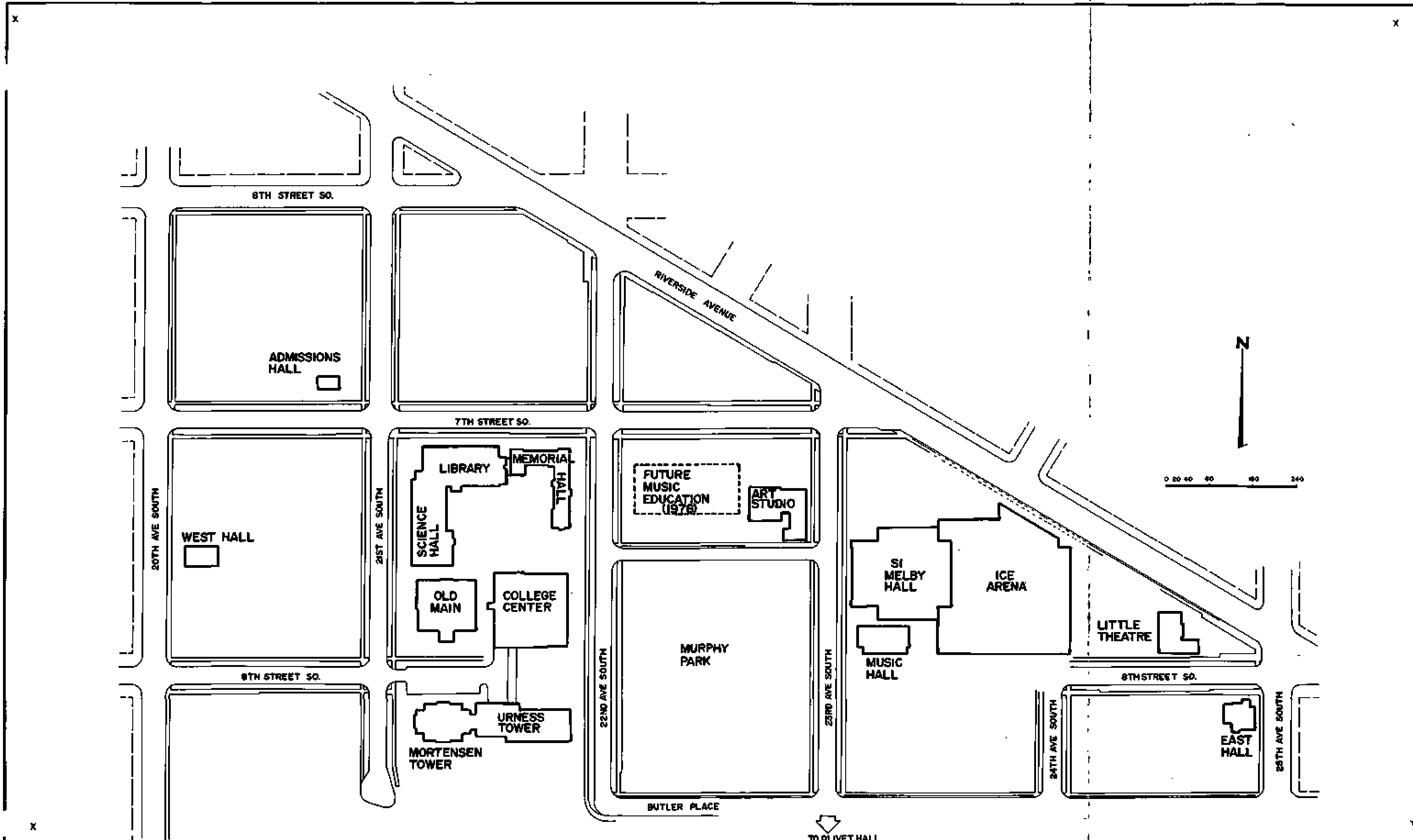


university of minnesota
minneapolis

AUGSBURG COLLEGE

BUILDING SPACE AS OF JANUARY 1, 1977

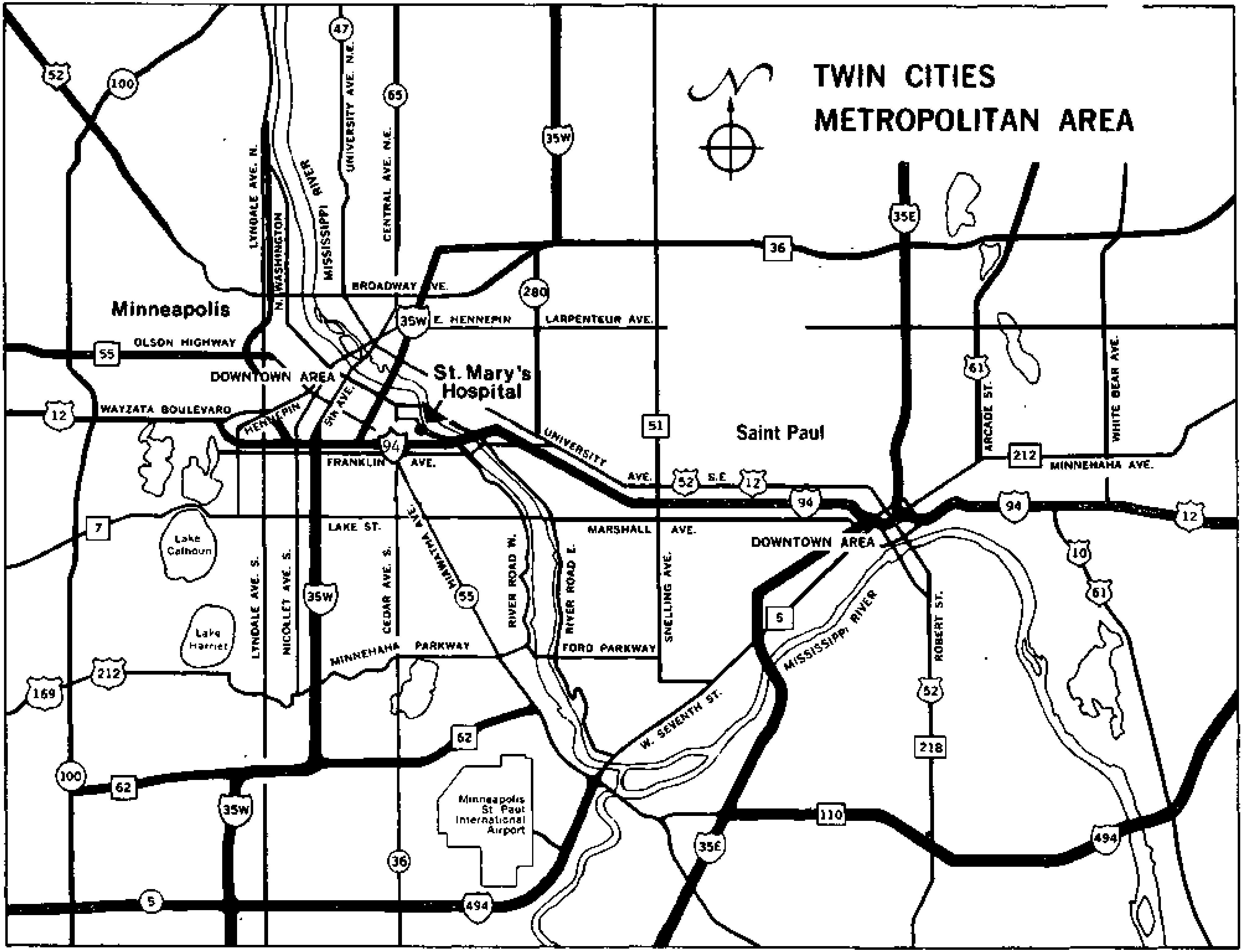
Building Name & Use	Gross Area (Square Feet)
High Rise Dormitory	90,000
Urness Tower Dormitory	78,800
Augsburg College Building	28,600
Student Union	62,500
Science Hall	46,800
Sverdrup Library	30,600
Sverdrup - Offdal Hall	30,700
Melby Hall	61,800
Ice Arena	56,000
Art Studio	9,000
Total Gross Square Feet	494,800

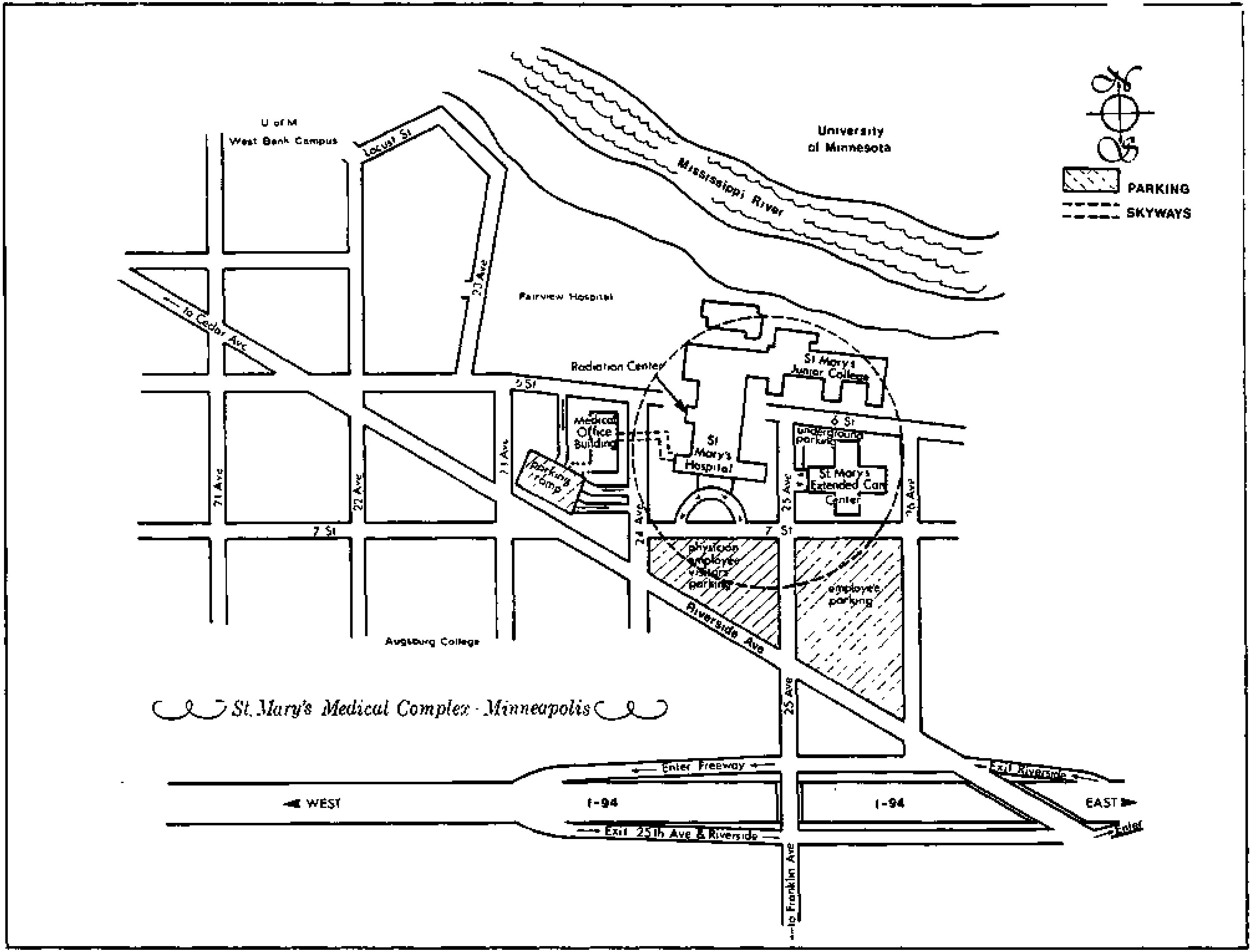


UNIVERSITY OF MINNESOTA

AUGSBURG COLLEGE CAMPUS

BY	BUILDING	SCALE	SHEET
CHECKED	DATE 3-20-77	REVISED	DRAWING


TWIN CITIES
METROPOLITAN AREA
Minneapolis
Saint Paul
St. Mary's
Hospital
DOWNTOWN AREA
DOWNTOWN AREA
OLSON HIGHWAY
WAYZATA BOULEVARD
HENNEPIN
5th AVE.
BROADWAY AVE.
E. HENNEPIN
LARPENTEUR AVE.
UNIVERSITY AVE. S.E.
FRANKLIN AVE.
LAKE ST.
MARSHALL AVE.
MINNEHAHA AVE.
MINNEHAHA PARKWAY
FORD PARKWAY
W. SEVENTH ST.
LYNDALE AVE. N.
N. WASHINGTON
MISSISSIPPI RIVER
UNIVERSITY AVE. N.E.
CENTRAL AVE. N.E.
LYNDALE AVE. S.
NICOLLET AVE. S.
CEDAR AVE. S.
HIAWATHA AVE.
RIVER ROAD W.
RIVER ROAD E.
SNELLING AVE.
ROBERT ST.
ARCADE ST.
WHITE BEAR AVE.
MISSISSIPPI RIVER
Lake Calhoun
Lake Harriet
Minneapolis St. Paul International Airport
52
100
47
65
35W
280
36
35E
55
12
94
51
61
212
7
10
5
169
62
218
110
494



St. Mary's Medical Complex - Minneapolis

1.3 TOPOGRAPHICAL DATA

The East Bank Campus is situated on a bluff overlooking the Mississippi River. The landscape slopes east and west from a crest running from Shevlin Hall near the "knoll area" down through Northrop Auditorium, the Engineering Complex, Health Science Unit "A", to the park south of Pioneer Court. The topography from this crest drops approximately 10 feet both east and west across the campus. To the east of this crest the landscape slopes at less than 1% toward the railroad yards. To the west of this crest topography slopes toward the river anywhere from 1% to 6% providing a visually noticeable grade change.

The West Bank portion of the Demonstration Community is divided by Washington Avenue into two different topo areas. North of Washington Avenue contours move across campus at 1% to 2% slope. The elevation above the river is about 80 feet, with changes in elevation of useable land occurring every 26 feet providing a distinct visual change.

The West Bank portion south of Washington Avenue is about 90 feet above the river with elevations changing over 10 feet. The overall slope of the area is minimal until the Fairview-St. Mary's complex is reached. This complex is about 110 feet above the river.

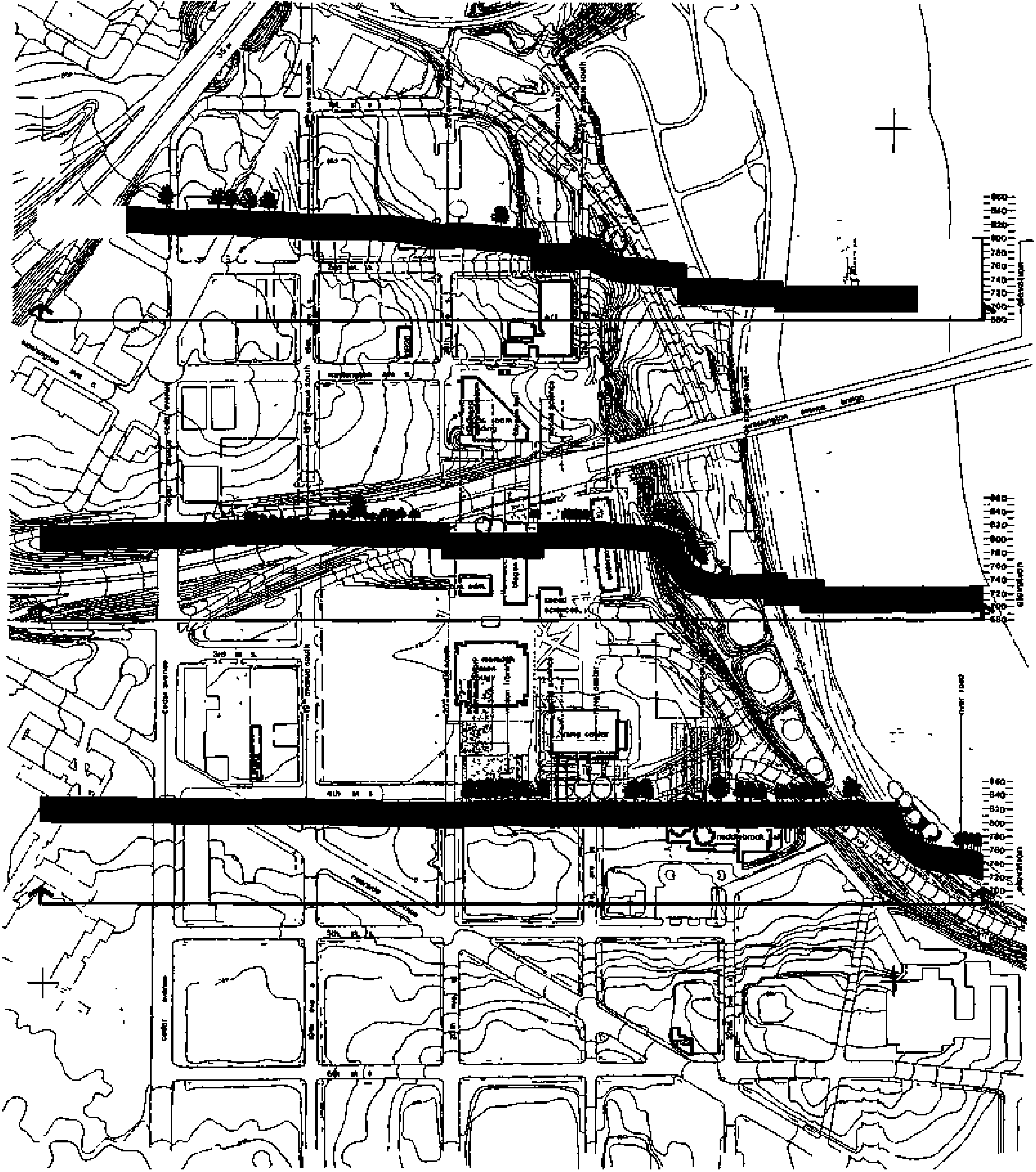
The topography is important to the Demonstration Community because the Southeast Steam Plant and the University Heating Plant are situated at the base of the river bluff with an average difference in elevation to the bluff tops of approximately 100 feet. This elevation has allowed most condensate to be returned to the central plant by gravity flow thus alleviating some pumping and energy requirements. There should also be little pumping required for condensate from St. Mary's Hospital.

The topography and the geology will also be important to development of seasonal thermal storage as will be described in a later section.

The important feature of the topography between the two central plants is the adequate amount of relatively flat land between the plants to allow for development of parks, pedestrian corridors and energy system conveyances.

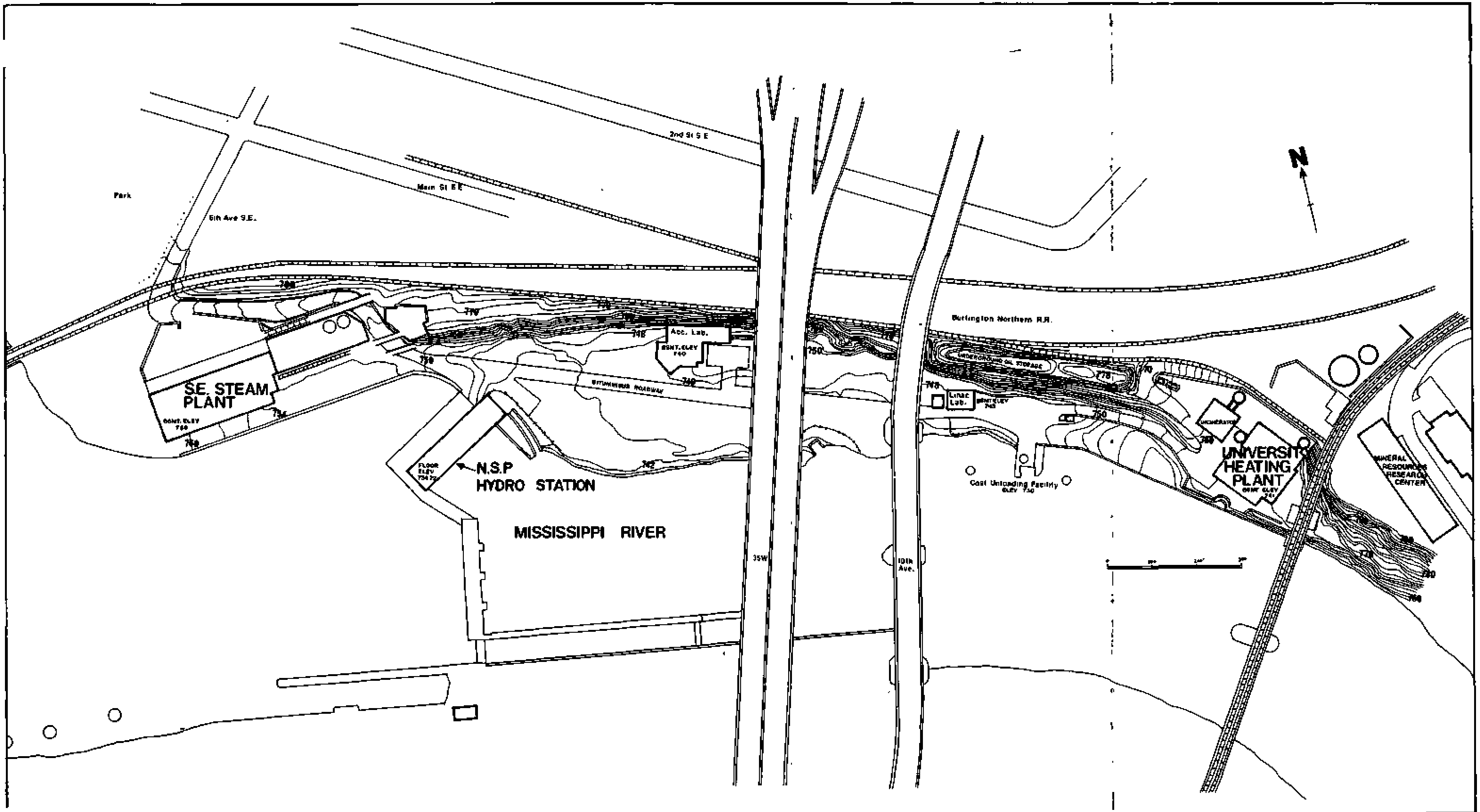
sections

university of minnesota
minneapolis campus east bank



topography sections

university of minnesota
minneapolis campus west bank



UNIVERSITY OF MINNESOTA	GRID-CONNECTED ICES TOPOGRAPHY - S.E. STEAM PLANT TO UNIVERSITY HEATING PLANT	BY GDM	BUILDING	SCALE	SHEET
		CHECKED J.Q.	DATE 3-21-77	REVISED	DRAWING


williams arena
field house
memorial stadium
armory
northrop memorial auditorium
architecture
space science center
johnston hall
morrill hall
walter library
tate laboratory of physics
mechanical engineering
electrical engineering
smith hall
vincent hall
murphy hall
ford hall
kolthoff hall
chemical engineering
parking ramp a
washington avenue s.e.
washington avenue bridge
coffman memorial union
zoology
jackson hall
lyon laboratory
millard hall
owre hall
health sciences unit a
minnesota dept. of health
parking ramp c
mayo memorial building
university hospitals
diehl hall
centennial hall
territorial hall
comstock hall
parking ramp b
health service
powell hall
university avenue s.e.
nicholson hall
pillsbury hall
folwell hall
university of minnesota
minneapolis campus

1.4 TRANSPORTATION INVENTORY

Primary transportation movement to or from the Demonstration Community is provided by a regional highway system and city streets which are not entirely under the jurisdiction of the Community. Planning and implementation studies are usually shared between the University and other city, county, and state agencies. A recent study by a University consultant provided a forecast of Minneapolis Campus users by approach direction.

This survey indicated that the predominant entry points to the Community is University Avenue from the west, University Avenue from the east, U. S. Hwy. 12 from the west and I-35W from the south.

Traffic volumes on internal streets are especially significant in the Community. Private cars constitute the vast majority of the traffic volumes. It is estimated that close to 1,750,000 square feet of land is dedicated to parking in the Community, exclusive of street parking.

It is not expected that development of ICES within the Demonstration Community will seriously alter characteristics of transportation as it exists today. There will be impact in the vicinity of the Southeast Plant, and this impact will be discussed in a later section.

This section will document, for later assessments, important characteristics of the Demonstration Community transportation.

The reported characteristics were determined through an extensive set of surveys conducted on-campus by the University Planning Department in 1974. Fortunately, this survey included all of the Demonstration Community.

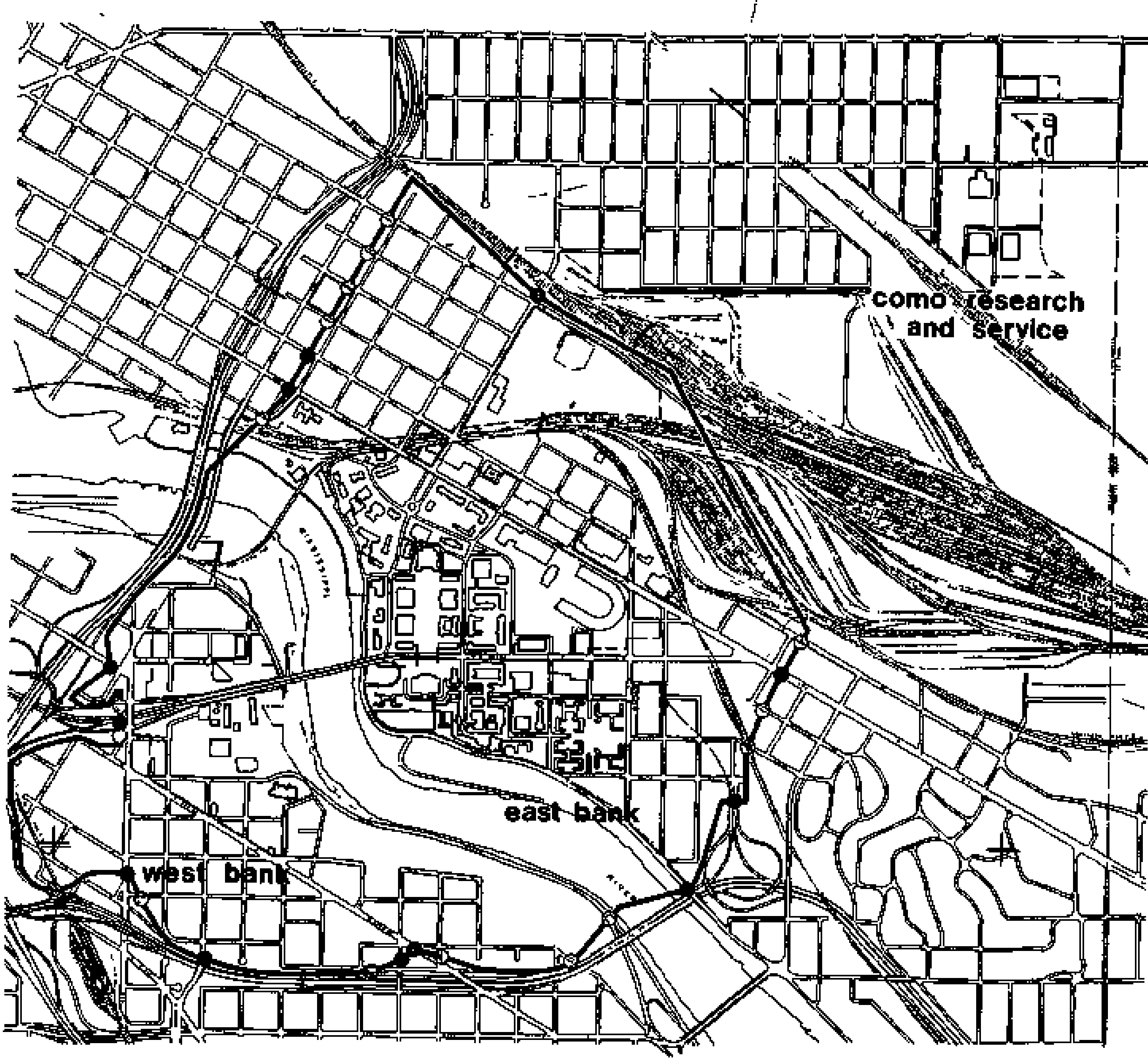
To determine the trips entering campus a cordon line was drawn and information on trips crossing the line was recorded. The location of the cordon line and count station are shown in the figure entitled Cordon Traffic Survey.

One important result of that survey is documentation of Daily Vehicle Volumes Entering the Demonstration Community. The three percent decrease in traffic entering the Community between 1971 and 1974 can be related to a number of factors including:

1. Larger transit use.
2. Development of more housing within the survey line.
3. Completion of I-35W to East Hennepin Avenue.

Inbound traffic volume overall stations peaked between 7:00 - 9:00 A.M. and between 9:00 A.M. and 8:00 P.M. was quite uniform.

Since 1974, the campus student population has grown and could be expected to have increased traffic density slightly, although there are trial programs underway to allow multiple use of cars into campus. This impact was not studied.

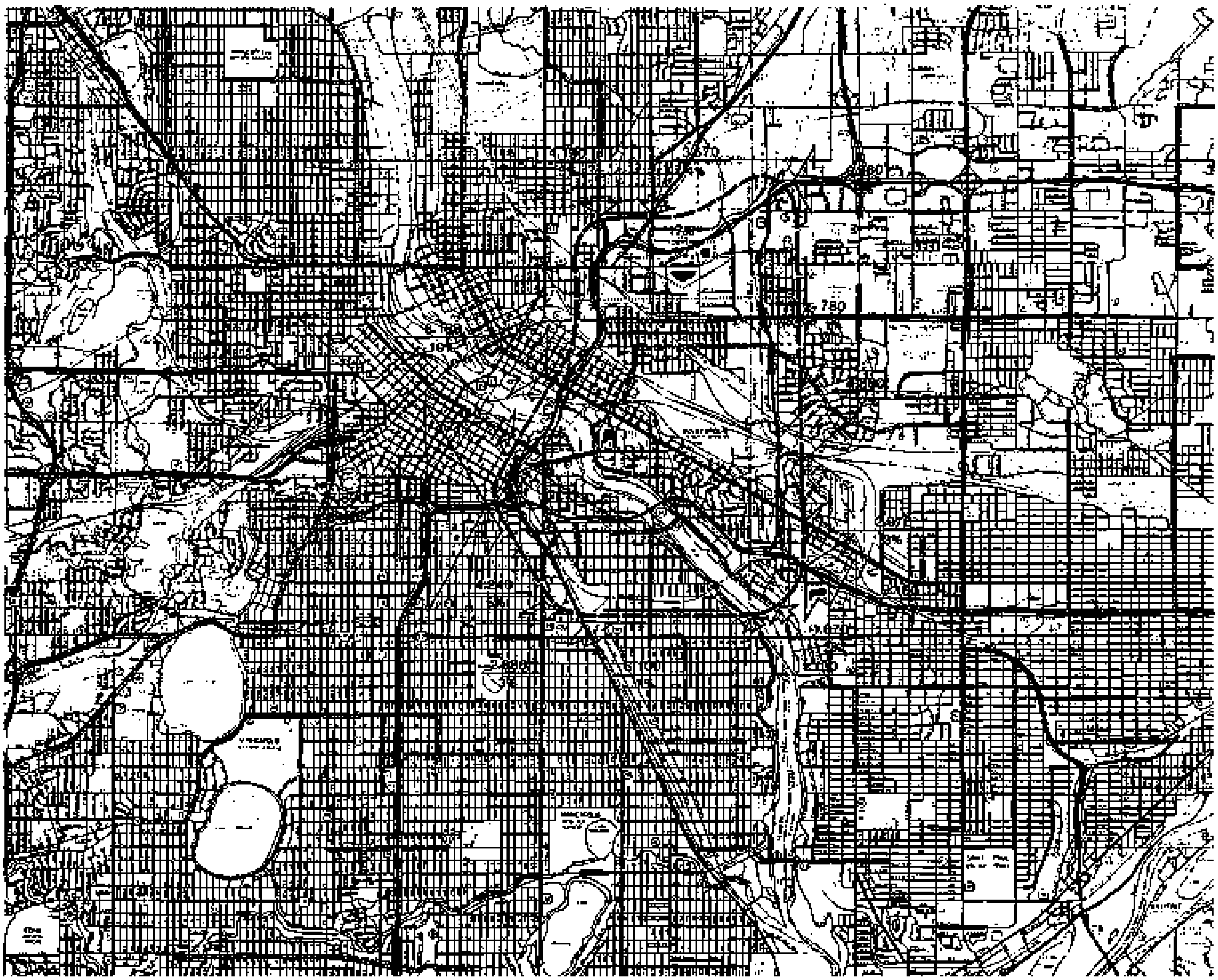


cordon line
major station
minor station

note
- at major stations information was obtained by 15 minute interval on mode of travel (auto truck bus, bicycle and pedestrian) and on auto occupancy
- at minor stations vehicular volumes were counted

cordon traffic survey

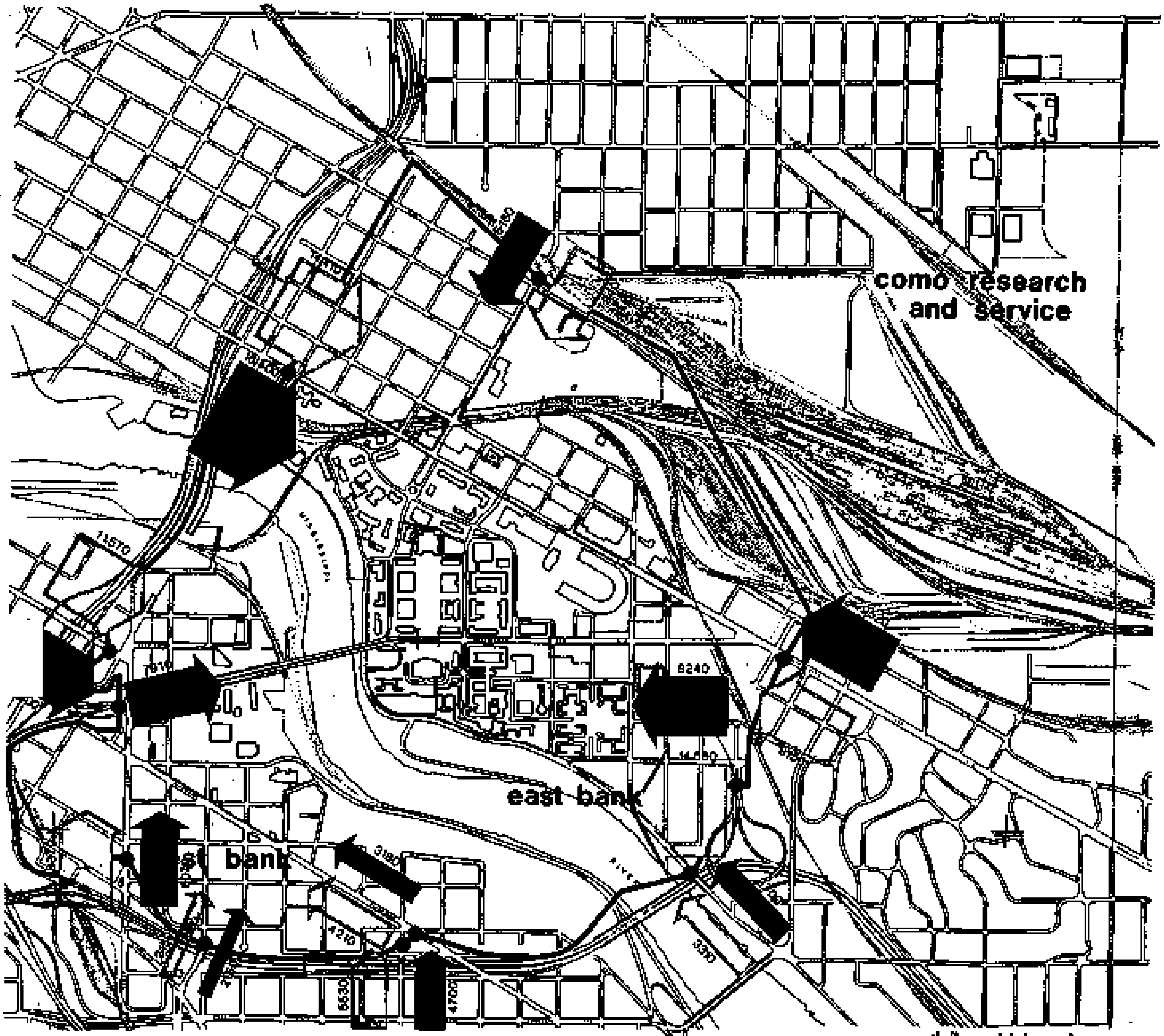
university of minnesota
minneapolis campus



FORECAST OF MINNEAPOLIS CAMPUS USERS BY APPROACH DIRECTION

minimum travel time paths to campus

82,720 / 100% traffic volumes



total daily vehicle volumes entering the campus

year	major stations	minor stations	total for all stations
1971	[illegible]	12,830	[illegible]
1974	[illegible]	[illegible]	[illegible]

6000 — daily volume from survey conducted on 2/17/ - 2/23/71

5000 — daily volume from survey conducted on 10/4 - 11/27/74

note: figures represent 24 hour volumes entering the campus at major cordon stations. vehicles included may be destined either to locations within the campus or locations outside.

daily vehicle volumes entering campus

university of minnesota
minneapolis campus

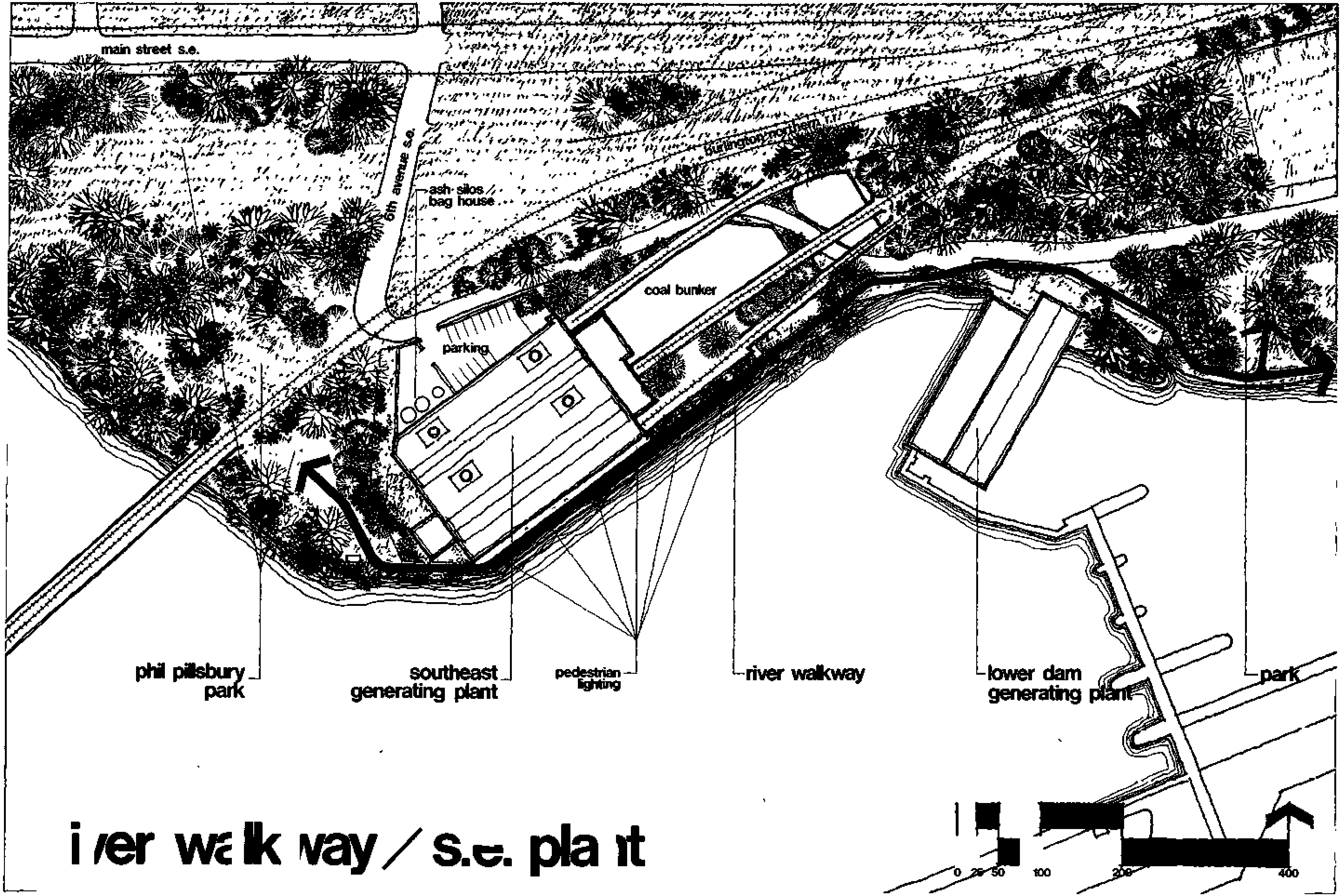
1.5 ENVIRONMENTAL DATA

This section will deal with the overall physical "environment" of the Demonstration Community. While the bulk of the information pertains to natural systems and conditions, other data related to man-made environmental elements which have had an effect upon the development of the Community is discussed.

The data contained in this section will be used to form a basis from which an environmental analysis can be made by a consultant. The University will have an assessment made. The "Environmental Impact Statement" is made by the state and federal governments. This analysis will be preliminary in nature and will require additional consultants during Phase II to completely assess the environment and the effects of ICES upon the Demonstration Community.

An architects rendition of Southeast Steam Plant is presented at this time to reinforce the University's commitment to preservation of the environment and historic landmarks of which the Southeast Steam Plant may qualify. Prominent will be a river pathway. That will be discussed in Section 5.7.

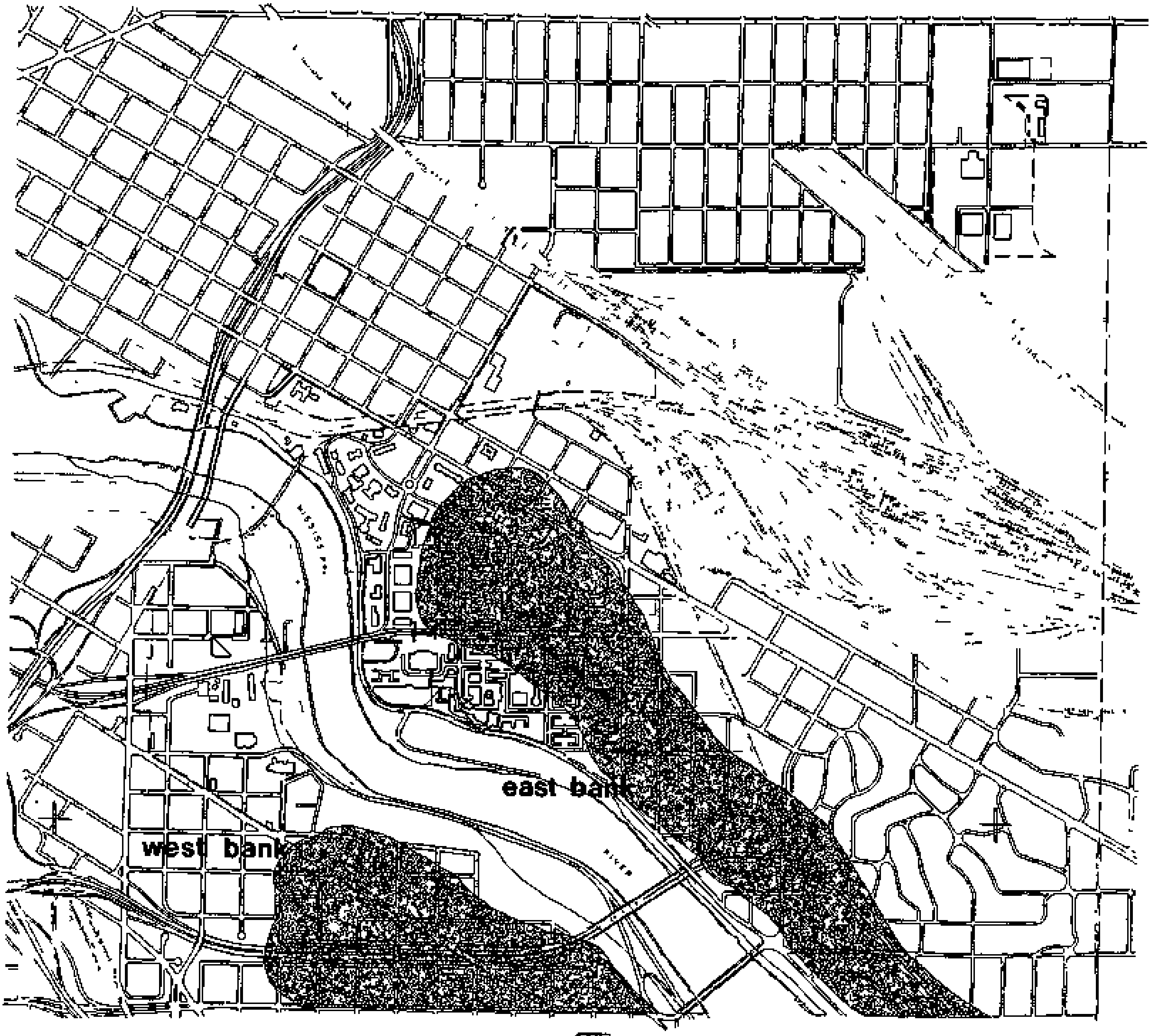
river walkway / s.e. plant

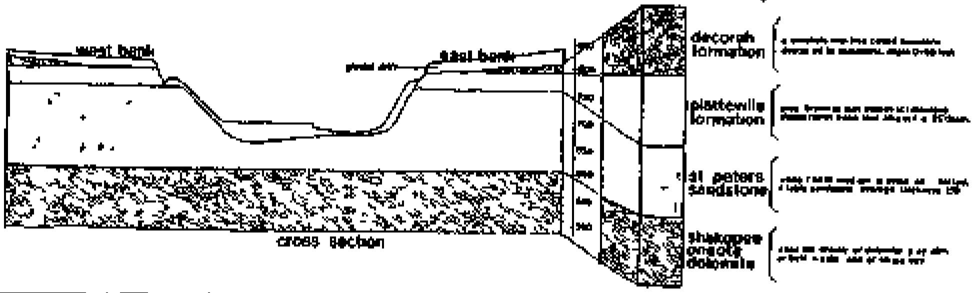


1.5.1 GEOLOGY

Sedimentary materials laid down in the Ordovician period of the Paleozoic Era compose the bedrock geology of the Demonstration Community. The drawing on the following page indicates this geology.

The geology of the area is very important to ICES. As part of the program seasonal thermal storage units will be developed along the river bank of the Mississippi in what is known as the St. Peters Sandstone. This layer of geological formation is known to exist over much of the western part of the United States. Development of useful thermal storage techniques would prove to be very beneficial. This development will be addressed in detail in a later section.





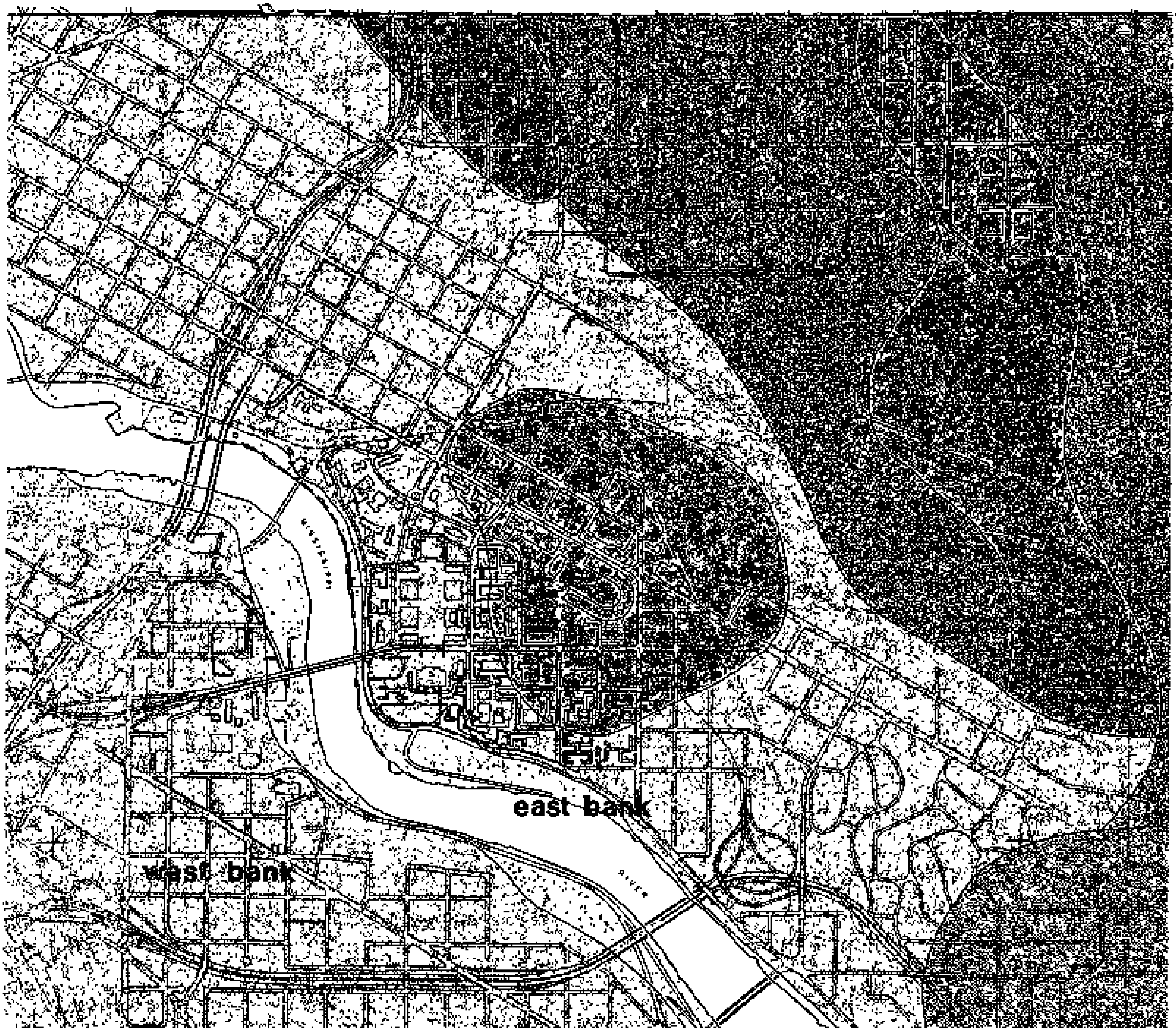
geology

university of minnesota
minneapolis campus

1.5.2 SURFICIAL GEOLOGY

The surficial geology was laid down during the Pleistocene period (glacial) of the Cenozoic Era. The phases of advance and recession of the glacial masses moved materials back and forth with ice invasions showing no signs of existence in the Twin Cities Metropolitan Area.

Again the St. Peters Sandstone forms the bedrock of the Community.



bedrock

alluvium deposit

dune sand deposit

patrician terminal moraine deposit

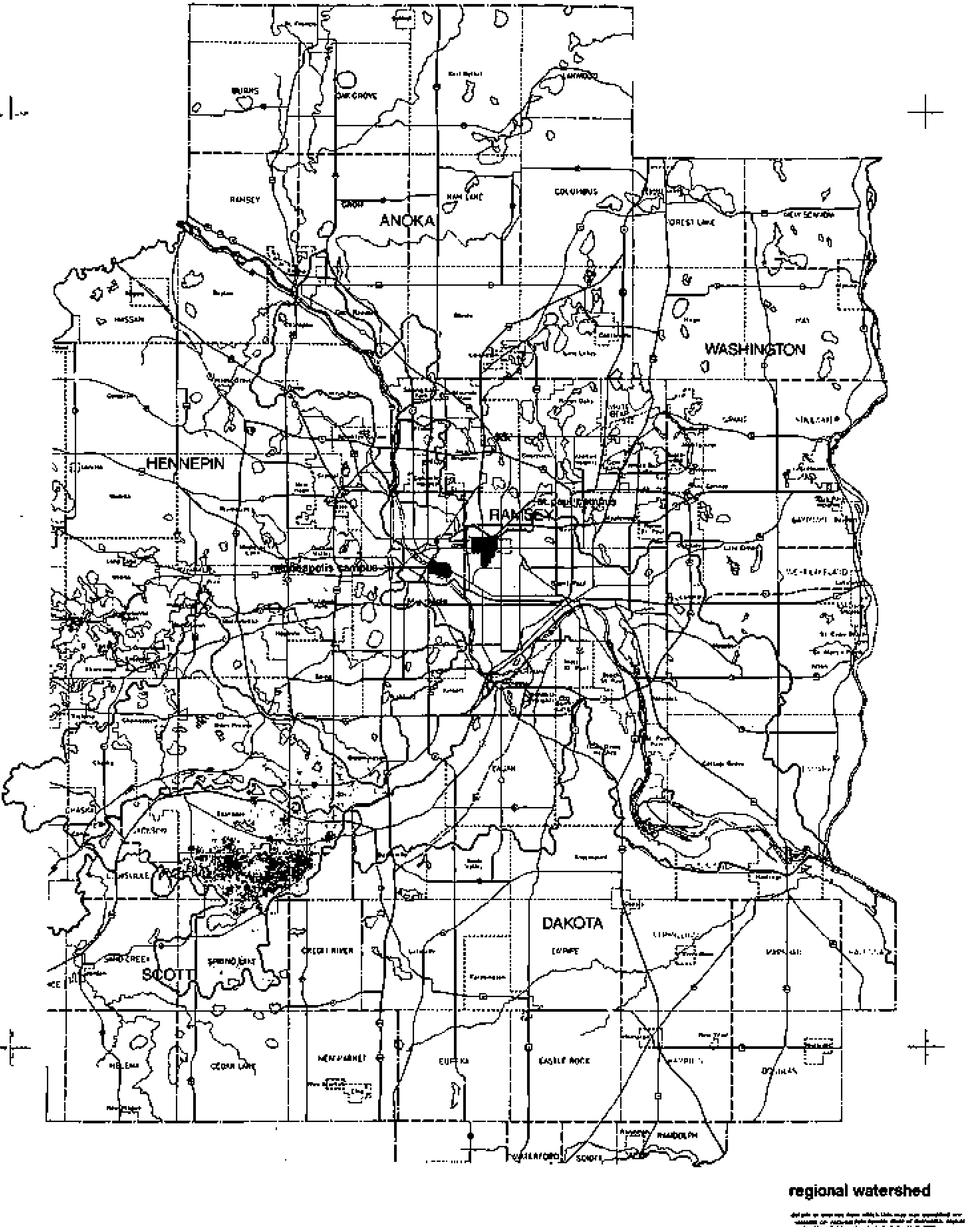
peat deposit

surficial geology

university of minnesota minneapolis campus

1.5.3 REGIONAL WATERSHED

The Metropolitan Regional Watershed of which the Demonstration Community is a part can be classified as "interstitial watershed." The Mississippi River provides one of the major drainage basins for the metropolitan region. ICES will not use river water for any purpose. Where water is used the system will be closed-cycle with small amounts of city water used for makeup.



regional watershed

university of minnesota
minneapolis campus

1.5.4 TREES - EAST BANK CAMPUS

The drawing on the following page shows the density and quantity of trees in the Demonstration Community. The majority of plant life in the Community has been planted by landowners or the City of Minneapolis. The river bluffs are the only areas where native vegetation exists.

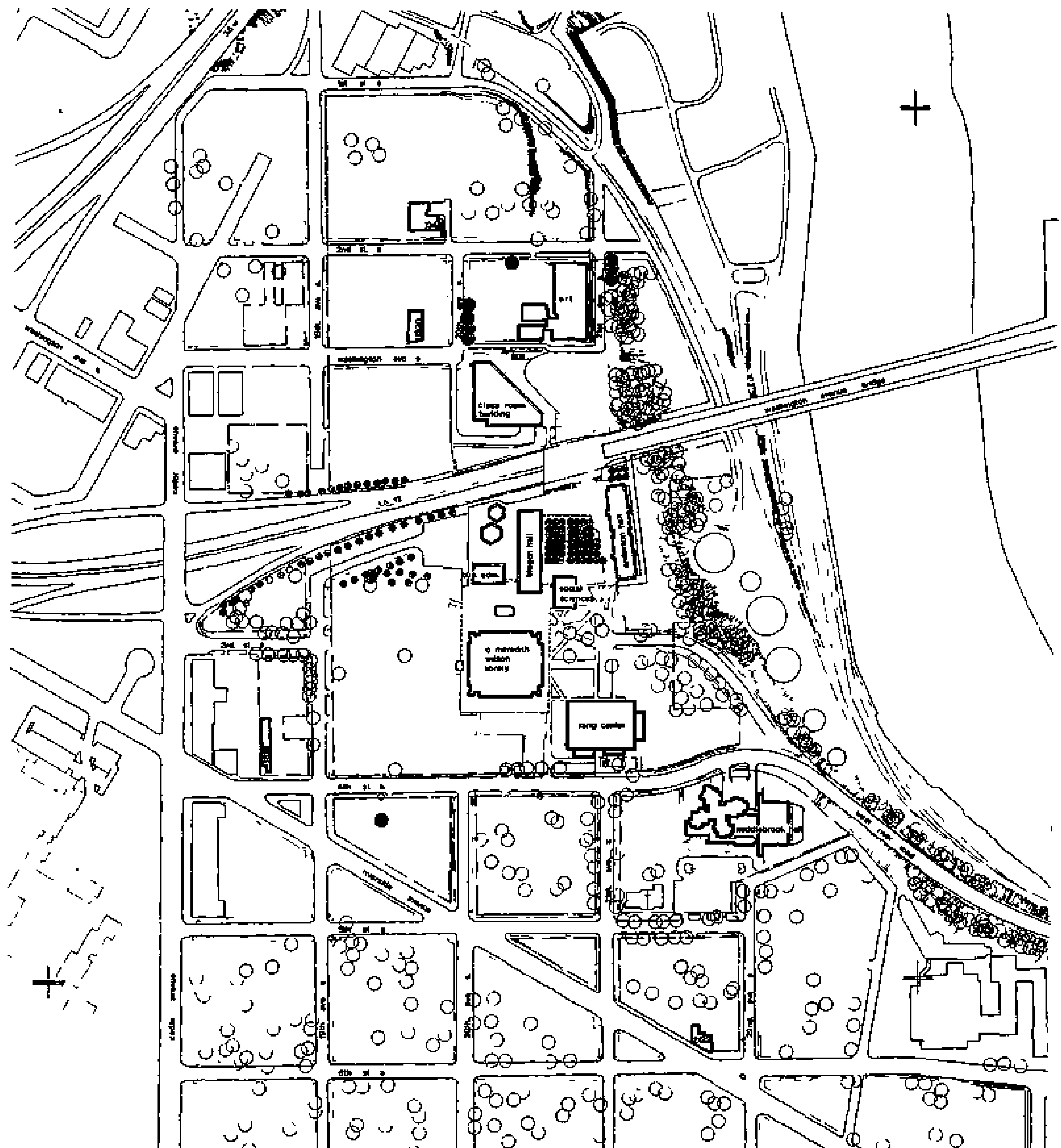
A major concern presently facing the Community is the spread of "Dutch Elm Disease." With the majority of trees in the Community being elms, the impact of this disease would drastically change the character and microclimate of the Community.

A further major concern of local governmental officials is the proper disposal of the infected elm wood. Pyrolysis can impact this area by providing a safe, convenient and environmentally safe disposal means for the infected elms and at the same time provide a needed community service.

northrop memorial auditorium
johnston hall
morrill hall
architecture
space science center
fraser hall
walter library
tate laboratory of physics
mechanical engineering
electrical engineering
smith hall
vincent hall
murphy hall
ford hall
kolthoff hall
chemical engineering
parking ramp c
washington avenue s.e.
washington avenue bridge
coffman memorial union
jackson hall
millard hall
owre hall
health sciences unit a
minnesota dept. of health
parking ramp a
comstock hall
health services
mayo memorial building
diehl hall
university hospitals
parking ramp b
powell hall
folwell hall
pillsbury hall
nicholson hall
shevlin hall
eddy hall
burton hall
armory
field house
williams arena
memorial stadium
cooke hall
university avenue s.e.
on campus trees species elm
mature trees other than elm e.g. oak, ash, hackberry
young trees other than elm
evergreen trees
trees
university of minnesota
minneapolis campus

1.5.5 TREES - WEST BANK CAMPUS

The following drawing describes the density and different types of plant life on the campus. At the present time the University Heating Plant, St. Mary's plant and the heating plants at Augsburg seem not to have a detrimental effect upon the flora and fauna of the campus or of the native vegetation along the river bluffs. Decommission of the St. Mary's and Augsburg boilers coupled with addition of baghouses to the University Heating Plant and Southeast Steam Plant can only improve plant life conditions because of the better than 95% efficiency of the baghouses in reducing air pollution.



off campus trees species unknown

on campus trees species elm

mature trees other than elm e.g. oak, ash hackberry

young trees other than elm

evergreen trees

trees

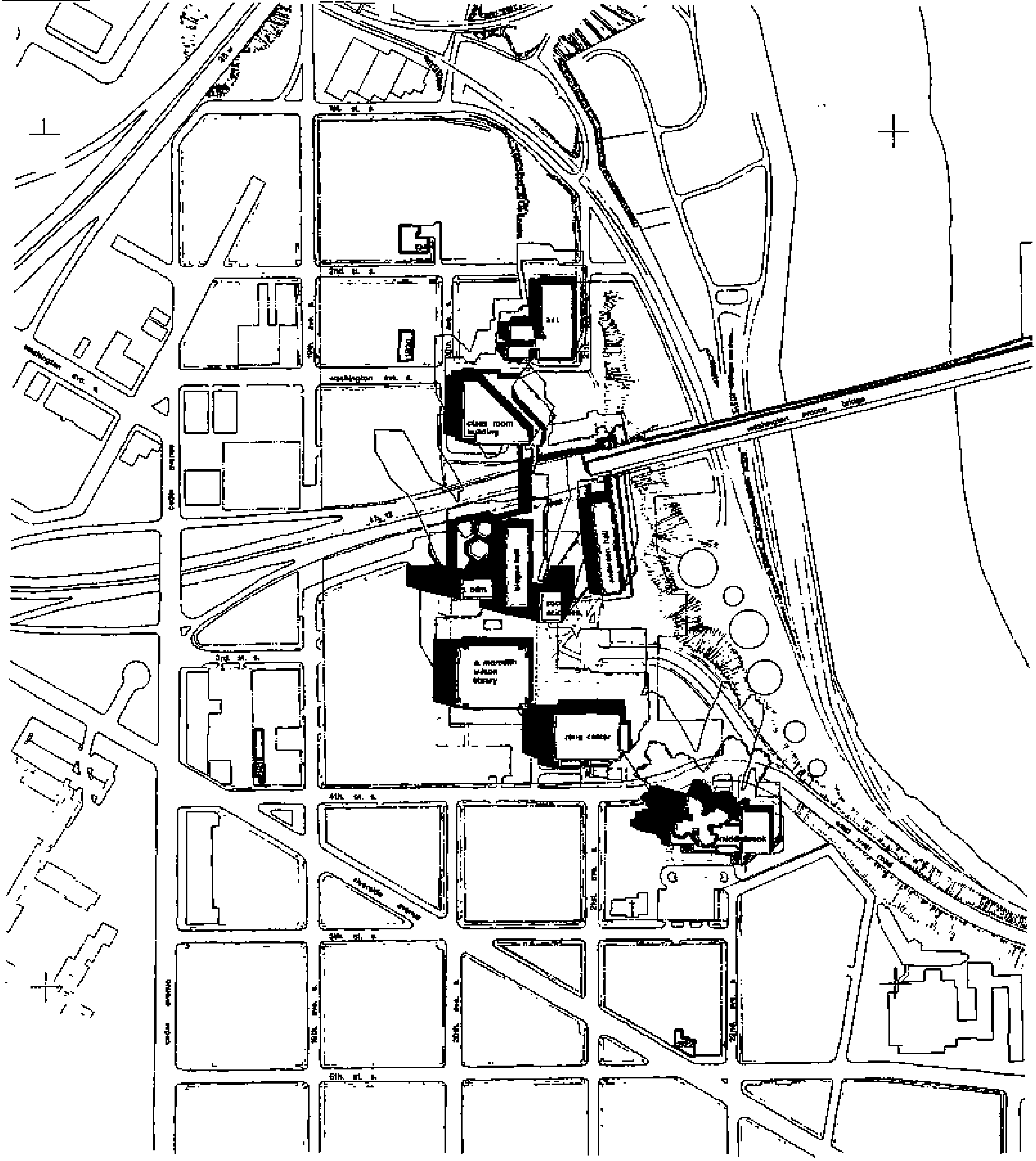
university of minnesota
minneapolis campus west bank

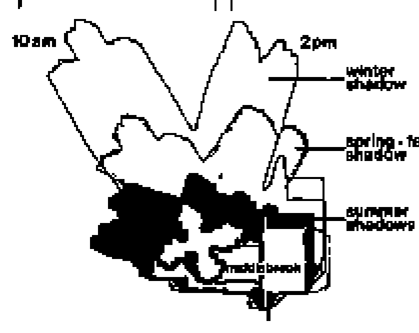
1.5.6 BUILDING SHADOWS

The following drawings show the relative lengths of building shadows on December 20, March/October, June 20 at 10:00 A.M. and, 2:00 P.M. Since the reference data available is for central standard time the summer shadows are in the darkest tone because in most cases those areas are always in shadow, where as, during other seasons the shadow only occurs during that season.

Impingement of shadows by one building upon another has some effect upon the heat obtainable from the sun for in-building use. During the winter of 1977 this effect was very noticeable especially as building temperatures were required to be maintained at 65° F. In the mornings University buildings gradually accumulated some heat from the sun and in some buildings radiation could be turned off for several hours at a time.


building shadows
university of minnesota
minneapolis campus east bank
10 am
2 pm
winter shadow
spring fall shadow
fall shadow
washington avenue bridge
coffman memorial union
northrop memorial auditorium
johnston hall
morrill hall
architecture
space science center
mechanical engineering
electrical engineering
tate laboratory of physics
walter library
smith hall
kolthoff hall
ford hall
chemical engineering
field house
williams arena
memorial stadium
cooke hall
parking ramp a
parking ramp b
parking ramp c
minnesota dept of health
owre hall
health sciences unit a
zoology
mayo memorial building
university hospitals
health services
diehl hall
powell hall
centennial hall
nicholson hall
pillsbury hall
folwell hall
bell museum of natural history
peik hall
eddy hall
fraser hall
murphy hall
jackson hall
millard hall
boynton
university avenue
washington avenue s.e.
delaware
fulton
river road east
centennial showboat





building shadows

university of minnesota
minneapolis campus west bank

1.5.7 CLIMATOLOGICAL DATA

The climate of Minneapolis-St. Paul region is predominantly the continental, typical of the cities situated very close to the geographical center of the North American continent. There are wide variations in temperature, ample summer rainfall, and scanty winter precipitation. In general, there exists a tendency to have extremes in all climatic features. Disturbances originating in the north-western United States, many others which have their origin in the southwest, migrate eastward near the Twin Cities followed by cooler, sometimes much colder, polar air masses from the northwest and north. This cyclonic control of climate gives the Twin Cities its changeable weather.

TEMPERATURE. The temperature variation from season to season is quite large. It ranges from very warm though comfortable to very cold in winter. The normal mean temperature for the winter months of December, January, and February is about 15° F., and for the summer months of June, July, and August about 70° F. Record temperature extremes cover a range of 137°, from -34° F. in January 1936, to 103° F. in July of that same year. Cold winters are accepted, but more attention is given the warmer months, the length of the growing season, and the rainfall.

PRECIPITATION. The normal total precipitation is 26 inches annually. Although the total annual precipitation is important, its proper distribution during the growing season (late April through September) the normal rainfall is 16 inches, approximately 65 percent of the total. Winter snowfall can be heavy and averages more than 40 inches a season. Snow has been recorded during all months except June, July, and August.

WIND CHILL TEMPERATURES AND WIND ROSE AVERAGES. The typical winter dry bulb temperature is 20° to 5° Fahrenheit and with wind velocity at speeds of 5 to 15 mph, a wind chill as low as 25 below zero develops. Wind and temperature are the two climatological elements which give the impression of extreme cold winter temperatures. Winter winds are primarily from the northwest. The summer humidity is the result of southeast winds. The southwest winds from the Denver, Colorado region bring hot dry summer conditions.

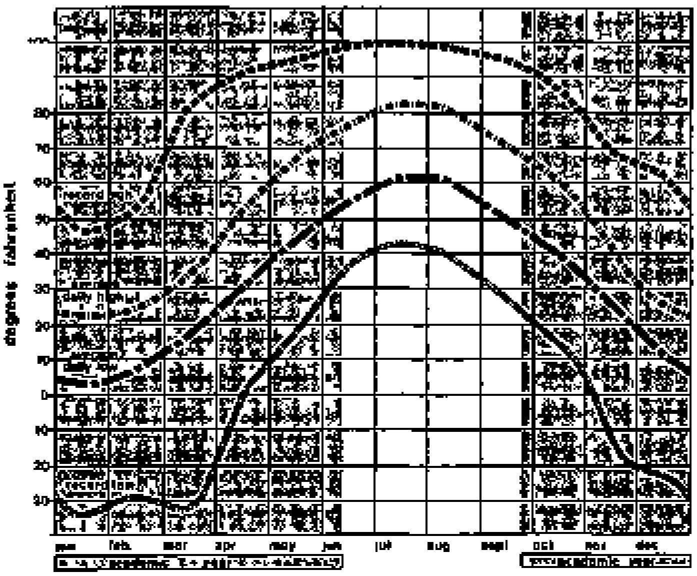
During the winter months humidities are high and sunshine is at a minimum. During the months of November, December, and January frequently less than 40 percent of possible sunshine has been observed.

The Twin Cities lie along the northern edge of the region of maximum tornado frequency in the United States. Although not numerous, five severe tornadoes have struck the Twin Cities area in the years 1904, 1951, and three in 1965. During each storm, lives were lost, many persons were injured and millions of dollars of property damage occurred.

Recently the University, working under an ERDA grant, developed an underground building with partial heating and cooling provided by solar panels. Physical Plant will be assessing the effects of solar heating and cooling upon this building.

As will be shown on heating duration profiles, the periods of early spring and fall climates cause midwest central heating plants load factor to be seriously deteriorated because of low requirements for heating and cooling.

Solar energy as it becomes more cost effective will cause more erosion of central plant load factors.

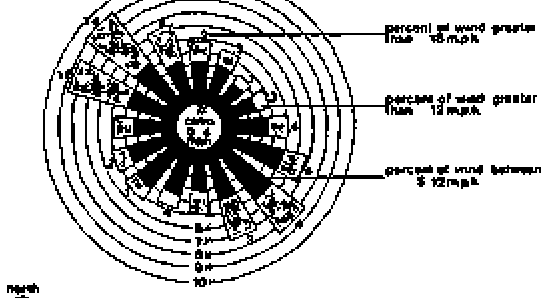


temperature (30 year averages)

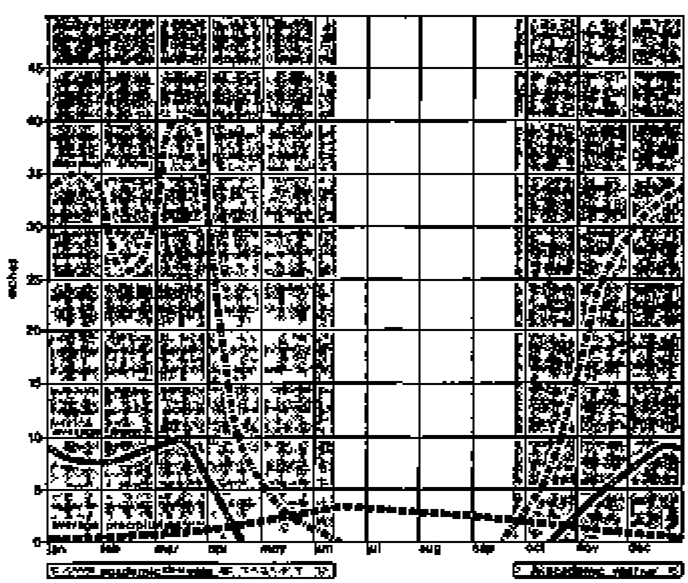
wind velocity in mph / dry bulb temperature (degrees fahrenheit)

	35	30	25	20	15	10	5	0	-5
25	8	1	-7	-15	-22	-29	-36	-44	-51
20	12	4	-3	-10	-17	-24	-31	-39	-46
	16	9	2	-5	-11	-18	-25	-31	-38
	22	16	10	3	-3	-9	-15	-22	-27
	32	27	22	16	11	6	0	-5	-10
4	35	30	25	20	15	10	5	0	-5

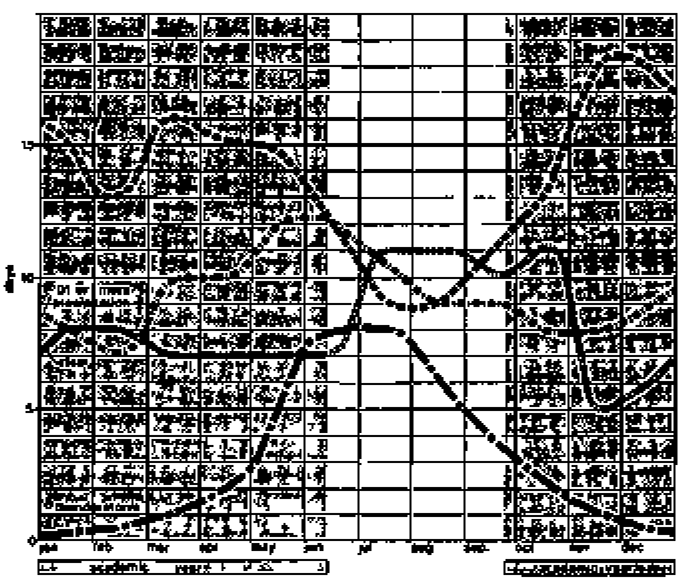
wind chill temperature



windrose averages



precipitation (30 year averages)



weather conditions (30 year averages)

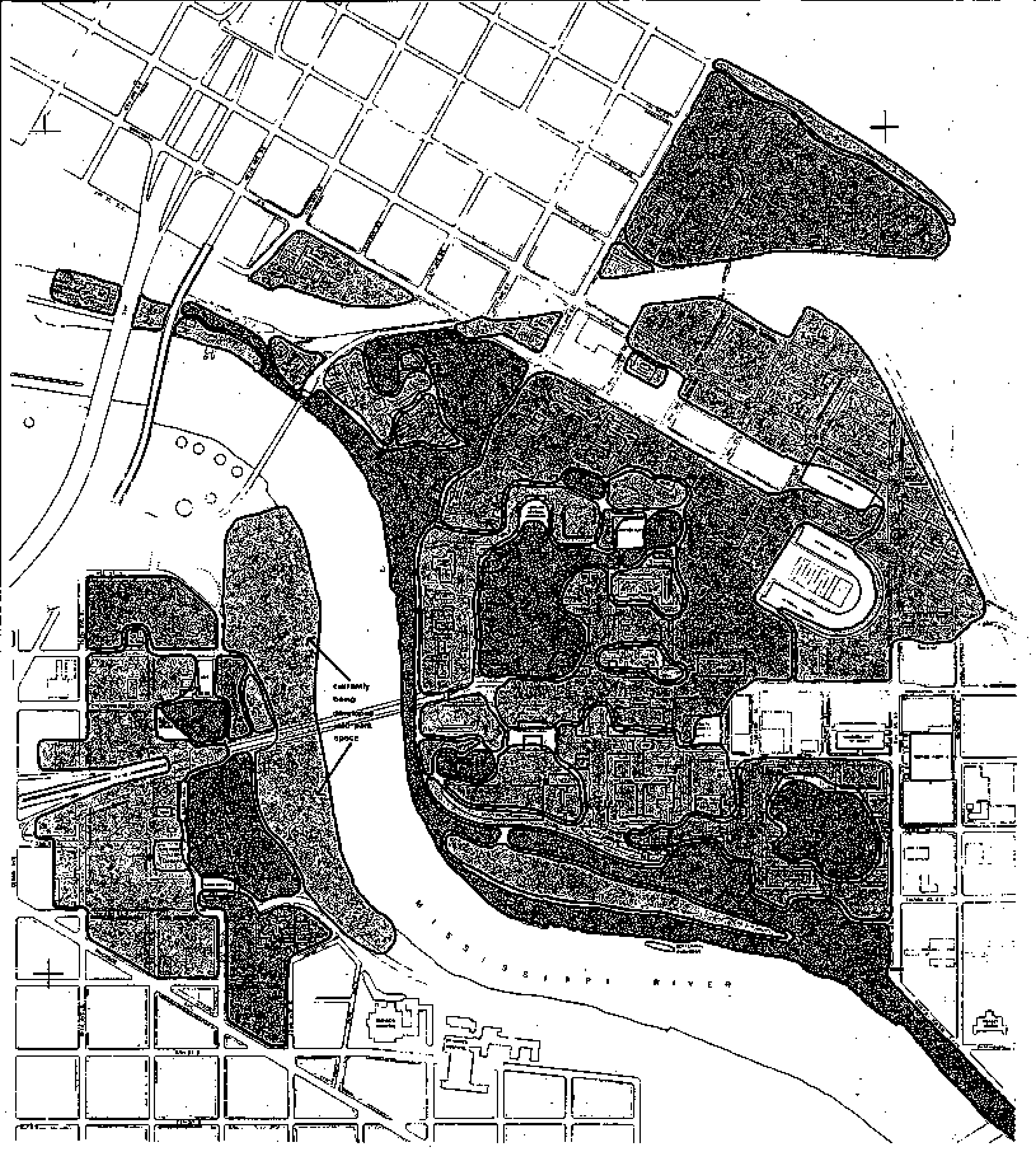
climatological data
university of minnesota
minneapolis campus

1.5.8 ENVIRONMENTAL QUALITY

Environmental quality is difficult to assess because of individualistic perspectives of the built environment. University planning personnel developed the following schematic of environmental quality based upon architecture, vegetation, and circulation. The key on the schematic defines the type of environmental quality in relation to each group.

We are presenting this study because construction of ICES will have to maintain at least this quality of the environment, particularly between the existing heating plant and the Southeast Steam Plant. ICES does address preservation of this environment.

There are suitable flat areas between the two plants so that development of pathways, rest areas, and small recreational areas is possible. Of prime consideration is getting people by the central heating plants safely. As will be shown in later discussion the employment of elevated enclosures and tunnels for moving people, energy products, and fuel supplies will be given strong consideration as ICES develops. Community impact has been sought and that impact will weigh heavily upon our decisions in this area.



poor - visually confusing - no sense of place - confusing circulation.

fair - visually interesting in terms of architecture and vegetation.

good - visually unique - a sense of place.

environmental quality

university of minnesota minneapolis campus

1.5.9 MICROCLIMATE

Weather effects created by natural or man-made objects on specific outdoor areas are important factors in determining the human comfort range of any exterior environment.

A detailed microclimate study for a particular site can involve many individual conditions. For the purposes of ICES, the element of human comfort temperature was determined as the key factor for analysis.

In a previous study made by University planning personnel micro-climate models were established. These models are presented here for the purposes of establishing a basis for integration of ICES into the Demonstration Community.

The Human Comfort Temperature Model is the relationship of specific on site conditions influencing the surrounding environment. The "comfort model" is similar in concept to the wind chill index except that the comfort model goes several steps beyond and accounts for temperature, wind, humidity, natural features, and man-made features. The human comfort temperature formula for measuring climatic influences was developed by Meterologist, Bruce F. Watson. The actual formula used to compute comfort temperature is (Tc) = T + f (h) + f (s) + f (HS) - f (w).

where:

T = AMBIENT TEMPERATURE

f (h) = A FUNCTION OF THE WATER VAPOR PRESSURE

f (s) = A FUNCTION OF THE SUN ANGLE

f (HS) = A FUNCTION OF THE HARD SURFACE MATERIAL TEMPERATURE SUCH AS ASPHALT OR CONCRETE

f'(w) = A FUNCTION OF THE WIND SPEED

Implementation of a temperature model as extensive as this involves a synthesis of the planning base inventory data into the information presented here. The base data used for this evaluation were the topography, vegetation and building shadow maps with wind direction and velocity interpoltated by the meterologist and landscape architect.

The process by which this formula is implemented involves an analysis of all possible site conditions, the calculation of a comfort temperature for each site condition using all variables and the grouping together of similar comfort temperatures.

The Minneapolis Campus has 19 different site conditions. Examples of some of those site conditions are:

- the sunny, windward, and vegetated side of a building
- the shady, leeward, and unvegetated side of a building
- the leeward southside of a hill, with vegetation
- open, flat, and hard surface conditions (such as parking lots)

The 19 different temperatures calculated were grouped into four categories for summer conditions and three categories for winter. Site conditions were evaluated by the overlay process using the data mentioned earlier. All similar site conditions were grouped together giving the different shapes presented.

A person can feel a one degree Fahrenheit temperature change as determined by the comfort formula. A temperature change of only one degree is noticeable since the site conditions between one area and another change and the amount of humidity, wind and sun elevation angle also change accordingly.

The formula can also be used for:

1. Landscape planting design in terms of present environmental

conditions. This would aid in the proper selection of plant material.

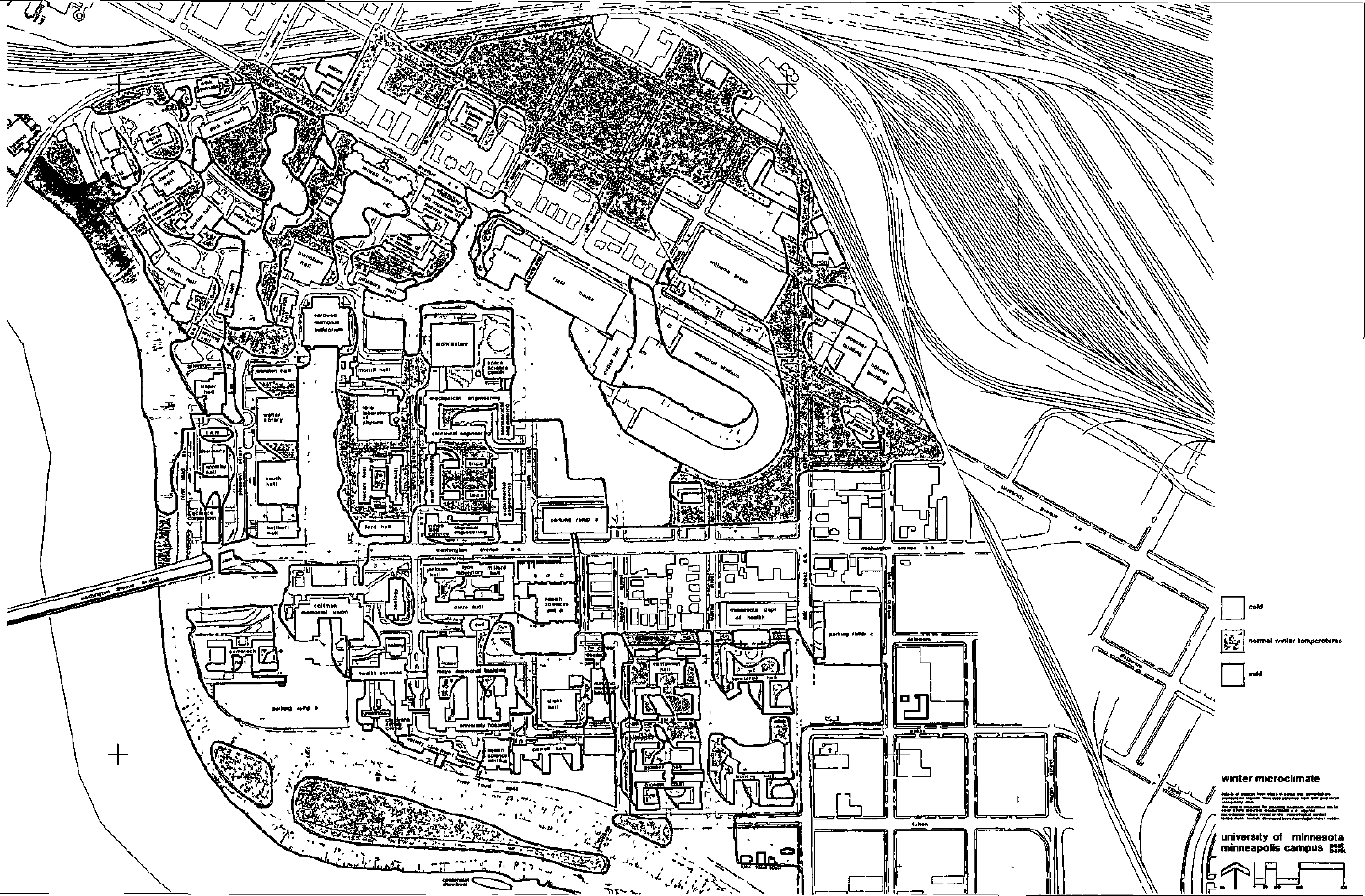
2. The environmental impact of new structures in terms of changing the comfort temperature.
3. The comfort degree days between different sites for new buildings. The comfort degree day temperature compared to the human comfort temperature desired gives the temperature increase or decrease necessary, which in turn can give the amount of energy necessary to heat or cool a building.
4. An aid in the improvement of present comfort temperatures.

1.5.9.1 WINTER MICROCLIMATE - EAST BANK

The winter comfort temperatures for East Bank are mixed but primarily of mild to warmer winter temperatures. The values for these temperatures in relation to climate data used is:

cool	11° F. to 15° F.	
normal	16° F. to 20° F.	— where the ambient temperature is 18° F.
mild	21° F. to 29° F.	

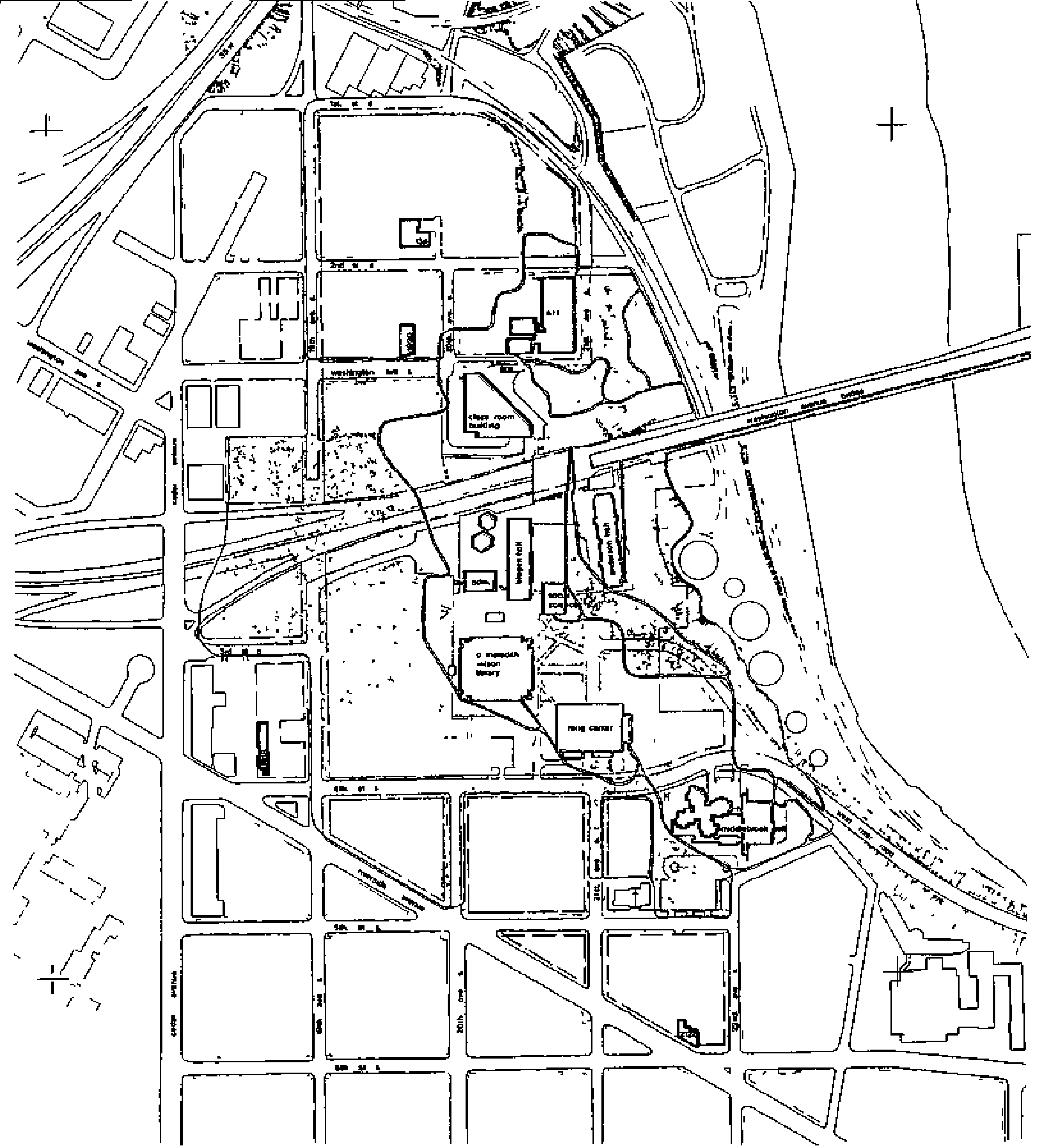
It should be noted that these values are for one day and should be used for comparative purposes only. Architectural and environmental features such as low building masses, significant numbers of above roof trees, and other vegetation provide wind breaks and create smaller open spaces which help to temper the winter temperatures in the area.



cold
normal winter temperatures
mild
winter microclimate
university of minnesota
minneapolis campus
washington avenue bridge
coffman memorial union
parking ramp b
parking ramp a
parking ramp c
memorial stadium
williams arena
field house
northrop memorial auditorium
walter library
smith hall
ford hall
mechanical engineering
electrical engineering
tate laboratory of physics
health service
mayo memorial building
university hospital
diehl hall
minnesota dept of health
washington avenue s.e.
university avenue s.e.
delaware
fulton

1.5.9.2 WINTER MICROCLIMATE - WEST BANK

The winter temperature for West Bank in the pedestrian corridors are typically cooler than normal. The cool temperatures develop because of long winter building shadows and the free movement of wind through Campus from the northwest. High wind velocities created by the tall buildings can change the temperatures presented here. Values as low as -9^{o} F. are possible.



cool

normal winter temperature

mild

winter microclimate

university of minnesota
minneapolis campus west bank

1.5.9.3 SUMMER MICROCLIMATE - EAST BANK

The human comfort temperature formula adds yet another piece of informational data to the planning decision process. The value system utilized for each map represents the relative temperature between different spaces. To place values in context with temperatures we are familiar with, the ambient temperature for summer of 67° F. and 18° F. for winter were used. Placing these values in the comfort formula as well as other values for humidity, wind, sun angle and paving surfaces, it was found that the comfort temperature for summer can range from 66° F. to 96° F. and 11° F. to 29° F. in the winter. Although these figures represent one particular day, it should be noted that temperatures change from day to day while the overall spacial organization of common temperatures do not.

The base inventory data has provided a foundation for a realistic analysis of human comfort in the Community landscape. An analysis of this data shows the extreme conditions encountered by the pedestrian moving through the Community. These harsh conditions can be improved by simply reversing the comfort temperature model to determine those conditions needed for an improved comfort temperature and implementing those changes in the built environment.

The summer temperatures for East Bank are well mixed varying from cool to extremely hot temperatures throughout the pedestrian areas on Campus. The values for these temperatures in relation to climatic data used is:

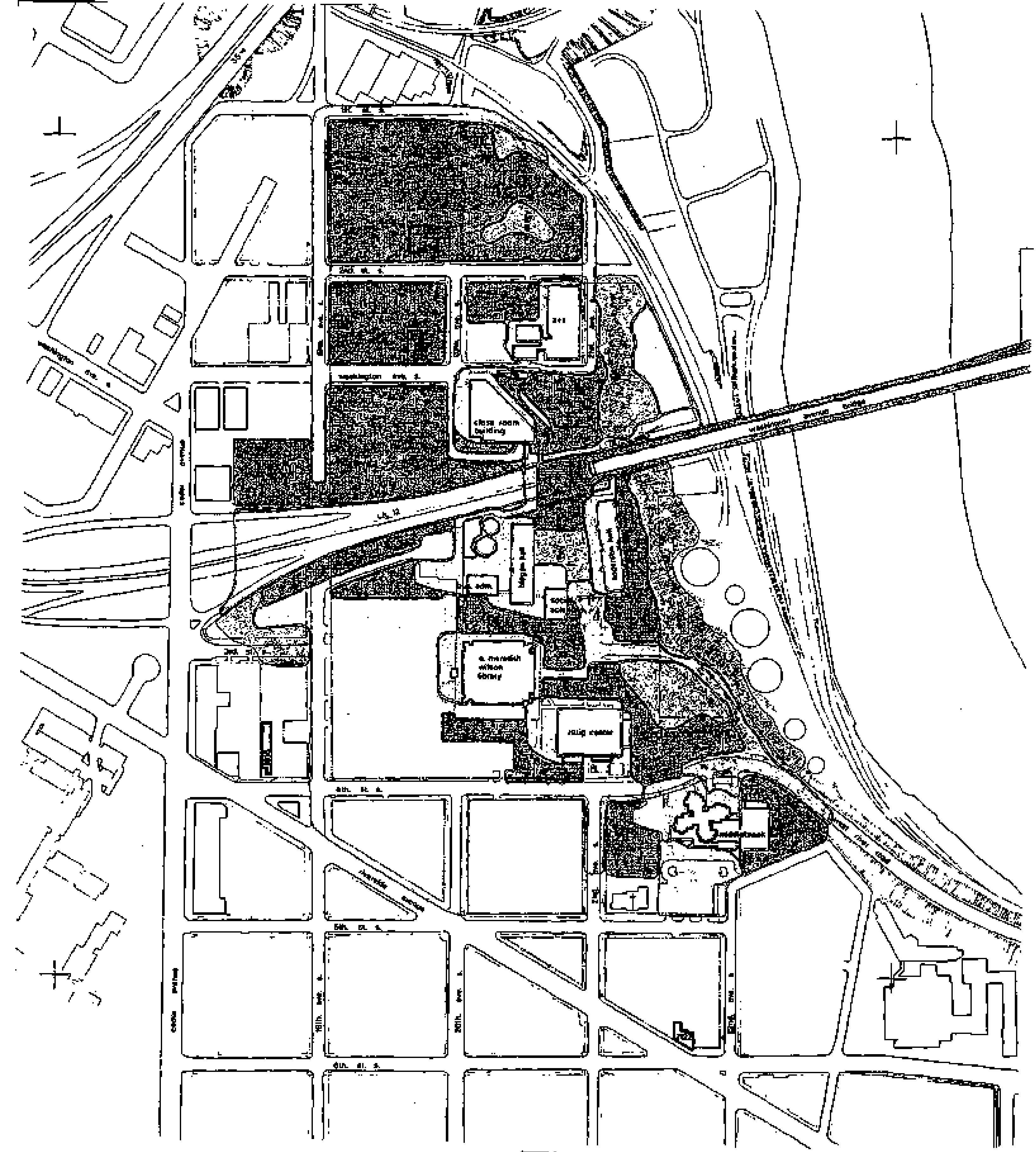
cool	66° to 71° F.	where the ambient temperature is 67° F.
warm	73° to 76° F.	
hot	77° to 87° F.	
extremely hot	87° to 96° F.	

It is important to remember the data relates to one day only and the values presented here are for comparative purposes only. The diversity of temperatures on East Bank is the product of architectural and environmental features such as low buildings, significant over storey vegetation and soft surfacing materials such as grass and ivy.

cool
warm summer temperature
hot summer temperature
extremely hot
summer microclimate
university of minnesota
minneapolis campus
northrop memorial auditorium
walter library
smith hall
johnston hall
fraser hall
architecture
mechanical engineering
electrical engineering
chemical engineering
ford hall
memorial stadium
williams arena
parking ramp b
parking ramp c
washington avenue s.e.
washington avenue bridge
health sciences unit a
minnesota dept. of health
mayo memorial building
university hospital
health services
diehl hall
powell hall
comstock
centennial hall

1.5.9.4 SUMMER MICROCLIMATE - WEST BANK

The summer temperatures for West Bank are primarily hot to extremely hot. The higher temperatures develop because of the large paved surfaces and open spaces which have no topographical changes or vegetation to cool the temperature. Many buildings on the West Bank affect temperatures because of their height. Wind is stopped and forced down onto the paved surfaces causing temperatures to increase by as much as 20° F. The intense winds of West Bank create poor human comfort conditions.



cool

warm summer temperature

hot summer temperature

extremely hot

summer microclimate

university of minnesota
minneapolis campus west bank

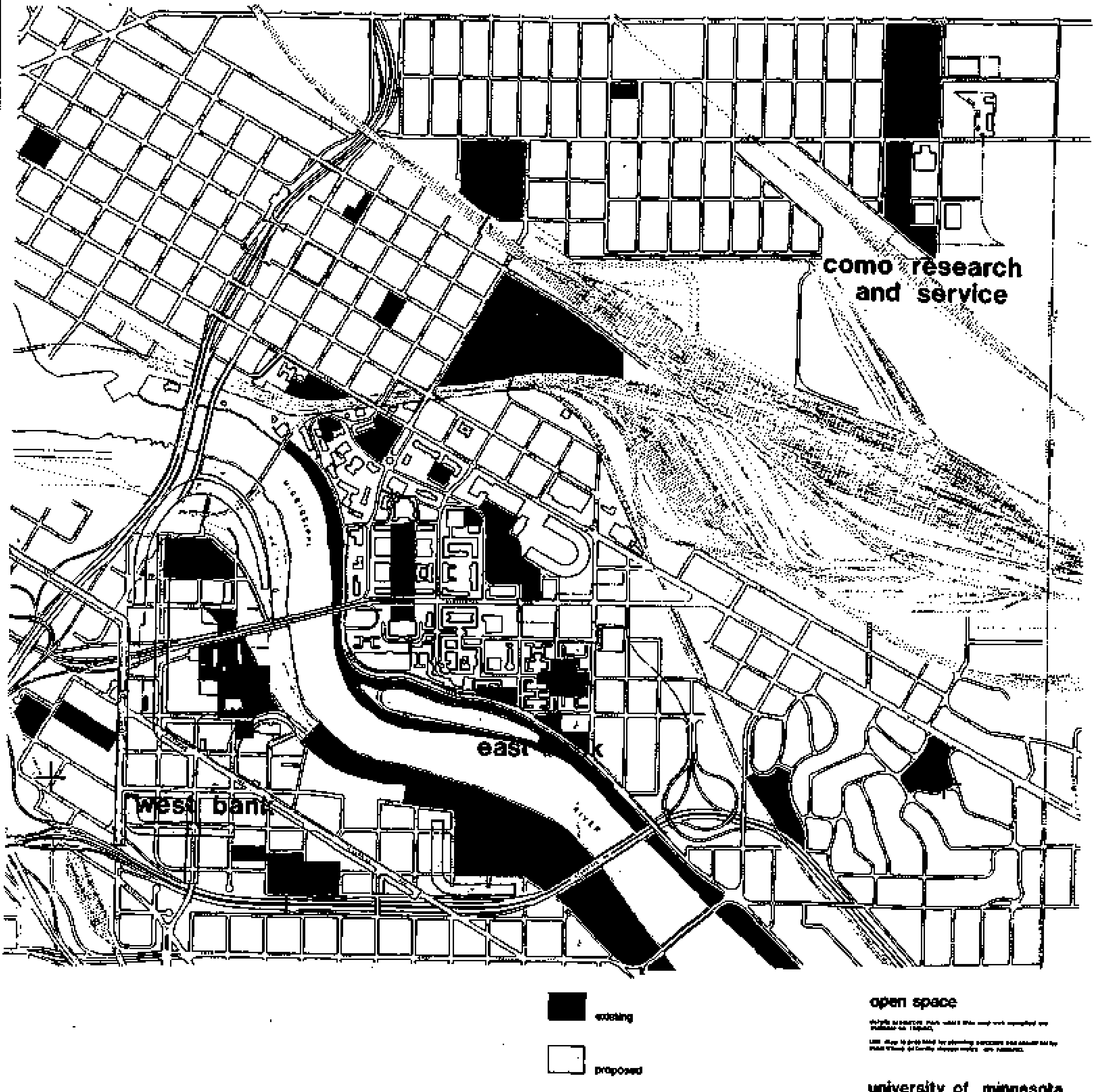
1.5.10 OPEN SPACE

For the purposes of this study, open space is defined as those areas where passive and/or active recreational activities can take place. Passive open space would also include areas that are basically visual in character while not actually providing the capability for recreation.

Although the drawing opposite does not attempt to define the type of recreational uses for different parcels of land, it does present existing and proposed recreational land in the University community. Existing recreational areas on this drawing cover many types; the public park, tot lot, University ball fields, malls and plazas. Proposed open space on or near the East Bank is minimal. The only proposed project is a "bridge park" over 35W by the Highway Department. Proposed open space on West Bank consists primarily of malls, plazas and parkway type developments all part of Cedar-Riverside "New Town-In-Town." One area along the river east of the West Bank Campus development is presently under construction as a park by the Minneapolis Park Board.

The land between the University Heating Plant and Southeast Steam Plant would be impacted by ICES. One of the purposes of the multipurpose elevated enclosure is to move sightseers through the power production area efficiently and safely, and at the same time provide a view of the river and the surrounding landscape. The open spaces between the plants can become park areas.

All of these developments correspond with park board interests and interests of the "Long Range Regional River Development and Acquisition (LRRRDAC) committee". Significant is the rehabilitation into community centered redevelopment adjacent to the plants. The LRRRDAC Committee and park board were very happy with the ICES Plan.



open space

university of minnesota
minneapolis campus

1.5.11 OUTDOOR USE

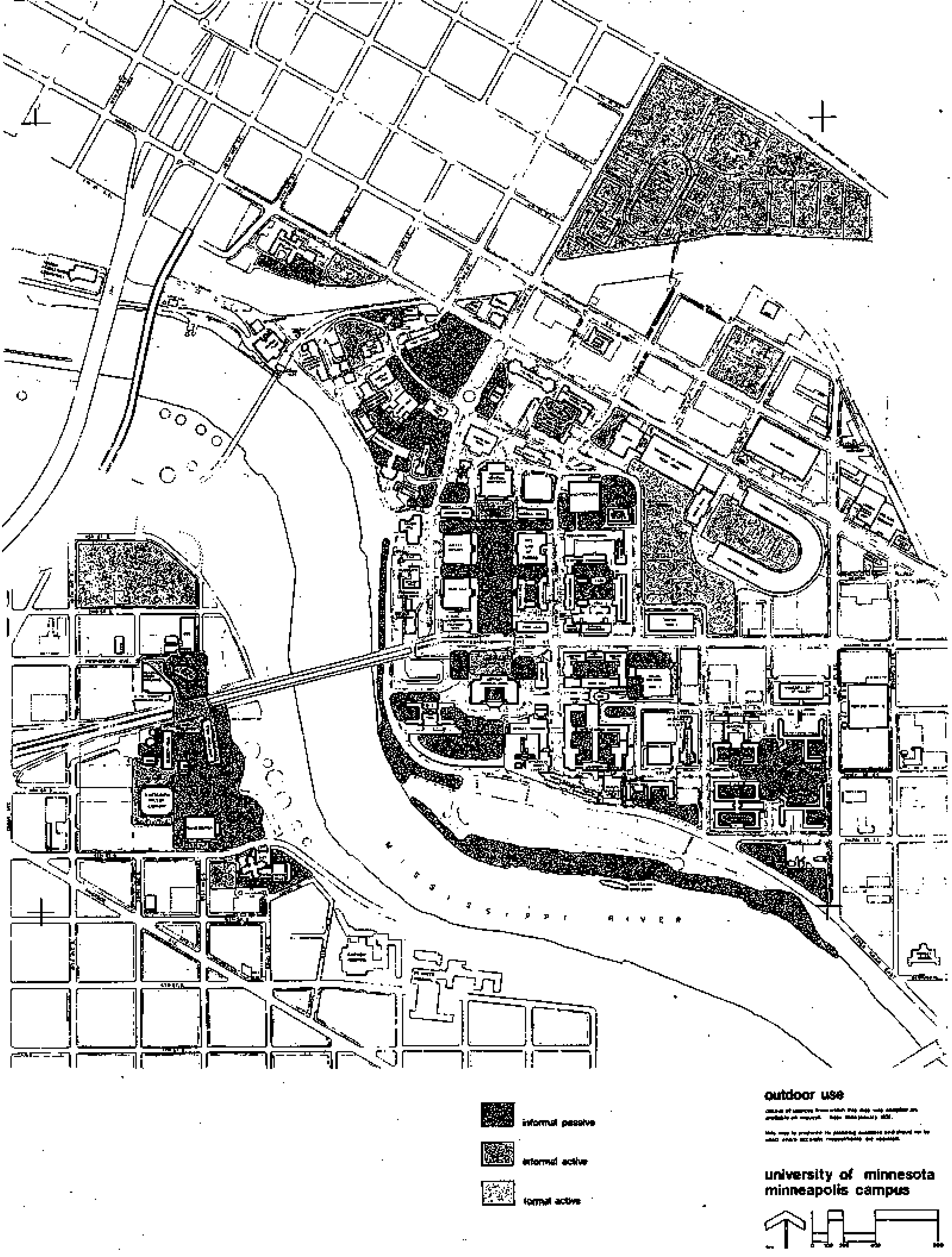
Three types of outdoor uses have been documented; informal passive, informal active, and formal active. No separation between winter and summer activities is shown. All winter activities are in buildings expect for the ice rink south of the Field House, and the ice rink at Augsburg College.

Formal active outdoor activities on Campus include: field hockey, field soccer, softball, baseball, football, tennis, track, cross country practice, broomball, cross country skiing, skating and walking.

Informal active outdoor functions are typically the same games as the formal activities except that these recreational areas provide an informal setting and some limitations to the game. Trees and shrubs are used as goal posts and boundary lines, for example.

Informal passive outdoor activities include: Frisbee™, sun-bathing, outdoor studying, sledding, snow sculpture and various University scheduled, yet informal activities, such as concerts on the mall.

The outdoor use of space between the central plant sites can be developed to informal passive activities, if development is deemed necessary by the community residents and the Park Board. We would ask the Park Board to share in these developmental costs.



outdoor use

university of minnesota
minneapolis campus

1.5.12 WILDLIFE HABITAT

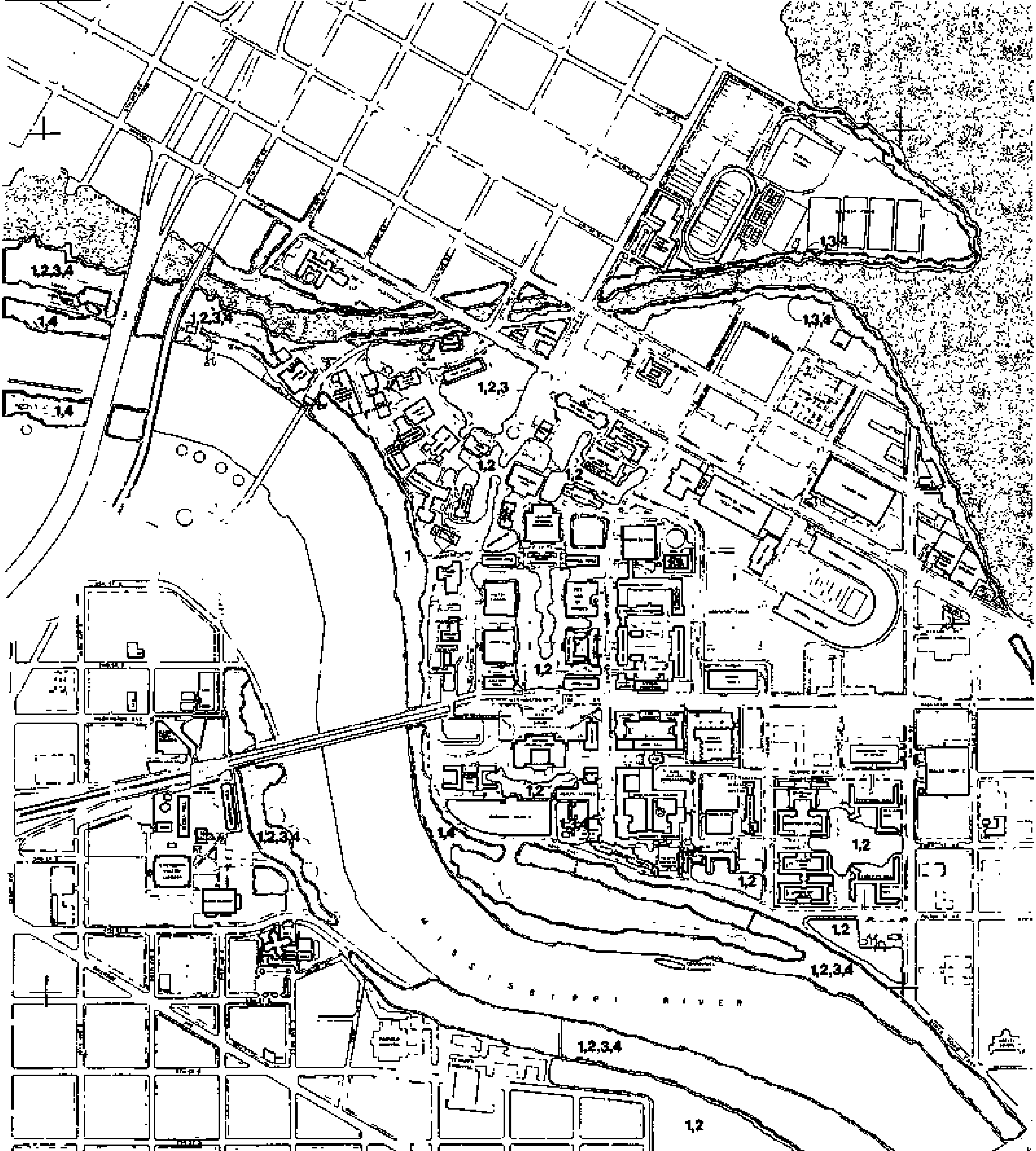
"Wildlife habitat" is a description for an environmental condition which maintains the proportions of food, water and shelter necessary for the survival of species of wildlife.

Wildlife in the urban environment can be classified into two groups of animals:

1. Those species of animals adapted to man and dependent upon man for food and some shelter. Such animals would be the pigeon, starling, english sparrow, night hawk, house mice, rats, cats and dogs.
2. Those species of animals tolerant of man and which take advantage of man, but are not dependent on man. Such animals would be the blue jay, robin, wood pecker, cardinal, crow, gray squirrel, cottontail rabbit, gopher, chipmunk, bat and red fox.

Animals of both groups can be found in and around the Community.

Integration of ICES into the Community will have minimal effects upon wildlife habitat because all systems to ICES will be totally enclosed and closed-cycle in design and operation. Environmental pollution will be alleviated as is technically and economically prudent. All systems being used are state-of-the-art systems having proven environmentally efficient subsystems. A major impact upon air quality will be the use of baghouses at both central plants to correct particulate emission to near zero.



present wildlife habitat

maintained vegetation

feeding areas

1 song birds
2 grey squirrels
3 rabbits
4 rodents

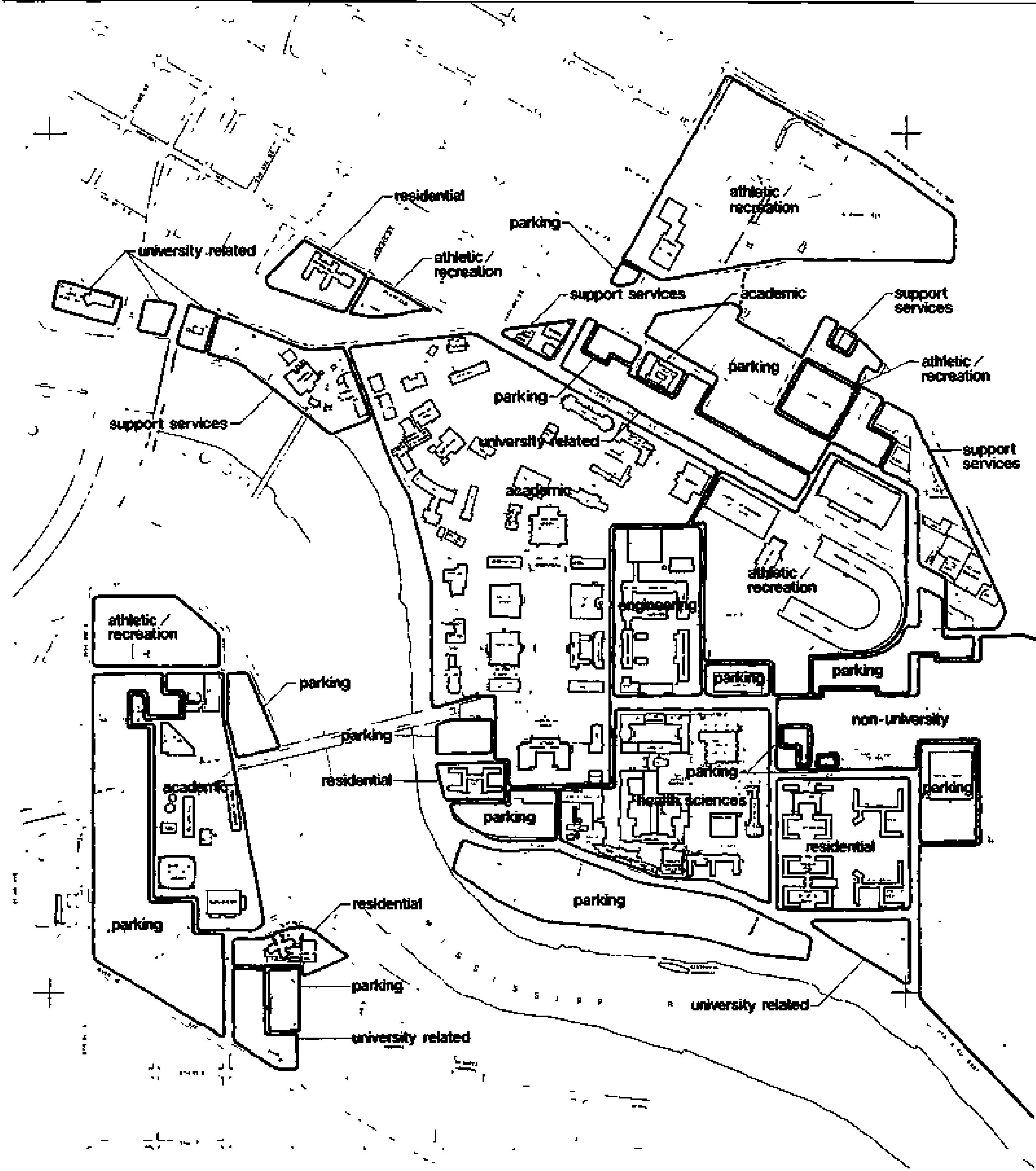
wildlife habitat

university of minnesota
minneapolis campus

1.6 BUILDING SECTORS

The following general map illustrates the general location of the key sectors developed for this feasibility study. While there is some overlap especially in the support service and housing area the drawing depicts the general location of the key sectors developed.

We have not singled out University related sectors because there are fraternity houses not under the control of the University regarding income, energy-use, or internal management. The facilities are generally owned by the fraternity.



campus land use

university of minnesota
minneapolis campus

1.6.1 BUILDING INFORMATION

The following information will give a representation of key building sectors within the Demonstration Community. The Key Sectors are developed by building, function, i.e. academic, support service, dormitory, etc. In most cases the key sector contains a mixture of old and new buildings except for West Bank Campus which is relatively new since construction was started in 1969.

The following tabulation provides a list of buildings within the Key Sectors, its primary function code, and dates of construction or major renovation. Only major buildings are included in this listing.

Academic Sector - East Bank

Building Name	Function	Date of Construction
Burton Hall	C	1895, 1959
Peik Hall	C	1950, 53
Child Development	C	1903, 67-70
Pattee Hall	C	1889, 1950
Shevlin Hall	C	1906, 61
Elliott Hall	C	1938, 39
Scott Hall	C	1922, 23
Music Education	C	1903
Wulling Hall	C	1892
Wesbrook Hall	C	1896
Nicholson Hall	C-B	1890, 1927
Northrop Memorial Auditorium	C-A	1928
Pillsbury	C	1889
Bell Museum	C	1939, 40, 47

Building Name	Function	Date of Construction
Armory	C	1896, 1965
Johnston Hall	C-O	1949-50
Tate Laboratory of Physics	C-L	1927, 37, 39
Walter Library	C	1923, 58
Smith Hall	C	1914, 23
Fraser Hall	C	1927, 53-57
Appleby Hall	C	1915
Science Classroom	C	1961
Kolthoff Hall	C-L	1971
Ford Hall	C	1949-50
Vincent Hall	C	1936-38, 69
Murphy Hall	C	1938-40
Zoology	C	1914
Botany	C	1926
Coffman Memorial Union	U	1937
Klaeber Court	O	1968-69

Academic Sector - West Bank

Studio Art	C	1965
Classroom Building	C	1974
Business Administration	C	1961
Blegan Hall	C	1961
Social Science	C	1961
Anderson Hall	C	1967
Wilson Library	C	1968
Rarig Center	P	1974

Support Services - East Bank

Building Name	Function	Date of Construction
Shops Building	S-O	1923, 44, 35
Shops Annex	O	1940
Morrill Hall	O	1924-25, 62
Folwell Hall	O	1907
Mineral Resources Research Center	R	1923-24
Tandem Van de Graph	R	1963-67
Linac Laboratory	R	1951
Standard Oil	S-O	1967
Inventory Warehouse	W	1967
Holman-Poucher	L-W-O-C	1953
Police	O	1947

Residential - East Bank

Centennial Hall	D	1948-51, 54
Comstock Hall	D	1938-40, 58-59
Territorial Hall	D	1956-58
Frontier Hall	D	1958
Pioneer Hall	D	1928, 32
Sanford Hall	D	1910, 67

Residential - West Bank

Middlebrook Hall	D	1969

Athletic - East Bank

Williams Arena	HO-B	1927, 1950
Field House	IS	1948
Cooke Hall	O-SW	1934
Memorial Stadium	F-R	1925

Engineering - East Bank

Building Name	Function	Date of Construction
Electrial Engineering	C	1924, 64
Space Science Center	C-L	1968
Mechanical-Aeronautical Engineering	C	1943-49
Aeronautical Engineering	C-L	1943-49
Chemical Engineering	C-L	1948
Mines and Mettalurgy	C	1956-60
Experimental Engineering	C-O	1911, 20
Architecture	C	1958

Non-Support - East Bank

Minn. State Board of Health	O-L	1969

Health Sciences and Hospital - East Bank

Jackson Hall	HST	1912, 59, 69
Jackson-Owre	HST	1958
Millard Hall	HST	1912, 35-37, 58-61
Owre Hall	HST	1930, 66-69
Unit "A"	HST	1974
Unit "K-E"	HST	1976
Mayo	H	1965
Child Rehabilitation	H	1963-66
Diehl Hall	HST	1958, 63-66
Powell Hall	O	1931, 33, 43
VFW Cancer Research	H	1958-60
Heart Hospital	H	1948, 61, 68, 71
Health Service	H	1948, 57-61, 68-71

Garages - East Bank

Building Name	Function	Date of Construction
Mayo	UG	1965
Northrop	UG	1928
Bell Museum	UG	1939, 40, 47
Coffman	UG	1967
Ramp C	RA	
Ramp B	RA	1967-69
Ramp A	RA	1953-56

Health Sciences and Hospital - West Bank

St. Mary's Hospital	H	
Fairview Hospital	H	
Extended Care Center	H	
St. Mary's Junior College	H	1976

Function Code for Key Sectors

Code	Designation Function
C	Classroom
B	Bookstore
A	Auditorium
O	Office
L	Laboratory
P	Performing Arts
S	Trade Shops
R	Research
W	Warehouse
D	Dormitory
HO	Hockey
B	Basketball
IS	Indoor Sports

Code	Designation Function
SW	Swimming
F	Football
HST	Health Science Teaching
H	Hospital
UG	Underground Garage
RA	Ramp

1.6.1.1 SECTOR ENERGY DENSITY

Total energy consumption and energy density requirements vary widely from key sector to key sector.

Laundry facilities, while representing only .4% of the total floor space within the University, consumes 2.4% of the total annual steam supplied, and 0.9% of the total electricity used on campus.

Medical and Health Sciences, the other energy intensive sector, requires 38.5% of the annual steam load and 41.5% of the annual electrical load, while representing only 24.7% of the University floor space.

The lower steam and electric energy intensive sectors are the Garage and Athletic sectors.

The Support Services sector which has a below average steam demand density, has a high electric demand density.

Computer printouts of 1976 gross square feet, steam requirements, and steam demand densities by University building follows.

Next is a table which summarizes sector steam and electric use densities.

UNIVERSITY ENERGY DENSITY BY SECTORS

Sector*	Floor Space $(10^3\ ft^2)$	Floor Space %	Annual Steam Requirement $(10^6\ lbs/yr)$	Annual Steam Requirement %	Steam Density $(lbs/ft^2 - yr)$	Peak Demand $(10^3\ lbs/hr)$	Peak Demand Density $(10^{-3}\ lbs/ft^2 - hr)$	Electric Demands $(10^3\ KWh/yr)$	Electric Demands %	Electric Demand Density $(KWh/ft^2 - yr)$
Academic	4,516	41.2	472	37.1	105	94.5	21	36,955	33.2	8.2
Athletic	729	6.6	34	2.6	49	10.5	14	2,835	2.5	3.9
Engineering	803	7.3	45	3.5	56	11.0	14	6,674	6.0	8.3
Garages	241	2.2	8	0.6	33	2.5	10	800	0.7	3.3
Medical and Health Sciences	2,707	24.7	490	38.5	181	115.5	43	46,170	41.5	11.1
Residential	1,183	10.8	116	9.1	98	27.0	23	7,805	7.0	6.6
Support Services	743	6.8	75	5.9	101	15.0	20	9,108	8.2	12.3
Laundry**	46	0.4	30	2.4	625	8.6	178	983	0.9	20.5
TOTAL	10,970	100.0	1,272	100.0	116	410.0	37	111,331	100.0	10.1

*Sectors include University East and West Bank Campuses only.

**Steam totals are extrapolated from a three day hourly steam demand study.

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1976 BUILDING STEAM REQUIREMENTS (THOUSANDS OF POUNDS)

BUILDING NAME	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	GSF
EDDY HALL	499	419	343	187	104	41	30	33	82	230	392	481	32645
PILLSBURY HALL	867	727	596	325	181	71	52	57	142	399	680	835	56667
PATTEE HALL	464	389	319	174	97	38	28	30	76	213	364	447	30312
NICHOLSON HALL	1351	1134	928	507	282	110	81	89	221	622	1060	1302	88343
WULLING HALL	418	351	287	157	87	34	25	27	68	192	328	402	27310
BURTON HALL	857	719	589	322	179	70	51	56	140	394	673	826	56037
WESBROOK HALL	615	516	423	231	129	50	37	40	101	283	483	593	40223
ARMORY	1253	1052	861	470	262	102	75	82	205	577	983	1207	81938
PHARMACY GREENHOUSE	300	232	221	151	120	59	60	47	66	142	215	286	5010
JONES HALL	378	317	259	142	79	31	23	25	62	174	296	364	24691
CHILD DEV. (OLD)	931	684	605	317	136	25	3	2	117	391	643	915	31897
CHILD DEV. (NEW)	296	216	189	92	183	405	457	481	384	316	212	288	15160
ELLIOTT HALL	2885	2500	2415	1498	2033	6920	7759	7798	3059	1578	2500	2810	190209
SHEVLIN HALL	668	515	442	281	214	58	22	18	119	426	565	652	33174
FOLWELL HALL	1623	1362	1115	609	339	132	97	106	265	747	1274	1564	106115
MUSIC EDUCATION	115	97	79	43	24	9	7	8	19	53	91	111	7552
SANFORD HALL	2865	2211	1896	1208	919	251	96	77	512	1829	2426	2798	142369
UNIVERSITY HOSPITALS	4945	3767	3716	3237	2411	2649	2945	3089	2219	1808	2895	4338	312990
EXP. ENGINEERING	858	711	623	401	195	89	91	85	201	396	636	788	66896
MAIN ENGINEERING	1185	981	861	554	369	123	126	117	278	546	879	1088	92383
JACKSON HALL	1866	1402	885	885	871	931	790	1188	1227	1615	1769	1795	83946
MILLARD HALL	2192	1580	997	997	981	1049	890	1338	1382	1819	1992	2022	94559
HEATING PLANT	0	0	0	0	0	0	0	0	0	0	0	0	55250
CHEMISTRY	5018	4107	3561	2431	1343	712	642	671	1177	2226	4607	4836	187032
NORRIS GYM	865	640	579	392	227	26	14	14	162	495	692	858	44186
NORRIS FIELDHOUSE	461	91	0	0	0	0	0	0	0	111	586	513	20104
APPLEBY HALL	1271	1035	831	397	488	204	192	195	328	520	1004	1090	52799
ZOOLOGY	1067	852	764	436	316	237	131	163	191	568	831	1100	66543
SCOTT HALL	470	383	225	269	56	245	275	355	430	272	407	446	32906
MINES EXP. STATION	1312	1207	802	536	122	0	0	0	43	467	941	1259	58041
WALTER LIBRARY	2100	2016	1307	850	172	101	55	59	225	1043	1540	1556	267218
ELECTRICAL ENG.	1082	896	786	506	245	112	115	107	254	499	803	994	84366
SHOPS BUILDING	1308	1098	899	491	273	107	78	86	214	602	1026	1260	85514
MEMORIAL STADIUM	1345	1100	837	568	214	65	73	82	145	355	1004	1380	195739
MORRILL HALL	1446	1218	1002	558	432	552	571	383	336	671	1136	1394	92921
BOTANY GREENHOUSE	683	527	504	344	274	134	136	106	150	324	489	651	11393
BOTANY	643	513	460	263	190	143	79	98	115	342	501	663	40084
TATE LAB. OF PHYSICS	2941	2468	2021	1104	615	240	175	193	481	1353	2308	2833	192268
WILLIAMS ARENA	1612	1242	1021	487	462	101	0	0	1	335	601	2097	267588
FRASER HALL	859	732	745	423	137	19	19	17	170	396	760	854	100190
PIONEER HALL	3010	2700	2444	1420	675	397	292	299	608	570	2403	2915	193439
NORTHRUP AUDITORIUM	2448	2095	1702	893	592	19	19	15	382	695	2130	2359	181388
OWRE HALL	2055	1544	975	975	959	1025	869	1308	1351	1778	1948	1977	92430
POWELL HALL	2286	1438	845	225	132	73	74	76	137	728	1701	3121	154702
COOKE HALL	2333	1726	1562	1057	612	70	38	38	437	1315	1867	2314	119182
NOLTE CENTER	1797	1396	1066	237	8	0	0	0	15	512	1291	1732	37125
NOLTE GARAGE	283	278	156	233	3	1	1	1	3	32	16	207	50036
VINCENT HALL	1257	1047	938	536	352	897	1166	1070	448	651	1193	1135	95313
BELL MUSEUM	1225	1020	841	460	256	754	727	734	854	563	961	1180	80067
MURPHY HALL	751	613	539	288	139	1	1	2	103	396	683	641	53064
COMSTOCK HALL	2690	2413	2184	1269	603	355	261	267	543	509	2148	2605	173882
COFFMAN	4359	3910	3539	2056	977	575	423	433	880	825	3481	4221	380133
COFFMAN GARAGE	387	380	213	318	4	1	1	1	4	44	22	283	68337
MECHANICAL ENG.	1016	814	704	426	164	50	43	53	128	596	797	1056	142083
AERONAUTICAL ENG.	1626	1374	1216	809	435	224	237	209	491	632	1163	1371	63921

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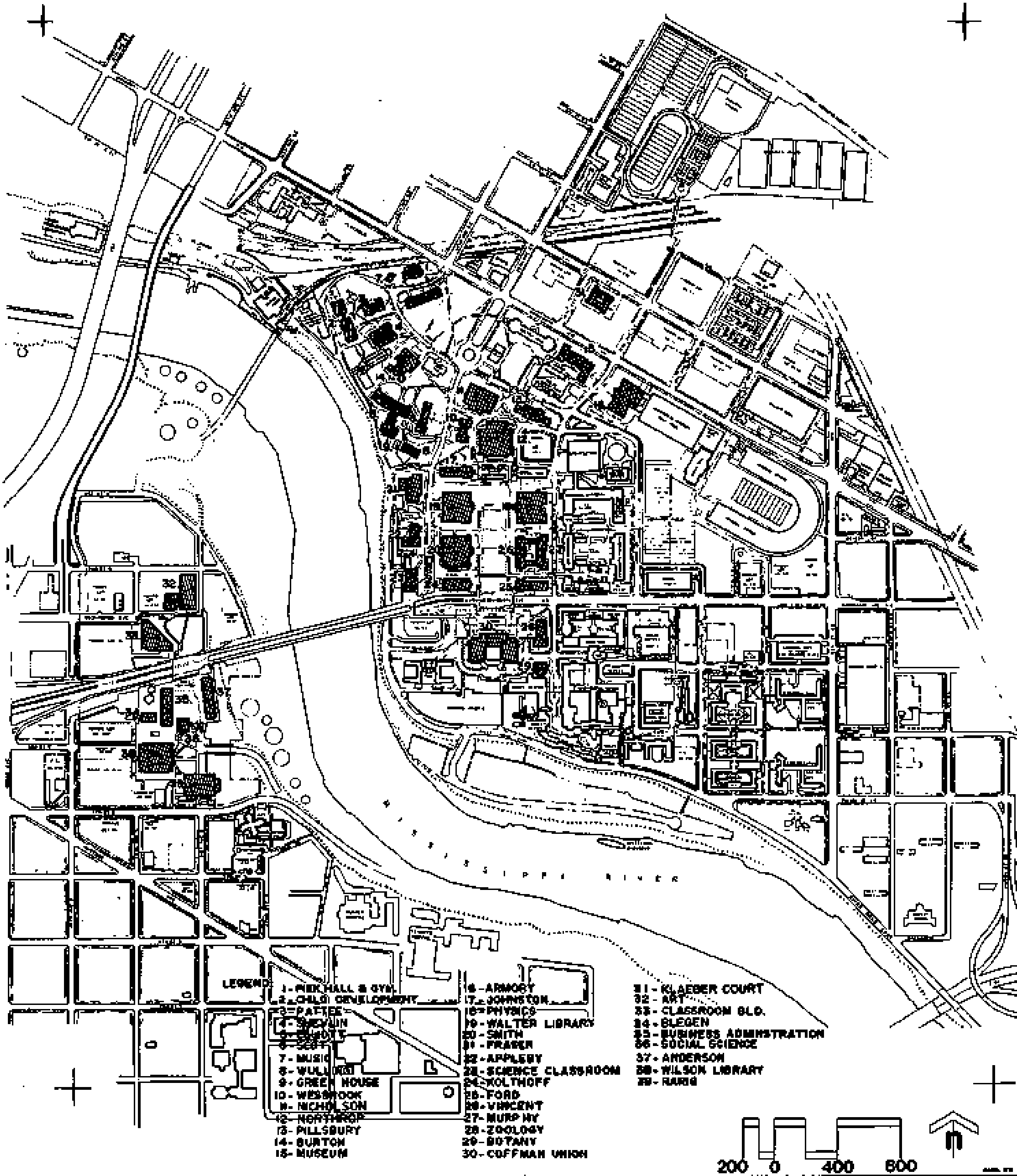
1976 BUILDING STEAM REQUIREMENTS (THOUSANDS OF POUNDS)

BUILDING NAME	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	GSF
CHEMICAL ENGINEERING	1109	885	713	369	218	65	45	43	88	339	722	1162	71151
U OF M FIELDHOUSE	1612	1242	1021	487	462	101	0	0	1	335	801	2097	83073
CENTENNIAL HALL	3555	3189	2886	1677	797	469	345	353	718	673	2838	3442	228450
HEART HOSPITAL	1493	1175	1032	705	967	860	4298	2973	1707	839	1038	1438	95969
HEALTH SERVICE	1615	1323	1592	1286	1785	3196	3438	4287	1668	2234	1732	2356	139805
FORD HALL	783	695	617	306	170	29	27	28	150	458	641	860	85842
JOHNSTON HALL	874	683	610	311	31	23	10	9	176	378	654	887	79816
MAYO BUILDING	7367	5562	3794	3684	1096	1683	2140	1856	2380	4372	6583	7827	471020
MAYO GARAGE	1191	947	711	403	181	36	25	26	67	140	789	1055	90264
LINAC LABORATORY	43	39	25	16	4	4	4	3	3	4	23	39	5018
PEIK HALL	987	828	678	370	206	80	59	65	161	454	774	951	64521
PEIK HALL GYM	369	273	247	167	97	11	6	6	69	211	295	366	18848
LYON LABORATORIES	1054	792	500	500	492	526	446	671	693	912	999	1014	47411
HARVARD ARTS.	802	620	511	331	80	25	18	9	1	367	608	793	50688
T.N.C.E.	105	89	73	30	26	8	0	0	4	41	69	116	7200
T.S.C.E.	105	89	73	30	26	8	0	0	4	41	69	116	7200
POLICE BUILDING	208	176	144	59	50	15	0	0	8	82	135	228	14202
E.N. OF APPLEBY HALL	195	165	135	56	47	14	0	0	7	77	127	214	13320
SHOPS ANNEX	201	169	138	76	42	16	12	13	33	93	158	194	13164
POULNER BUILDING	2549	2517	2294	2024	2068	1755	1768	1729	1753	2000	1283	1564	50128
HOLMAN BUILDING	705	596	490	201	171	52	0	0	26	277	459	774	48224
UNIV. PRESS BUILDING	266	184	164	72	31	2	0	0	10	94	182	269	21634
MINES AND METALLURGY	860	686	553	286	169	50	35	33	68	263	560	901	55152
TERRITORIAL HALL	1657	1486	1345	782	371	219	161	164	335	314	1323	1605	106500
MASONIC MEM. HOSP.	2091	1642	1451	843	749	564	503	547	729	967	1305	1743	80707
DIEHL HALL	7780	5271	5602	6195	7173	9497	12182	9007	6928	4390	5023	8354	197022
VFW CANCER RES. CTR.	1751	1363	1126	723	590	531	488	321	143	853	1067	1517	26142
FRONTIER HALL	1693	1561	1474	869	582	116	49	48	112	147	2419	1761	113037
ARCHITECTURE	1613	1286	1037	536	300	61	59	67	187	491	902	1215	103411
JACKSON-OWRE	1061	797	503	517	875	1351	1595	1744	1759	1281	1006	1021	47736
CHILDREN'S REHAB. CT	1114	877	770	526	722	642	3208	2219	1274	626	775	1073	71630
SCIENCE CLSRM BLDG.	641	549	446	234	155	5	5	4	100	182	558	618	47522
TANDEM ACC. LAB.	720	550	550	550	349	713	1116	1071	869	545	531	716	28653
KOLTHOFF HALL	3077	2245	1969	959	1907	4213	4747	5002	3992	3285	2208	2996	157569
SPACE SCIENCE CENTE	1874	1368	1199	584	1162	2567	2892	3047	2432	2629	2215	2952	95989
YMCA	258	218	179	74	63	19	0	0	10	101	168	283	17637
11 OAK STREET S.E.	227	192	158	65	55	17	0	0	8	89	148	249	15526
STANDARD OIL EAST	478	404	332	136	116	35	0	0	18	188	311	525	32686
STANDARD OIL WEST	375	317	261	107	91	28	0	0	14	147	244	412	25642
UNIT 'A'	12174	9484	7671	5748	8421	14006	14215	14700	9804	8126	11464	14861	679904
UNIT 'K-E'	4742	3269	3050	2065	2261	4773	6356	5213	3056	1819	1456	4760	110891
UNIT 'R-C'	0	0	0	0	0	0	0	0	0	0	4085	7768	574000
ADMIS. RCRDS/BKSTR	0	0	0	0	0	0	0	0	0	0	414	683	83480
BUSINESS ADMIN.	1756	1342	1075	343	370	621	636	627	440	779	1042	1481	100408
SOCIAL SCIENCES	1873	1431	1146	366	395	662	678	669	469	831	1111	1579	107074
BLEGEN HALL	2053	1421	1090	639	407	191	168	252	322	822	1333	1651	102200
WILSON LIBRARY	4954	3401	2874	888	6187	16387	17633	18098	8576	2201	3849	4772	386517
ANDERSON HALL	1660	1264	1022	501	488	331	143	158	204	628	1071	1651	83281
AUD. CLASS. BLDG.	1311	917	691	600	1042	2026	2204	1515	1631	823	1067	1279	80626
MIDDLEBROOK HALL	4111	3034	2262	623	404	1742	1936	1243	138	1182	3049	3678	226668
RARIG CENTER	4297	2248	1158	2012	2261	4083	4571	4630	3359	1612	1560	1776	133121
LAW BUILDING	0	0	0	0	0	0	0	0	0	0	184	482	245000
ART BUILDING	799	676	556	228	194	59	0	0	29	314	520	878	54684

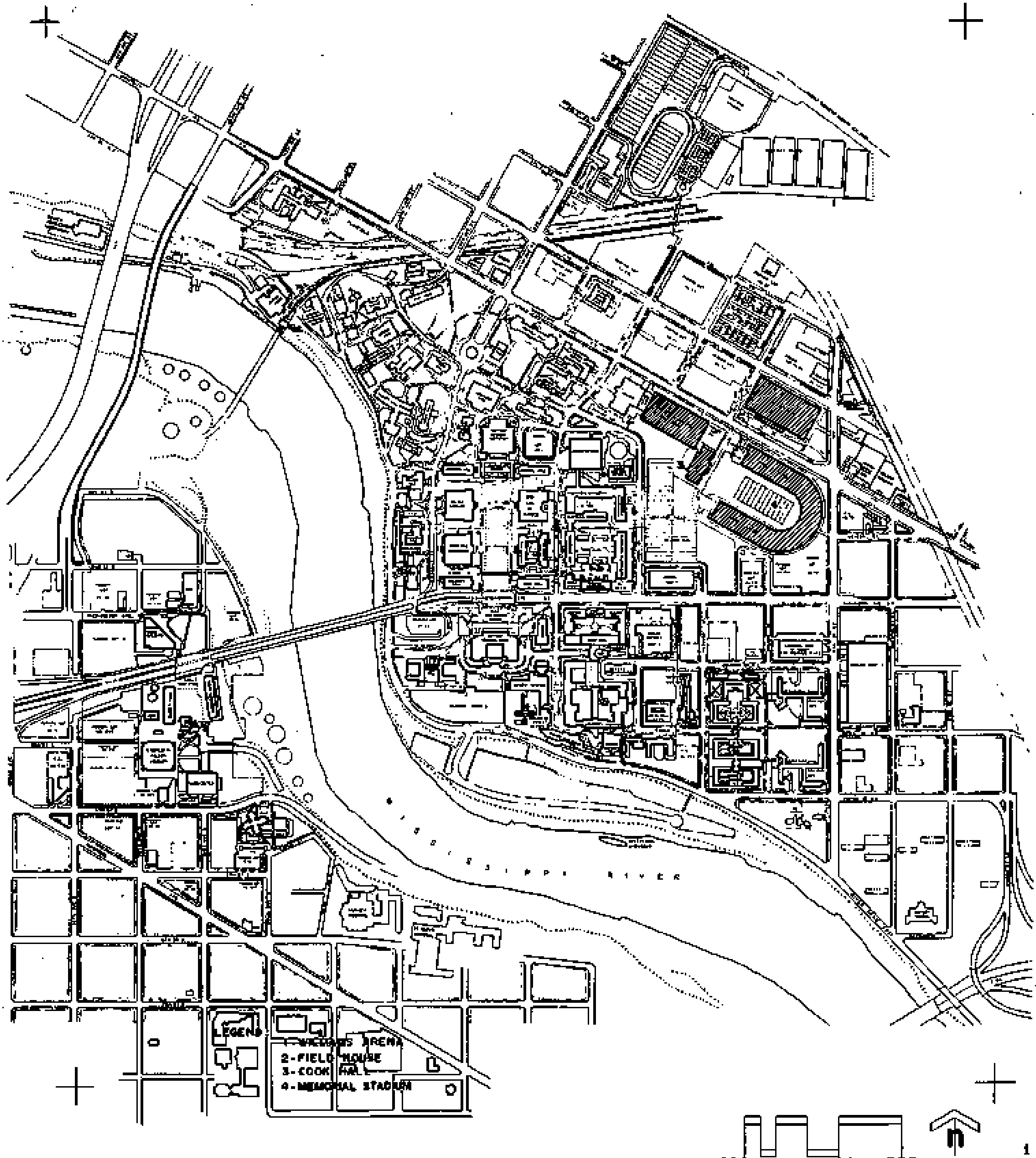
BUILDING NAME	GSF	1976 LBS(1000'S)	YEARLY LBS/GSF	MON. AV. LBS/GSF
EDDY HALL	32645	2841	87.03	7.25
PILLSBURY HALL	56667	4932	87.03	7.25
PATTEE HALL	30312	2639	87.06	7.26
NICHOLSON HALL	88343	7687	87.01	7.25
WULLING HALL	27310	2376	87.00	7.25
BURTON HALL	56037	4876	87.01	7.25
WESBROOK HALL	40223	3501	87.04	7.25
ARMORY	81938	7129	87.00	7.25
PHARMACY GREENHOUSE	5010	1899	379.04	31.59
JONES HALL	24691	2150	87.08	7.26
CHILD DEV. (OLD)	31897	4769	149.51	12.46
CHILD DEV. (NEW)	15160	3519	232.12	19.34
ELLIOTT HALL	190209	43755	230.04	19.17
SHEVLIN HALL	33174	3980	119.97	10.00
FOLWELL HALL	106115	9233	87.01	7.25
MUSIC EDUCATION	7552	656	86.86	7.24
SANFORD HALL	142369	17088	120.03	10.00
UNIVERSITY HOSPITALS	312990	38019	121.47	10.12
EXP. ENGINEERING	66896	5074	75.85	6.32
MAIN ENGINEERING	92382	7007	75.85	6.32
JACKSON HALL	83946	15224	181.35	15.11
MILLARD HALL	94559	17149	181.36	15.11
HEATING PLANT	55250	0	0	0
CHEMISTRY	187032	31331	167.52	13.96
NORRIS GYM	44186	4964	112.34	9.36
NORRIS FIELDHOUSE	20104	1762	87.64	7.30
APPLEBY HALL	52799	7555	143.09	11.92
ZOOLOGY	66543	6656	100.03	8.34
SCOTT HALL	32906	3833	116.48	9.71
MINES EXP. STATION	58041	6689	115.25	9.60
WALTER LIBRARY	267218	11032	41.28	3.44
ELECTRICAL ENG.	84366	6399	75.85	6.32
SHOPS BUILDING	85514	7442	87.03	7.25
MEMORIAL STADIUM	195739	7188	36.72	3.06
MORRILL HALL	92921	9699	104.38	8.70
BOTANY GREENHOUSE	11393	4322	379.36	31.61
BOTANY	40084	4010	100.04	8.34
TATE LAB. OF PHYSICS	192268	16732	87.02	7.25
WILLIAMS ARENA	267588	7959	29.74	2.48
FRASER HALL	100190	5131	51.21	4.27
PIONEER HALL	193439	17733	91.67	7.64
NORTHRUP AUDITORIUM	181388	13349	73.59	6.13
OWRE HALL	92430	16764	181.37	15.11
POWELL HALL	154702	10836	70.04	5.84
COOKE HALL	119182	13389	112.34	9.36
NOLTE CENTER	37125	7954	214.25	17.85
NOLTE GARAGE	50036	1214	24.26	2.02
VINCENT HALL	95313	10690	112.16	9.35
BELL MUSEUM	80067	9583	119.69	9.97
MURPHY HALL	53064	4157	78.34	6.53
COMSTOCK HALL	172882	15847	91.66	7.64
COFFMAN	280133	25679	91.67	7.64
COFFMAN GARAGE	68337	1658	24.26	2.02
MECHANICAL ENG.	142083	5847	41.15	3.43
AERONAUTICAL ENG.	63921	9777	152.95	12.75

BUILDING NAME	GSF	1976 LBS(1000'S)	YEARLY LBS/GSF	MON. AV. LBS/GSF
CHEMICAL ENGINEERING	71151	5758	80.93	6.74
U OF M FIELDHOUSE	83073	7959	95.81	7.98
CENTENNIAL HALL	228450	20942	91.67	7.64
HEART HOSPITAL	95969	18525	193.03	16.09
HEALTH SERVICE	139805	26512	189.64	15.80
FORD HALL	85842	4764	55.50	4.62
JOHNSTON HALL	79816	4646	58.21	4.85
MAYO BUILDING	471020	48344	102.64	8.55
MAYO GARAGE	90264	5571	61.72	5.14
LINAC LABORATORY	5018	197	39.26	3.27
PEIK HALL	64521	5613	86.99	7.25
PEIK HALL GYM	18848	2117	112.32	9.36
LYON LABORATORIES	47411	8599	181.37	15.11
HARVARD APTS.	50688	4165	82.17	6.85
T.N.C.E.	7200	561	77.92	6.49
T.S.C.E.	7200	561	77.92	6.49
POLICE BUILDING	14202	1105	77.81	6.48
T.N. OF APPLEBY HALL	13320	1037	77.85	6.49
SHOPS ANNEX	13164	1145	86.98	7.25
POUCHER BUILDING	50128	23304	464.89	38.74
HOLMAN BUILDING	48224	3751	77.78	6.48
UNIV. PRESS BUILDING	21634	1274	58.89	4.91
MINES AND METALLURGY	55152	4464	80.94	6.74
TERRITORIAL HALL	106500	9762	91.66	7.64
MASONIC MEM. HOSP.	80707	13134	162.74	13.56
DIEHL HALL	197022	87402	443.62	36.97
VFW CANCER RES. CTR.	26142	10473	400.62	33.38
FRONTIER HALL	113037	10821	95.73	7.98
ARCHITECTURE	103411	7754	74.98	6.25
JACKSON-OWRE	47736	13510	283.01	23.58
CHILDREN'S REHAB. CT	71630	13826	193.02	16.08
SCIENCE CLSRM BLDG.	47522	3497	73.59	6.13
TANDEM ACC. LAB.	28653	8280	288.97	24.08
KOLTHOFF HALL	157569	36600	232.28	19.36
SPACE SCIENCE CENTE	95989	24921	259.62	21.64
YMCA	17637	1373	77.85	6.49
111 OAK STREET S.E.	15526	1208	77.80	6.48
STANDARD OIL EAST	32686	2543	77.80	6.48
STANDARD OIL WEST	25642	1996	77.84	6.49
UNIT 'A'	679904	130674	192.19	16.02
UNIT 'K-E'	110891	42820	386.14	32.18
UNIT 'B-C'	574000	11853	20.65	1.72
ADMIS, RCRDS/BKSTR	83400	1097	13.14	1.10
BUSINESS ADMIN.	100408	10512	104.69	8.72
SOCIAL SCIENCES	107074	11210	104.69	8.72
BLEGEN HALL	102200	10349	101.26	8.44
WILSON LIBRARY	386517	89820	232.38	19.37
ANDERSON HALL	83281	9121	109.52	9.13
AUD. CLASS. BLDG.	80626	15106	187.36	15.61
MIDDLEBROOK HALL	226668	23402	103.24	8.60
RARIG CENTER	133121	33567	252.15	21.01
LAW BUILDING	245000	666	2.72	.23
ART BUILDING	54684	4253	77.77	6.48



university of minnesota
minneapolis

KEY SECTOR
ACADEMIC HALLS



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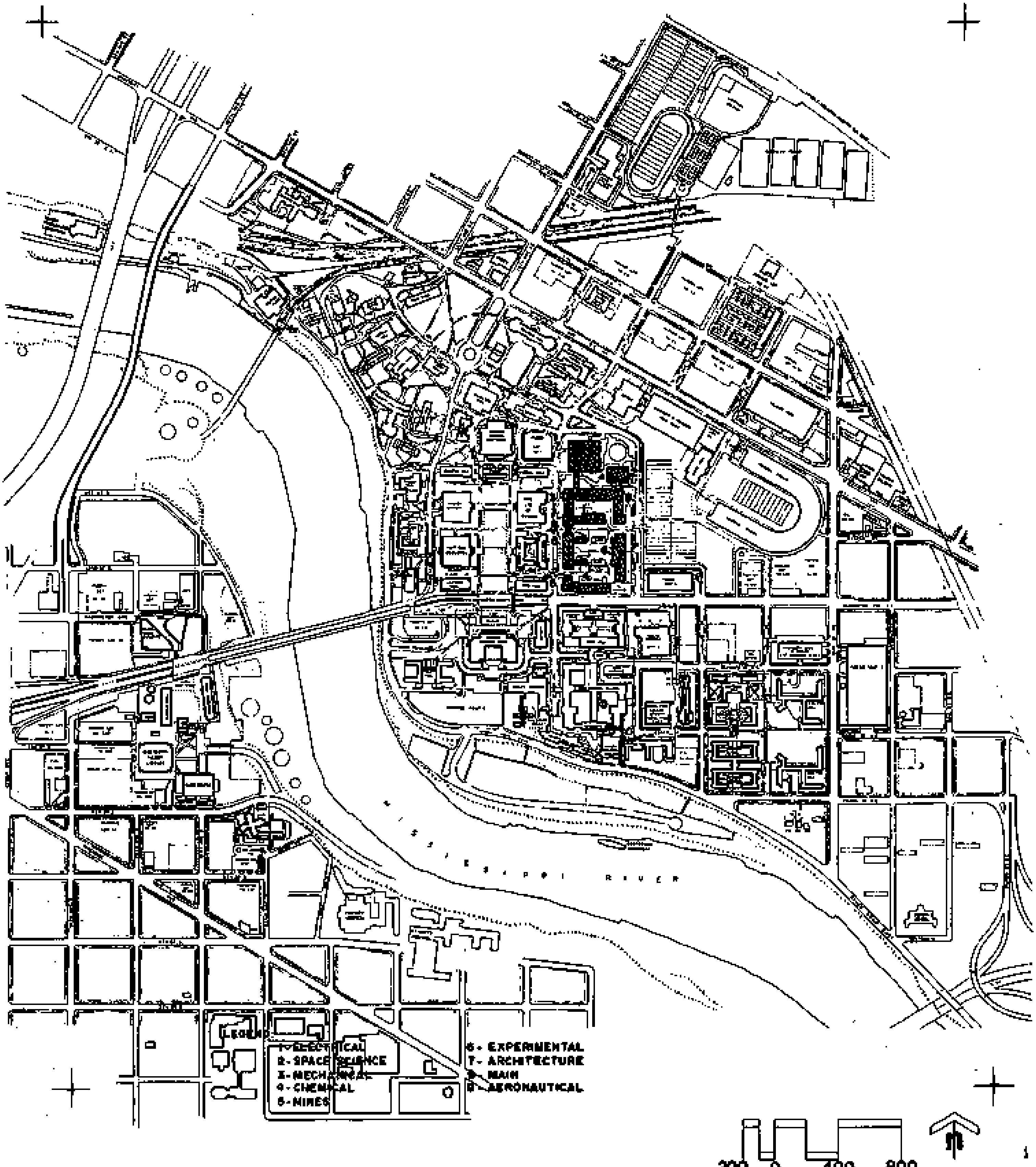
minneapolis

KEY SECTOR
ATHLETIC



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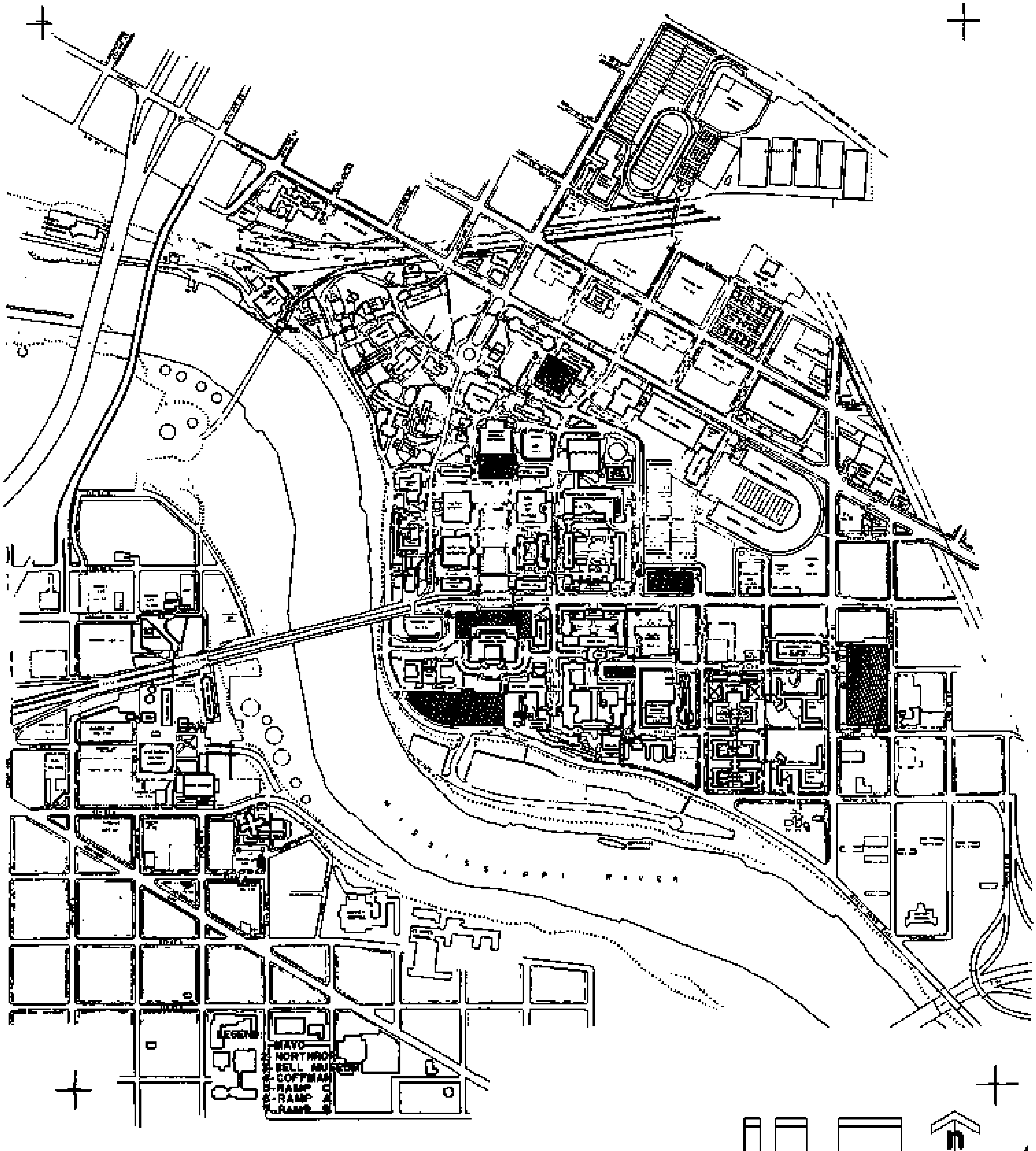
KEY SECTOR
ENGINEERING



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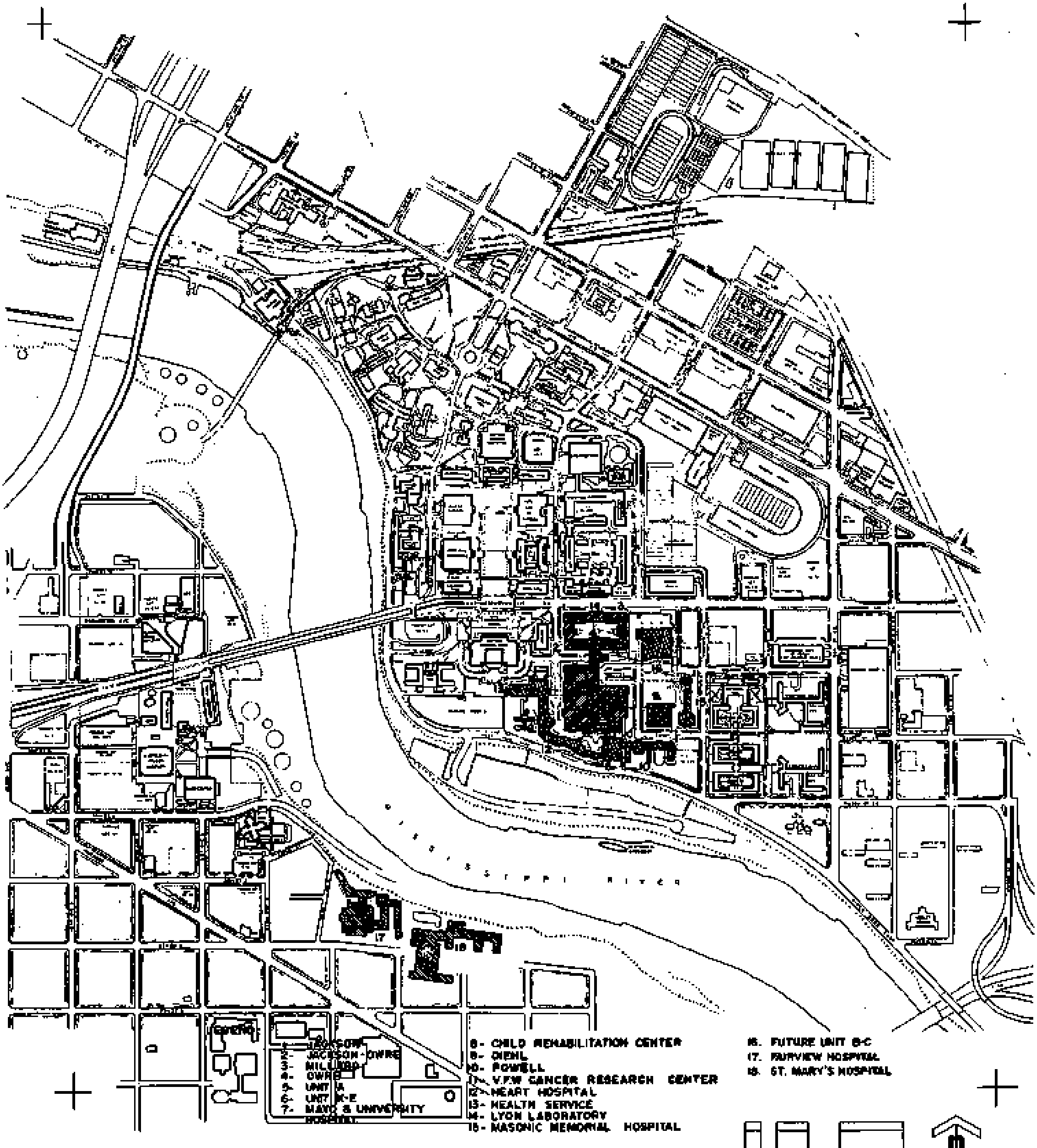
KEY SECTOR
GARAGES



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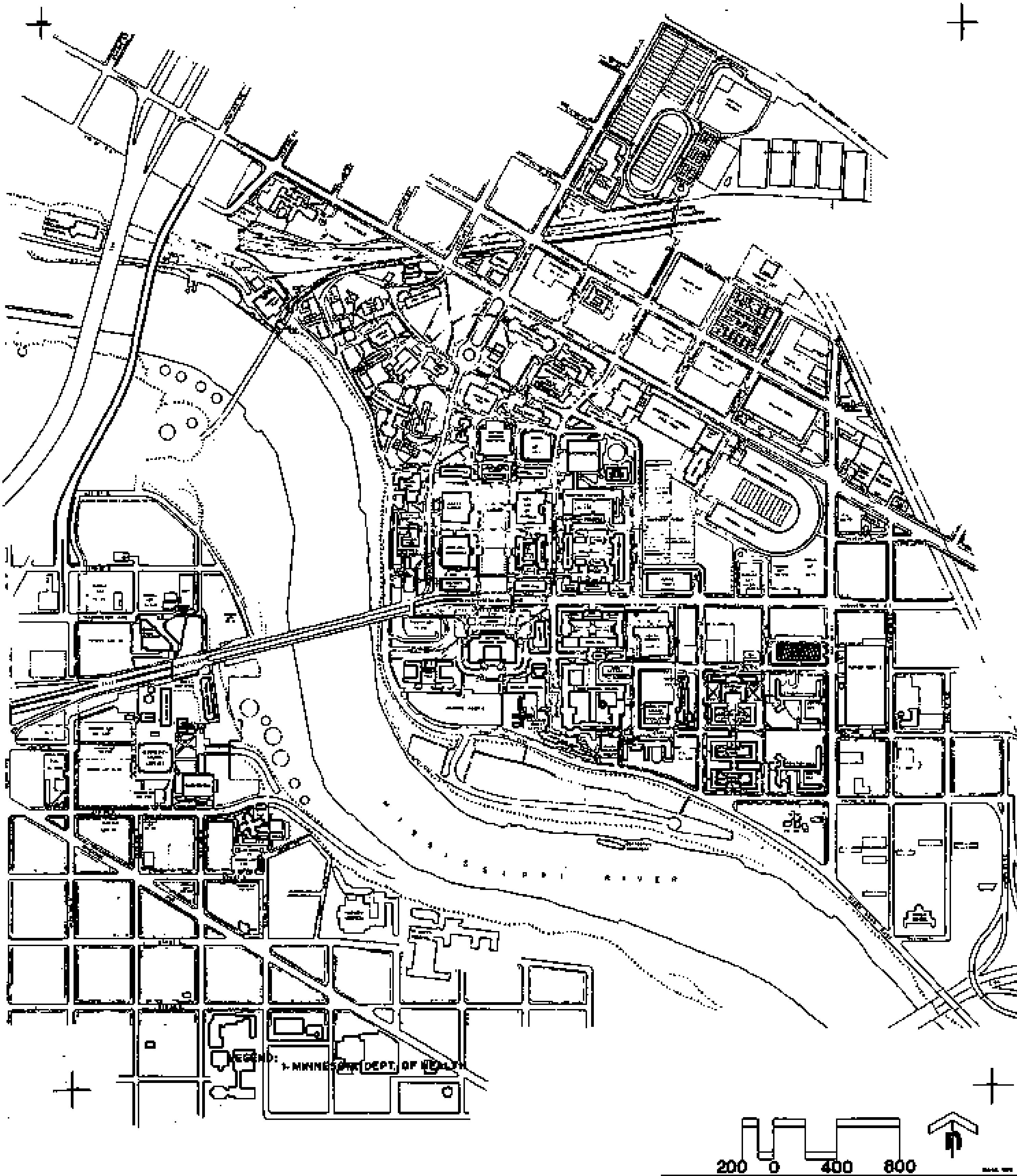
KEY SECTOR

MEDICAL & HEALTH SCIENCES



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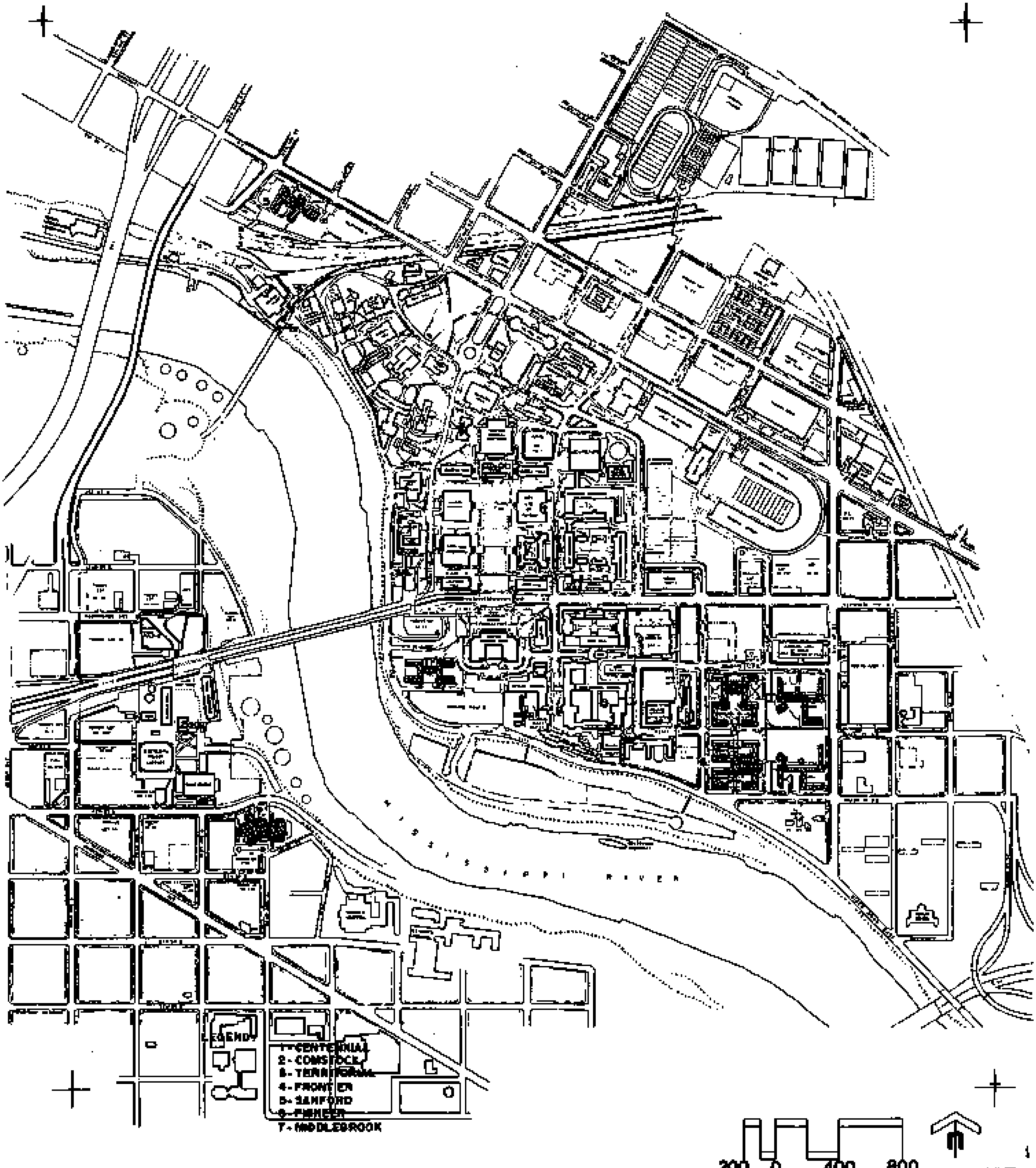
KEY SECTOR
NON-UNIVERSITY



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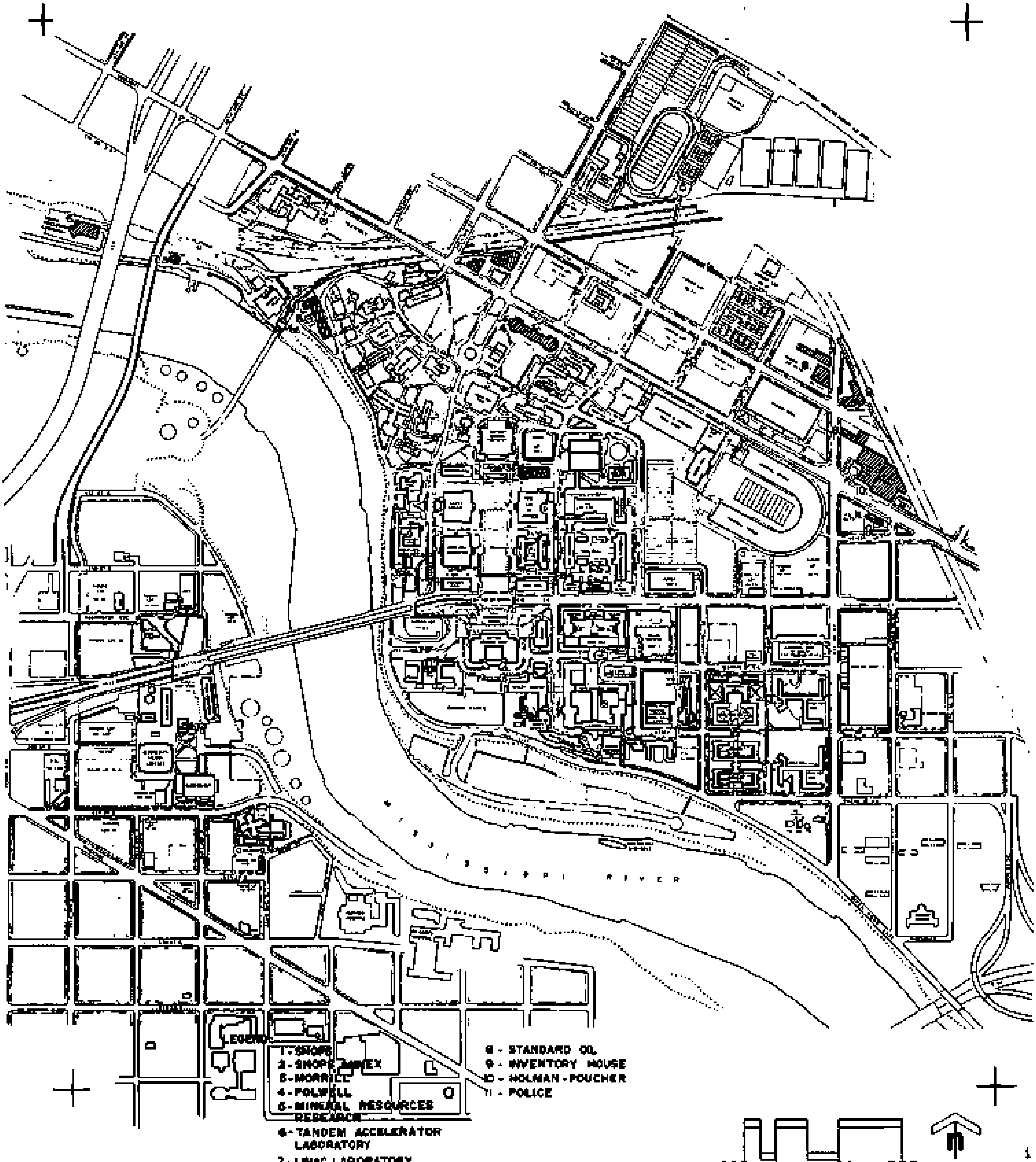
KEY SECTOR

RESIDENTIAL HALLS



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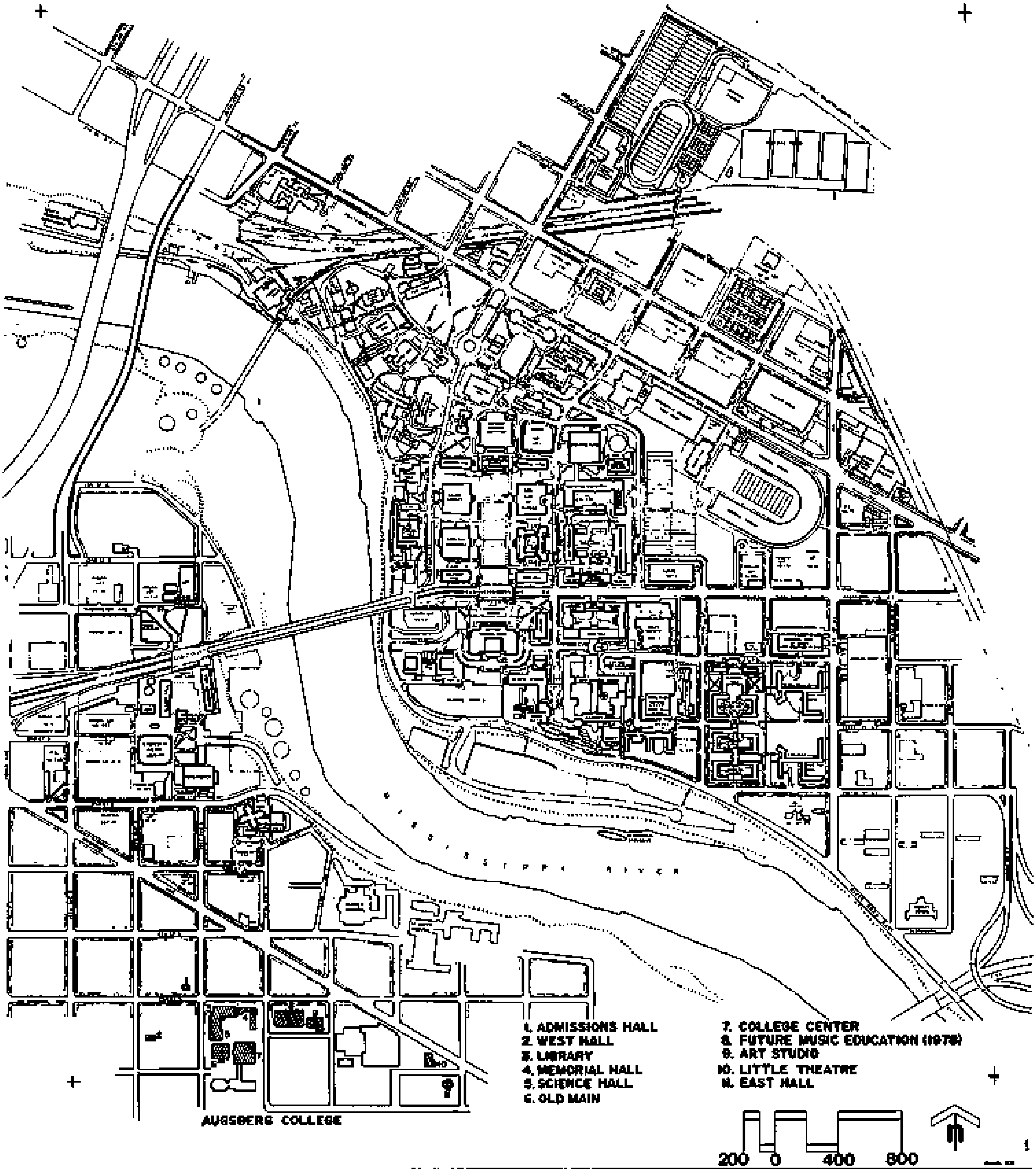
KEY SECTOR

SUPPORT SERVICES



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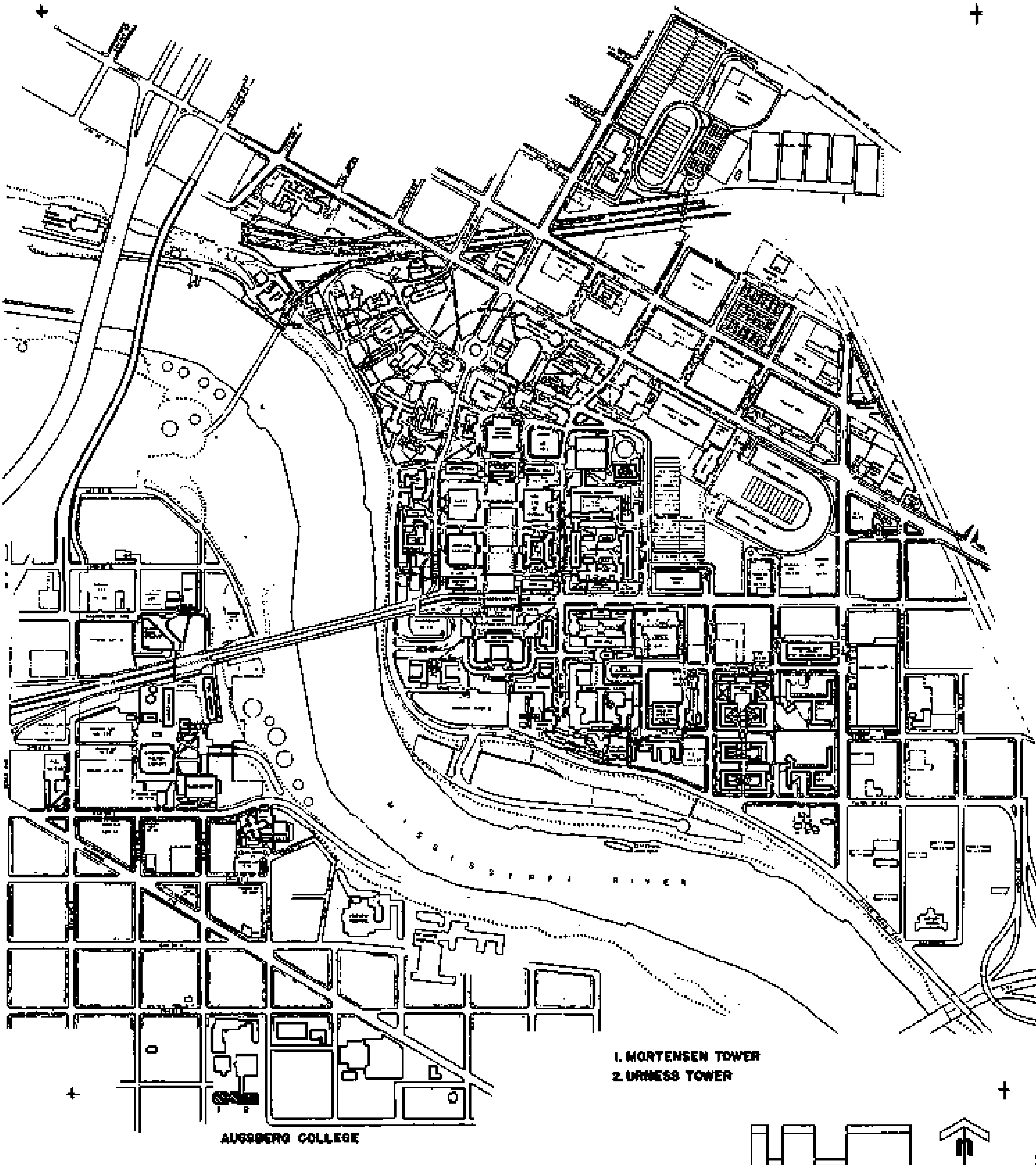
KEY SECTOR
ACADEMIC HALLS



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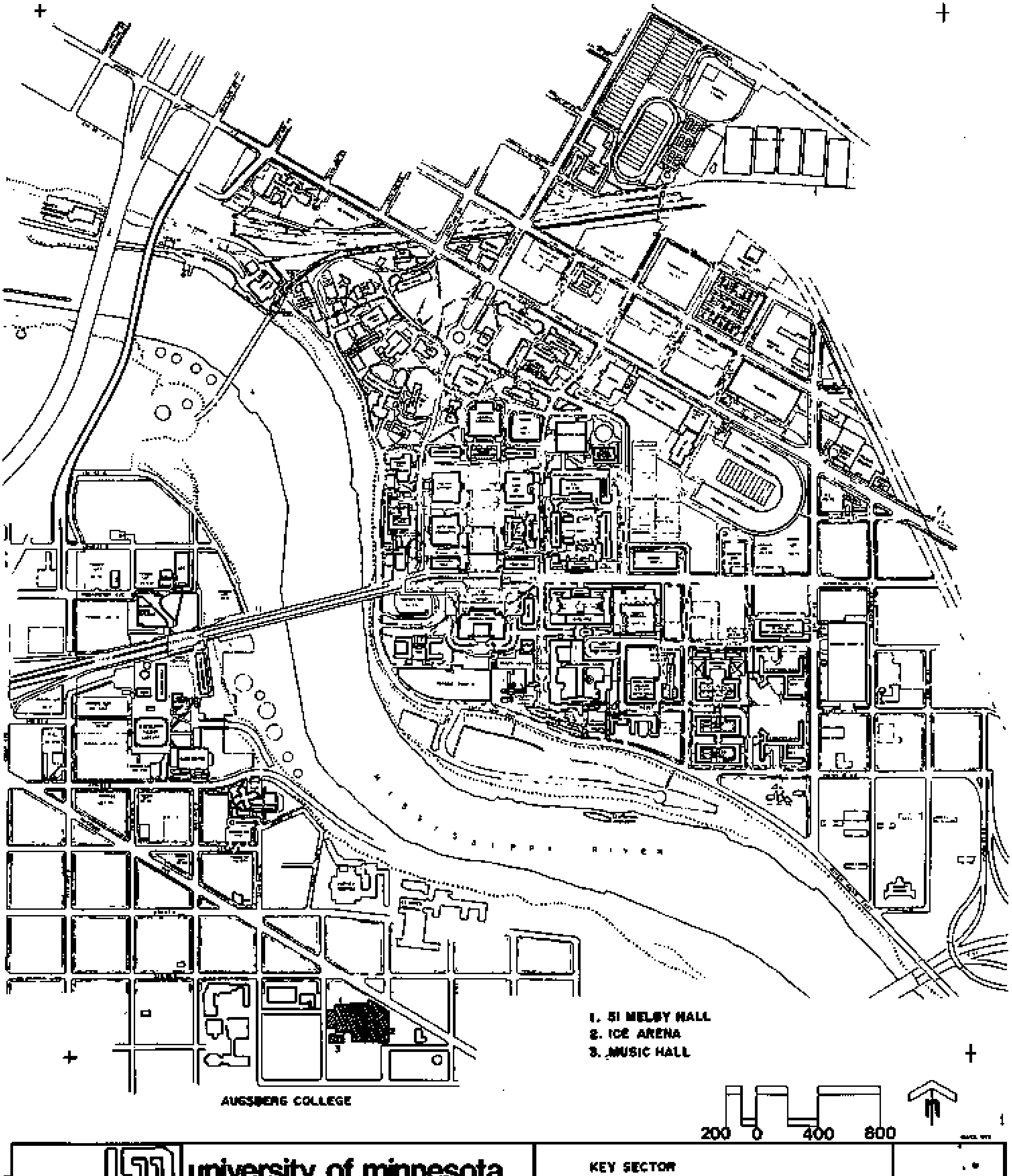
minneapolis

KEY SECTOR

RESIDENTIAL HALLS



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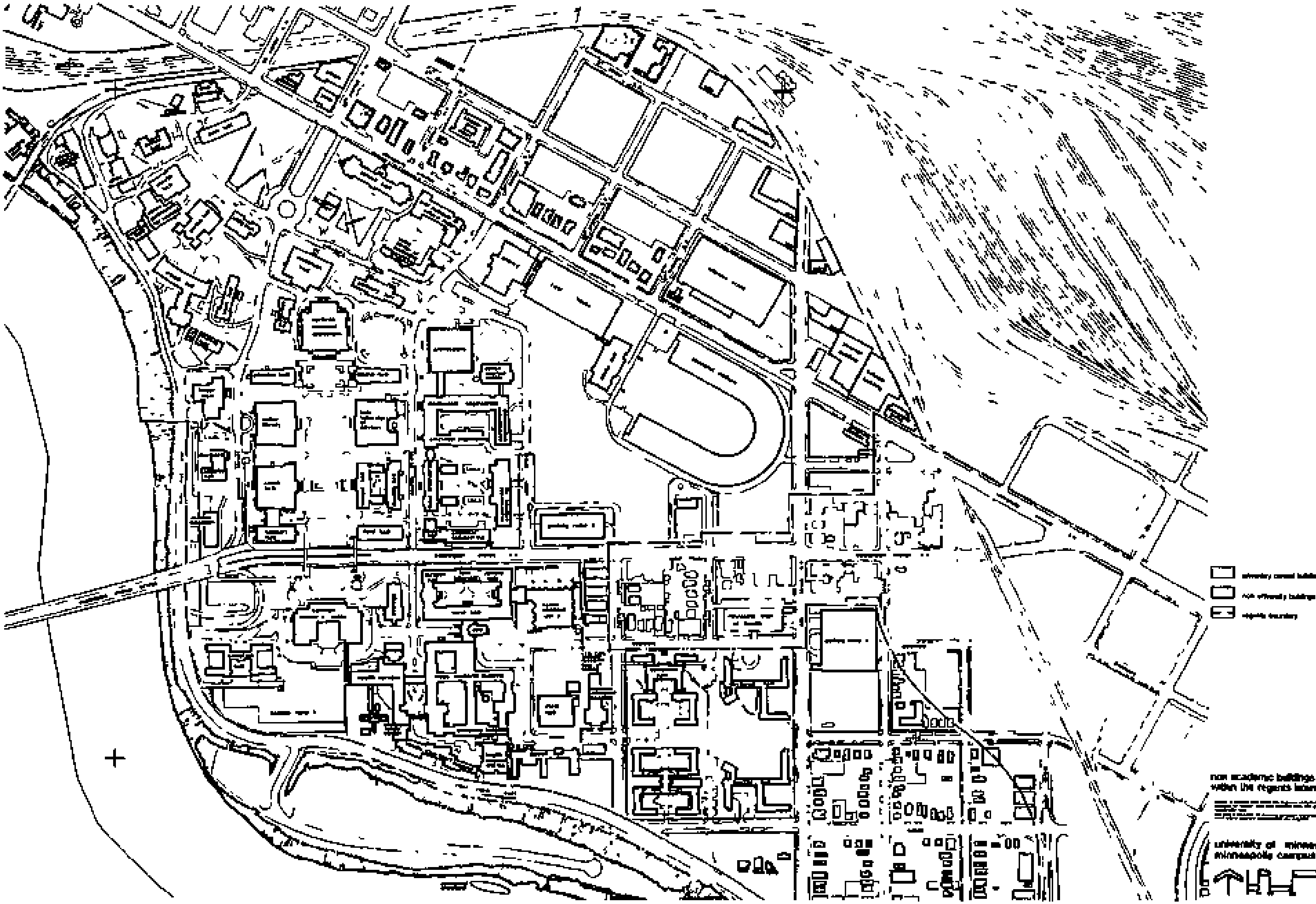
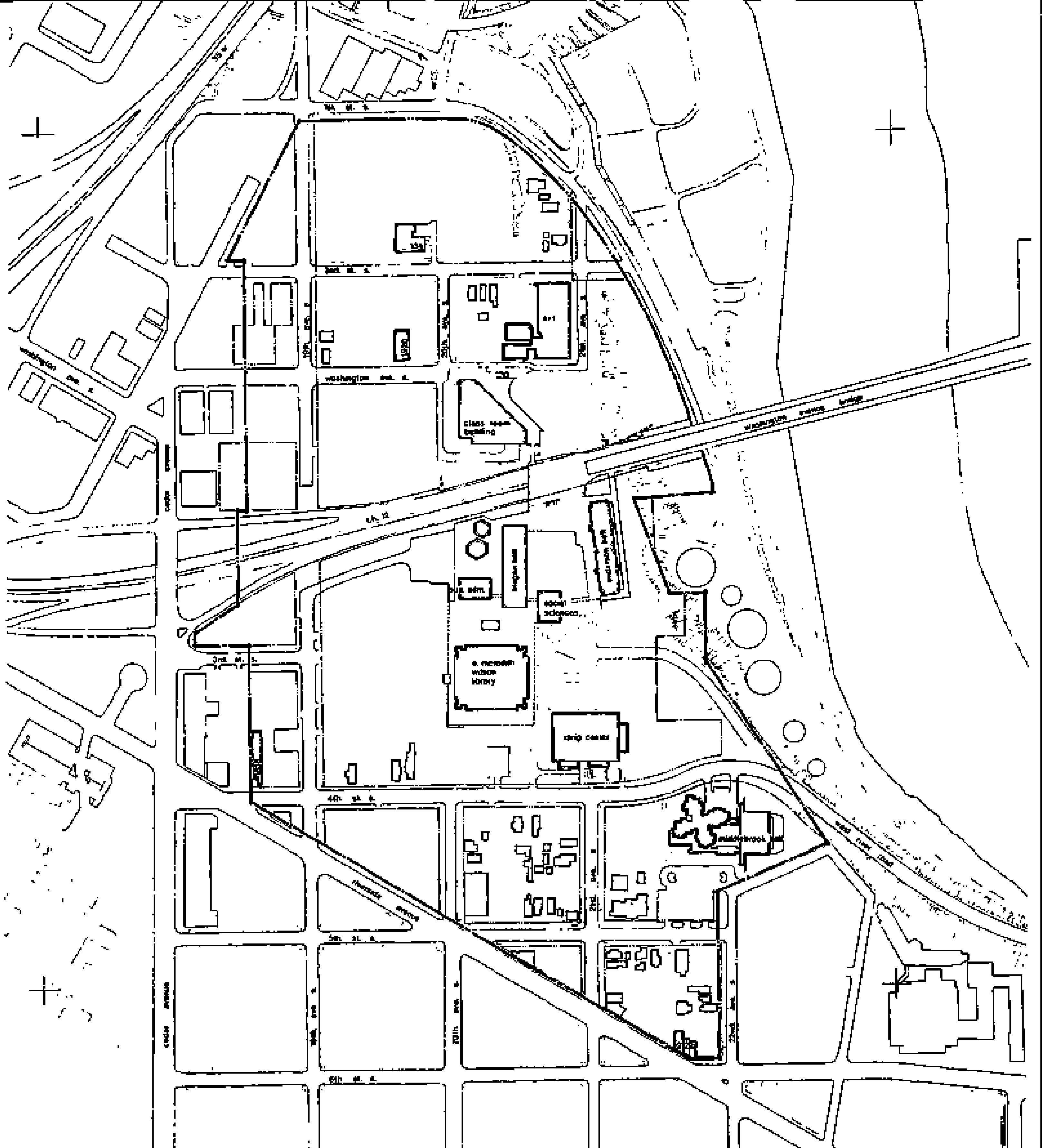
KEY SECTOR
ATHLETIC FACILITIES



non academic buildings
within the regents boundary

university of minnesota
minneapolis campus



university owned buildings

non-university buildings

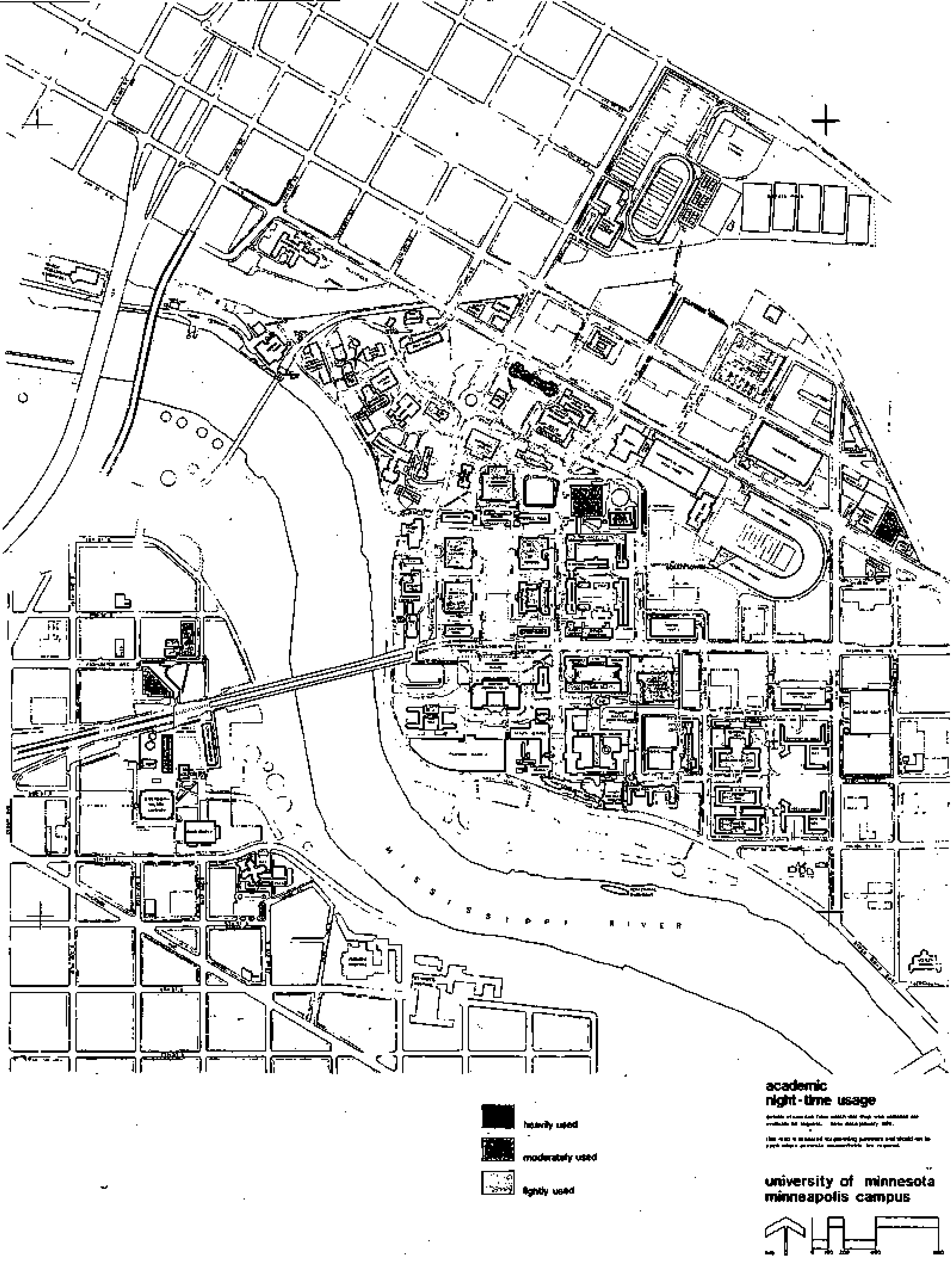
regents boundary

non-academic buildings within the regents boundary

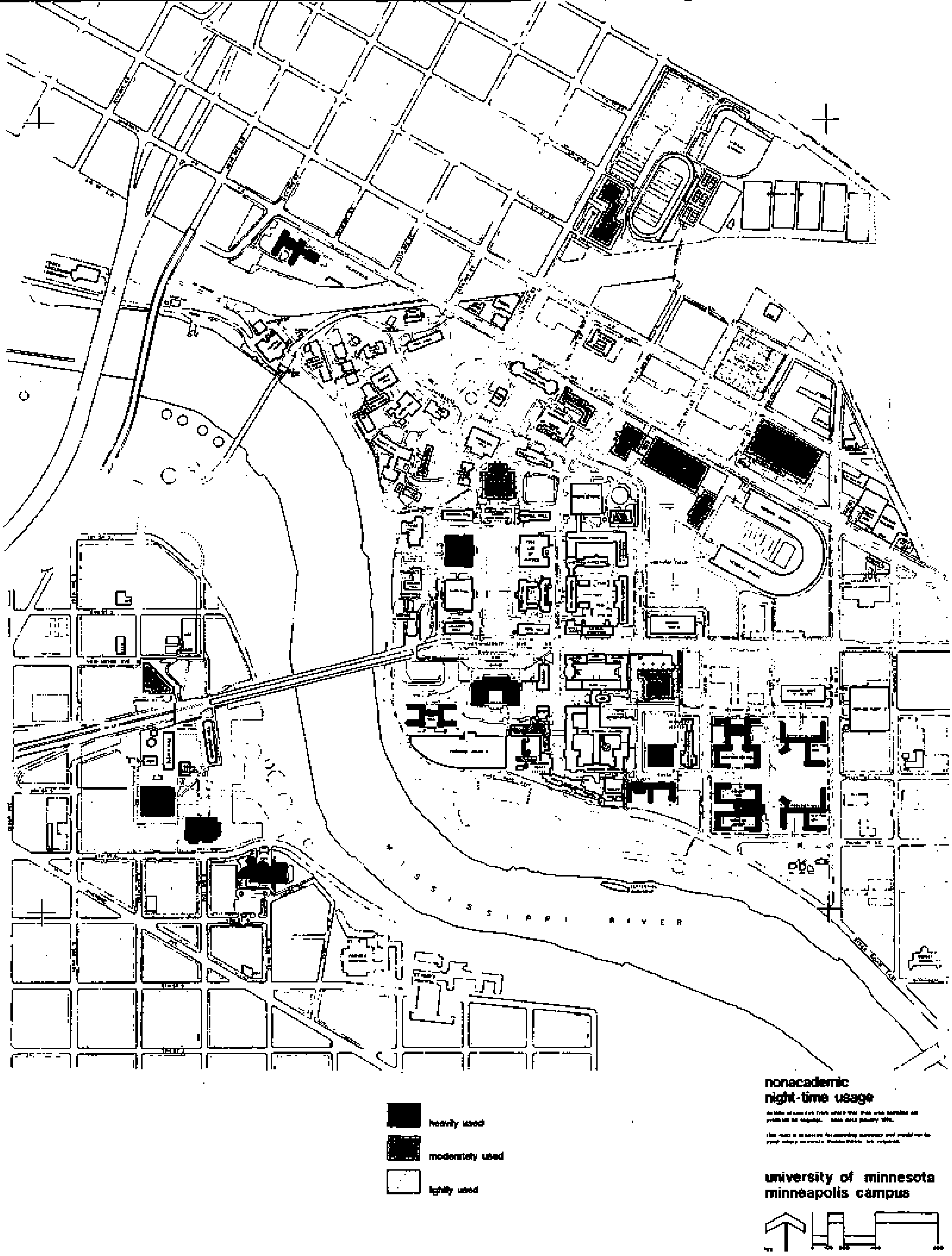
university of minnesota
minneapolis campus west bank

1.6.2 NIGHT TIME USAGE

The University operates an extensive extension division and night school. The following drawings depict the density of academic and nonacademic activity on the campuses. Of prime interest is that there is little academic night time usage after 10 P.M. and little nonacademic usage after 12 A.M. This allows an excellent opportunity for ICES to demonstrate heating degradation to be considered for the district hot water system.



M I S S I S S I P P I R I V E R
heavily used
moderately used
lightly used
academic
night-time usage
university of minnesota
minneapolis campus



nonacademic night-time usage

university of minnesota minneapolis campus

1.6.3 BUILDING CONSTRUCTION

The following forms were completed within the time frame allowed to provide a cross section of buildings regarding their construction, occupancy and building systems.

The forms were completed based upon the following assumptions regarding data assembly:

1. For percent of wall construction, only the surface area above grade was taken into account.
2. The procedure for exactness in the number of stories was to take a typical floor and divide its floor area into the floor area in question, then adding the ratios down, long hand. For example, 1 + 1.08 + 1.19 + .79 + .04, typically 4 floors with the 5th floor being a penthouse. If only a whole number is used, to best represent the building area, it is given after the word "or" in the answer space.
3. A typical story height is the average story height from the building construction plans.
4. All data is given to the nearest ± 1%.
5. If skylights are at an angle with the horizontal, the percent of construction for the roof and wall is that percentage seen as looking at the plan and elevated views respectively.
6. In general, if the data asked for a "yes" or "no" and the building was somewhere between, the majority ruled.
7. In general, if the data asked for a required number, this number, if it varied throughout the building, was given as an average value.

8. Fan systems are operated according to an occupancy schedule, so a percent by CFM is presented in "HVAC Operation." "HVAC Operation" is defined as ALL Air Systems. Radiation or fan coil system run 24 Hrs/Day.
9. The roof construction was broken down by the element which best reflected the majority of construction.
10. Glazing was listed by what was used for over 50% of the windows.

BUILDING INFORMATION FORM (One form per building)

Date Form completed: 3-7-77 Form completed by: ____

Bldg Name: Smith Hall, Bldg. #035

Owner/User/Operator: University of Minnesota /

Street Address: U of M Room 200 Shops Building City Minneapolis Zip 55455

Contact Person: J. C. O'Gara Telephone 612-376-3455

BUILDING USE

Primary Use: ( ) 1. Office ( ) 4. Classroom ( ) 7. Warehouse
( ) 2. Hospital ( ) 5. Athletic ( ) 8. Library
( ) 3. Dormitory ( ) 6. Maintenance garage (X) 9. Laboratory
( ) 10. Auditorium (Fine Arts)

Description of other use(s): Classroom

HVAC Operation: Hours per day ____ Hours per week 150 Weeks per year 50

Average number of occupants 675 Percentage of building occupied 100

Gross Area (ft²) 187,032 Gross Volume (ft³) 2,712,97

Number of Stories: Below Grade .14 + .5 or 1 .5 + 1 + 1 + .79 + .54 or Above Grade 4

Typical Story Height: Below Grade 10' - 6" Above Grade 13' - 0

BUILDING CONSTRUCTION

Wall Construction: Masonry 79 % Metal Panel 0 % Wood 0 % Glass 21

Insulation: Yes ( ) No (X) Thickness (if known) ____ Type ____
Glazing: Single (x) Double ( ) Tinted ( )

Roof Construction: Concrete 29 % Metal 0 % Wood 68 % Skylights 3

Skylight Glazing: Single (X) Double ( ) Tinted
Insulation: Yes ( ) No (x) Thickness (if known) ____ Type ____

ATTACH PHOTOGRAPH OR SKETCH OF BUILDING WITH APPROXIMATE DIMENSIONS AND SHOW NORTH ARROW

HVAC SYSTEMS

Heating (X) Steam ( ) Warm Air ( ) Hot Water ( ) Electric Other: -

Heating Plant ( ) In Building (X) Remote

Cooling 15%( ) Electric 15%( ) Steam ( ) Gas

Cooling Plant 15%( ) In Building 15%( ) Remote

HVAC System Type 20%( ) Reheat ( ) Double Duct ( ) Multizone ( ) Variable Volume ( ) Induc
( ) Packaged 80%( ) Single Zone ( ) Unit vent. ( ) Radiation

Outdoor Air Controlled (x) Automatically ( ) Manually

BUILDING INFORMATION FORM (One form per building)

Date form completed: 3-7-77 Form completed by: ______

Building Name: Norris Gymnasium, Bldg. #036.

Owner/User/Operator: University/of Minnesota /

Street Address: U of M Room 200 Shops Building City Minneapolis Zip 554

Contact Person: J. C. O'Gara Telephone 612-376-3455

BUILDING USE

Primary Use: ( ) 1. Office ( ) 4. Classroom ( ) 7. Warehouse
( ) 2. Hospital (X) 5. Athletic ( ) 8. Library
( ) 3. Dormitory ( ) 6. Maintenance garage ( ) 9. Laboratory
( )10. Auditorium (Fine Arts)

Description of other use(s): Swimming Pool, Office

HVAC Operation: Hours per day 18 Hours per week ______ Weeks per year 48

Average number of occupants ______ Percentage of building occupied ______

Gross Area (ft^2) 25,241 Gross Volume (ft^3) ______

Number of Stories: Below Grade 1.3 Above Grade 2

Typical Story Height: Below Grade 13'-6" Above Grade 17'-6

BUILDING CONSTRUCTION

Wall Construction: Masonry 88 % Metal Panel 0 % Wood 0 % Glass 12

Insulation: Yes ( ) No ( ) Thickness (if known) ______ Type ______
Glazing: Single (X) Double ( ) Tinted ( )

Roof Construction: Concrete 0 % Metal 0 % Wood 99 % Skylights 1

Skylight Glazing: Single (X) Double ( ) Tinted
Insulation: Yes ( ) No (X) Thickness (if known) ______ Type ______

ATTACH PHOTOGRAPH OR SKETCH OF BUILDING WITH APPROXIMATE DIMENSIONS AND SHOW NORTH ARROW

HVAC SYSTEMS

Heating ( ) Steam ( ) Warm Air (X) Hot Water ( ) Electric Other: ______

Heating Plant ( ) In Building (X) Remote

Cooling ( ) Electric ( ) Steam ( ) Gas None

Cooling Plant ( ) In Building ( ) Remote

HVAC System Type ( ) Reheat ( ) Double Duct ( ) Multizone ( ) Variable Volume ( ) Induc
( ) Packaged 50%) Single Zone ( ) Unit vent. ( ) Radiation

Outdoor Air Controlled (X) Automatically ( ) Manually

BUILDING INFORMATION FORM (One form per building)

Date form completed: 3-7-77 Form completed by: ________

Building Name: Norris Field House, Bldg. #036.

Owner/User/Operator: University of Minnesota

Street Address: U of M Room 200 Shops Building City Minneapolis Zip 55455

Contact Person: James C. O'Gara Telephone 612-376-3455

BUILDING USE

Primary Use: ( ) 1. Office ( ) 4. Classroom ( ) 7. Warehouse
( ) 2. Hospital (X) 5. Athletic ( ) 8. Library
( ) 3. Dormitory ( ) 6. Maintenance garage ( ) 9. Laboratory
( ) 10. Auditorium (Fine Arts)

Description of other use(s): Swimming Pool

HVAC Operation: Hours per day 18 Hours per week ________ Weeks per year 48

Average number of occupants 125 Percentage of building occupied 100

Gross Area (ft^2) 39,479 Gross Volume (ft^3) 1,152,589

Number of Stories: Below Grade .3 Above Grade 1

Typical Story Height: Below Grade 13'-0" Above Grade 12'-6"

BUILDING CONSTRUCTION

Wall Construction: Masonry 86 % Metal Panel 0 % Wood 1 % Glass 13 %

Insulation: Yes ( ) No (X) Thickness (if known) ________ Type ________
Glazing: Single (X) Double ( ) Tinted ( )

Roof Construction: Concrete 100 % Metal ____ % Wood ____ % Skylights ____ %

Skylight Glazing: Single ( ) Double ( ) Tinted ( )
Insulation: Yes (X) No ( ) Thickness (if known) 1" Type Celotex

ATTACH PHOTOGRAPH OR SKETCH OF BUILDING WITH APPROXIMATE DIMENSIONS AND SHOW NORTH ARROW

HVAC SYSTEMS

Heating ( ) Steam ( ) Warm Air (X) Hot Water ( ) Electric Other: ________

Heating Plant ( ) In Building (X) Remote

Cooling ( ) Electric ( ) Steam ( ) Gas None

Cooling Plant ( ) In Building ( ) Remote

HVAC System Type ( ) Reheat ( ) Double Duct ( ) Multizone ( ) Variable Volume ( ) Induction
( ) Packaged (50%) Single Zone ( ) Unit vent. ( ) Radiation

Outdoor Air Controlled ( ) Automatically (X) Manually

BUILDING INFORMATION FORM (One form per building)

Date form completed: 3-7-77 Form completed by: ______

Building Name: Norris Field House, Bldg. #036.

Owner/User/Operator: University of Minnesota

Street Address: U of M Room 200 Shops Building City Minneapolis Zip 55455

Contact Person: James C. O'Gara Telephone 612-376-3455

BUILDING USE

Primary Use: ( ) 1. Office ( ) 2. Hospital ( ) 3. Dormitory ( ) 4. Classroom (X) 5. Athletic ( ) 6. Maintenance garage ( ) 7. Warehouse ( ) 8. Library ( ) 9. Laboratory ( ) 10. Auditorium (Fine Arts)

Description of other use(s): Swimming Pool

HVAC Operation: Hours per day 18 Hours per week ______ Weeks per year 48

Average number of occupants 125 Percentage of building occupied 100

Gross Area (ft^2) 39,479 Gross Volume (ft^3) 1,152,589

Number of Stories: Below Grade .3 Above Grade 1

Typical Story Height: Below Grade 13'-0" Above Grade 12'-6"

BUILDING CONSTRUCTION

Wall Construction: Masonry 86 % Metal Panel 0 % Wood 1 % Glass 13 %

Insulation: Yes ( ) No (X) Thickness (if known) ______ Type ______
Glazing: Single (X) Double ( ) Tinted ( )

Roof Construction: Concrete 100 % Metal ______ % Wood ______ % Skylights ______ %

Skylight Glazing: Single ( ) Double ( ) Tinted ( )
Insulation: Yes (X) No ( ) Thickness (if known) 1" Type Celotex

ATTACH PHOTOGRAPH OR SKETCH OF BUILDING WITH APPROXIMATE DIMENSIONS AND SHOW NORTH ARROW

HVAC SYSTEMS

Heating ( ) Steam ( ) Warm Air (X) Hot Water ( ) Electric Other: ______

Heating Plant ( ) In Building (X) Remote

Cooling ( ) Electric ( ) Steam ( ) Gas None

Cooling Plant ( ) In Building ( ) Remote

HVAC System Type ( ) Reheat ( ) Double Duct ( ) Multizone ( ) Variable Volume ( ) Induction
( ) Packaged 50%) Single Zone ( ) Unit vent. ( ) Radiation

Outdoor Air Controlled ( ) Automatically (X) Manually

BUILDING INFORMATION FORM (One form per building)

Date form completed: 3-7-77 Form completed by: ______

Building Name: Appleby Hall, Bldg. #037.

(er/User/Operator: University of Minnesota /

Street Address: U of M Room 200 Shops Building City Minneapolis Zip 5545

Contact Person: J. C. O'Mara Telephone 612-376-3455

BUILDING USE

Primary Use: ( ) 1. Office ( ) 2. Hospital ( ) 3. Dormitory (X) 4. Classroom ( ) 5. Athletic ( ) 6. Maintenance garage ( ) 7. Warehouse ( ) 8. Library ( ) 9. Laboratory ( )10. Auditorium (Fine Arts

Description of other use(s): ______

HVAC Operation: Hours per day ______ Hours per week, 132 Weeks per year 48

Average number of occupants 275 Percentage of building occupied 100

Gross Area (ft^2) 52,79) Gross Volume (ft^3) 823, 99

Number of Stories: Below Grade .07 + 1 or 1 Above Grade 1 + 1 + 1 + or 3

Typical Story Height: Below Grade 14'-0" Above Grade 13'-0"

BUILDING CONSTRUCTION

Wall Construction: Masonry 78 % Metal Panel 0 % Wood 0 % Glass 22

Insulation: Yes ( ) No (X) Thickness (if known) ______ Type ______
Glazing: Single (X) Double ( ) Tinted ( )

Roof Construction: Concrete 76 % Metal 16 % Wood 7 % Skylights 1

Skylight Glazing: Single (X) Double ( ) Insulite Tinted
Insulation: Yes (XX) No ( ) Thickness (if known) 2" Type or Celotex

ATTACH PHOTOGRAPH OR SKETCH OF BUILDING WITH APPROXIMATE DIMENSIONS AND SHOW NORTH ARROW

HVAC SYSTEMS

Heating ( ) Steam ( ) Warm Air (X) Hot Water ( ) Electric Other: ______

Heating Plant ( ) In Building (X) Remote

Cooling ( ) Electric ( ) Steam ( ) Gas None

Cooling Plant ( ) In Building ( ) Remote

HVAC System Type 20%(X) Reheat ( ) Double Duct ( ) Multizone ( ) Variable Volume ( ) Induc
( ) Packaged ( ) Single Zone ( ) Unit vent. ( ) Radiation

Outdoor Air Controlled (XX) Automatically ( ) Manually

BUILDING INFORMATION FORM (One form per building)

Date form completed: 3-7-77 Form completed by: ________

Building Name: Zoology, Bldg. #038

Owner/User/Operator: University of Minnesota

Street Address: U of M Room 200 Shops Building City Minneapolis Zip 55455

Contact Person: J. C. O'Gara. Telephone 612-376-3455

BUILDING USE

Primary Use: ( ) 1. Office ( ) 2. Hospital ( ) 3. Dormitory (X) 4. Classroom ( ) 5. Athletic ( ) 6. Maintenance garage ( ) 7. Warehouse ( ) 8. Library ( ) 9. Laboratory ( ) 10. Auditorium (Fine Arts)

Description of other use(s): Office, Laboratory

HVAC Operation: Hours per day 24 Hours per week ________ Weeks per year 52

Average number of occupants 180 Percentage of building occupied 100

Gross Area (ft^2) 66,543 Gross Volume (ft^3) 910,002

Number of Stories: Below Grade 2 Above Grade (3x1) + .5 o

Typical Story Height: Below Grade 11'-6" Above Grade 12'-8"

BUILDING CONSTRUCTION

Wall Construction: Masonry 80 % Metal Panel 0 % Wood 0 % Glass 20 %

Insulation: Yes ( ) No (X) Thickness (if known) ________ Type ________
Glazing: Single (x) Double ( ) Tinted ( )

Roof Construction: Concrete 53% Concrete slab 33% Pyrobar Tile Metal 0 % Wood 2 % Skylights 12

Skylight Glazing: Single (x) Double ( ) Tinted (
Insulation: Yes ( ) No (x) Thickness (if known) ________ Type ________

ATTACH PHOTOGRAPH OR SKETCH OF BUILDING WITH APPROXIMATE DIMENSIONS AND SHOW NORTH ARROW

HVAC SYSTEMS

Heating ( ) Steam ( ) Warm Air (x) Hot Water ( ) Electric Other: ________

Heating Plant ( ) In Building (x) Remote

Cooling ( ) Electric ( ) Steam ( ) Gas None

Cooling Plant ( ) In Building ( ) Remote

HVAC System Type 20% ( ) Reheat ( ) Double Duct ( ) Multizone ( ) Variable Volume ( ) Induct ( ) Packaged ( ) Single Zone ( ) Unit vent. ( ) Radiation

Outdoor Air Controlled (x) Automatically ( ) Manually

BUILDING INFORMATION FORM (One form per building)

Date form completed: 3-7-77 Form completed by: ______

Building Name: Walter Library, Bldg. #042.

Owner/User/Operator: University of Minnesota /

Street Address: U of M Room 200 Shops Building City Minneapolis Zip 55455

Contact Person: J. C. O'Gara Telephone 612-376-3455

BUILDING USE

Primary Use:
( ) 1. Office
( ) 2. Hospital
( ) 3. Dormitory
( ) 4. Classroom
( ) 5. Athletic
( ) 6. Maintenance garage
( ) 7. Warehouse
(XX) 8. Library
( ) 9. Laboratory
( ) 10. Auditorium (Fine Arts)

Description of other use(s): ______

HVAC Operation: Hours per day 24 Hours per week 128 Weeks per year 50

Average number of occupants 250 Percentage of building occupied 100

Gross Area (ft^2) 267,213 Gross Volume (ft^3) 3,018,336

Number of Stories: Below Grade 2 Above Grade (2x1) + .7 o

Typical Story Height: Below Grade 10'-6" Above Grade 18'-6

BUILDING CONSTRUCTION

Wall Construction: Masonry 77 % Metal Panel 0 % Wood 0 % Glass 23 %

Insulation: Yes ( ) No (X) Thickness (if known) ______ Type ______
Glazing: Single (X) Double ( ) Tinted ( )

Roof Construction: Concrete 20 % Metal 0 % Wood 73 % Skylights 7

Skylight Glazing: Single ( ) Double (X) Tinted (
Insulation: Yes ( ) No (x) Thickness (if known) ______ Type ______

ATTACH PHOTOGRAPH OR SKETCH OF BUILDING WITH APPROXIMATE DIMENSIONS AND SHOW NORTH ARROW

HVAC SYSTEMS

Heating (X) Steam ( ) Warm Air ( ) Hot Water ( ) Electric Other: ______

Heating Plant ( ) In Building (X) Remote

Cooling ( ) Electric ( ) Steam ( ) Gas None

Cooling Plant ( ) In Building ( ) Remote

HVAC System Type
(X) Reheat ( ) Double Duct ( ) Multizone ( ) Variable Volume ( ) Induct
( ) Packaged ( ) Single Zone ( ) Unit vent. ( ) Radiation

Outdoor Air Controlled (x) Automatically ( ) Manually

BUILDING INFORMATION FORM (One form per building)

Date form completed: 3-7-77 Form completed by: ____

Building Name: Morrill Hall, Bldg. #046.

Owner/User/Operator: University of/ Minnesota /

Street Address: U of M Room 200 Shops Building City Minneapolis Zip 55455

Contact Person: J. C. O'Gara Telephone 612-376-3455

BUILDING USE

Primary Use: (X) 1. Office ( ) 2. Hospital ( ) 3. Dormitory ( ) 4. Classroom ( ) 5. Athletic ( ) 6. Maintenance garage ( ) 7. Warehouse ( ) 8. Library ( ) 9. Laboratory ( ) 10. Auditorium (Fine Arts)

Description of other use(s): ____

HVAC Operation: Hours per day ____ Hours per week 148 Weeks per year 52

Average number of occupants 375 Percentage of building occupied 100

Gross Area (ft^2) 92,921 Gross Volume (ft^3) 1,253,091

Number of Stories: Below Grade 1 Above Grade (4x1) + .63 + or 6

Typical Story Height: Below Grade 10' Above Grade 12'-6"

BUILDING CONSTRUCTION

Wall Construction: Masonry 71 % Metal Panel 0 % Wood 0 % Glass 29 %

Insulation: Yes ( ) No (X) Thickness (if known) ____ Type ____
Glazing: Single (X) Double ( ) Tinted ( )

Roof Construction: Concrete 46 % Metal 0 % Wood 51 % Skylights 3 %

Skylight Glazing: Single (X) Double ( ) Tinted (
Insulation: Yes ( ) No (X) Thickness (if known) ____ Type ____

ATTACH PHOTOGRAPH OR SKETCH OF BUILDING WITH APPROXIMATE DIMENSIONS AND SHOW NORTH ARROW

HVAC SYSTEMS

Heating (X) Steam ( ) Warm Air ( ) Hot Water ( ) Electric Other: ____

Heating Plant ( ) In Building (X) Remote

Cooling 60%( ) Electric 40%( ) Steam ( ) Gas

Cooling Plant (X) In Building ( ) Remote

HVAC System Type 20%( ) Reheat ( ) Double Duct ( ) Multizone ( ) Variable Volume ( ) Induct
( ) Packaged 30%( ) Single Zone 20%( ) Unit vent. ( ) Radiation

Outdoor Air Controlled ( ) Automatically ( ) Manually

BUILDING INFORMATION FORM (One form per building)

Date Form completed: 3-7-77 Form completed by: ______

Building Name: Tate Laboratory of Physics, Bldg. #049.

Owner/User/Operator: ______ / University of Minnesota

Street Address: U of M Room 200 Shops Building City Minneapolis Zip 55455

Contact Person: J. C. O'Gara Telephone 612-376-3455

BUILDING USE

Primary Use:
( ) 1. Office ( ) 4. Classroom ( ) 7. Warehouse
( ) 2. Hospital ( ) 5. Athletic ( ) 8. Library
( ) 3. Dormitory ( ) 6. Maintenance garage (X) 9. Laboratory
( ) 10. Auditorium (Fine Arts)

Description of other use(s): Classroom, Office

HVAC Operation: Hours per day ______ Hours per week 108 Weeks per year 50

Average number of occupants 900 Percentage of building occupied 100

Gross Area (ft²) 192,268 Gross Volume (ft³) 2,632,67

Number of Stories: Below Grade 1 + .5 or 2 Above Grade .5 + 1 + .86 + .69 + .44 + .14 + .01 or 4

Typical Story Height: Below Grade 13'-6" Above Grade 13'-0

BUILDING CONSTRUCTION

Wall Construction: Masonry 72 % Metal Panel 11 % Wood 0 % Glass 17

Insulation: Yes ( ) No (X) Thickness (if known) ______ Type ______
Glazing: Single (X) Double ( ) Tinted ( )

Roof Construction: Concrete 76 % Metal 16 % Wood 0 % Skylights 8

Skylight Glazing: Single (X) Double ( ) Tinted
Insulation: Yes (X) No ( ) Thickness (if known) 3/4 inch Type Fiberboard

ATTACH PHOTOGRAPH OR SKETCH OF BUILDING WITH APPROXIMATE DIMENSIONS AND SHOW NORTH ARROW

HVAC SYSTEMS

Heating 50%( ) Steam ( ) Warm Air 50(X) Hot Water ( ) Electric Other: ______

Heating Plant ( ) In Building (X) Remote

Cooling 10%( ) Electric ( ) Steam ( ) Gas

Cooling Plant (X) In Building ( ) Remote

HVAC System Type
( ) Reheat ( ) Double Duct ( ) Multizone ( ) Variable Volume ( ) Induc
( ) Packaged (X) Single Zone ( ) Unit vent. ( ) Radiation

Outdoor Air Controlled (X) Automatically ( ) Manually

BUILDING INFORMATION FORM (One form per building)

Date form completed: 3-7-77 Form completed by: ____

Building Name: Cooke Hall, Bldg. #056.

Owner/User/Operator: University of Minnesota /

Street Address: U of M Room 200 Shops Building City: Minneapolis Zip 5545

Contact Person: J. C. O'Gara Telephone 612-376-3455

BUILDING USE

Primary Use: ( ) 1. Office ( ) 4. Classroom ( ) 7. Warehouse
( ) 2. Hospital (XX) 5. Athletic ( ) 8. Library
( ) 3. Dormitory ( ) 6. Maintenance garage ( ) 9. Laboratory
( )10. Auditorium (Fine Arts)

Description of other use(s): Office, Swimming Pools

HVAC Operation: Hours per day 24 Hours per week ____ Weeks per year 50

Average number of occupants 275 Percentage of building occupied 100

Gross Area (ft²) 118,239 Gross Volume (ft³) 2,229,67

Number of Stories: Below Grade 2 Above Grade 4

Typical Story Height: Below Grade 10'-6" Above Grade 11'-3

BUILDING CONSTRUCTION

Wall Construction: Masonry 86 % Metal Panel 0 % Wood 0 % Glass 14

Insulation: Yes (X) No ( ) Thickness (if known) 1" Type Celotex
Glazing: Single (X) Double ( ) Tinted ( )

Roof Construction: Concrete 0 % Metal 74 % Wood 0 % Skylights 26

Skylight Glazing: Single (X) Double ( ) Tinted (
Insulation: Yes (X) No ( ) Thickness (if known) 2" Type Celotex

ATTACH PHOTOGRAPH OR SKETCH OF BUILDING WITH APPROXIMATE DIMENSIONS AND SHOW NORTH ARROW

HVAC SYSTEMS

Heating (X) Steam ( ) Warm Air ( ) Hot Water ( ) Electric Other: ____

Heating Plant ( ) In Building (X) Remote

Cooling ( ) Electric ( ) Steam ( ) Gas None

Cooling Plant ( ) In Building ( ) Remote

HVAC System Type ( ) Reheat ( ) Double Duct ( ) Multizone ( ) Variable Volume ( ) Induct
( ) Packaged 20%) Single Zone ( ) Unit vent. ( ) Radiation

Outdoor Air Controlled (X) Automatically ( ) Manually

BUILDING INFORMATION FORM (One form per building)

Date form completed: 3-7-77 Form completed by: ______

Building Name: Comstock Hall, Bldg. #063.

Owner/User/Operator: University of Minnesota / ______

Street Address: U of M Room 200 Shops Building City Minneapolis Zip 55455

Contact Person: J. C. O'Gara Telephone 612-376-3455

BUILDING USE

Primary Use: ( ) 1. Office ( ) 4. Classroom ( ) 7. Warehouse
( ) 2. Hospital ( ) 5. Athletic ( ) 8. Library
(X) 3. Dormitory ( ) 6. Maintenance garage ( ) 9. Laboratory
( )10. Auditorium (Fine Arts)

Description of other use(s): Kitchen & Cafeteria

HVAC Operation: Hours per day None Hours per week ______ Weeks per year ______

Average number of occupants 555 Percentage of building occupied 100

Gross Area (ft²) 172,883 Gross Volume (ft³) 1,302,720
(3 x 1.0) + (2 x .85) + (2 x .63

Number of Stories: Below Grade 1 Above Grade or 7

Typical Story Height: Below Grade 16' Above Grade 9'

BUILDING CONSTRUCTION

Wall Construction: Masonry 88 % Metal Panel ____ % Wood ____ % Glass 22 %

Insulation: Yes ( ) No (X) Thickness (if known) ______ Type ______
Glazing: Single ( ) Double (X) Tinted ( )

Roof Construction: Concrete 100 % Metal ____ % Wood ____ % Skylights ______

Skylight Glazing: Single ( ) Double ( ) Tinted (
Insulation: Yes (x) No ( ) Thickness (if known) 1 inch Type Firtex

ATTACH PHOTOGRAPH OR SKETCH OF BUILDING WITH APPROXIMATE DIMENSIONS AND SHOW NORTH ARROW

HVAC SYSTEMS

Heating (x) Steam ( ) Warm Air ( ) Hot Water ( ) Electric Other: ______

Heating Plant ( ) In Building ( ) Remote

Cooling ( ) Electric ( ) Steam ( ) Gas None

Cooling Plant ( ) In Building ( ) Remote

HVAC System Type ( ) Reheat ( ) Double Duct ( ) Multizone ( ) Variable Volume ( ) Induc
( ) Packaged ( ) Single Zone ( ) Unit vent. (X) Radiation

Outdoor Air Controlled ( ) Automatically ( ) Manually

BUILDING INFORMATION FORM (One form per building)

Date form completed: 3-7-77 Form completed by: ____

Building Name: Centennial Hall, Bldg. #068.

Owner/User/Operator: University of Minnesota

Street Address: U of M Room 200 Shops Bldg. City Minneapolis Zip 55455

Contact Person: J. C. O'Gara Telephone 612-376-3455

BUILDING USE

Primary Use: ( ) 1. Office ( ) 2. Hospital (X) 3. Dormitory ( ) 4. Classroom ( ) 5. Athletic ( ) 6. Maintenance garage ( ) 7. Warehouse ( ) 8. Library ( ) 9. Laboratory ( ) 10. Auditorium (Fine Arts

Description of other use(s): Kitchen & Cafeteria

HVAC Operation: Hours per day None Hours per week ____ Weeks per year ____

Average number of occupants 670 Percentage of building occupied 100

Gross Area (ft^2) 228,450 Gross Volume (ft^3) 2,808.747

Number of Stories: Below Grade .19 + 1.19 or 1 Above Grade 1.07 + 1 + 1 + .40 + .12 + or 5

Typical Story Height: Below Grade 17'-0" Above Grade 9' - 0"

BUILDING CONSTRUCTION

Wall Construction: Masonry 78 % Metal Panel 1 % Wood 0 % Glass 21

Insulation: Yes ( ) No (X) Thickness (if known) ____ Type ____
Glazing: Single (X) Double ( ) Tinted ( )

Roof Construction: Concrete 100 % Metal ____ % Wood ____ % Skylights ____

Skylight Glazing: Single ( ) Double ( ) Tinted
Insulation: Yes (x) No ( ) Thickness (if known) 1 inch Type Rigid

ATTACH PHOTOGRAPH OR SKETCH OF BUILDING WITH APPROXIMATE DIMENSIONS AND SHOW NORTH ARROW

HVAC SYSTEMS

Heating (X) Steam ( ) Warm Air ( ) Hot Water ( ) Electric Other: ____

Heating Plant ( ) In Building (X) Remote

Cooling ( ) Electric ( ) Steam ( ) Gas

Cooling Plant ( ) In Building ( ) Remote None

HVAC System Type ( ) Reheat ( ) Double Duct ( ) Multizone ( ) Variable Volume ( ) Induc ( ) Packaged ( ) Single Zone ( ) Unit vent. (x) Radiation

Outdoor Air Controlled ( ) Automatically ( ) Manually

BUILDING INFORMATION FORM (One form per building)

Date form completed: 3-7-77 Form completed by: ____________

Building Name: Ford Hall, Bldg. #071

Owner/User/Operator: University of Minnesota

Street Address: U of M Room 200 Shops Bldg. City Minneapolis Zip 5545

Contact Person: J. C. O'Gara Telephone 612-376-3455

BUILDING USE

Primary Use: ( ) 1. Office (X) 4. Classroom ( ) 7. Warehouse
( ) 2. Hospital ( ) 5. Athletic ( ) 8. Library
( ) 3. Dormitory ( ) 6. Maintenance garage ( ) 9. Laboratory
( ) 10. Auditorium (Fine Arts)

Description of other use(s): Offices

HVAC Operation: Hours per day 108 Hours per week ____ Weeks per year 50

Average number of occupants 675 Percentage of building occupied 100

Gross Area (ft^2) 85,842 Gross Volume (ft^3) 948,145

.5 + 1 ± 1 + 1 + 1 + .17 or

Number of Stories: Below Grade 1 + .5 or 1 Above Grade 5

Typical Story Height: Below Grade 9'-0" Above Grade 11' - 8

BUILDING CONSTRUCTION

Wall Construction: Masonry 74 % Metal Panel 5 % Wood 0 % Glass 21 %

Insulation: Yes ( ) No (X) Thickness (if known) ____ Type ____
Glazing: Single (X) Double ( ) Tinted ( )

Roof Construction: Concrete 100 % Metal 0 % Wood 0 % Skylights 0

Skylight Glazing: Single ( ) Double ( ) Tinted (
Insulation: Yes (X) No ( ) Thickness (if known) 2 inches Type Rigid fibergl

ATTACH PHOTOGRAPH OR SKETCH OF BUILDING WITH APPROXIMATE DIMENSIONS AND SHOW NORTH ARROW

HVAC SYSTEMS

Heating (X) Steam ( ) Warm Air ( ) Hot Water ( ) Electric Other: -

Heating Plant ( ) In Building (X) Remote

Cooling ( ) Electric ( ) Steam ( ) Gas None

Cooling Plant ( ) In Building ( ) Remote

HVAC System Type (X) Reheat ( ) Double Duct ( ) Multizone ( ) Variable Volume ( ) Induct
( ) Packaged ( ) Single Zone ( ) Unit vent. ( ) Radiation

Outdoor Air Controlled (X) Automatically ( ) Manually

BUILDING INFORMATION FORM (One form per building)

Date form completed: 3-7-77 Form completed by: ______

Building Name: Johnston Hall, Bldg. #073

Owner/User/Operator: University of Minnesota /

Street Address: U of M Room 200 Shops Bldg. City Minneapolis Zip 55455

Contact Person: J. C. O'Gara Telephone 612-376-3455

BUILDING USE

Primary Use: (X) 1. Office ( ) 4. Classroom ( ) 7. Warehouse
( ) 2. Hospital ( ) 5. Athletic ( ) 8. Library
( ) 3. Dormitory ( ) 6. Maintenance garage ( ) 9. Laboratory
( )10. Auditorium (Fine Arts)

Description of other use(s): ______

HVAC Operation: Hours per day 24 Hours per week ______ Weeks per year 52

Average number of occupants 250 Percentage of building occupied 100

Gross Area (ft^2) 79,816 Gross Volume (ft^3) 1,132,015
1 + 1 + 1 + 1 + .56 + .25 or

Number of Stories: Below Grade 1 Above Grade 5

Typical Story Height: Below Grade 10'-0" Above Grade 14'-6"

BUILDING CONSTRUCTION

Wall Construction: Masonry 69 % Metal Panel 0 % Wood 0 % Glass 31 %

Insulation: Yes ( ) No (X) Thickness (if known) ______ Type ______
Glazing: Single (X) Double ( ) Tinted ( )

Roof Construction: Concrete 54 % Metal 46 % Wood 0 % Skylights 0

Skylight Glazing: Single ( ) Double ( ) Tinted (
Insulation: Yes ( ) No (X) Thickness (if known) ______ Type ______

ATTACH PHOTOGRAPH OR SKETCH OF BUILDING WITH APPROXIMATE DIMENSIONS AND SHOW NORTH ARROW

HVAC SYSTEMS

Heating (x) Steam ( ) Warm Air ( ) Hot Water ( ) Electric Other: ______

Heating Plant ( ) In Building (x) Remote

Cooling ( ) Electric ( ) Steam ( ) Gas None

Cooling Plant ( ) In Building ( ) Remote

HVAC System ( ) Reheat ( ) Double Duct ( ) Multizone ( ) Variable Volume ( ) Induct
Type 20%) Packaged ( ) Single Zone ( ) Unit vent. ( ) Radiation

Outdoor Air Controlled (X) Automatically ( ) Manually

BUILDING INFORMATION FORM (One form per building)

Date form completed: 3-7-77 Form completed by: ______

Building Name: Mines & Metallurgy, Bldg. #104.

Owner/User/Operator: University of Minnesota /

Street Address: U of M Room 200 Shops Building City Minneapolis Zip 55455

Contact Person: J. C. O'Gara Telephone 612-376-3455

BUILDING USE

Primary Use: ( ) 1. Office ( ) 4. Classroom ( ) 7. Warehouse
( ) 2. Hospital ( ) 5. Athletic ( ) 8. Library
( ) 3. Dormitory ( ) 6. Maintenance garage (X) 9. Laboratory
( ) 10. Auditorium (Fine Arts)

Description of other use(s): Office, Classroom

HVAC Operation: Hours per day ______ Hours per week 120 Weeks per year 48

Average number of occupants 100 Percentage of building occupied 100

Gross Area (ft^2) 55,152 Gross Volume (ft^3) 584,471
1 + 1 + 1 + 1 + .35

Number of Stories: Below Grade 1 Above Grade or 5

Typical Story Height: Below Grade 11'-3/8" Above Grade 11'-1-3/8"

BUILDING CONSTRUCTION

Wall Construction: Masonry 71 % Metal Panel 19 % Wood 0 % Glass 10 %

Insulation: Yes ( ) No (X) Thickness (if known) ______ Type ______
Glazing: Single (X) Double ( ) Tinted ( )

Roof Construction: Concrete 65 % Metal 35 % Wood 0 % Skylights 0 %

Skylight Glazing: Single ( ) Double ( ) Tinted ( )
Insulation: Yes (X) No ( ) Thickness (if known) 2 inches Type Rigid Insul...

ATTACH PHOTOGRAPH OR SKETCH OF BUILDING WITH APPROXIMATE DIMENSIONS AND SHOW NORTH ARROW

HVAC SYSTEMS

Heating ( ) Steam ( ) Warm Air (X) Hot Water ( ) Electric Other: ______

Heating Plant ( ) In Building (X) Remote

Cooling ( ) Electric ( ) Steam ( ) Gas None

Cooling Plant ( ) In Building ( ) Remote

HVAC System Type ( ) Reheat ( ) Double Duct ( ) Multizone ( ) Variable Volume ( ) Induct...
( ) Packaged 20%) Single Zone ( ) Unit vent. ( ) Radiation

Outdoor Air Controlled (X) Automatically ( ) Manually

BUILDING INFORMATION FORM (One form per Building)

Date form completed: 3-7-77 Form completed by: ______

Building Name: Territorial Hall, Bldg. #105.

Owner/User/Operator: University of Minnesota /

Street Address: U of M Shops Bldg., Room 200 City Minneapolis Zip 55

Contact Person: J. C. O'Gara Telephone 512-376-3455

BUILDING USE

Primary Use: ( ) 1. Office ( ) 2. Hospital (X) 3. Dormitory ( ) 4. Classroom ( ) 5. Athletic ( ) 6. Maintenance garage ( ) 7. Warehouse ( ) 8. Library ( ) 9. Laboratory ( ) 10. Auditorium (Fine Arts)

Description of other use(s): ______

HVAC Operation: Hours per day None Hours per week ______ Weeks per year ______

Average number of occupants 560 Percentage of building occupied 100

Gross Area (ft^2) 106,500 Gross Volume (ft^3) 1,030,355

Number of Stories: Below Grade .16 or 0 Above Grade 1 + 1 + .88 + .59 or 4

Typical Story Height: Below Grade 9'-0" Above Grade 9'- 1-3

BUILDING CONSTRUCTION

Wall Construction: Masonry 74 % Metal Panel 1 % Wood 0 % Glass 25 %

Insulation: Yes ( ) No (X) Thickness (if known) ______ Type ______
Glazing: Single ( ) Double (x) Tinted ( )

Roof Construction: Concrete 100 % Metal ______ % Wood ______ % Skylights ______

Skylight Glazing: Single ( ) Double ( ) Tinted (
Insulation: Yes ( ) No (X) Thickness (if known) ______ Type ______

ATTACH PHOTOGRAPH OR SKETCH OF BUILDING WITH APPROXIMATE DIMENSIONS AND SHOW NORTH ARROW

HVAC SYSTEMS

Heating ( ) Steam ( ) Warm Air (x) Hot Water ( ) Electric Other: ______

Heating Plant ( ) In Building (x) Remote

Cooling ( ) Electric ( ) Steam ( ) Gas

Cooling Plant ( ) In Building ( ) Remote None

HVAC System Type ( ) Reheat ( ) Double Duct ( ) Multizone ( ) Variable Volume ( ) Induc
( ) Packaged ( ) Single Zone ( ) Unit vent. (X) Radiation

Outdoor Air Controlled ( ) Automatically ( ) Manually

BUILDING INFORMATION FORM (One form per building)

Date form completed: 3-7-77 Form completed by: ______

Building Name: Frontier Hall, Bldg. #110.

Owner/User/Operator: University of Minnesota

Street Address: U of M Room 200 Shops Bldg. City Minneapolis Zip 5545

Contact Person: J. C. O'Gara Telephone 612-376-3455

BUILDING USE

Primary Use: ( ) 1. Office ( ) 4. Classroom ( ) 7. Warehouse
( ) 2. Hospital ( ) 5. Athletic ( ) 8. Library
(X) 3. Dormitory ( ) 6. Maintenance garage ( ) 9. Laboratory
( )10. Auditorium (Fine Arts

Description of other use(s): ______

HVAC Operation: Hours per day None Hours per week ______ Weeks per year ______

Average number of occupants 570 Percentage of building occupied 100

Gross Area (ft²) 113,037 Gross Volume (ft³) 1,009,44

Number of Stories: Below Grade 0 Above Grade 1 + 1 + .87 or 4

Typical Story Height: Below Grade 0 Above Grade 9'- 1-

BUILDING CONSTRUCTION

Wall Construction: Masonry 83 % Metal Panel 0 % Wood 0 % Glass 17

Insulation: Yes ( ) No (X) Thickness (if known) ______ Type ______
Glazing: Single ( ) Double (X) Tinted ( )

Roof Construction: Concrete 100 % Metal ____ % Wood ____ % Skylights ______

Skylight Glazing: Single ( ) Double ( ) Tinted
Insulation: Yes (X) No ( ) Thickness (if known) 3-1/2" Type Lt. Wt. Ther Fi

ATTACH PHOTOGRAPH OR SKETCH OF BUILDING WITH APPROXIMATE DIMENSIONS AND SHOW NORTH ARROW

HVAC SYSTEMS

Heating ( ) Steam ( ) Warm Air (X) Hot Water ( ) Electric Other: ______

Heating Plant ( ) In Building (X) Remote

Cooling ( ) Electric ( ) Steam ( ) Gas None

Cooling Plant ( ) In Building ( ) Remote

HVAC System Type ( ) Reheat ( ) Double Duct ( ) Multizone ( ) Variable Volume ( ) Indu
( ) Packaged ( ) Single Zone ( ) Unit vent. (X) Radiation

Outdoor Air Controlled ( ) Automatically ( ) Manually

BUILDING INFORMATION FORM (One form per building)

Date Form completed: 3-7-77 Form completed by: ______

[illegible]lding Name: Science Classroom, Bldg. #116.

Owner/User/Operator: University of Minnesota /

Street Address: U of M Room 200 Shops Building City Minneapolis Zip 5545

Contact Person: J. C. O'Gara Telephone 612-376-3455

BUILDING USE

Primary Use: ( ) 1. Office ( ) 2. Hospital ( ) 3. Dormitory (X) 4. Classroom ( ) 5. Athletic ( ) 6. Maintenance garage ( ) 7. Warehouse ( ) 8. Library ( ) 9. Laboratory ( ) 10. Auditorium (Fine Arts

Description of other use(s): ______

HVAC Operation: Hours per day 108 Hours per week ______ Weeks per year 48

Average number of occupants 630 Percentage of building occupied 100

Gross Area (ft^2) 41,905 Gross Volume (ft^3) 632,535

Number of Stories: Below Grade 2 Above Grade 3

Typical Story Height: Below Grade 10'-10" Above Grade 12'-10"

BUILDING CONSTRUCTION

Wall Construction: Masonry 50 % Metal Panel 0 % Wood 37 % Glass 13

Insulation: Yes (XX) No ( ) Thickness (if known) 2 inches Type blanket Insu

Glazing: Single ( ) Double ( ) Tinted ( )

Roof Construction: Concrete 0 % Metal 0 % Wood 100 % Skylights 0

Skylight Glazing: Single ( ) Double ( ) Tinted

Insulation: Yes (X) No ( ) Thickness (if known) 2 inches Type blanket

ATTACH PHOTOGRAPH OR SKETCH OF BUILDING WITH APPROXIMATE DIMENSIONS AND SHOW NORTH ARROW

HVAC SYSTEMS

Heating ( ) Steam ( ) Warm Air (X) Hot Water ( ) Electric Other: ______

Heating Plant ( ) In Building (X) Remote

Cooling ( ) Electric ( ) Steam ( ) Gas None

Co[illegible]ng Plant ( ) In Building ( ) Remote

HVAC System Type (X) Reheat ( ) Double Duct ( ) Multizone ( ) Variable Volume ( ) Induc ( ) Packaged ( ) Single Zone ( ) Unit vent. ( ) Radiation

Outdoor Air Controlled (X) Automatically ( ) Manually

BUILDING INFORMATION FORM (One form per building)

Date form completed: 3-7-77 Form completed by: ________

Building Name: Kolthoff Hall, Bldg. #122.

Owner/User/Operator: University of Minnesota /

Street Address: U of M Room 200 Shops Bldg. City Minneapolis Zip 5545

Contact Person: J. C. O'Gara Telephone 612-376-3455

BUILDING USE

Primary Use: ( ) 1. Office ( ) 4. Classroom ( ) 7. Warehouse
( ) 2. Hospital ( ) 5. Athletic ( ) 8. Library
( ) 3. Dormitory ( ) 6. Maintenance garage (X) 9. Laboratory
( )10. Auditorium (Fine Arts

Description of other use(s): ________

HVAC Operation: Hours per day 24 Hours per week ____ Weeks per year 51

Average number of occupants 255 Percentage of building occupied 100

Gross Area (ft^2) 157,569 Gross Volume (ft^3) 4,566,60

Number of Stories: Below Grade 1.54 + 1.90 Above Grade .76 + .76 + 1 + 1 + 1 + .2 or 5

Typical Story Height: Below Grade 14'-8" Above Grade 14' -

BUILDING CONSTRUCTION

Wall Construction: Masonry 86 % Metal Panel 0 % Wood 0 % Glass 14

Insulation: Yes (X) No ( ) Thickness (if known) 1" Type Rigid
Glazing: Single ( ) Double (X) Tinted ( )

Roof Construction: Concrete 99 % Metal 0 % Wood 0 % Skylights 1

Skylight Glazing: Single ( ) Double (X) All weather Tinted
Insulation: Yes (X) No ( ) Thickness (if known) 5" Type Crete thermo setting fill

ATTACH PHOTOGRAPH OR SKETCH OF BUILDING WITH APPROXIMATE DIMENSIONS AND SHOW NORTH ARROW

HVAC SYSTEMS

Heating ( ) Steam ( ) Warm Air (X) Hot Water ( ) Electric Other: ________

Heating Plant ( ) In Building (X) Remote

Cooling ( ) Electric (X) Steam ( ) Gas

Cooling Plant (X) In Building ( ) Remote

HVAC System Type (X) Reheat ( ) Double Duct ( ) Multizone ( ) Variable Volume ( ) Induc
( ) Packaged ( ) Single Zone ( ) Unit vent. ( ) Radiation

Outdoor Air Controlled (X) Automatically ( ) Manually

BUILDING INFORMATION FORM (One form per building)

Date form completed: 3-7-77 Form completed by: ______

Building Name: Space Science Center, Bldg. #125

Owner/User/Operator: University of Minnesota /

Street Address: U of M Room 200 Shops Building City Minneapolis Zip 5545

Contact Person: J. C. O'Gara Telephone 612-376-3455

BUILDING USE

Primary Use: ( ) 1. Office ( ) 4. Classroom ( ) 7. Warehouse
( ) 2. Hospital ( ) 5. Athletic ( ) 8. Library
( ) 3. Dormitory ( ) 6. Maintenance garage (x) 9. Laboratory
( ) 10. Auditorium (Fine Arts

Description of other use(s): ______

HVAC Operation: Hours per day 24 Hours per week ______ Weeks per year 52

Average number of occupants 75 Percentage of building occupied 100

Gross Area (ft^2) 95,989 Gross Volume (ft^3) 1,321,4

Number of Stories: Below Grade 1 Above Grade (1x5) + .12 + or 5

Typical Story Height: Below Grade 15'-0" Above Grade 13'-1-5/8

BUILDING CONSTRUCTION

Wall Construction: Masonry 83 % Metal Panel 11 % Wood 0 % Glass 6

Insulation: Yes ( ) No (X) Thickness (if known) ______ Type ______
Glazing: Single ( ) Double (x) Tinted ( )

Roof Construction: Concrete 100 % Metal 0 % Wood 0 % Skylights 0

Skylight Glazing: Single (x) Double ( ) Tinted
Insulation: Yes (X) No ( ) Thickness (if known) 5-1/2" Type Rigid foamgl

ATTACH PHOTOGRAPH OR SKETCH OF BUILDING WITH APPROXIMATE DIMENSIONS AND SHOW NORTH ARROW

HVAC SYSTEMS

Heating ( ) Steam ( ) Warm Air (X) Hot Water ( ) Electric Other: ______

Heating Plant ( ) In Building (X) Remote

Cooling ( ) Electric (X) Steam ( ) Gas

Cooling Plant (X) In Building ( ) Remote

HVAC System Type (X) Reheat ( ) Double Duct ( ) Multizone ( ) Variable Volume ( ) Induct
( ) Packaged ( ) Single Zone ( ) Unit vent. ( ) Radiation

Outdoor Air Controlled (x) Automatically ( ) Manually

BUILDING I?FC??TIO? FO?M (One form per building)

Date form completed: 3-7-77 Form completed by: ______

?ding Name: MacPhail Center, Bldg. #126.

Owner/User/Operator: University of Minnesota /

Street Address: U of M Room 200 Shops Building City Minneapolis Zip 5545?

Contact Person: J. C. O'Gara Telephone 612-376-3455

BUILDING USE

Primary Use: ( ) 1. Office (X) 4. Classroom ( ) 7. Warehouse
( ) 2. Hospital ( ) 5. Athletic ( ) 8. Library
( ) 3. Dormitory ( ) 6. Maintenance garage ( ) 9. Laboratory
( )10. Auditorium (Fine Arts)

Description of other use(s): ______

HVAC Operation: Hours per day 24 Hours per week ______ Weeks per year 52

Average number of occupants 50 Percentage of building occupied 100

Gross Area (ft^2) 47,419 Gross Volume (ft^3) 509,21?

Number of Stories: Below Grade 1.17 or 1 Above Grade (1x4) + .03 or

Typical Story Height: Below Grade 10'-0" Above Grade 12'-1/4"

BUILDING CONSTRUCTION

Wall Construction: Masonry 78 % Metal Panel 0 % Wood 0 % Glass 22

Insulation: Yes ( ) No (X) Thickness (if known) ______ Type ______
Glazing: Single (x) Double ( ) Tinted ( )

Roof Construction: Concrete 100 % Metal ___ % Wood ___ % Skylights ______

Skylight Glazing: Single ( ) Double ( ) Tinted
Insulation: Yes ( ) No (x) Thickness (if known) ______ Type ______

ATTACH PHOTOGRAPH OR SKETCH OF BUILDING WITH APPROXIMATE DIMENSIONS AND SHOW NORTH ARROW

HVAC SYSTEMS

Heating (X) Steam ( ) Warm Air ( ) Hot Water ( ) Electric Other: ______

Heating Plant (X) In Building ( ) Remote

Cooling ( ) Electric ( ) Steam ( ) Gas None

?ling Plant ( ) In Building ( ) Remote

HVAC System Type ( ) Reheat ( ) Double Duct ( ) Multizone ( ) Variable Volume ( ) Indu?
( ) Packaged ( ) Single Zone 30( ) Unit vent. ( ) Radiation

Outdoor Air Controlled ( ) Automatically ( ) Manually

BUILDING INFORMATION FORM (One form per building)

Date form completed: 3-7-77 Form completed by: ______

Building Name: Klaeber Court, Bldg. #132.

Owner/User/Operator: University of Minnesota /

Street Address: U of M Room 200 Shops Building City Minneapolis Zip 5545

Contact Person: J. C. O'Gara Telephone 612-376-3455

BUILDING USE

Primary Use:
- (X) 1. Office
- ( ) 2. Hospital
- ( ) 3. Dormitory
- ( ) 4. Classroom
- ( ) 5. Athletic
- ( ) 6. Maintenance garage
- ( ) 7. Warehouse
- ( ) 8. Library
- ( ) 9. Laboratory
- ( ) 10. Auditorium (Fine Arts

Description of other use(s): ______

HVAC Operation: Hours per day 18 Hours per week ______ Weeks per year 50

Average number of occupants 60 Percentage of building occupied 100

Gross Area (ft^2) 14,846 Gross Volume (ft^3) 178,152

Number of Stories: Below Grade 0 Above Grade 1

Typical Story Height: Below Grade 0 Above Grade 9'-1"

BUILDING CONSTRUCTION

Wall Construction: Masonry 91 % Metal Panel 0 % Wood 2 % Glass 7

Insulation: Yes ( ) No (X) Thickness (if known) ______ Type ______
Glazing: Single (X) Double ( ) Tinted ( )

Roof Construction: Concrete 1 % Metal 99 % Wood 0 % Skylights 0

Skylight Glazing: Single ( ) Double ( ) Tinted
Insulation: Yes (X) No ( ) Thickness (if known) 1-1/2" Type Rigid Celote

ATTACH PHOTOGRAPH OR SKETCH OF BUILDING WITH APPROXIMATE DIMENSIONS AND SHOW NORTH ARROW

HVAC SYSTEMS

Heating ( ) Steam (X) Warm Air ( ) Hot Water ( ) Electric Other: ______

Heating Plant (X) In Building ( ) Remote

Cooling (X) Electric ( ) Steam ( ) Gas

Cooling Plant (X) In Building ( ) Remote

H System Type ( ) Reheat ( ) Double Duct ( ) Multizone ( ) Variable Volume ( ) Induc
( ) Packaged (X) Single Zone ( ) Unit vent. ( ) Radiation

Outdoor Air Controlled (X) Automatically ( ) Manually

BUILDING INFORMATION FORM (One form per building)

Date form completed: 3-7-77 Form completed by: ____

Iding Name: Administrative Services, Bldg. #135.

Owner/User/Operator: University of Minnesota /

Street Address: U of M Room 200 Shops Building City Minneapolis Zip 554

Contact Person: J. C. O'Gara Telephone 612-376-3455

BUILDING USE

Primary Use: (X) 1. Office ( ) 4. Classroom ( ) 7. Warehouse
( ) 2. Hospital ( ) 5. Athletic ( ) 8. Library
( ) 3. Dormitory ( ) 6. Maintenance garage ( ) 9. Laboratory
( )10. Auditorium (Fine Arts)

Description of other use(s): Computer Center

HVAC Operation: Hours per day 20 Hours per week ____ Weeks per year 50

Average number of occupants 250 Percentage of building occupied 100

Gross Area (ft^2) 64,332 Gross Volume (ft^3) 771,984

Number of Stories: Below Grade 1 or 1 Above Grade 1 + 1 + 1 + 1 + 1 or 5

Typical Story Height: Below Grade 12'-4-1/2" Above Grade 12'-0"

BUILDING CONSTRUCTION

Wall Construction: Masonry 84 % Metal Panel 0 % Wood 0 % Glass 16 %

Insulation: Yes ( ) No ( ) Thickness (if known) ____ Type ____
Glazing: Single ( ) Double (X) Tinted ( )

Roof Construction: Concrete 100 % Metal 0 % Wood 0 % Skylights 0

Skylight Glazing: Single ( ) Double ( ) Tinted (
Insulation: Yes (X) No ( ) Thickness (if known) 1 inch Type Fibre-board

ATTACH PHOTOGRAPH OR SKETCH OF BUILDING WITH APPROXIMATE DIMENSIONS AND SHOW NORTH ARROW

HVAC SYSTEMS

Heating (X) Steam ( ) Warm Air ( ) Hot Water ( ) Electric Other: ____

Heating Plant (X) In Building ( ) Remote

Cooling (X) Electric ( ) Steam ( ) Gas

Cooling Plant (X) In Building ( ) Remote

HVAC System Type (X) Reheat ( ) Double Duct ( ) Multizone ( ) Variable Volume ( ) Induct
( ) Packaged ( ) Single Zone ( ) Unit vent. ( ) Radiation

Outdoor Air Controlled (X) Automatically ( ) Manually

BUILDING INFORMATION FORM (One form per building)

Date form completed: 3-7-77 Form completed by: ______

Building Name: Personnel, Bldg. #137

Owner/User/Operator: University of Minnesota /

Street Address: U of M Room 200 Shops Building City Minneapolis Zip 5545

Contact Person: J. C. O'Gara Telephone 612-376-3455

BUILDING USE

Primary Use: (X) 1. Office ( ) 4. Classroom ( ) 7. Warehouse
( ) 2. Hospital ( ) 5. Athletic ( ) 8. Library
( ) 3. Dormitory ( ) 6. Maintenance garage ( ) 9. Laboratory
( ) 10. Auditorium (Fine Arts)

Description of other use(s): ______

HVAC Operation: Hours per day 24 Hours per week ______ Weeks per year 52

Average number of occupants 125 Percentage of building occupied 100

Gross Area (ft^2) 12,959 Gross Volume (ft^3) 120,00

Number of Stories: Below Grade 0 Above Grade 1.5

Typical Story Height: Below Grade -- Above Grade 10

BUILDING CONSTRUCTION

Wall Construction: Masonry 75 % Metal Panel ____ % Wood ____ % Glass 25

Insulation: Yes ( ) No (X) Thickness (if known) ______ Type ______
Glazing: Single (X) Double ( ) Tinted ( )

Roof Construction: Concrete 100 % Metal ____ % Wood ____ % Skylights ______

Skylight Glazing: Single ( ) Double ( ) Tinted
Insulation: Yes ( ) No (X) Thickness (if known) ______ Type ______

ATTACH PHOTOGRAPH OR SKETCH OF BUILDING WITH APPROXIMATE DIMENSIONS AND SHOW NORTH ARROW

HVAC SYSTEMS

Heating (X) Steam ( ) Warm Air ( ) Hot Water ( ) Electric Other: ______

Heating Plant ( ) In Building (X) Remote separate bldg.

Cooling (X) Electric ( ) Steam ( ) Gas

Cooling Plant (X) In Building ( ) Remote

HVAC System Type ( ) Reheat ( ) Double Duct ( ) Multizone ( ) Variable Volume ( ) Induct
( ) Packaged (X) Single Zone ( ) Unit vent. ( ) Radiation

Outdoor Air Controlled ( ) Automatically ( ) Manually

BUILDING INFORMATION FORM (One form per building)

Date form completed: 3-7-77 Form completed by: ____________

Building Name: Health Science Unit A, Bldg. #142.

Owner/User/Operator: University of Minnesota /

Street Address: U of M Room 200 Shops Building City Minneapolis Zip 5545

Contact Person: J. C. O'Gara Telephone 612-376-3455

BUILDING USE

Primary Use: ( ) 1. Office ( ) 2. Hospital ( ) 3. Dormitory ( ) 4. Classroom ( ) 5. Athletic ( ) 6. Maintenance garage ( ) 7. Warehouse ( ) 8. Library (XX) 9. Laboratory ( )10. Auditorium (Fine Arts

Description of other use(s): Office, Classroom

HVAC Operation: Hours per day 24 Hours per week ____ Weeks per year 52

Average number of occupants 4,000 Percentage of building occupied 100

Gross Area (ft^2) 679,904 Gross Volume (ft^3) 12,301,222

(7x1) + (6x.92) + (5x.53) + .C

Number of Stories: Below Grade 1.1 + 1.35 + 1.83 or 3 Above Grade or 19

Typical Story Height: Below Grade 16'-8" Above Grade 13'-4"

BUILDING CONSTRUCTION

Wall Construction: Masonry 79 % Metal Panel 0 % Wood 0 % Glass 21

Insulation: Yes (X) No ( ) Thickness (if known) 1-1/2 inches Type Polystyrene Foam boar

Glazing: Single ( ) Double ( ) Tinted ( )

Roof Construction: Concrete 100 % Metal 0 % Wood 0 % Skylights 0

Skylight Glazing: Single ( ) Double ( ) Tinted

Insulation: Yes (X) No ( ) Thickness (if known) 4" Type Silbrico All Weather

ATTACH PHOTOGRAPH OR SKETCH OF BUILDING WITH APPROXIMATE DIMENSIONS AND SHOW NORTH ARROW

HVAC SYSTEMS

Heating ( ) Steam ( ) Warm Air (X) Hot Water ( ) Electric Other: ____

Heating Plant ( ) In Building (XX) Remote

Cooling ( ) Electric (XX) Steam ( ) Gas

Cooling Plant (X) In Building ( ) Remote

H System Type (X) Reheat ( ) Double Duct ( ) Multizone ( ) Variable Volume ( ) Indu ( ) Packaged ( ) Single Zone ( ) Unit vent. ( ) Radiation

Outdoor Air Controlled (X) Automatically ( ) Manually

(one form per building)

Date form completed: 3-7-77 Form completed by:

Building Name: Blegen Hall, Bldg. #203.

Owner/User/Operator: University of Minnesota /

Street Address: U of M Room 200 Shops Bldg. City Minneapolis Zip 5

Contact Person: J. C. O'Gara Telephone 612-376-3455

BUILDING USE

Primary Use: ( ) 1. Office ( ) 2. Hospital ( ) 3. Dormitory (x) 4. Classroom ( ) 5. Athletic ( ) 6. Maintenance garage ( ) 7. Warehouse ( ) 8. Library ( ) 9. Laboratory ( ) 10. Auditorium (Fine Art

Description of other use(s): Cafeteria

HVAC Operation: Hours per day ______ Hours per week 120 Weeks per year 50
sometimes more if special schedule

Average number of occupants 800 Percentage of building occupied 100

Gross Area (ft^2) 102,200 Gross Volume (ft^3) 1,341.5

Number of Stories: Below Grade 1.68 Above Grade 4

Typical Story Height: Below Grade 13' - 4" Above Grade 11'- 1-

BUILDING CONSTRUCTION

Wall Construction: Masonry 82 % Metal Panel 0 % Wood 0 % Glass 18

Insulation: Yes ( ) No (x) Thickness (if known) ______ Type
Glazing: Single ( ) Double (x) Tinted ( )

Roof Construction: Concrete 100 % Metal ____ % Wood ____ % Skylights

Skylight Glazing: Single ( ) Double ( ) Tinted
Insulation: Yes (x) No ( ) Thickness (if known) 1-1/2 inches Type Rigid

ATTACH PHOTOGRAPH OR SKETCH OF BUILDING WITH APPROXIMATE DIMENSIONS AND SHOW NORTH ARROW

HVAC SYSTEMS

Heating ( ) Steam ( ) Warm Air (X) Hot Water ( ) Electric Other:

Heating Plant ( ) In Building (X) Remote

Cooling ( ) Electric (X) Steam ( ) Gas

Cooling Plant ( ) In Building (X) Remote

HVAC System Type (X) Reheat ( ) Double Duct ( ) Multizone ( ) Variable Volume ( ) Induct
( ) Packaged ( ) Single Zone ( ) Unit vent. ( ) Radiation

Outdoor Air Controlled (X) Automatically ( ) Manually

BUILDING INFORMATION FORM (One form per building)

Date form completed: 3-7-77 Form completed by:

Building Name: Wilson Library, Bldg. #204.

Owner/User/Operator: University/of Minnesota /

Street Address: U of M Room 200 Shops Building City Minneapolis Zip 5545

Contact Person: J. C. O'Gara Telephone 612-376-3455

BUILDING USE

Primary Use: ( ) 1. Office ( ) 4. Classroom ( ) 7. Warehouse
( ) 2. Hospital ( ) 5. Athletic (x) 8. Library
( ) 3. Dormitory ( ) 6. Maintenance garage ( ) 9. Laboratory
( )10. Auditorium (Fine Arts

Description of other use(s):
A = 80% of fans; B = 20% of fans.

HVAC Operation: Hours per day A - 24 Hours per week B - 100 Weeks per year A - 52 B - 52

Average number of occupants 300 Percentage of building occupied 100

Gross Area (ft^2) 386,517 Gross Volume (ft^3) 5,692,895

Number of Stories: Below Grade 2 Above Grade 5

Typical Story Height: Below Grade 14'-6" Above Grade 12'-9"

BUILDING CONSTRUCTION

Wall Construction: Masonry 82 % Metal Panel 0 % Wood 0 % Glass 18

Insulation: Yes (X) No ( ) Thickness (if known) 1" Type Rigid Styro
Glazing: Single ( ) Double (X) Tinted ( )

Roof Construction: Concrete 99 % Metal 0 % Wood 0 % Skylights 1

Skylight Glazing: Single ( ) Double ( ) Tinted
Insulation: Yes (X) No ( ) Thickness (if known) Type Foamglas boar

ATTACH PHOTOGRAPH OR SKETCH OF BUILDING WITH APPROXIMATE DIMENSIONS AND SHOW NORTH ARROW

HVAC SYSTEMS

Heating ( ) Steam (X) Warm Air ( ) Hot Water ( ) Electric Other:

Heating Plant ( ) In Building (X) Remote

Cooling ( ) Electric (X) Steam ( ) Gas

Cooling Plant (X) In Building ( ) Remote

HVAC System Type ( ) Reheat (X) Double Duct ( ) Multizone ( ) Variable Volume ( ) Induc
( ) Packaged ( ) Single Zone ( ) Unit vent. ( ) Radiation

Outdoor Air Controlled (X) Automatically ( ) Manually

Date form completed: 3-7-77 Form completed by: ______

Building Name: Anderson Hall, Bldg. #205.

O___r/User/Operator: University of Minnesota /

Street Address: U of M Room 200 Shops Building City Minneapolis Zip 5545[illegible]

Contact Person: J. C. O'Gara Telephone 612-376-3455

BUILDING USE

Primary Use: ( ) 1. Office (X) 4. Classroom ( ) 7. Warehouse
( ) 2. Hospital ( ) 5. Athletic ( ) 8. Library
( ) 3. Dormitory ( ) 6. Maintenance garage ( ) 9. Laboratory
( )10. Auditorium (Fine Arts)

Description of other use(s): ______

HVAC Operation: Hours per day ______ Hours per week 120 Weeks per year 50

Average number of occupants 1600 Percentage of building occupied 100

Gross Area (ft^2) 64,291 Gross Volume (ft^3) 952,538

Number of Stories: Below Grade 0 Above Grade 2.05 + 1 + : or 3

Typical Story Height: Below Grade 0 Above Grade 12'-2-1/

BUILDING CONSTRUCTION

Wall Construction: Masonry 89 % Metal Panel 0 % Wood 0 % Glass 11 %

Insulation: Yes ( ) No (X) Thickness (if known) ______ Type ______
Glazing: Single ( ) Double ( ) Tinted (XX) Gray

Roof Construction: Concrete 100 % Metal ___ % Wood ___ % Skylights ______

Skylight Glazing: Single ( ) Double ( ) Tinted (
Insulation: Yes (X) No ( ) Thickness (if known) 1-1/2" Type Foamglas (Rigi

ATTACH PHOTOGRAPH OR SKETCH OF BUILDING WITH APPROXIMATE DIMENSIONS AND SHOW NORTH ARROW

HVAC SYSTEMS

Heating ( ) Steam ( ) Warm Air (x) Hot Water ( ) Electric Other: ______

Heating Plant ( ) In Building (x) Remote

Cooling ( ) Electric (x) Steam ( ) Gas

Cooling Plant ( ) In Building (X) Remote

HVAC System Type (X) Reheat ( ) Double Duct ( ) Multizone ( ) Variable Volume ( ) Induc
( ) Packaged ( ) Single Zone ( ) Unit vent. ( ) Radiation

Outdoor Air Controlled (x) Automatically ( ) Manually

BUILDING INFORMATION FORM (One form per building)

Date form completed: 3-7-77 Form completed by: ______

Building Name: Auditorium Classroom Bldg., #207.

Owner/User/Operator: University of Minnesota

Street Address: U of M Room 200 Shops Building City Minneapolis Zip 55455

Contact Person: J. C. O'Gara Telephone 612-376-3455

BUILDING USE

Primary Use: ( ) 1. Office (X) 4. Classroom ( ) 7. Warehouse
( ) 2. Hospital ( ) 5. Athletic ( ) 8. Library
( ) 3. Dormitory ( ) 6. Maintenance garage ( ) 9. Laboratory
( )10. Auditorium (Fine Arts)

Description of other use(s): Cafeteria & Kitchen

HVAC Operation: Hours per day ______ Hours per week 100 Weeks per year 48

Average number of occupants 1200 Percentage of building occupied 100

Gross Area (ft^2) 60,626 Gross Volume (ft^3) 832, 956

Number of Stories: Below Grade .30 or 0 Above Grade 3

Typical Story Height: Below Grade 9'-4" Above Grade 14'-6"

BUILDING CONSTRUCTION

Wall Construction: Masonry 53 % Metal Panel 37 % Wood 0 % Glass 10 %

Insulation: Yes ( ) No (X) Thickness (if known) ______ Type ______
Glazing: Single ( ) Double ( ) Tinted (X) Gray

Roof Construction: Concrete 0 % Metal 97 % Wood 0 % Skylights 3

Skylight Glazing: Single ( ) Double ( ) Tinted (
Insulation: Yes (X) No ( ) Thickness (if known) 2" Type Fescoboard

ATTACH PHOTOGRAPH OR SKETCH OF BUILDING WITH APPROXIMATE DIMENSIONS AND SHOW NORTH ARROW

HVAC SYSTEMS

Heating ( ) Steam ( ) Warm Air (X) Hot Water ( ) Electric Other: ______

Heating Plant ( ) In Building (X) Remote

Cooling ( ) Electric (X) Steam ( ) Gas

Cooling Plant (X) In Building ( ) Remote

HVAC System Type ( ) Reheat ( ) Double Duct (X) Multizone ( ) Variable Volume ( ) Induct
( ) Packaged ( ) Single Zone ( ) Unit vent. ( ) Radiation

Outdoor Air Controlled (XX) Automatically ( ) Manually

BUILDING INFORMATION FORM (One form per building)

Date form completed: 3-7-77 Form completed by: ____

Building Name: Middlebrook Hall, Bldg. #208.

Owner/User/Operator: University of Minnesota /

Street Address: U of M Room 200 Shops Building City Minneapolis Zip 55455

Contact Person: J. C. O'Gara Telephone 612-376-3455

BUILDING USE

Primary Use: ( ) 1. Office ( ) 4. Classroom ( ) 7. Warehouse
( ) 2. Hospital ( ) 5. Athletic ( ) 8. Library
(X) 3. Dormitory ( ) 6. Maintenance garage ( ) 9. Laboratory
( )10. Auditorium (Fine Arts)

Description of other use(s): Kitchen & Cafeteria

HVAC Operation: Hours per day 24 Hours per week 168 Weeks per year 50

Average number of occupants 730 Percentage of building occupied 100

Gross Area (ft^2) 226,668 Gross Volume (ft^3) 2,496,166

Number of Stories: Below Grade 2 Above Grade 12

Typical Story Height: Below Grade 12'-4" Above Grade 8'-8"

BUILDING CONSTRUCTION

Wall Construction: Masonry 82 % Metal Panel 3 % Wood 0 % Glass 15 %

Insulation: Yes ( ) No (X) Thickness (if known) ____ Type ____
Glazing: Single ( ) Double (X) Tinted ( )

Roof Construction: Concrete 100 % Metal ____ % Wood ____ % Skylights ____ %

Skylight Glazing: Single ( ) Double ( ) Tinted ( )
Insulation: Yes (XX) No ( ) Thickness (if known) 1-1/2" Type Foamglas Board

ATTACH PHOTOGRAPH OR SKETCH OF BUILDING WITH APPROXIMATE DIMENSIONS AND SHOW NORTH ARROW

HVAC SYSTEMS

Heating ( ) Steam ( ) Warm Air (X) Hot Water ( ) Electric Other: ____

Heating Plant ( ) In Building (X) Remote

Cooling ( ) Electric (X) Steam ( ) Gas

Cooling Plant (X) In Building ( ) Remote

HVAC System Type ( ) Reheat ( ) Double Duct ( ) Multizone ( ) Variable Volume (XX) Induct
( ) Packaged ( ) Single Zone ( ) Unit vent. ( ) Radiation

Outdoor Air Controlled (X) Automatically ( ) Manually

BUILDING INFORMATION FORM (one form per building)

Date form completed: 3-7-77 Form completed by: ____

Building Name: Rarig Center, Bldg. #209.

Owner/User/Operator: University of Minnesota

Street Address: U of M Room 200 Shops Building City Minneapolis Zip 55455

Contact Person: J. C. O'Gara Telephone 612-376-3455

BUILDING USE

Primary Use: ( ) 1. Office ( ) 4. Classroom ( ) 7. Warehouse
( ) 2. Hospital ( ) 5. Athletic ( ) 8. Library
( ) 3. Dormitory ( ) 6. Maintenance garage ( ) 9. Laboratory
(X) 10. Auditorium (Fine Arts)

Description of other use(s): Office

A = 60% of fans; B = 30% of fans; C = 10% of fans.

HVAC Operation: Hours per day C - 24 Hours per week A - 70 B - 100 Weeks per year A - 44 B - 5[illegible] C - 5[illegible]

Average number of occupants 250 Percentage of building occupied 100

Gross Area (ft^2) 133,121 Gross Volume (ft^3) 2,559,225

Number of Stories: Below Grade 1 Above Grade 6

Typical Story Height: Below Grade 14' Above Grade 18'

BUILDING CONSTRUCTION

Wall Construction: Masonry 92 % Metal Panel 2 % Wood 0 % Glass 6 %

Insulation: Yes (X) No ( ) Thickness (if known) 1" & 2" Type Rigid
Glazing: Single ( ) Double ( ) Tinted ( )

Roof Construction: Concrete 100 % Metal ____ % Wood ____ % Skylights ____

Skylight Glazing: Single ( ) Double ( ) Tinted (
Insulation: Yes (X) No ( ) Thickness (if known) 1-1/2" Type Fesio Board

ATTACH PHOTOGRAPH OR SKETCH OF BUILDING WITH APPROXIMATE DIMENSIONS AND SHOW NORTH ARROW

HVAC SYSTEMS

Heating ( ) Steam ( ) Warm Air (X) Hot Water ( ) Electric Other: ____

Heating Plant ( ) In Building (X) Remote

Cooling ( ) Electric (X) Steam ( ) Gas

Cooling Plant (X) In Building ( ) Remote

HVAC System Type (X) Reheat ( ) Double Duct ( ) Multizone ( ) Variable Volume ( ) Induc[tion]
( ) Packaged ( ) Single Zone ( ) Unit vent. ( ) Radiation

Outdoor Air Controlled (X) Automatically ( ) Manually

BUILDING INFORMATION FORM (One form per building)

Date form completed: 3-7-77 Form completed by: ______

Building Name: Coffey Hall, Bldg. #322.

Owner/User/Operator: University of Minnesota

Street Address: U of M Room 200 Shops Building City Minneapolis Zip 55455

Contact Person: J. C. O'Gara Telephone 612-376-3455

BUILDING USE

Primary Use: (X) 1. Office ( ) 4. Classroom ( ) 7. Warehouse
( ) 2. Hospital ( ) 5. Athletic ( ) 8. Library
( ) 3. Dormitory ( ) 6. Maintenance garage ( ) 9. Laboratory
( )10. Auditorium (Fine Arts)

Description of other use(s): ______

HVAC Operation: Hours per day 132 Hours per week ______ Weeks per year 50

Average number of occupants 300 Percentage of building occupied 100

Gross Area (ft²) 134,394 Gross Volume (ft³) 1,768,199

Number of Stories: Below Grade 1 Above Grade 1 + 1 + 1 or

Typical Story Height: Below Grade 11'-5" Above Grade 15'-0"

BUILDING CONSTRUCTION

Wall Construction: Masonry 82 % Metal Panel 0 % Wood 0 % Glass 18 %

Insulation: Yes ( ) No (X) Thickness (if known) ______ Type ______
Glazing: Single ( ) Double (X) Tinted ( )

Roof Construction: Concrete 0 % Metal 0 % Wood 99 % Skylights 1

Skylight Glazing: Single ( ) Double ( ) Tinted (
Insulation: Yes (X) No ( ) Thickness (if known) 2" Type Blanket

ATTACH PHOTOGRAPH OR SKETCH OF BUILDING WITH APPROXIMATE DIMENSIONS AND SHOW NORTH ARROW

HVAC SYSTEMS

Heating (X) Steam ( ) Warm Air ( ) Hot Water ( ) Electric Other: ______

Heating Plant ( ) In Building (X) Remote

Cooling ( ) Electric (X) Steam ( ) Gas

Cooling Plant (X) In Building ( ) Remote

HVAC System Type (X) Reheat ( ) Double Duct ( ) Multizone ( ) Variable Volume ( ) Induct
( ) Packaged ( ) Single Zone ( ) Unit vent. ( ) Radiation

Outdoor Air Controlled (X) Automatically ( ) Manually

BUILDING INFORMATION FORM (one form per building)

Date form completed: 3-7-77 Form completed by: ______

Building Name: Bailey Hall, Bldg. #383.

Owner/User/Operator: University of Minnesota

Street Address: U of M Room 200 Shops Bldg. City Minneapolis Zip 55455

Contact Person: J. C. O'Gara Telephone 612-376-3455

BUILDING USE

Primary Use: ( ) 1. Office ( ) 4. Classroom ( ) 7. Warehouse
( ) 2. Hospital ( ) 5. Athletic ( ) 8. Library
(X) 3. Dormitory ( ) 6. Maintenance garage ( ) 9. Laboratory
( ) 10. Auditorium (Fine Arts

Description of other use(s): ______

HVAC Operation: Hours per day None Hours per week ______ Weeks per year ______

Average number of occupants 310 Percentage of building occupied 100

Gross Area (ft^2) 70,157 Gross Volume (ft^3) 759,845

Number of Stories: Below Grade 1 Above Grade 1 + (3 x .78) .07 or 4

Typical Story Height: Below Grade 10' - 0" Above Grade 9' -

BUILDING CONSTRUCTION

Wall Construction: Masonry 76 % Metal Panel 9 % Wood 0 % Glass 15

Insulation: Yes ( ) No (X) Thickness (if known) ______ Type ______
Glazing: Single ( ) Double (X) Tinted ( )

Roof Construction: Concrete 78 % Metal 22 % Wood 0 % Skylights 0

Skylight Glazing: Single ( ) Double ( ) Tinted
Insulation: Yes (X) No ( ) Thickness (if known) 1.5 inches Type Rigid

ATTACH PHOTOGRAPH OR SKETCH OF BUILDING WITH APPROXIMATE DIMENSIONS AND SHOW NORTH ARROW

HVAC SYSTEMS

Heating ( ) Steam ( ) Warm Air (X) Hot Water ( ) Electric Other: ______

Heating Plant ( ) In Building (X) Remote

Cooling ( ) Electric ( ) Steam ( ) Gas

Cooling Plant ( ) In Building ( ) Remote None NONE

HVAC System Type ( ) Reheat ( ) Double Duct ( ) Multizone ( ) Variable Volume ( ) Indu
( ) Packaged ( ) Single Zone ( ) Unit vent. (X) Radiation

Outdoor Air Controlled ( ) Automatically ( ) Manually

BUILDING INFORMATION FORM (One form per building)

Date form completed: 3-7-77 Form completed by: ______

Building Name: Office Classroom, Bldg. #412.

Owner/User/Operator: / University of Minnesota

Street Address: U of M Room 200 Shops Bldg. City Minneapolis Zip 55455

Contact Person: J. C. O'Gara Telephone 612-376=3455

BUILDING USE

Primary Use: ( ) 1. Office (X) 4. Classroom ( ) 7. Warehouse
( ) 2. Hospital ( ) 5. Athletic ( ) 8. Library
( ) 3. Dormitory ( ) 6. Maintenance garage ( ) 9. Laboratory
( )10. Auditorium (Fine Arts

Description of other use(s): Office

HVAC Operation: Hours per day 24 Hours per week ______ Weeks per year 52

Average number of occupants 500 Percentage of building occupied 100

Gross Area (ft^2) 130,566 Gross Volume (ft^3) 1,700,4

Number of Stories: Below Grade .75 or 1 Above Grade(4x1) + .25

Typical Story Height: Below Grade 15'-9" Above Grade 15'-9"

BUILDING CONSTRUCTION

Wall Construction: Masonry 79 % Metal Panel 0 % Wood 0 % Glass 21

Insulation: Yes (X) No ( ) Thickness (if known) ______ Type Zonolite Mas
Glazing: Single (X) Double ( ) Tinted ( )

Roof Construction: Concrete 92 % Metal 0 % Wood 0 % Skylights 8

Skylight Glazing: Single ( ) Double ( ) Tinted
Insulation: Yes (x) No ( ) Thickness (if known) 1 inch Type "Styrofoam Rm"

ATTACH PHOTOGRAPH OR SKETCH OF BUILDING WITH APPROXIMATE DIMENSIONS AND SHOW NORTH ARROW

HVAC SYSTEMS

Heating ( ) Steam ( ) Warm Air ( ) Hot Water ( ) Electric Other: all air

Heating Plant ( ) In Building (X) Remote

Cooling ( ) Electric (X) Steam ( ) Gas

Cooling Plant (X) In Building ( ) Remote

HVAC System Type (X) Reheat ( ) Double Duct ( ) Multizone ( ) Variable Volume ( ) Induc
( ) Packaged ( ) Single Zone ( ) Unit vent. ( ) Radiation

Outdoor Air Controlled (x) Automatically ( ) Manually

1.6.4 STEAM ADSORPTION AIR CONDITIONING

The following tabulation provides the quantity of steam adsorption air conditioning presently installed in the Demonstration Community. Steam usage factors were developed by metering actual usage of several representative units and applying the usage factor to actual tonnage. The usage factor developed for this purpose was 18 lb/Hr/ton of steam.

Minneapolis Campus and Hospital Group

Steam Adsorption Air Conditioning

Building Name	Existing Function	Tons A/C	[1]Steam Usage Lb/Hr
Unit A	Health Science	3,300	59,400
*Wilson Library	Library	1,650	29,700
*Rarig Center	Performing Arts	500	9,000
*Auditorium-Classroom	Auditorium, Classroom	200	3,600
*Kolthoff Hall	Chemistry Laboratory	800	14,400
*Smith Hall	Chemistry Classroom-Laboratory	150	2,700
Mayo Hospital	Hospital	750	13,500
Diehl Hall	Health Science	1,000	18,000
Jackson-Owre	Health Science	250	4,600
Jackson	Health Science	60	1,080
Lyons Lab	Research	105	1,890
Unit K-E	Health Science	500	9,000
*Northrop Auditorium	Auditorium	225	4,050
Space Science Center	Research Laboratory	500	9,000
*Elliott Hall	Classroom-Laboratory	420	7,560

Building Name	Function	Tons A/C	[1]Steam Usage Lb/Hr
Morrill Hall	Office	50	900
Electrical Engr.	Engineering	50	900
Vincent-Murphy Halls	Classroom	250	4,500
Museum of Natural History	Museum	200	3,600
Eddy Hall	Classroom	25	450
University Hospital	Hospital	300	5,400
St. Mary's Hospital	Hospital	500	9,000
Heart Hospital	Hospital	200	3,600
Child Rehabilitation	Health	400	7,200
Health Science	Health	300	5,400
*Middlebrook	Dormitory	500	9,000
Augsburg College		239	4,302
Totals		13,419 tn	241,632 lb/hr

*To be converted from steam adsorption to hot water adsorption as part of ICES hot water distribution system.

1.6.5 ELECTRIC AIR CONDITIONING

The majority of the older buildings in the key sectors did not have provision for steam adsorption air conditioning. To provide cooling a great number of window air conditioning units have been added over the years.

The following lists will describe the quantity and amounts of electric air conditioning existing in the Community.

The University policy regarding window air conditioning is to convert to steam adsorption at major remodeling times.

Demonstration Community

Window Air Conditioners

(Less University Hospitals)

Building Name	No. of Units	Total BTU
Eddy Hall	8	132,000
Pillsbury Hall	12	131,500
Pattee Hall	1	36,000
Nicholson Hall	1	24,000
Wulling Hall	2	35,000
Burton Hall	2	35,000
Armory	1	9,500
Jones Hall	2	21,000
Elliott Hall	2	27,000
Shevlin Hall	8	113,000
Sanford Hall	2	17,000
Experimental Engineering	7	105,500
Main Engineering	11	166,500

Building Name	No. of Units	Total BTU
Jackson Hall	37	528,000
Millard Hall	96	1,342,500
Smith Hall	14	191,000
Appleby Hall	19	296,500
Zoology	11	187,500
Mineral Resources Research Center	7	104,500
Walter Library	13	163,500
Electrical Engineering	11	198,000
Shops Building	1	17,500
Morrill Hall	129	1,133,500
Botany	16	259,000
Tate Laboratory of Physics	15	239,500
Williams Arena	2	35,000
Fraser Hall	3	37,000
Northrop Memorial Auditorium and Garage	9	142,500
Owre Hall	26	438,000
Powell Hall	15	151,000
Cooke Hall	5	79,500
Nolte Center for Cont. Education and Garage	14	151,000
Vincent Hall	4	70,000
Bell Museum of Natural History	2	25,500
Comstock Hall	2	17,000
Coffman Memorial Union	1	9,500
Mechanical-Aeronautical Engineering	11	186,000
Chemical Engineering	2	29,000
Variety Club Heart Hospital	9	128,500
Health Service	1	17,500
Ford Hall	2	19,000

Building Name	No. of Units	Total BTU
Johnston Hall	71	799,500
Linac Lab	1	15,000
Lyon Laboratories	39*	512,000
318 Harvard Street S.E.	2	28,000
Temporary North Court Engineering	5	75,000
312 Harvard Street S.E.	1	15,500
Department of Police Building	23	287,500
Eastcliff	2	21,500
Shops Annex	1	27,500
Poucher Building	2	39,000
University Press Building	20	203,000
Mines and Metallurgy	6	99,000
Territorial Hall	2	15,000
Masonic Memorial Hospital	11	132,000
V.F.W. Cancer Research Center	4	60,000
Frontier Hall	1	7,500
Jackson-Owre Addition	1	9,500
Business Administration	1	18,500
1920 Washington Avenue South	1	17,500

*See Review

1.6.6 UNIVERSITY HOSPITAL AIR CONDITIONING SUMMARY

The following tabulation provides a listing of kinds, amounts and square footage served for air conditioning systems at University Hospitals and Health Sciences areas.

University o. nnesota Health Sciences Center Ma .976
Physical Pla.. Department

REVIEW OF AREA AIR CONDITIONED IN
University of Minnesota Hospitals, Dental & Medical School Buildings

Type & Name	Location Building	Area Served	In Operation Since	No. of Units	H.P.	Cap. Ton	Total Sq. Ft.	Sq. F Per T
A. ABSORPTION & CENTRIFUGAL UNITS								
York Absorption	029	Hospitals, Sta. 22	Spring 1964	2	55	100	13,565	135.6
Trane Absorption	029	S.W. courtyard Hosp. labs & offices	Spring 1965	1	30	188	23,537	125.2
Trane Reciprocating Chiller	032	4th flr. remodeling & additions	Spring 1970	1	79	55	4,057	73.2
Carrier Absorption	069	Heart Hosp. 1 & 2 flrs. add'n.	Spring 1965	1	76	140	30,741	219.6
York Centrifugal	074	Mayo & auditorium	Spring 1954	3	985	750	187,844	250.5
Arkla Servel Absorption	079	Lyon Labs., 3rd floor	Summer 1966	3	31	75	5,867	78.2
Carrier Absorption	111	Diehl Hall & Lib. (95,813 s.f.)	2 units 1961	4	241	968	173.639	179.4
(4 units in Diehl Hall)	107	Masonic Hospital (57,035 s.f.)	3 units 1964					
	109	V.F.W. (20,791 s.f.)	4 units 1967					
Carrier Absorption	114	Jackson/Owre Addn. (14,707 s.f.)	1 unit 1961	2	39	230	30,418	132.3
170 (2 units in Jackson/Owre)	032	Jackson, 4th floor (1,254 s.f.)	2 units 1967					
	054	Owre, 4 & 5 flrs. (14,457 s.f.)						
Trane Absorption	115	Children's Rehab.	Spring 1964	2	99	300	60,531	201.8
Trane Absorption	142	Unit A, part. Bsmt., 1-19 flrs.	August 1973	3	1,120	3,300	527,587	159.9
York Absorption	143	Unit K-E	Spring 1975	2	305	1,200	110,891	92.4
TOTAL - ABSORPTION & CENTRIFUGAL UNITS				24	3,060	7,306	1,168,677	160.0
B. SMALLER UNITS (Window Air Conditioners & Units 1-3 H.P.)								
1. University of Minnesota Hospitals (029/074)				209	297.5	223.1	49,592	222.3
2. Dental & Medical Areas:								
Bldg. 029 - Physical Plant Space				8	11.5	8.6	2,011	233.8
Bldg. 032 - Jackson Hall				50	85.0	63.8	13,099	205.3
Bldg. 033 - Millard Hall				123	224.0	168.0	34,946	208.0
Bldg. 054 - Owre Hall				25	53.5	40.1	8,257	205.9
Bldg. 055 - Powell Hall				13	14.0	10.5	2,407	229.2
Bldg. 069 - Variety Club Heart Hospital				10	17.5	13.1	2,661	203.1
Bldg. 074 - Medical School				96	161.0	120.8	20,496	169.7
Bldg. 079 - Lyon Laboratory				34	58.0	43.5	8,615	198.0
Bldg. 083 - 608 Oak Street				7	13.5	10.1	2,190	216.8
Bldg. 114 - Jackson-Owre Addition				8	12.0	8.4	2,795	332.7
Total No. 2				374	650.0	486.9	97,477	200.2
TOTAL - SMALLER UNITS				583	947.5	710.0	147,069	207.1

REVIEW OF AREA AIR CONDITIONED IN 1973

Type & Name	No. of Units	H.P.	Cap. ton	Total Sq. Ft.	Sq.Ft Per Ton
C. LARGER UNITS (5 - 10 H.P. Direct Expansion Water Cooled)					
1. University of Minnesota Hospitals (029/074)	10	104.0	164.0	26,600	162.2
2. Dental & Medical School Areas:					
Bldg. 029 - Physical Plant Space	3	50.0	50.0	4,073	81.5
Bldg. 032 - Jackson Hall	3	20.0	20.0	1,800	90.0
Bldg. 033 - Millard Hall	1	5.0	5.0	542	108.4
Bldg. 055 - Powell Hall	2	11.0	11.0	332	30.0
Bldg. 069 - Variety Club Heart Hospital	2	57.5	57.5	6,399	111.3
Bldg. 074 - Medical School	8	116.0	95.0	6,626	70.0
Bldg. 079 - Lyon Laboratory	4	79.5	92.5	14,131	152.8
Bldg. 114 - Jackson/Owre Hall Addition	2	10.2	5.0	1,113	223.0
Total - No. 2	25	348.7	336.0	35,016	104.2
TOTAL - LARGER UNITS	35	452.7	500.0	61,616	123.2
TOTAL - SYSTEMS A & B & C	640	4,155.2	7,316.0	1,266,471	173.1

Animal Rooms Area Air Conditioned in 1973: 33,706 sq. ft. = 2.7% of total area of 1,266,471 sq. ft.

UNIVERSITY OF MINNESOTA HOSPITALS AIR CONDITIONING IN 1973
SMALLER B1 UNITS (Window Air Conditioners & Units 1-3 HP)

Location	Area Air Conditioned	No. of Units	Total HP	S[illegible]al Ft.
Station 12	Rms. C130 thru C139	10	15.5	1,[illegible]31
Todd 2nd Flr.	C244-1 Chrysler Air Temp. H13-63, 12,300 BTU	1	1.5	[illegible]45
	C244-2 Chrysler Air Temp. H21-68, 17,500 BTU	1	2.0	[illegible]20
	C244-4 Chrysler Air Temp. H21-68, 17,500 BTU	1	2.1	[illegible]00
C367 M.E.	C271 Dishwasher, Carrier 6640-309, 10 ton Refrig.	1	2.0	[illegible]32
Station 31	Rms. B341 & B342	2	2.0	[illegible]58
Station 32	Rms. C349 & C353	2	2.0	[illegible]91
Station 35	Rms. D329-2, -4 & -6	3	3.5	[illegible]86
D Wing	Rms. D305-2, -3, -4, D307-1, -2 & -3	6	10.0	1,[illegible]70
D Wing	Rms. D349-2 & -6	2	4.0	[illegible]28
Station 40-41	Rms. B448, B450, C424 & 1 floating W.A.C.*	4	4.0	[illegible]92
Station 42	Rms. C415, C440 & C484	4	5.0	[illegible]63
Station 44	13 Floating W.A.C. Ave. Patient BR 226 sq. ft.	13	18.0	2,[illegible]38
Station 45	AAF Nelson/Aire, 18,000 BTU ea., Rms. D429-1 thru -8	9	18.0	[illegible],[illegible]38
172	Ceiling Unit Koldwave, 3 ton Refrig.	1	3.0	[illegible]84
	G.E. Thinline, covs. Window Unit, 9,500 BTU, Comp. Rm. D429-12	1	1.5	[illegible]82
Station 46	Rms. D425-3 & -7	2	2.0	[illegible]63
Station 47	Rms. D417, D496 & 1 floating WAC**	3	3.5	[illegible]32
Station 49	Rms. A430, A464	2	2.0	[illegible]08
Station 50	Rms. B529 thru B534, B541-B544, B552, B553, B555, B559, B564-1 thru -9, B565, B571, plus 7 floating WAC for any patien dbl. BR, Ave. 332 sq. ft.	23	25.5	5,[illegible]78
Station 51	Rms. C545, C549 & C550	3	3.0	[illegible]38
Station 52	Rms. C510, C515, C585, C590 plus 1 floating WAC**	5	7.5	1,[illegible]06
Station 55-56	Rms. D529-2, -5 & D527	2	2.0	[illegible]32
Station 57	Rms. D510 & D554	2	2.0	[illegible]74
Station 61-62	Rms. C630 & B665	2	3.0	713
Station 64	3 floating WAC**	3	4.5	966
Eye Clinic	Rms. D319, D381, D383, D385, D388-2	7	7.5	1,[illegible]09
Heart Hospital				
Station 201	Rms. 259 kitchen 225C, D, E, F, plus 20 floating (214 s.f. average patient BR)	25	30.0	5,[illegible]21

SMALLER B1 UNITS (Cont.)

Location	Area Air Conditioned	No. of Units	Total HP	Total Sq. Ft.
Heart Hospital (Cont.)				
3rd Floor	Rms. 310, 353 plus 7 floating (214 sq. ft. ave. patient BR & 9 floating 285 sq. ft. ave. patient dbl. BR)	18	24.0	4,484
	Chrysler Air Temp., 16,600 BTU Rm. 359	1	2.0	243
Bldg. 074 Hospital				
Main Kitchen	C262, C265-1, -2, -5 thru -8	19	38.0	4,008
Diet Kitchen	D232	2	4.0	846
Dishwashing	C270	2	4.0	396
Kidney Room	C477	1	2.0	258
Canteen Rm.	C112	1	2.0	685
X-Ray Therapy	Rms. C225, C229, C239, C252, C254, plus 1 floating WAC	7	8.5	1,611
173 Out-Patient Blood Test	A265, A269-1	2	4.0	643
Pharmacy	Rms. D179 & D185	3	3.5	1,040
Skin Clinic	Rms. D374-1D	1	2.0	187
Med.Spec.Clinic	Rms. C560-1	1	2.0	115
Pathology	Rms. B426 & B427	2	2.5	423
Rehab.	Rms. 852, 860, 860-1 thru -4, 860-7, 860-8	8	11.5	1,795
Other	Rm. D698	1	1.0	160
	TOTAL - B1 SMALLER UNITS	209	297.5	49,592

* WAC - Window Air Conditioner

** Any Patient Double BR 332 sq. ft. average

*** Any Patient BR 226 sq. ft. average

SURVEY OF 82 SMALLER UNIT INDIVIDUAL AIR CONDITIONING INSTALLATIONS IN MEDICAL SCHOOL BUILDINGS
(Window Air Conditioners & Units 1-3 HP)

Room	Type	No. of Units	H.P.	Area Serviced Room	Area Serviced Sq. Ft.
PP - Bldg. 029					
C124-1	York Upright A.C., 800 CFM	1	.75	D124	62
				D124-2	55
				D124-3	77
				Serv. Corr.	70
D133	Ceiling A.C. Brudage Co., Mod. No. B6X8A353 (Fan & motor sealed bearing, 1/4HP)	1	.75	D133	97
				D133-1	93
D136-5	G.E. 1R192-B26, 18,000 BTU	1	2.0	D136-5	378
D224	Chrysler Air Temp. H-10-94, 9,600 BTU	1	1.0	D224	106
174				D224-1	52
				D224-2	52
D229	Yorkaire Upright A.C. Mod. HCF2W (Self-Contained)	1	1.0	D229	126
				D225	133
C338	Chrysler Air Temp., S-184KF, 18,000 BTU	3	6.0	C337	125
				C338	482
				C340	105
	TOTAL - PP Bldg. 029	8	11.5		2,011
Jackson Hall - Bldg. 032					
76B	Carrier, Old Mod., 75 HP Chrysler H18-87, 15,000 BTU	2	3.0	76A	114
				76B	111
				76C	79
80	Chrysler Air Temp., 15,000 BTU	2	4.0	80	390
84	Chrysler Air Temp., 16,300 BTU	2	4.0	84	553
93	G. E. Thinline, Mod. 1RH801C-T1, 16,300 BTU	1	2.0	93	317
93A	G. E. Thinline, Mod. 1RH801C-T1, 16,300 BTU	1	2.0	93A	145
				93B	37
95A	G. E. Thinline, Mod. 1RH801C-T1, 16,300 BTU	1	2.0	95	135
				95A	132
				95B	35
				95C	110

SMALLER B2 UNITS (Cont.)

Room	Type	No. of Units	H.P.	Area Serviced Room	Sq. Ft.
Jackson Hall - Bldg. 032 (Cont.)					
96	G.M. Frigidaire Deluxe Twin 100	2	3.0	96	204
				96A	81
96B	G.M. Frigidaire Deluxe Twin 100	1	1.5	96B	177
96C	G.M. Frigidaire Deluxe Twin 100	2	3.0	96C	124
				96D	37
97	Yorkaire Upright Wat. Cool. Cond., Mod. HCP2W	1	2.0	97	345
98	Carrier, Mod. 51T-A 150200	1	1.0	98	376
99	Worthington, Old Model	1	1.0	99	317
175	Chrysler Air Temp., H09-20F, 8,800 BTU	1	1.0	175	189
178	Chrysler Air Temp., 16,300 BTU	1	2.0	178	470
183	Chrysler Air Temp., H12-40F, 12,300 BTU	1	1.5	183	293
184	Chrysler Air Temp., 16,300 BTU ea.	2	4.0	184	1,023
184M	Chrysler Air Temp., 16,300 BTU	1	2.0	184M, N	366
197	Chrysler Air Temp., H18-40F, 17,500 BTU	2	4.0	197	677
198	Chrysler Air Temp., C-08-82, 7,500 BTU	1	1.0	198	350
198A	Chrysler Air Temp., C-08-82, 7,500 BTU	1	1.0	198A	210
199	Chrysler Air Temp., H18-40F, 17,500 BTU	1	2.0	199	341
272	Chrysler Air Temp., H-18-87, 15,500 BTU	1	2.0	272	439
272B	A.C. Unit Remington & Dehumidifier Bendex	2	4.0	272B	106
282	Chrysler Air Temp., H-18-87, 15,500 BTU	1	2.0	282	485
284A	G. E. Thinline, Mod. 1R681-B26, 13,000 BTU	1	1.5	284A	113
286	G. E. Thinline, Mod. 1RH801C-T1, 16,300 BTU	1	2.0	286	430
288C	Dehumidifier Bendex RIE, Mod. 21-H	1	1.0	288C	174
292	G. E. Thinline, Mod. 1RH801C-T1, 16,300 BTU	1	2.0	292	226
295A	G. E. Thinline, Mod. 1RH801C-T1, 16,300 BTU	1	2.0	295A	122
295B	G. E. Thinline, Mod. 1RH801C-T1, 16,300 BTU	1	2.0	295B	125
295C	G. E. Thinline, Mod. 1RH801C-T1, 16,300 BTU	1	2.0	295	237
				295C	81
296	G. E. Thinline, Mod. 1RH801C-T1, 16,300 BTU	1	2.0	296	428
379B	G. E. Thinline, Mod. 1RL92-B26 & Dehumidifier	2	2.5	379	86
				379A	86
				379B	178

SMALLER B2 UNITS (Cont.)

Room	Type	No. of Units	H.P.	Area Serviced Room	Area Serviced Sq. Ft.
Jackson Hall - Bldg. 032 (Cont.)					
381	G. E. Thinline, Mod. 1RL92-B26 & Dehumidifier	2	2.5	381	249
472	Chrysler Air Temp., H-16-40GT, 16,000 BTU	1	2.0	472	380
474A	Chrysler Air Temp., H-14-40GT, 14,000 BTU	1	2.0	474A	247
478	Chrysler Air Temp., H12-40F, 12,300 BTU	2	3.0	478	475
482	Chrysler Air Temp., H12-40F, 12,300 BTU	2	3.0	482	452
484A	Chrysler Air Temp., H-18-40GT, 18,000 BTU	1	2.0	484A	212
	TOTAL - Jackson Hall, Bldg. 032	50	85.0		[illegible],099
Millard Hall - Bldg. 033					
Pipespace	A.C. Unit Brunner Compr. Mot. 208V, 1 ph.	1	1.5	12A	283
3	Chrysler Air Temp. Imperial, H-18-78, 16,000 BTU	1	2.0	3	185
3A	Chrysler Air Temp., H-18-78, 17,500 BTU	1	2.0	3A	158
				3B	27
4A	A.C. Unit S-6, Heat-X, Compr. Motor Mod. RCV200	1	2.0	4A	123
				4	79
5A	Chrysler Air Temp., 17,500 BTU	1	2.0	5A	161
				5	105
6	Chrysler Air Temp., H09-72, 8,800 BTU	1	1.0	6	190
6	Chrysler Air Temp., H09-72, 8,800 BTU	1	1.0	6A	17
12A	A.C. Unit Brunner Blower in Crawlspace	1	1.5	12A	283
14	Chrysler Air Temp., H19-43, 14,900 BTU	1	2.0	14C	58
				14	175
14A	A.C. Unit Brunner, Compr. Mot. 220V, 3 Ph.	1	2.0	14A	184
14B	Chrysler Air Temp., S10-53, 9,900 BTU	1	1.5	14B	117
15	Chrysler Air Temp., H21-58, 17,500 BTU	1	2.0	15	535
15A	Chrysler Air Temp., S10-53, 9,900 BTU	1	1.5	15A	122
16	Chrysler Air Temp., H21-58, 17,500 BTU	1	2.0	16	238
18	A.C. Unit Pathfinder, Mod. P36F, 34,000 BTU	1	3.5	18	747
				18A	38
19	A.C. Unit Pathfinder, Mod. P24F, 23,000 BTU ea	2	5.0	19	700
20A	Feeders, Mod. 4A12W-5A, 9,000 BTU	1	1.0	20	133
				20A	116

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SMALLER B2 UNITS (Cont.)

Room	Type	No. of Units	H.P.	Area Serviced Room	Area Serviced Sq. Ft.
Millard Hall - Bldg. 033 (Cont.)					
21	A.C. Unit Heat-X, Comp. Motor Mod. RCV200	1	2.0	21	405
23A	Chrysler Air Temp., 16,000 BTU	1	2.0	23A	126
23B	Chrysler Air Temp. Imperial, H18-43, 14,900 BTU	1	2.0	23B	299
				23	88
23C	Chrysler Air Temp. Imperial, H18-43, 14,900 BTU	1	2.0	23C	284
24	Air Temp. Imperial, H18-78, 17,500 BTU	1	2.0	24	439
24A	Air Temp., H16-74, 16,000 BTU	1	2.0	24A	144
27	Chrysler Air Temp., H16-40F, 15,500 BTU	1	2.0	27	241
29	G.M. Frigidaire Window Well, 657-10954A22-340-21	1	2.0	29	224
29A	G.M. Frigidaire Window Well, 657-10954A22-340-21	1	2.0	29A	113
102A	Air Temp Imperial, H09-72, 8,800 BTU	2	1.0	102	407
104A	Air Temp Imperial, H09-72, 8,800 BTU	1	1.0	104A	85
				104	139
26	Chrysler Air Temp., H09-72, 8,800 BTU	1	1.0	26	255
105	Air Temp. Imperial, H09-74, 16,000 BTU	1	2.0	105	494
				105B-1	24
109	Chrysler Air Temp., 18,000 BTU	1	2.0	109	357
111	Chrysler Air Temp., 18,000 BTU	1	2.0	111	357
124A	Chrysler Air Temp., 15,000 BTU	1	2.0	124 & -A	220
126	Chrysler Air Temp., H18-78, 17,500 BTU	1	2.0	126	216
				127	127
126A	Chrysler Air Temp., 15,000 BTU	1	2.0	126A	126
130	Chrysler Air Temp., H18-78, 17,500 BTU	1	2.0	130	600
130A	G.E. Thinline Mod. 1RL504C-C1, 9,500 BTU	1	1.0	130A	214
131A	Chrysler Air Temp., HO-16-78, 15,000 BTU	1	2.0	131A	224
131	Chrysler Air Temp., HO-16,78, 15,500 BTU	1	2.0	131B	224
134	G.E. Thinline, Mod. 1RH091C-T1, 16,300 BTU	1	2.0	134	211
135	Air Temp. Imperial, H09-72, 8,800 BTU	1	1.0	135	257
136	Air Temp. Imperial, H16-74, 16,000 BTU	2	4.0	136	834
202	Chrysler Air Temp., T28-40G, 28,400 BTU	4	16.0	202	1,217
210	Carrier Mod. 51JA150260, 15,000 BTU & Dehumidifier Model 3-159	2	3.0	210	219
212	Chrysler Air Temp., 18,000 BTU	1	2.0	212	481
212B	Chrysler Air Temp., 18,000 BTU	1	2.0	212B	347
215A	Chrysler Air Temp., 18,000 BTU	1	2.0	215 & -A	197

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SMALLER B2 UNITS (Cont.)

Room	Type	No. of Units	H.P.	Area Serviced Room	Area Serviced Sq. Ft.
Millard Hall - Bldg. 033 (Cont.)					
218	Chrysler Air Temp., 18,000 BTU	1	2.0	218	604
221	Chrysler Air Temp., 18,000 BTU	1	2.0	221	525
224	Carrier, Mod. 51JA150260, 15,000 BTU	1	2.0	224	353
225	Carrier, Mod. 51JA150260, 15,000 BTU	2	4.0	225	631
228	Chrysler Air Temp., 11,000 BTU	1	1.5	228	247
235	Chrysler Air Temp., H18-40GT, 18,000 BTU	3	6.0	235	873
239A	Chrysler Air Temp., H18-40GT, 18,000 BTU	1	2.0	239A	224
307	Chrysler Air Temp., H19-43 & H19-63, 15,500 BTU ea.	2	4.0	307	610
317	G.E., 1R192-B26, 18,000 BTU	1	2.0	317	382
326	Chrysler Air Temp. Imperial, 14,900 BTU	1	2.0	326	297
328	Chrysler Air Temp. Imperial, 14,900 BTU	1	2.0	328	243
330	Chrysler Air Temp. Imperial, 14,900 BTU	1	2.0	330	109
334	Chrysler Air Temp. Imperial, 14,900 BTU	2	4.0	334	577
334	Chrysler Air Temp. Imperial, 14,900 BTU	2	4.0	334A	71
336A	Chrysler Air Temp. Titan, Mod. 128-74, 27,000 BTU	2	6.0	336	234
				336A	102
				336C	108
339	G.E. Mod. 1R192-B26, 18,000 BTU	1	2.0	339	285
339A	A.C. Unit Fedders, Mod. C924AS (in false ceiling)	1	2.0	339B	116
129	Chrysler Air Temp., H18-98, 17,500 BTU	2	4.0	129	892
227A	Chrysler Air Temp., H15-84, 15,000 BTU	1	2.0	227A	150
227B	Chrysler Air Temp., H16-84, 15,000 BTU	1	2.0	227B	143
227C	Chrysler Air Temp., H16-84, 15,000 BTU	1	2.0	227	161
				227C	265
340	G.E. Mod. 1R192-B26, 18,000 BTU	2	4.0	340	254
				340A	77
				340B	64
343	Imperial, 15,000 BTU	1	2.0	343	555
343A	Imperial, 15,000 BTU	1	2.0	343A	85
402	Chrysler Air Temp. Upright, 7,500 BTU	1	1.5	402	422
405	G.E., Mod. 1R190-26, 16,000 BTU & G.E., 15,000 BTU	2	4.0	405	520
406	Chrysler Air Temp., C08-72, 7,500 BTU	3	3.0	408	503
409	Chrysler Air Temp., 16,000 BTU	2	4.0	409	531

SMALLER BZ UNITS (Cont.)

Room	Type	No. of Units	H.P.	Area Serviced Room	Area Serviced Sq. Ft.
Millard Hall - Bldg. 033 (Cont.)					
410	Chrysler Air Temp., C08-72, 7,500 BTU	3	3.0	410	535
				410A	118
414	G.M. Frigidaire Lone Star, 18,000 BTU	1	2.0	414	228
418	Chrysler Air Temp., C10-22, 7,500 BTU ea.	3	3.0	418	511
420	Chrysler Air Temp., C19-22, 7,500 BTU ea.	3	3.0	420	482
424A	Air Temp., C08-72, 7,500 BTU	2	2.0	424A	348
424B	Air Temp., C08-72, 7,500 BTU	1	1.0	424B	148
424C	Air Temp., C08-72, 7,500 BTU	1	1.0	424C	103
				424	377
424D	Air Temp., C08-72, 7,500 BTU	1	1.0	424D	142
				424E	64
				424F	155
430	Chrysler Air Temp. Upright, 7,500 BTU	2	3.0	430	860
434	Chrysler Air Temp. Upright, 12,300 BTU	1	1.5	434	477
435	A.C. Unit Trane, H203A, Cond. Mod. 1/3HP	1	1.0	435	455
				435A	123
436A	Chrysler Air Temp., H16-84, 16,000 BTU	2	4.0	436	133
				436A	275
				436B	126
440	Carrier, Mod. 51JA130250, 13,000 BTU	2	3.0	440	311
440A	Air Temp. Imperial, 15,800 BTU	1	2.0	440A	159
450	Chrysler Air Temp. Upright, 16,000 BTU ea.	2	4.0	450 & -B	1,593
462	Chrysler Air Temp., C08-82, 7,500 BTU	2	2.0	462	538
	TOTAL - Millard Hall, Bldg. 033	123	224.0		34,946
Owre Hall - Bldg. 054					
19	Chrysler Air Temp., H19-43, 14,900 BTU	2	4.0	19	576
19A	Fedders, 4A12W-5A, 9,000 BTU	1	1.0	19A	189
21	Chrysler Air Temp., H21-58, 17,500 BTU	1	2.0	21	371
132	Air Temp. Imperial, H11-72, 11,000 BTU	1	1.5	132	225
146	Chrysler Air Temp., 16,000 BTU	1	2.0	146	240
150	G.E. Thinline, M2MA2-26	1	1.0	150	553
210A	Chrysler Air Temp., H16-84, 15,500 BTU	1	2.0	210A	170

SMALLER B2 UNITS (Cont.)

Room	Type	No. of Unit	H.P.	Area Serviced Room	Area Serviced Sq. Ft.
Owre Hall - Bldg. 054 (Cont.)					
210C	Chrysler Air Temp., H16-84, 15,500 BTU	1	2.0	210C	154
210D	Chrysler Air Temp., H16-84, 15,500 BTU	2	4.0	210D	444
				210J	333
210E	Chrysler Air Temp., H16-84, 15,500 BTU	1	2.0	210E	161
210F	Chrysler Air Temp., H16-84, 15,500 BTU	1	2.0	210F	190
214	Chrysler Air Temp., H09-20F, 8,800 BTU	1	1.0	214	150
221	Air Temp. Imperial H18-78, 17,500 BTU ea.	2	4.0	221	1,048
223A	Air Temp. Imperial H18-78, 17,500 BTU	1	2.0	223A	500
				221B	31
225	Upright Carrier, 5CK4A179	1	3.0	225	454
				226	245
242C	Chrysler Air Temp., H16-40G, 18,000 BTU	1	2.0	242C	337
303	Chrysler, H18-88, 17,500 BTU	2	4.0	303	227
314	Chrysler Air Temp., T28-40G, 28,400 BTU ea.	2	8.0	314	464
519	Upright Air Temp., 725-US, Ser. 24212	1	2.0	519	642
				519A	81
				519B	96
				519C	120
				519D	52
536	Upright Brunner A.C., 202B375	1	2.0	536	224
	TOTAL - Owre Hall, Bldg. 054	25	53.5		8,257
Powell Hall - Bldg. 055					
1402	Amer. Standard, CP-2V-1, Electro Hydronic Ref. 22	1	2.0	1404	158
3303	Chrysler, H10-84, 9,600 BTU	1	1.0	3303	167
3305	Chrysler, H10-84, 9,600 BTU	1	1.0	3305	172
3307	Chrysler, H10-84, 9,600 BTU	1	1.0	3307	172
3313	Chrysler, H10-84, 9,600 BTU	1	1.0	3313	172
3319	Chrysler, H10-84, 9,600 BTU	1	1.0	3319	172
3321	Chrysler, H10-84, 9,600 BTU	1	1.0	3321	172
5302	Chrysler, H10-84, 9,600 BTU	1	1.0	5302	198
5303	Chrysler, H10-84, 9,600 BTU	1	1.0	5303	186

SMALLER B2 UNITS (Cont.)

Room	Type	No. of Units	H.P.	Area Serviced Room	Area Serviced Sq. Ft.
Powell Hall - Bldg. 055 (Cont.)					
5304	Chrysler, H10-84, 9,600 BTU	1	1.0	5304	226
5305	Chrysler, H10-84, 9,600 BTU	1	1.0	5305	210
5307	Chrysler, H10-84, 9,600 BTU	1	1.0	5307	201
5313	Chrysler, H10-84, 9,600 BTU	1	1.0	5313	201
	TOTAL - Powell Hall, Bldg. 055	13	14.0		2,407
Heart Hospital - Bldg. 069					
412	G. E. Thinline	1	1.5	412	198
414	G. E. Thinline	2	3.0	414	497
416	Air Temp. Imperial	1	1.5	416	391
417	Chrysler Air Temp., T28-40G, 28,400 BTU	1	4.0	417	480
421	Air Temp. Imperial	1	1.5	421	187
425	Air Temp. Imperial	1	1.5	425	172
450	G. M. Frigidaire	1	1.5	450	163
454	G. E., 1R71NA1-26	1	1.0	454	164
456	Westinghouse 200	1	2.0	456	409
	TOTAL - Heart Hospital, Bldg. 069	10	17.5		2,661
Mayo Memorial - Bldg. 074					
C304	Chrysler, H10-84, 9,600 BTU	1	1.0	C304	192
C305	RCA "One Hundred"	1	1.5	C305	145
C309	G. E., RD 808B, 16,500 BTU	2	4.0	C309-1	100
				C309-3	13
				C309-4	455
C309-2	Chrysler Air Temp., H09-82, 8,800 BTU	1	1.0	C309-2	105
C311	G.E., 1R192-B26, 18,000 BTU	1	2.0	C311	168
C312	Chrysler Air Temp., H09-72, 8,800 BTU	1	1.0	C312	172
C313	Chrysler, H10-84, 9,600 BTU	1	1.0	C313	166
C315-1	Carrier, 51JA150260, 15,000 BTU	1	2.0	C315-1	211
C317	Chrysler Air Temp., H07-10F, 6,500 BTU	1	.5	C317	168
C318	Chrysler Air Temp., H18-88, 11,000 BTU	1	1.5	C318	165

SMALLER B2 UNITS (Cont.)

Room	Type	No. of Units	H.P.	Area Serviced Room	Area Serviced Sq. Ft.
Mayo Memorial - Bldg. 074 (Cont.)					
C320	Carrier 51JA130250, 15,000 BTU	1	2.0	C320	204
C381	Chrysler Air Temp., H11-72, 17,500 BTU	3	6.0	C381	517
C384	Chrysler Air Temp., H18-40F, 18,000 BTU	1	2.0	C384	165
C386	Westinghouse, RW202D2	1	1.5	C386	339
C388	Carrier, 51JA130250, 15,000 BTU	1	2.0	C388	181
C389	G. E. Thinline, 1R1180-1B-T1, 16,300 BTU	1	2.0	C389	277
C391	Chrysler Air Temp., H18-98, 17,500 BTU	1	2.0	C391	325
C394	Chrysler Air Temp., H16-40GT, 16,000 BTU	1	2.0	C393	157
				C394	155
				C395	166
C396	Carrier 51JA150260, 15,000 BTU	1	2.0	C396	321
B507, 508	Chrysler Air Temp., H11-20, 11,000 BTU ea	3	4.5	B507, 508	891
B512-1	Gibson, No. 510-15B, 10,000 BTU	1	1.5	B512	119
				B512-1	153
B518	Chrysler Air Temp., H10-84, 9,600 BTU	1	1.0	B518	322
B518-1	Remington Wall Unit, K15FS, 14,000 BTU	1	2.0	B518-1	286
B518-5	Chrysler Air Temp., H10-84, 9,600 BTU	1	1.0	B518-5	105
B518-8	Chrysler Air Temp., H10-84, 9,600 BTU	1	1.0	B518-8	105
B520-1	Chrysler Air Temp., H10-84, 9,600 BTU	1	1.0	B520-1	134
B524	Chrysler Air Temp., H09-82, 8,800 BTU	1	1.0	B524	181
B525-2	Chrysler Air Temp., H09-82, 8,800 BTU	1	1.0	B525-2	104
B571-1	Chrysler Air Temp., H16-40G, 16,000 BTU	1	2.0	B571	78
				B571-1	84
B580	G. E., AGGSG32-DAX, 32,000 BTU	1	4.0	B580	416
B584-2	G. E. Thinline, 15,000 BTU	1	2.0	B584-2	122
B588	Chrysler Air Temp., H09-20, 8,800 BTU	1	1.0	B588	251
B592	Chrysler Air Temp., H09-20, 8,800 BTU	1	1.0	B592	236
B590-1	Chrysler Air Temp., H09-20, 8,800 BTU	1	1.0	B590	169
				B590-1	104
B590-2	Chrysler Air Temp., H09-20, 8,800 BTU	1	1.0	B590-2	111
C504-2	Chrysler Air Temp., H09-20, 8,800 BTU	1	1.0	C504-2	85
				C504	158
C504-3	Chrysler Air Temp., H09-20, 8,800 BTU	1	1.0	C504-3	85
C504-4	Chrysler Air Temp., H09-20, 8,800 BTU	1	1.0	C504-4	158
C504-6	Chrysler Air Temp., H09-20, 8,800 BTU	1	1.0	C504-6	90

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SMALLER B2 UNITS (Cont.)

Mayo Memorial - Bldg. 074 (Cont.)

Room	Type	No. of Units	H.P.	Area Serviced Room	Area Serviced Sq. Ft.
C594	G. E. Thinline, 1R61PA1-16, 7,000 BTU	1	1.0	C594	225
C596-1	G. E. Thinline, 1RL301A-A1, 6,200 BTU	1	1.0	C596	154
				C596-1	99
C596-2	G. E. Thinline, 1RL301A-A1, 6,200 BTU	1	1.0	C596-2	99
C598	G. E. Thinline, 1Rg1PA1-16, 7,000 BTU	1	1.0	C598	182
A611	Chrysler Air Temp., H16-94, 15,500 BTU	1	2.0	A611	340
A614	Air Temp. Titan, T28-74, 27,500 BTU	1	3.0	A614	332
A672	Fedders ACD 12E2A, 12,000 BTU	1	1.5	A672	925
B692-1	Chrysler Air Temp., H16-94, 14,400 BTU	1	2.0	B692-1	224
901-1	G. E. Thinline, 1RH901C-T1, 16,300 BTU	1	2.0	901-1	157
901-2	Chrysler Air Temp., H18-406, 18,000 BTU	1	2.0	901-2	219
910	G. E. Thinline, 1R891-B26, 16,000 BTU	2	4.0	910	540
915	G. E., Mod. RH801B-T1, 16,300 BTU	1	2.0	915	153
				915-1	90
920	G. E. Thinline, 1R192-B26, 18,000 BTU	2	4.0	920	296
923	Chrysler Air Temp., S184KF, 18,000 BTU	1	2.0	923	200
				923-1	125
925	G. E. Thinline, LR192-B2, 18,000 BTU	1	2.0	925	222
927	G. E. Thinline, 1R192-B26, 18,000 BTU	1	2.0	927	178
				927-1	126
930	G. E. Thinline, 1R891SA26, 16,000 BTU	2	4.0	930	393
933	G. E. Thinline, 1RH891S-A26, 16,000 BTU	1	2.0	933	163
933-1	Chrysler Air Temp., 16,000 BTU	2	4.0	933-1	250
953	Koldwave A.C. Unit Self-Contained	1	2.0	953	116
				953-1	94
960	Carrier, 51La1543, 14,000 BTU	4	8.0	960	602
				960-2	53
				960-3	53
				960-4	54
				960-7	89
				959	122
960-8	Carrier 51La1543, 14,000 BTU	1	2.0	960-8	241
1001-1	Chrysler Air Temp., 16,000 BTU	1	2.0	1001-1	212
1008-1	Chrysler Air Temp., S11-61, 6,500 BTU	1	1.0	1008	143
				1008-1	58

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SMALLER B2 UNITS (Cont.)

Room	Type	No. Of Units	H.P.	Area Serviced Room	Area Serviced Sq. Ft.
Mayo Memorial - Bldg. 074 (Cont.)					
1010	Chrysler Air Temp., H18-98, 17,500 BTU	1	2.0	1010	164
1015	Chrysler Air Temp., H18-98, 17,500 BTU	2	4.0	1015	420
1020	Chrysler Air Temp., 12,300 BTU	1	1.5	1020	160
1022	Chrysler Air Temp., 12,300 BTU	1	1.5	1022	164
1025	G. E. Thinline, 1RH801B-T1, 16,300 BTU	1	4.0	1025	87
	Chrysler Air Temp., 18,000 BTU	1	4.0	1025	87
1027	Chrysler Air Temp., H18-98, 17,500 BTU	1	2.0	1027	211
				1027-1	64
1030	G. E. Thinline, 1RH801B-T1, 16,300 BTU	1	2.0	1030	363
1035-1	Chrylser Air Temp., 16,000 BTU	1	2.0	1038-1	130
1040	G. E. Thinline, 1RH801B-T1, 16,300 BTU	1	2.0	1040	246
1045-4	Chrysler Air Temp., H18-406, 18,000 BTU	1	2.0	1045-4	34
				Serv. Corr.	148
1045-5	G. E., 1R681SA, 13,000 BTU	1	1.5	1045-5	53
1045-6	Chrysler Air Temp., 9,600 BTU	1	1.0	1045-6	53
1405	Chrysler Air Temp., H10-94, 9,600 BTU	1	1.0	1405	167
1439	Chrysler, K09-72, 8,800 BTU	1	1.0	1439	156
1038-2	Chrysler Air Temp., H09-82, 8,800 BTU	1	1.0	1038-2	110
1050	Chrysler Air Temp., H18-1840F, 18,000 BTU ea.	2	4.0	1050	736
	TOTAL - Mayo Memorial - Bldg. 074	96	161.0		20,496
Lyon Laboratories - Bldg. 079					
70	Chrysler Air Temp., H10-84, 9,600 BTU	1	1.0	70	64
162	Air Temp. Imperial, H18-78, 17,500 BTU	3	6.0	162	1,169
163	Air Temp. Imperial, H16-74, 16,000 BTU	1	2.0	163	276
165	Air Temp., H16-74, 16,000 BTU	1	2.0	165	212
167	Chrysler Air Temp., H18-40F, 18,000 BTU	3	6.0	167	1,094
182	Chrysler, H16-84, 15,500 BTU	1	1.0	182	299
262	Chrysler, C08-82, 7,500 BTU (upright)	1	1.0	262	217
262A	Upright A.C. Brunner, Comp. Mod. WC33FC, 1/2 HP fan	1	1.0	262A	94
263	Air Temp. Imperial, H16-74, 16,000 BTU	1	2.0	263	251
264	Fedders, Mod. 69-DG-25306208	1	1.0	264	310
265	Chrysler Air Temp., 15,000 BTU	1	2.0	265	318

SMALLER 32 UNITS (Cont.)

Room	Type	No. of Units	H.P.	Area Serviced Room	Area Serviced Sq. Ft.
Lyon Laboratories - Bldg. 079 (Cont.)					
266	Chrysler Air Temp., H11-20F, 11,000 BTU	1	1.5	266	166
269	Air Temp. Imperial, H16-74, 16,000 BTU	1	2.0	269	175
272	Chrysler Air Temp., H11-20F, 11,000 BTU	1	1.5	272	306
274A	A.C. Unit #13, McQuay Comp. Copeland-37,000 BTU/ Refrig. Freon 12	1	3.0	274	218
275	Air Temp. Imperial, H16-74, 17,500 BTU	1	2.0	275	217
277	Air Temp. Imperial, 15,800 BTU	2	4.0	277	351
280	Chrysler Air Temp., 11,000 BTU	1	1.5	280	248
281	Air Temp. Imperial, 15,000 BTU	1	2.0	281	206
2nd flr Corridor	A.C. Unit Westinghouse, Ref. 12 condenser on roof	1	2.0	270	161
				271	521
370	A.C. Unit #14, Mod. CU70W, 5 Ton	1	4.5	370	585
461&	Air Temp. Imperial, H16-74, 16,000 BTU	2	4.0	461	429
				461-A	57
464	Chrysler Air Temp., C08-92, 7,500 BTU	2	2.0	464	313
477	Air Temp. Imperial, C10-41, 5,800 BTU	3	3.0	477	358
	TOTAL - Lyon Labs. - Bldg. 079	34	58.0		[illegible],615
608 Oak Street - Bldg. 083					
1st flr.	Chrysler Air Temp., H18-78, 17,500 BTU	2	2.0	1st flr.	1,184
	Chrysler Air Temp., H12-74, 12,300 BTU		1.5		
2nd flr.	Chrysler H16-74, 15,000 BTU ea.	5	10.0	2nd flr.	1,006
	TOTAL - 608 Oak Street - Bldg. 083	7	13.5		2,190
Jackson-Owre Addition - Bldg. 114					
262	Chrysler, H10-84, 9,600 BTU	1	1.0	262	377
445	Chrysler Air Temp., 18,000 BTU	1	2.0	445	548
451A	Chrysler Air Temp., 8,800 BTU	1	1.0	451A	200

SMALLER B2 UNITS (Cont.)

Room	Type	No. of Units	H.P.	Area Serviced Room	Area Serviced Sq. Ft.
Jackson-Owre Addition - Bldg. 114 (Cont.)					
452	Chrysler Air Temp., H16-40GT, 16,000 BTU	1	2.0	452	402
456	Chrysler Air Temp., H14-409, 14,000 BTU	2	2.0	456	753
	Chrysler Air Temp., H14-40GT, 14,000 BTU		2.0		
464	Chrysler Air Temp., H09-20F, 8,800 BTU	2	2.0	464	515
	TOTAL - Jackson-Owre, Bldg. 114	8	12.0		2,795

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SURVEY OF C1 LARGER UNIT INDIVIDUAL AIR CONDITIONING INSTALLATIONS OF UNIVERSITY HOSPITAL AREA
(Larger Units 5-50 HP)

Room	Type	No. of Units	H.P.	Area Serv Room	. Ft.
Hospital - Bldg. 029					
B164	Chrysler Air Temp. w/Compressor	1	7.5	B254	172
				B255	280
D195	A.C. Kennard CT20, Mtr. 2 HP/Compressor 20 HP	1	22.0	Sta. 64	1,213
Sta. 61	Upright A.C. Carrier Compr. built-in	1	7.5	C652	805
	Unit Baker, Compr. fan motor 1.5 HP	1	20.0	C632	43
				C635	91
				C363	43
				C637	89
				C638	81
				C643	253
				C644	85
				C645	67
				C646	107
				C647	168
				C648	152
				Corr.	195
W.Attic	Trane A.C. Unit S-2, 37.5 ton. Serves Rms. A620, A623, A624, A625, A627, A628, A631, A634, A635, A638, A652, A654, A656, A658, A659, A660, -1, -2, -3, A662, A663 & corr. (1,280 sq.ft.)	1	7.5	Sta. 68	4,566
W.Attic	Trane A.C. Unit S-1, 37.5 ton. Serves Rms. A265, -1, -2, -3, -4, A267, A268, A269, -1, -2, -3, -4, corr., D254, D260, -1, -2, -3, -4, -5, -6, -7, -8, -9, -10, -11, -12, -13, -14, D275, D278, D279 Corr., D350, D352, -1, -2, -3, -4, -6, -7, -8, -9, -10, D360, -1, -2, -3, -4, D351, -1, & Corr.	1	7.5	W.Clinic	7,140

LARGER C1 UNITS

Room	Type	No. of Units	H.P.	Area Serviced Room	Area Serviced Sq. Ft.
Powell Hall - Bldg. 055					
1111A	15 ton A.C. unit by R.G. Products, Inc., Mod. No. CC-15-WC-S, 2 compressors 7.5 hp each, fan 5 HP condenser on 4th floor balcony	1	20.0	1111	338
				1111-A	853
				1111-B	106
				1111-C	149
				1111-D	285
				1111-E	301
				1111-F	204
Hospital - Bldg. 074					
825-3A	Custom made fan units, 2 compressors, Brunner, 1 G.E.	3	12.0	815	259
				815-3	163
				833	392
	TOTAL - Hospital Area	10	104.0		26,600

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SURVEY OF C2 LARGER UNIT INDIVIDUAL AIR CONDITIONG INSTALLATIONS IN MEDICAL SCHOOL BUILDINGS (Larger Units 5-50 HP)

Room	Type	No. of Units	H.P.	Area Serviced Room	Area Serviced Sq. Ft.
Physical Plant - Bldg. 029					
B151	Todd Amph. A.C. Unit #3, Bishop, Size 1.75 fan motor 2 HP, compressor Brunner W2MO-FH	1	22.0	C231	1,617
D214-1A	Eustis Amph. A.C. Unit #2, fan motor Wagner 1.5 HP, Compressor Brunner WHX20000FH	1	22.0	D230	1,764
C630	A.C. Barkow CK53A, compressor CLA502-53 & condenser on roof 1 HP	1	6.0	C667	294
				C667-1	95
				C667-2	128
				C667-3	53
				C667-4	122
	Total - Bldg. 029	3	50.0		4,073
Jackson Hall - Bldg. 032					
S-84	Dunham-Bush Cooling Unit, compr. 10 HP in S-84, Refrigerant #12	1	10.0	84A	175
				84B	317
				84C	80
				88	67
				88A	310
				88C	113
494	Bush Cooling Unit (Compr. in S84)	1	5.0	494	271
298	A.C. Unit TECUMSEH, compr. RA99132-2	1	5.0	288A	166
				288B	125
				288C	176
	TOTAL - Bldg. 032	3	20.0		1,800

C2 LARGER UNITS (Cont.)

Room	Type	No. of Units	H.P.	Area Serviced Room	Area Serviced Sq. Ft.
Millard Hall - Bldg. 033					
30	Fan S-7 compr. Mtr. RC0500	1	5.0	30	542
	TOTAL - Bldg. 033	1	5.0		542
Powell Hall - Bldg. 055					
5327	AAF SC/Nelson/Aire, self-contained cabinet unit 208V, 20A.	1	5.5	5327	166
6327	AAF SC/Nelson/Aire, self-contained cabinet unit 208V, 20A	1	5.5	6327	166
	TOTAL - Bldg. 055	2	11.0		332
Variety Club Heart Hospital - Bldg. 069					
505ME	Fan #29 Compr. Brunner & Pump .5 HP	1	7.5	419A	252
P.H. 605	Carrier Reciprocating Chiller	1	50.0	501	43
				502	26
				503	39
				504	334
				508	256
				513	94
				513-A	261
				514	344
				517	353
				518	37
				520	956
				523	139
				527	456
				528	128
				530	162
				531	302
				535	130
				535-B	55
				535-C	24
				550	33
				551	521

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LARGER CZ UNITS (Cont.)

Room	Type	No. of Units	H.P.	Area Serviced Room	Area Serviced Sq. Ft.
Variety Club Heart Hospital - Bldg. 069 (Cont.)					
P.H.	Carrier Reciprocating Chiller	1	50.0	554	214
				554-A	36
				560	147
				560-A	58
				560-B	89
				562	67
				565	185
				565-A	73
				565-B	83
				565-C	57
				565-D	100
				566	345
191	TOTAL - Bldg. 069	2	57.5		6,399
Mayo Memorial - Bldg. 074					
029/E. Attic	A.C. Unit #94 Trane, Model RAS-63A, condensing unit; 208V, 3 ph., 24.3A, 14.5 HP, condenser fan 2A, 1/2 HP	1	15.0	A616	202
				A618	215
				A664	127
				A665	125
				A667	118
				A669	47
943	A.C. Unit #95, Carrier Mod. 06ED150430 Cond. Unit, 71A	1	14.0	940	58
				940-2	110
				940-3	48
				942	224
				945	468
				945-1	65
1060	A.C. Unit #62 Compr. Brunner Rm. 1670, Mod. R5002	1	10.0	1055	467

LARGER C2 UNITS (Cont.)

Room	Type	No. of Units	H.P.	Area Serviced Room	Area Serviced Sq. Ft.
Mayo Memorial - Bldg. 074 (Cont.)					
1060	A.C. Unit #62 compr. Brunner Rm. 1670 Mod. R5002	1	10.0	1061	270
				1061-2	65
				1061-3	65
1128	A.C. Unit #26 Niagara Blower Fan Mod. 622, 2 compr. & 2 condensers (25 HP, 15 HP, 2-1/3 HP)	1	42.5	1020-4	87
				1125	94
				1132-1	55
				1134	44
				1135-1	40
				1135-3	52
				1138-1	86
1155	A.C. Unit Dunham Bush, compr. 15 HP Rm. 1128 (conditioning discontinued)	1		1155	142
				1155-1	22
				1155-2	28
1510 & 1517	A.C. Unit #80 Mod. #16K5FC4809, compr. Brunner R51002	1	5.75	1414	400
				1415	197
				1416	92
1510 & 1515	A.C. Unit #81 Mod. Recold AR70 compr. Brunner E1000M5Fh, 10 HP	1	10.75	1521	190
				1522	238
				1522-1	39
				1535	599
15th flr. Corr.	Trane A.C. Unit #86, Mod. RAS-12, 7 ton fan 2HP, condensing unit on roof 12 HP, 2 compressors, 14 HP each	1	28.0	1524	191
				1525	212
				1526	197
				1528	179
				1529	182
				1530	135
				Corr.	451
	TOTAL - Bldg. 074	8	116.0		6,626
Lyon Laboratories - Bldg. 079					
64ME	A.C. Unit & Compressor Brunner in S-61		10.0	64A	97
				64B	115
				64C	102

LARGER C2 UNITS (Cont.)

Room	Type	No. of Units	H.P.	Area Serviced Room	Area Serviced Sq. Ft.
Lyon Laboratory - Bldg. 079 (Cont.)					
65ME	A.C. Unit Buffalo (Fan S-1) plenum type V.P.C. - Size G 183B, N-20506, 5 HP compr. Brunner 30 HP	1	35.0	sub bsmnt. rooms	3,744
				Corr.	[illegible],612
270	A.C. Unit #11, Copeland, Mod. PRA1-0750-ALT-202, Fan 2 HP, 40,000 BTU, Compr. 7.5 HP on roof	1	9.5	270	2,477
Roof	A.C. Unit #12, McQuay, Mod. AHR038CD, Refr. #22 38 Ton	1	25.0	462	174
				463	255
				466	266
				467	[illegible],134
				467-A	121
				467-B	101
				468	380
				470	206
				471	340
				472	168
				474	293
				475	546
	TOTAL - Bldg. 079	4	79.5		[illegible],131

193

Room	Type	No. of Units	H.P.	Area Serviced Room	Area Serviced Sq. Ft.
Jackson-Owre- Bldg. 114					
448	2 Ton Trane Mod. BHSC2, Condensing Unit 24,000 BTU	1	3.7	446	164
				446-A	104
				446-B	57
				446-B1	53
				448	79
				450-A	88
453	3 Ton Trane Ceiling Mounted, 36,000 BTU	1	6.5	453	568
	TOTAL - Bldg. 114	2	10.2		[illegible],113

1.7 BUILDING SECTOR ENERGY PROFILES

The following graphs and data were generated by using an existing computer program which tabulates and correlates monthly meter readings for energy billing and conservation programs. Since steam usage is the primary service requirement as far as ICES is concerned we have developed by key sector the monthly steam usage profiles. Various key sectors have been combined to show overall usage. The profiles are clearly marked as to key sector and the buildings tabulated within the sector.

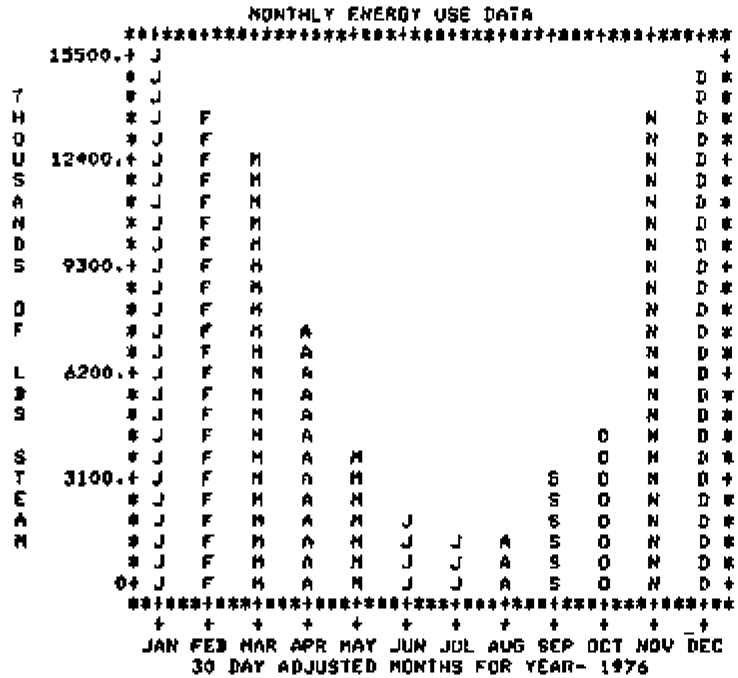
Under separate cover the University is also providing copies of its accumulated electrical and steam billing program. The program provides further information about individual buildings.

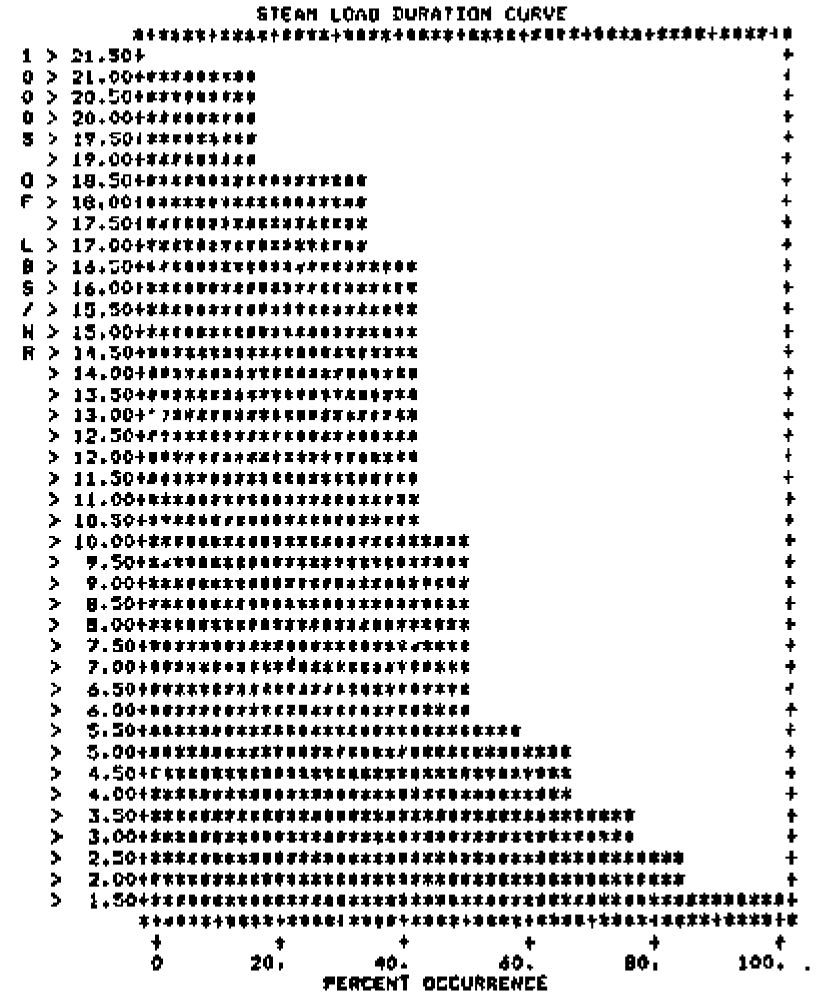
Additional sector service requirements are provided throughout the report.

The electrical data was compiled from maintenance reports.

EB RESIDENTIAL SERVICE DEMANDS AND LOAD DURATION FOR THE FOLLOWING BUILDINGS:

SANFORD HALL PIONEER HALL COMSTOCK HALL CENTENNIAL HALL TERRITORIAL HALL FRONTIER HALL





TABULAR DATA OF ENERGY REQUIREMENTS

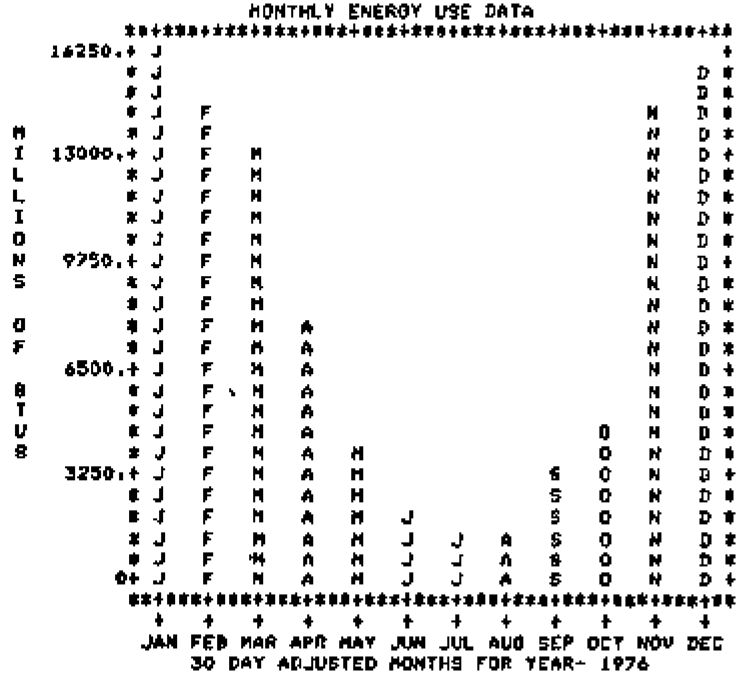
MONTH	STEAM LOAD(LBS)
JAN 1976	15,460,000.
FEB 1976	13,560,000.
MAR 1976	12,229,000.
APR 1976	7,225,000.
MAY 1976	3,947,000.
JUN 1976	1,807,000.
JUL 1976	1,204,000.
AUG 1976	1,208,000.
SEP 1976	2,826,000.
OCT 1976	4,042,000.
NOV 1976	13,557,000.
DEC 1976	15,126,000.

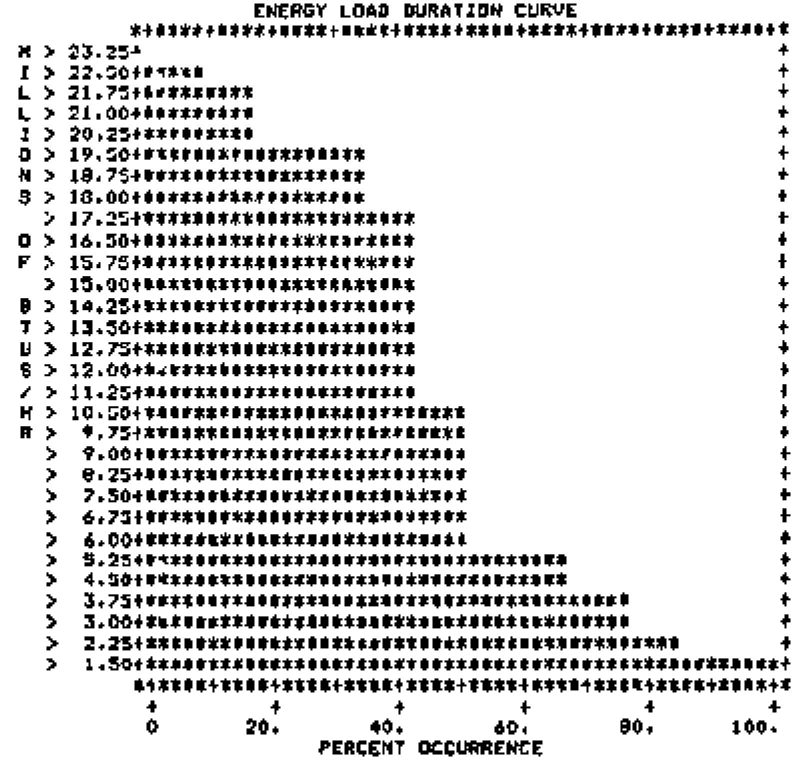
DATE OF COMPUTER RUN = 77/03/28.

CONVERSION FACTORS:

THOUSANDS OF LBS STEAM X 1.048 = MILLIONS OF BTU'S
THOUSANDS OF LBS STEAM X 7.396 = 1000'S OF LBS 300 F WATER
THOUSANDS OF LBS STEAM X .965 = 1000'S OF GALS 300 F WATER

SANFORD HALL   PIONEER HALL   COMSTOCK HALL   CENTENNIAL HALL   TERRITORIAL HALL   FRONTIER HALL





TABULAR DATA OF ENERGY REQUIREMENTS

MONTH	THOUSANDS OF BTU'S
JAN 1976	16,202,080.
FEB 1976	14,210,880.
MAR 1976	12,815,992.
APR 1976	7,571,800.
MAY 1976	4,136,456.
JUN 1976	1,893,736.
JUL 1976	1,261,792.
AUG 1976	1,265,984.
SEP 1976	2,963,744.
OCT 1976	4,236,016.
NOV 1976	14,207,736.
DEC 1976	15,852,048.

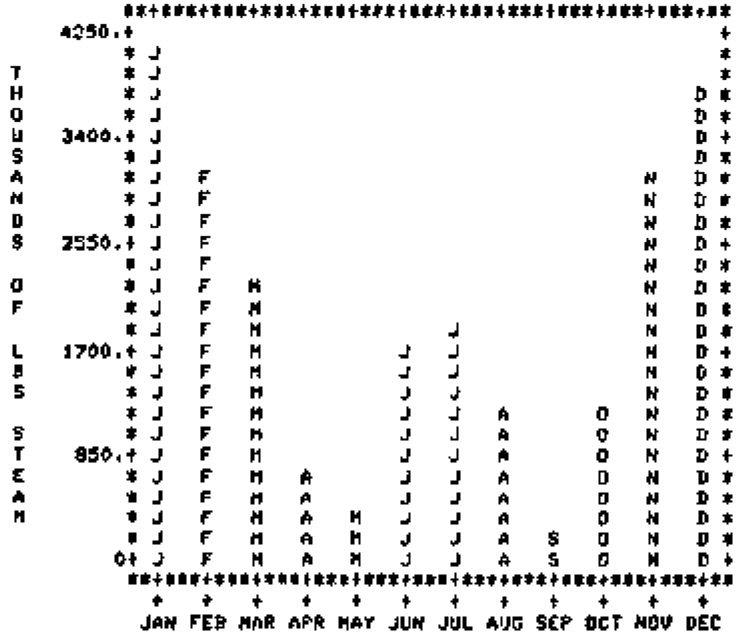
DATE OF COMPUTER RUN - 77/03/28.

CONVERSION FACTORS:

THOUSANDS OF LBS STEAM X 1.048 = MILLIONS OF BTU'S
THOUSANDS OF LBS STEAM X 7.396 = 1000'S OF LBS 300 F WATER
THOUSANDS OF LBS STEAM X .965 = 1000'S OF GALS 300 F WATER

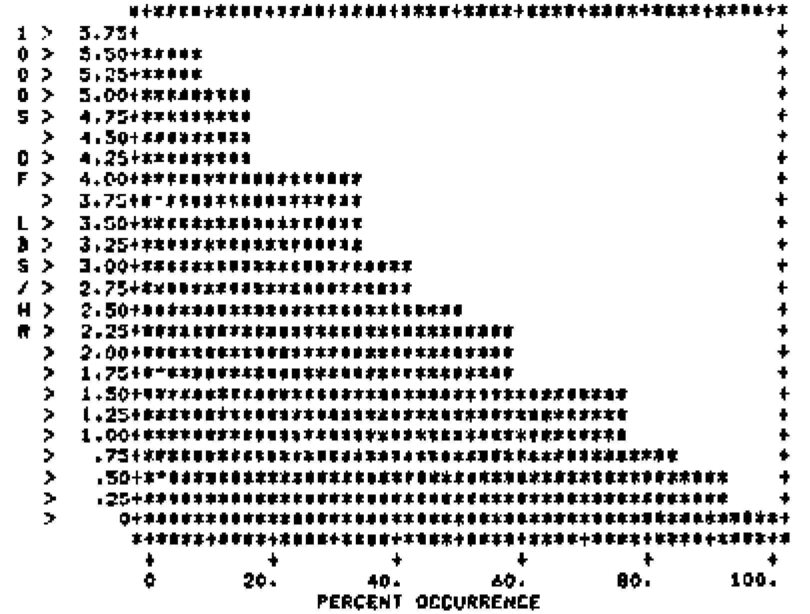
MIDDLEBROOK HALL

MONTHLY ENERGY USE DATA



30 DAY ADJUSTED MONTHS FOR YEAR- 1976

STEAM LOAD DURATION CURVE



TABULAR DATA OF ENERGY REQUIREMENTS

MONTH	STEAM LOAD(LBS)
JAN 1976	4,111,000.
FEB 1976	3,034,000.
MAR 1976	2,262,000.
APR 1976	623,000.
MAY 1976	404,000.
JUN 1976	1,742,000.
JUL 1976	1,936,000.
AUG 1976	1,243,000.
SEP 1976	138,000.
OCT 1976	1,182,000.
NOV 1976	3,049,000.
DEC 1976	3,478,000.

DATE OF COMPUTER RUN - 77/03/28.

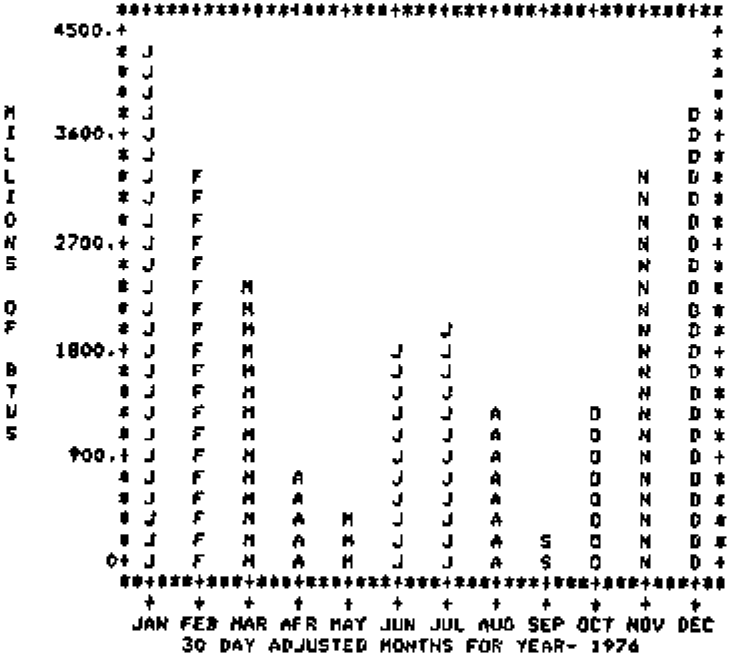
CONVERSION FACTORS:

THOUSANDS OF LBS STEAM X 1.048 = MILLIONS OF BTU'S
THOUSANDS OF LBS STEAM X 7.396 = 1000'S OF LBS 300 F WATER
THOUSANDS OF LBS STEAM X .965 = 1000'S OF GALS 300 F WATER

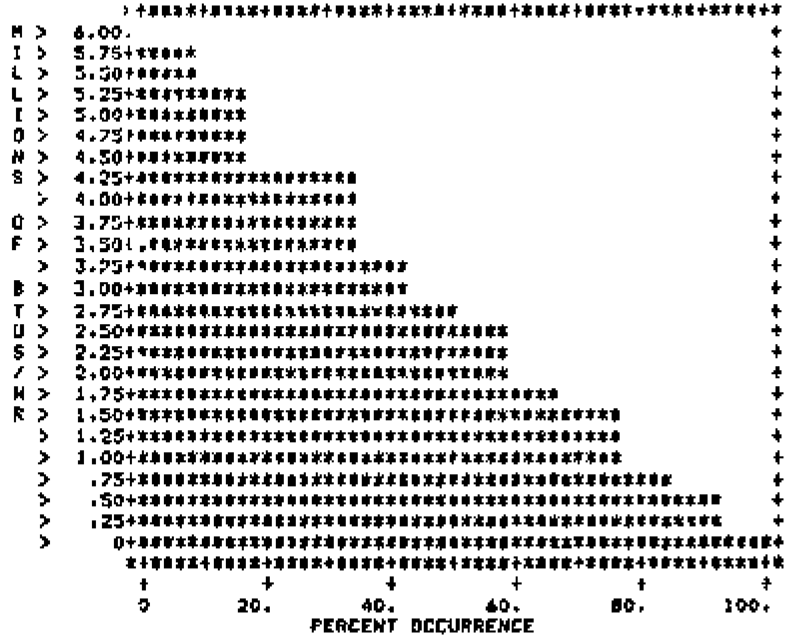
... ENERGY USE AND LOAD DURATION FOR THE FOLLOWING BUILDINGS:

MIDDLEBROOK HALL

MONTHLY ENERGY USE DATA



ENERGY LOAD DURATION CURVE



TABULAR DATA OF ENERGY REQUIREMENTS

MONTH	THOUSANDS OF BTU'S
JAN 1976	4,308,328.
FEB 1976	3,179,632.
MAR 1976	2,370,576.
APR 1976	652,904.
MAY 1976	423,392.
JUN 1976	1,825,616.
JUL 1976	2,028,928.
AUG 1976	1,302,464.
SEP 1976	144,624.
OCT 1976	1,238,736.
NOV 1976	3,195,352.
DEC 1976	3,854,544.

DATE OF COMPUTER RUN - 77/03/28.

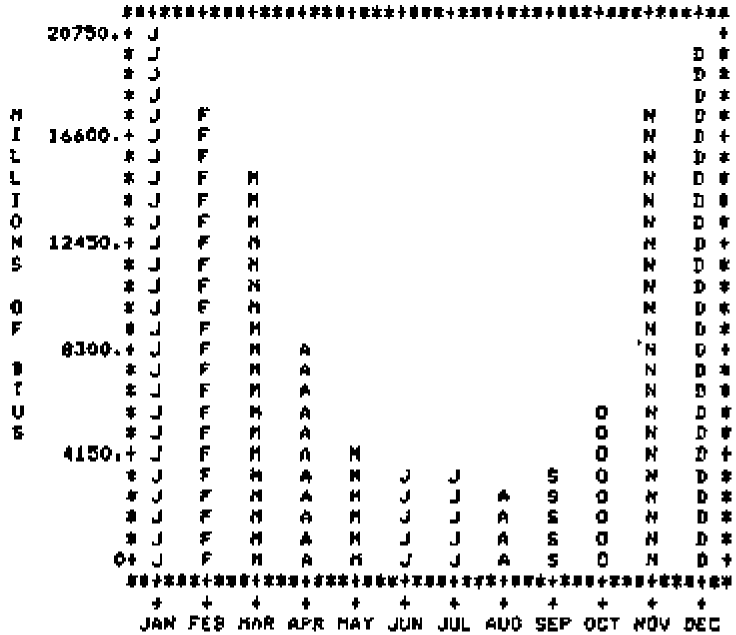
CONVERSION FACTORS:

THOUSANDS OF LBS STEAM X 1.048 = MILLIONS OF BTU'S
THOUSANDS OF LBS STEAM X 7.396 = 1000'S OF LBS 300 F WATER
THOUSANDS OF LBS STEAM X .965 = 1000'S OF GALS 300 F WATER

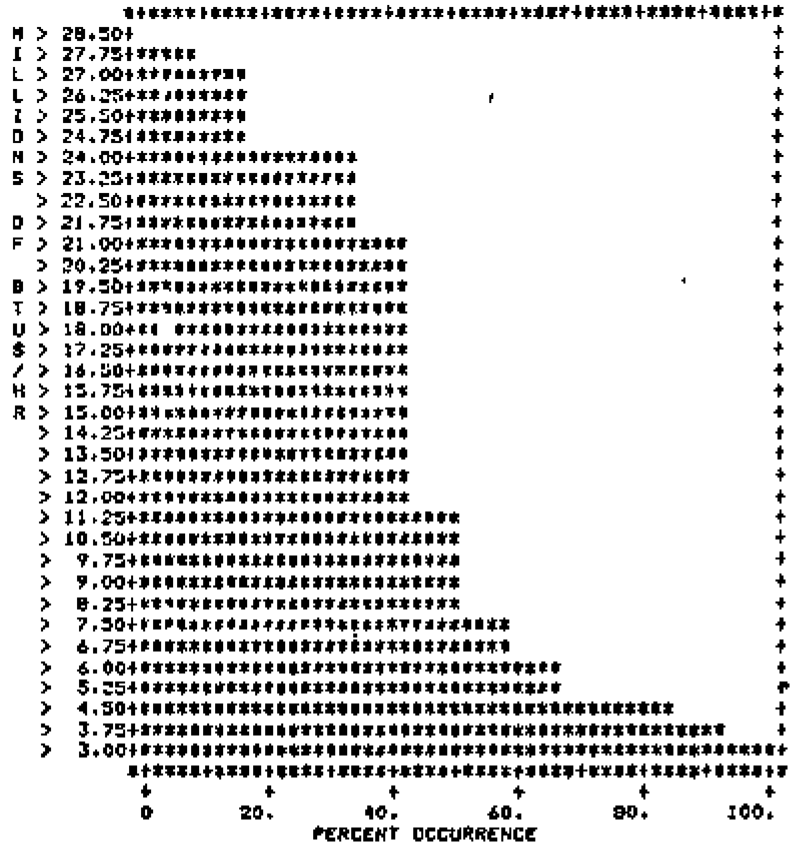
RESIDENTIAL SECTOR SERVICE DEMANDS AND LOAD DURATION FOR THE FOLLOWING BUILDINGS:

SANFORD HALL PIONEER HALL COMSTOCK HALL CENTENNIAL HALL TERRITORIAL HALL FRONTIER HALL
MIDDLEBROOK HALL

MONTHLY ENERGY USE DATA



ENERGY LOAD DURATION CURVE



TABULAR DATA OF ENERGY REQUIREMENTS

MONTH	THOUSANDS OF BTU'S
JAN 1976	20,510,408.
FEB 1976	17,390,512.
MAR 1976	15,186,568.
APR 1976	8,224,704.
MAY 1976	4,559,048.
JUN 1976	3,719,352.
JUL 1976	3,290,720.
AUG 1976	2,568,648.
SEP 1976	3,108,368.
OCT 1976	5,474,752.
NOV 1976	17,403,088.
DEC 1976	19,706,592.

DATE OF COMPUTER RUN - 77/03/29.

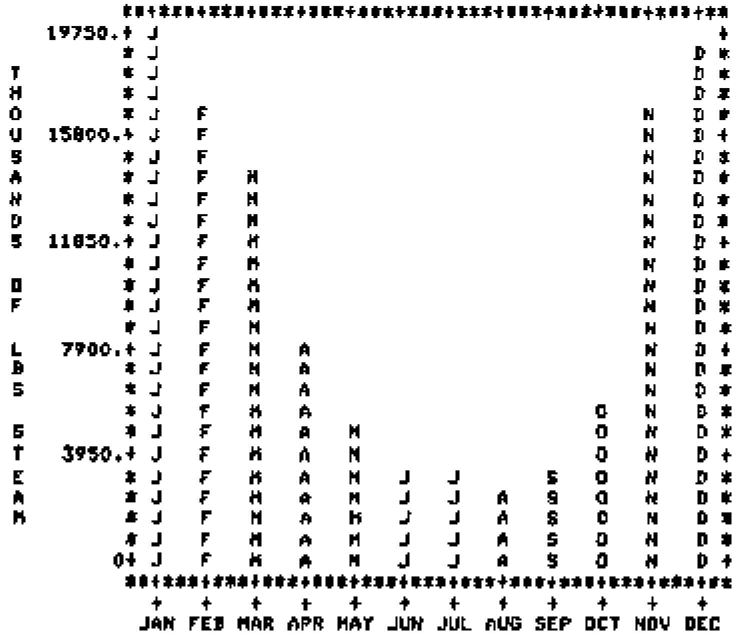
CONVERSION FACTORS:

THOUSANDS OF LBS STEAM X 1.048 = MILLIONS OF BTU'S
THOUSANDS OF LBS STEAM X 7.396 = 1000'S OF LBS 300 F WATER
THOUSANDS OF LBS STEAM X .945 = 1000'S OF GALS 300 F WATER

[illegible]

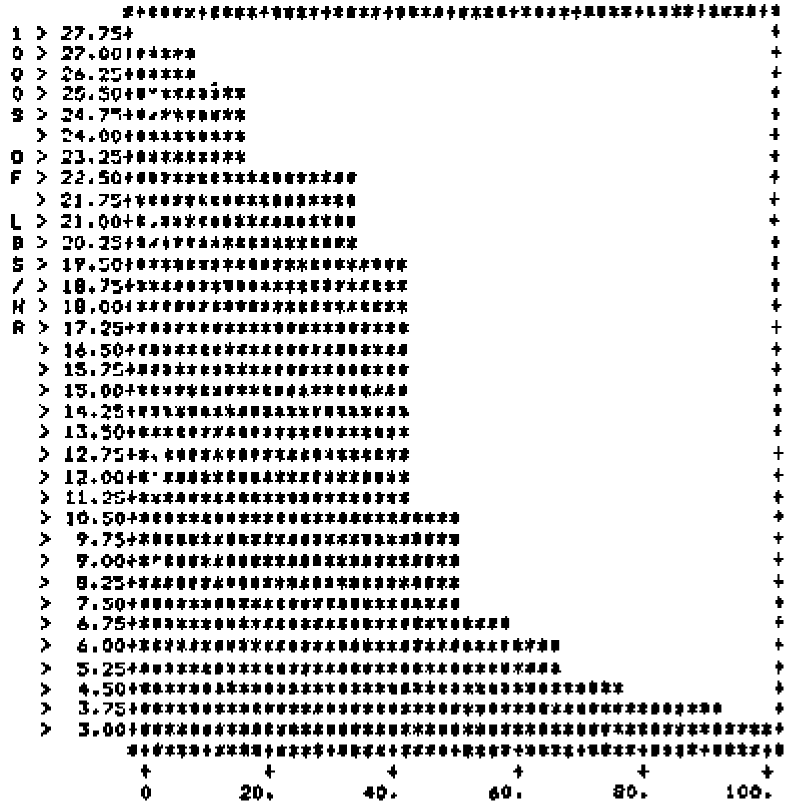
SANFORD HALL   PIONEER HALL   COMSTOCK HALL   CENTENNIAL HALL   TERRITORIAL HALL   FRONTIER HALL
MIDDLEBROOK HALL

MONTHLY ENERGY USE DATA



30 DAY ADJUSTED MONTHS FOR YEAR- 1976

STEAM LOAD DURATION CURVE



TABULAR DATA OF ENERGY REQUIREMENTS

MONTH	STEAM LOAD(LBS)
JAN 1976	19,571,000.
FEB 1976	16,594,000.
MAR 1976	14,491,000.
APR 1976	7,848,000.
MAY 1976	4,351,000.
JUN 1976	3,549,000.
JUL 1976	3,140,000.
AUG 1976	2,451,000.
SEP 1976	2,966,000.
OCT 1976	5,224,000.
NOV 1976	16,606,000.
DEC 1976	18,804,000.

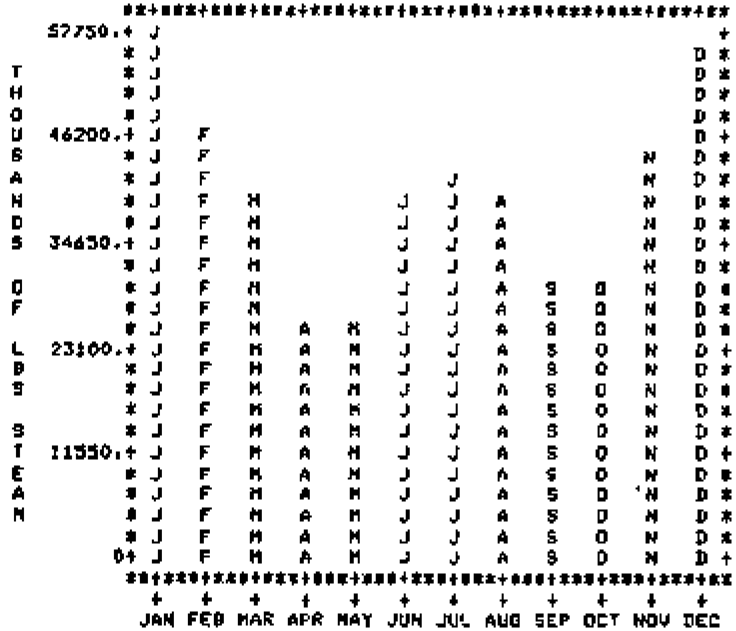
DATE OF COMPUTER RUN - 77/03/29.

CONVERSION FACTORS:

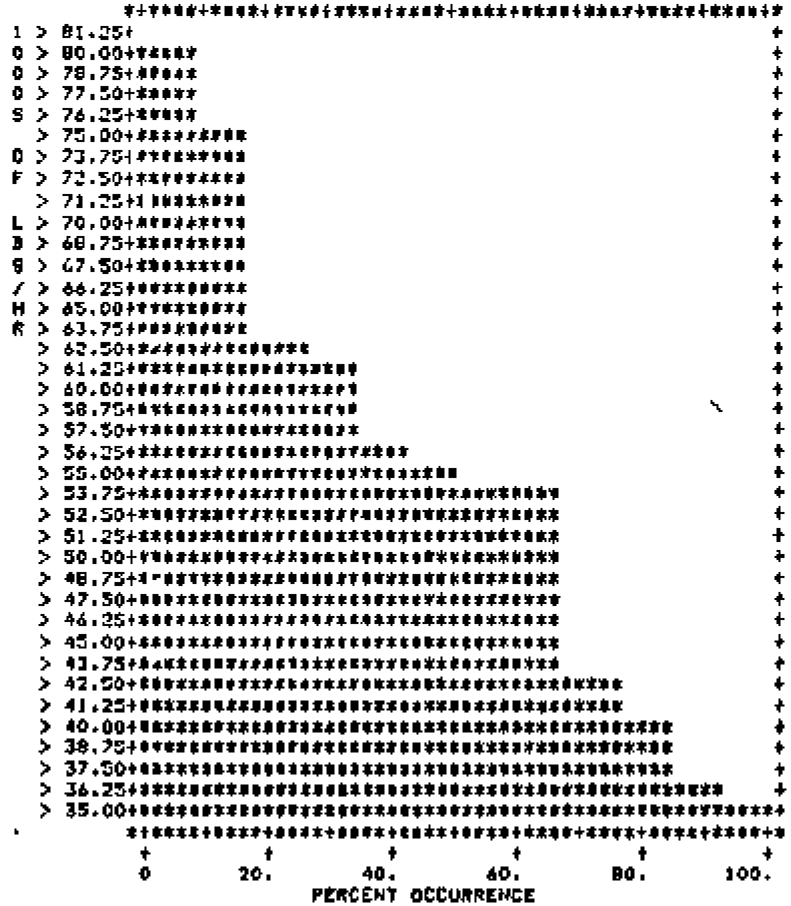
THOUSANDS OF LBS STEAM X 1.048 = MILLIONS OF BTU'S
THOUSANDS OF LBS STEAM X 7.396 = 1000'S OF LBS 300 F WATER
THOUSANDS OF LBS STEAM X .965 = 1000'S OF GALS 300 F WATER

BUSINESS ADMIN. SOCIAL SCIENCE BLEGEN HALL WILSON LIBRARY ANDERSON HALL AUD. CLASSROOM
RARIG CENTER AUGSBURG COLLEGE ART BLDG. MIDDLEBROOK HALL ST MARYS - FAIRVIEW

MONTHLY ENERGY USE DATA



STEAM LOAD DURATION CURVE



TABULAR DATA OF ENERGY REQUIREMENTS

MONTH	STEAM LOAD(LBS)
JAN 1976	57,637,000.
FEB 1976	45,260,000.
MAR 1976	38,951,000.
APR 1976	25,775,000.
MAY 1976	26,291,000.
JUN 1976	38,976,000.
JUL 1976	40,541,000.
AUG 1976	39,638,000.
SEP 1976	29,285,000.
OCT 1976	31,018,000.
NOV 1976	44,671,000.
DEC 1976	54,778,000.

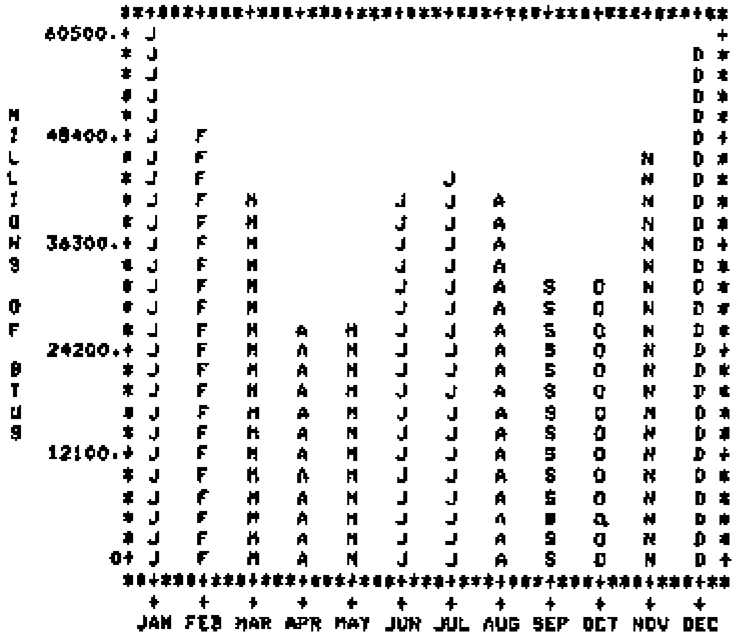
DATE OF COMPUTER RUN - 77/03/29.

CONVERSION FACTORS:

THOUSANDS OF LBS STEAM X 1.048 = MILLIONS OF BTU'S
THOUSANDS OF LBS STEAM X 7.396 = 1000'S OF LBS 300 F WATER
THOUSANDS OF LBS STEAM X .965 = 1000'S OF GALS 300 F WATER

BUSINESS ADMIN.　　SOCIAL SCIENCE　　BLEGEN HALL　　WILSON LIBRARY　　ANDERSON HALL　　AUD. CLASSROOM
RARIG CENTER　　AUGSBURG COLLEGE　　ART BLDG.　　MIDDLEBROOK HALL　　ST MARYS - FAIRVIEW

MONTHLY ENERGY USE DATA



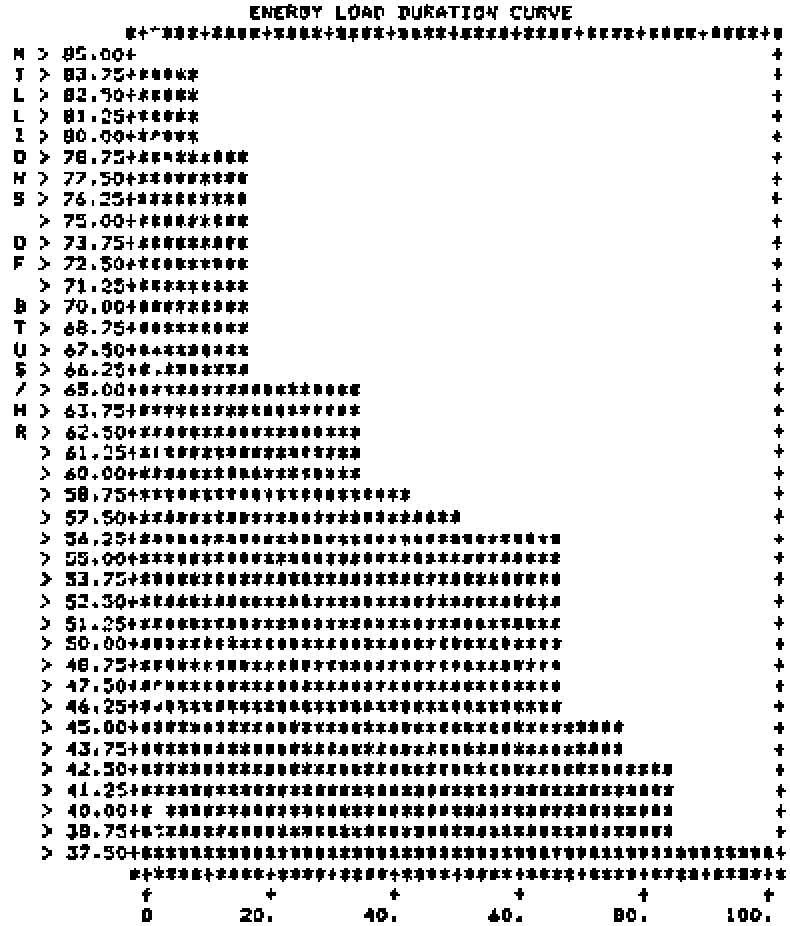
30 DAY ADJUSTED MONTHS FOR YEAR- 1976

TABULAR DATA OF ENERGY REQUIREMENTS

MONTH	THOUSANDS OF BTU'S
JAN 1976	60,403,576.
FEB 1976	47,432,480.
MAR 1976	40,820,648.
APR 1976	27,012,200.
MAY 1976	27,552,968.
JUN 1976	40,846,848.
JUL 1976	42,486,968.
AUG 1976	41,540,424.
SEP 1976	30,690,680.
OCT 1976	32,506,864.
NOV 1976	46,815,208.
DEC 1976	57,407,344.

DATE OF COMPUTER RUN - 77/03/29.

ENERGY LOAD DURATION CURVE



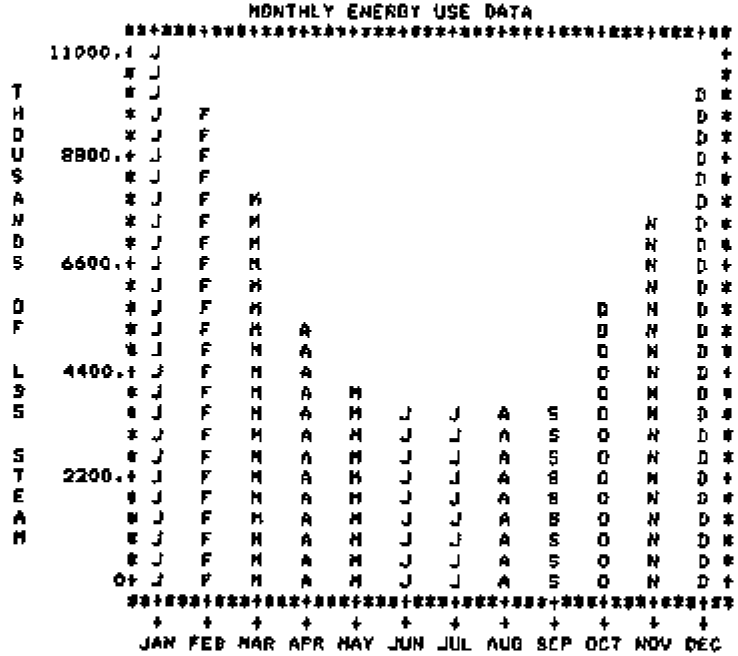
CONVERSION FACTORS:

THOUSANDS OF LBS STEAM X　1.048 = MILLIONS OF BTU'S
THOUSANDS OF LBS STEAM X　7.396 = 1000'S OF LBS 300 F WATER
THOUSANDS OF LBS STEAM X　.965 = 1000'S OF GALS 300 F WATER

EN SUPPORT SERVICES SERVICE DEMANDS AND LOAD DURATION FOR THE FOLLOWING BUILDINGS:

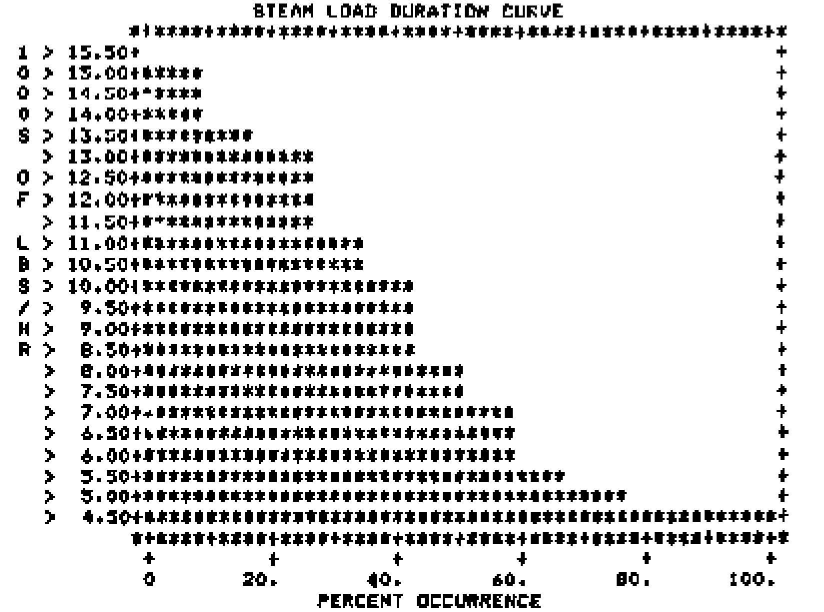
FOLWELL HALL	MINERAL RESOURCES	SHOPS BLDG	MORRILL HALL	LINAC LAB	POLICE BLDG
SHOPS ANNEX	POUCHER BLDG	HOLMAN BLDG	TANDEM LAB	STANDARD OIL BLDG	INVENTORY WHSE

MONTHLY ENERGY USE DATA



30 DAY ADJUSTED MONTHS FOR YEAR- 1976

STEAM LOAD DURATION CURVE



TABULAR DATA OF ENERGY REQUIREMENTS

MONTH	STEAM LOAD(LBS)
JAN 1976	10,768,000.
FEB 1976	9,643,000.
MAR 1976	8,052,000.
APR 1976	5,363,000.
MAY 1976	4,057,000.
JUN 1976	3,409,000.
JUL 1976	3,644,000.
AUG 1976	3,391,000.
SEP 1976	3,582,000.
OCT 1976	5,823,000.
NOV 1976	7,521,000.
DEC 1976	9,929,000.

DATE OF COMPUTER RUN - 77/03/28.

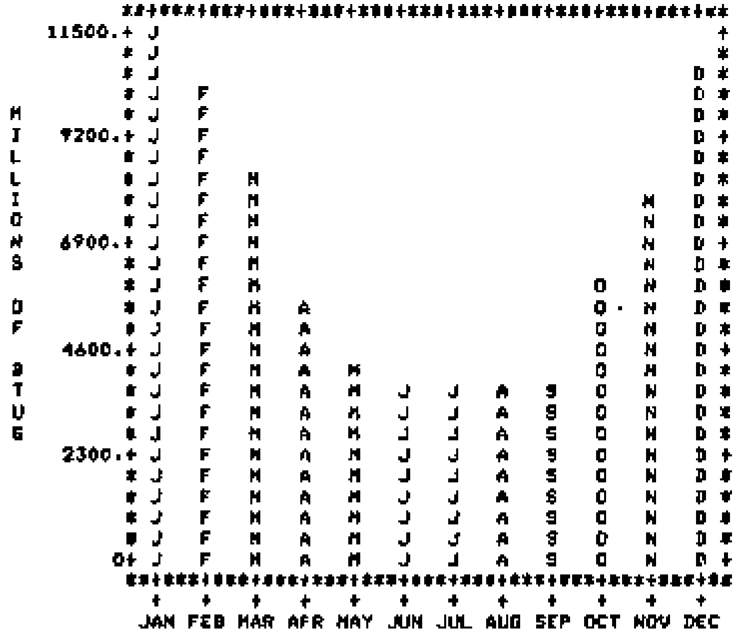
CONVERSION FACTORS:

THOUSANDS OF LBS STEAM X 1.048 = MILLIONS OF BTU'S
THOUSANDS OF LBS STEAM X 7.396 = 1000'S OF LBS 300 F WATER
THOUSANDS OF LBS STEAM X .965 = 1000'S OF GALS 300 F WATER

EB SUPPORT SERVICES SERVICE DEMANDS AND LOAD DURATION FOR THE FOLLOWING BUILDINGS:

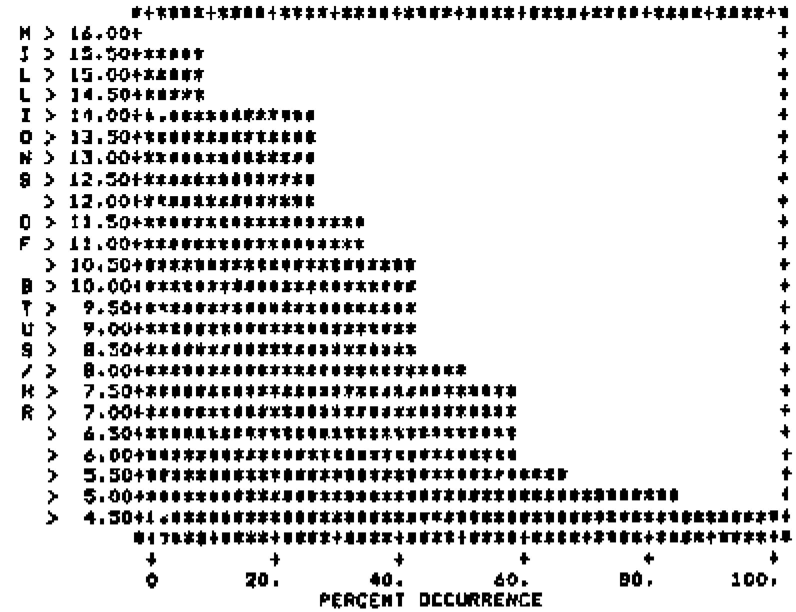
FOLWELL HALL	MINERAL RESOURCES	SHOPS BLDG	MORRILL HALL	LINAC LAB	POLICE BLDG
SHOPS ANNEX	FOUCHER BLDG	HOLMAN BLDG	TANDEM LAB	STANDARD OIL BLDG	INVENTORY WHSE

MONTHLY ENERGY USE DATA



30 DAY ADJUSTED MONTHS FOR YEAR- 1976

ENERGY LOAD DURATION CURVE



TABULAR DATA OF ENERGY REQUIREMENTS

MONTH	THOUSANDS OF BTU'S
JAN 1976	11,494,464.
FEB 1976	10,105,864.
MAR 1976	8,438,496.
APR 1976	5,620,424.
MAY 1976	4,251,736.
JUN 1976	3,572,632.
JUL 1976	3,821,008.
AUG 1976	3,553,768.
SEP 1976	3,753,936.
OCT 1976	6,102,504.
NOV 1976	7,882,008.
DEC 1976	10,405,592.

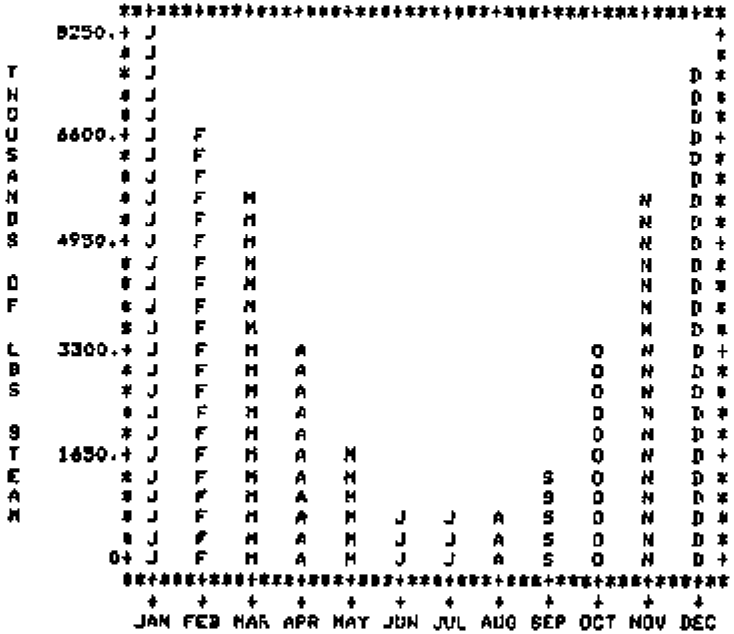
DATE OF COMPUTER RUN - 77/03/28.

CONVERSION FACTORS:

THOUSANDS OF LBS STEAM X 1.048 = MILLIONS OF BTU'S
THOUSANDS OF LBS STEAM X 7.396 = 1000'S OF LBS 300 F WATER
THOUSANDS OF LBS STEAM X .965 = 1000'S OF GALS 300 F WATER

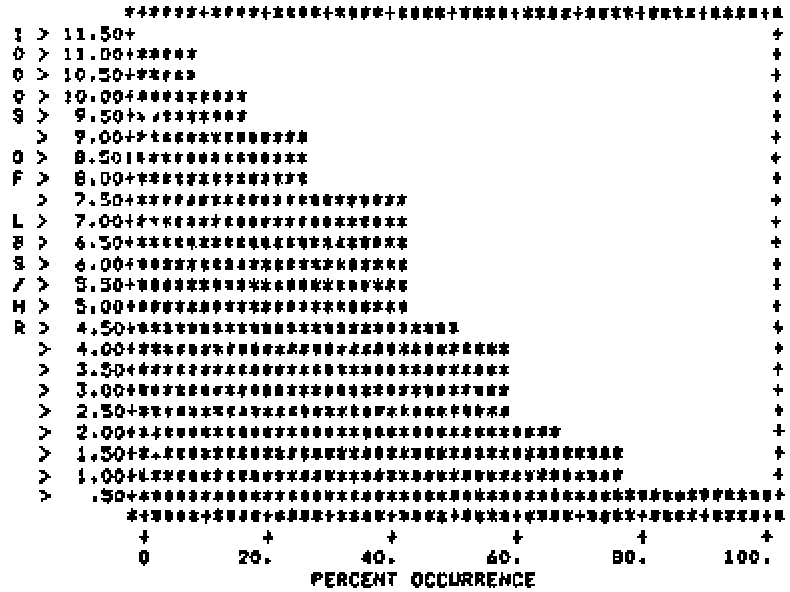
EXP. ENG. ELECT. ENG. MECH. ENG. AERO ENG. CHEM. ENG. MINES
ARCHITECTURE

MONTHLY ENERGY USE DATA



30 DAY ADJUSTED MONTHS FOR YEAR- 1976

STEAM LOAD DURATION CURVE



TABULAR DATA OF ENERGY REQUIREMENTS

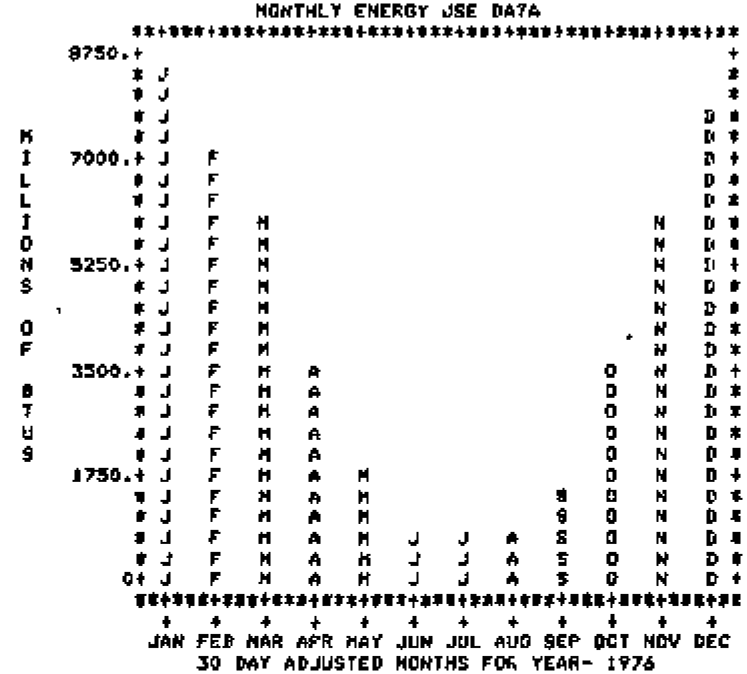
MONTH	STEAM LOAD(LBS)
JAN 1976	8,164,000.
FEB 1976	6,652,000.
MAR 1976	5,632,000.
APR 1976	3,333,000.
MAY 1976	1,726,000.
JUN 1976	651,000.
JUL 1976	625,000.
AUG 1976	597,000.
SEP 1976	1,417,000.
OCT 1976	3,206,000.
NOV 1976	5,583,000.
DEC 1976	7,487,000.

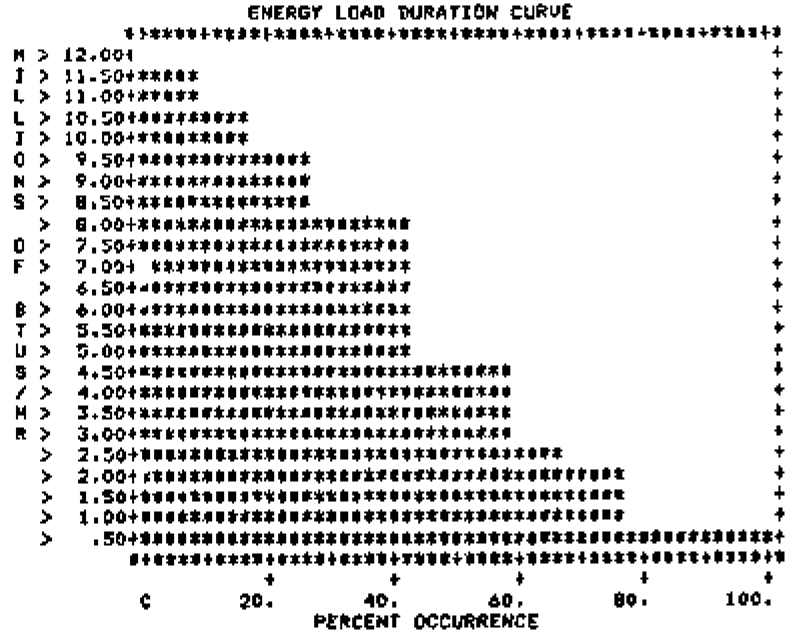
DATE OF COMPUTER RUN - 77/03/28.

CONVERSION FACTORS:

THOUSANDS OF LBS STEAM X 1.048 = MILLIONS OF BTU'S
THOUSANDS OF LBS STEAM X 7.396 = 1000'S OF LBS 300 F WATER
THOUSANDS OF LBS STEAM X .765 = 1000'S OF GALS 300 F WATER

EXP. ENG. ELECT. ENG. MECH. ENG. AERO ENG. CHEM. ENG. MINES
ARCHITECTURE





TABULAR DATA OF ENERGY REQUIREMENTS

MONTH	THOUSANDS OF BTU'S
JAN 1976	8,555,872.
FEB 1976	6,971,296.
MAR 1976	5,902,336.
APR 1976	3,492,984.
MAY 1976	1,808,848.
JUN 1976	682,240.
JUL 1976	655,000.
AUG 1976	625,656.
SEP 1976	1,485,016.
OCT 1976	3,359,888.
NOV 1976	5,850,984.
DEC 1976	7,846,376.

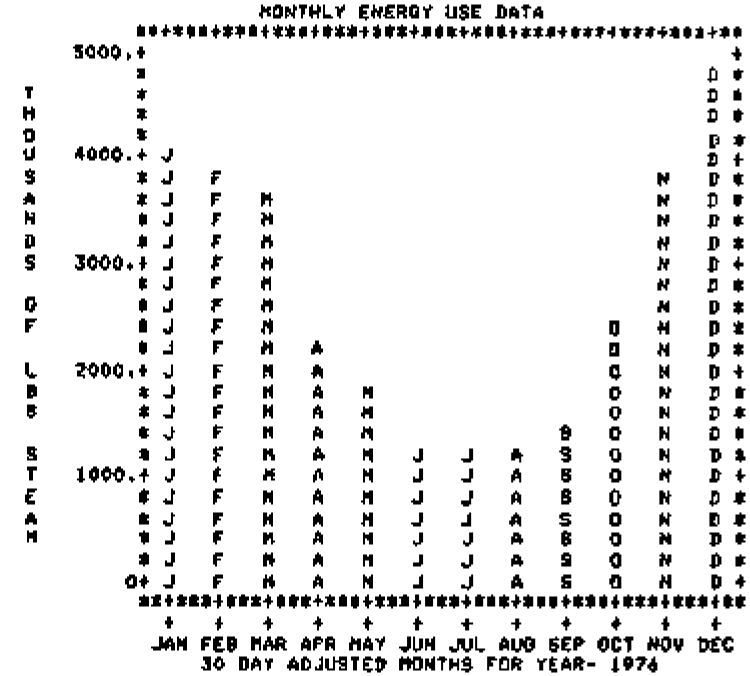
DATE OF COMPUTER RUN - 77/03/28.

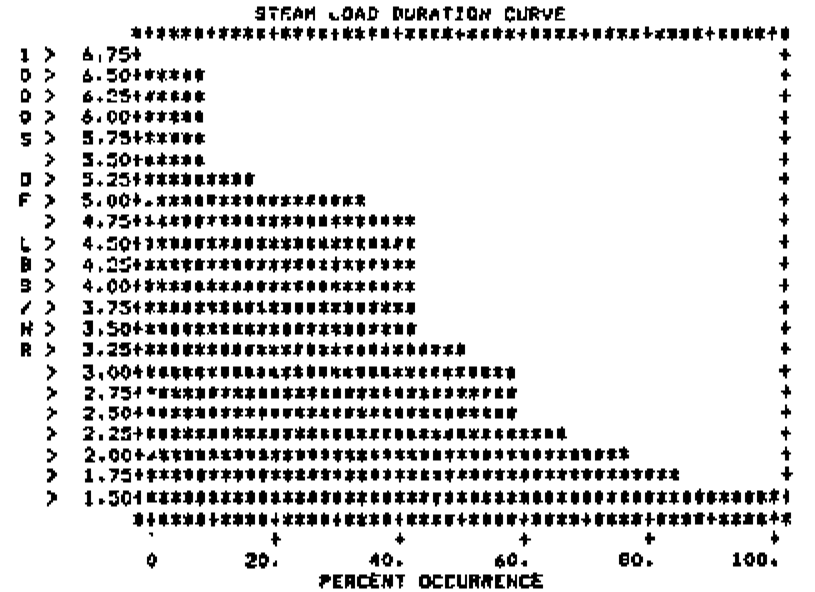
CONVERSION FACTORS:

THOUSANDS OF LBS STEAM X 1.048 = MILLIONS OF BTU'S
THOUSANDS OF LBS STEAM X 7.396 = 1000'S OF LBS 300 F WATER
THOUSANDS OF LBS STEAM X .965 = 1000'S OF GALS 300 F WATER

ED NON-UNIVERSITY SERVICE DEMANDS AND LOAD DURATION FOR THE FOLLOWING BUILDINGS:

MINN DEPT OF HEALTH





CONVERSION FACTORS:

THOUSANDS OF LBS STEAM X 1.048 = MILLIONS OF BTU'S
THOUSANDS OF LBS STEAM X 7.396 = 1000'S OF LBS 300 F WATER
THOUSANDS OF LBS STEAM X .965 = 1000'S OF GALS 300 F WATER

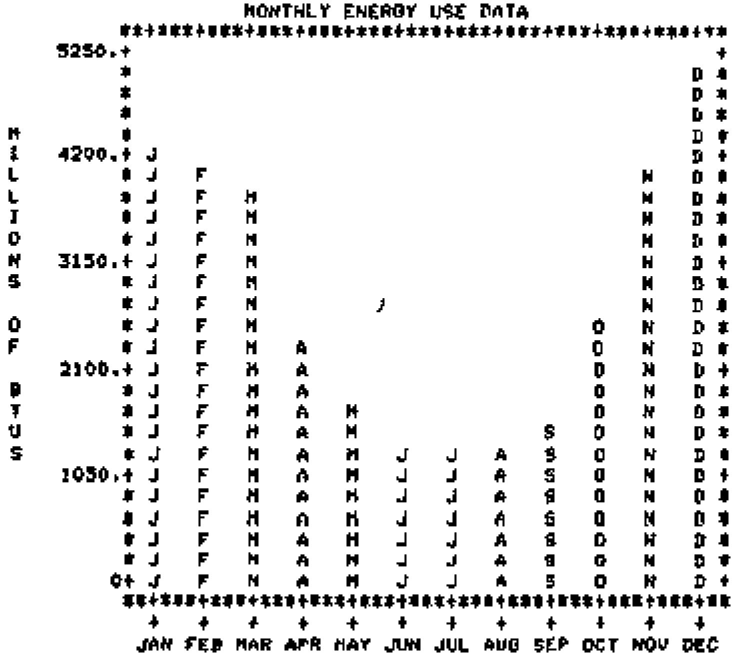
TABULAR DATA OF ENERGY REQUIREMENTS

MONTH	STEAM LOAD(LBS)
JAN 1976	3,926,000.
FEB 1976	3,768,000.
MAR 1976	3,539,000.
APR 1976	2,205,000.
MAY 1976	1,700,000.
JUN 1976	1,213,000.
JUL 1976	1,287,000.
AUG 1976	1,253,000.
SEP 1976	1,474,000.
OCT 1976	2,495,000.
NOV 1976	3,779,000.
DEC 1976	4,810,000.

DATE OF COMPUTER RUN - 77/03/28.

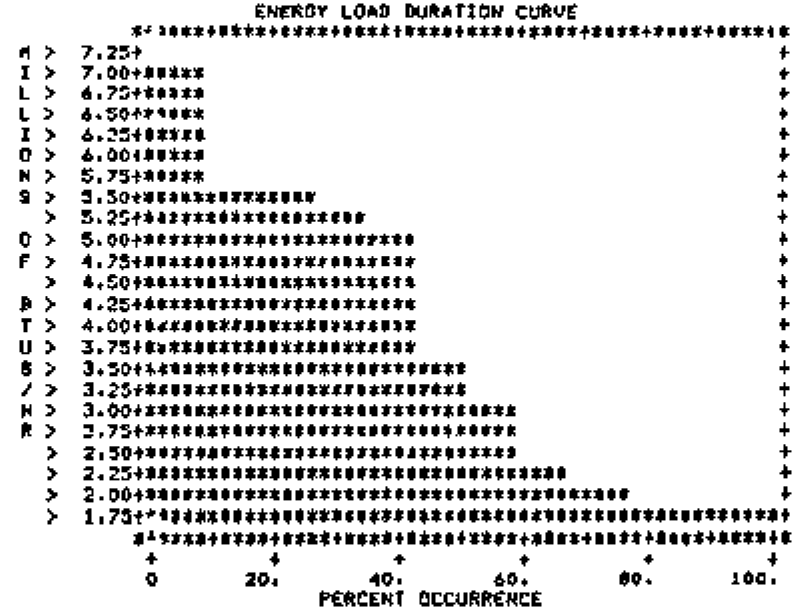
MINN DEPT OF HEALTH

MONTHLY ENERGY USE DATA



30 DAY ADJUSTED MONTHS FOR YEAR- 1976

ENERGY LOAD DURATION CURVE



TABULAR DATA OF ENERGY REQUIREMENTS

MONTH	THOUSANDS OF BTU'S
JAN 1976	4,114,448.
FEB 1976	3,948,864.
MAR 1976	3,708,872.
APR 1976	2,310,840.
MAY 1976	1,781,600.
JUN 1976	1,271,224.
JUL 1976	1,348,776.
AUG 1976	1,313,144.
SEP 1976	1,544,752.
OCT 1976	2,614,760.
NOV 1976	3,960,392.
DEC 1976	5,040,880.

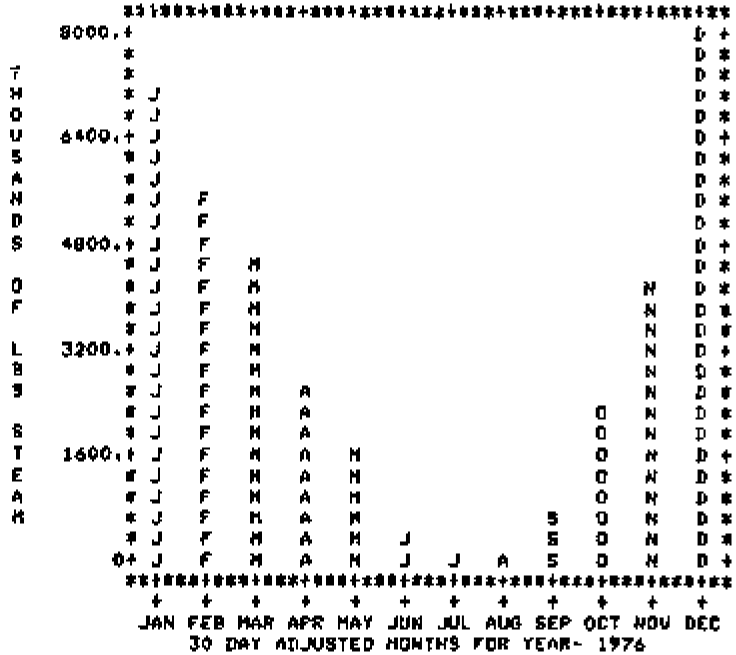
DATE OF COMPUTER RUN - 77/03/28.

CONVERSION FACTORS:

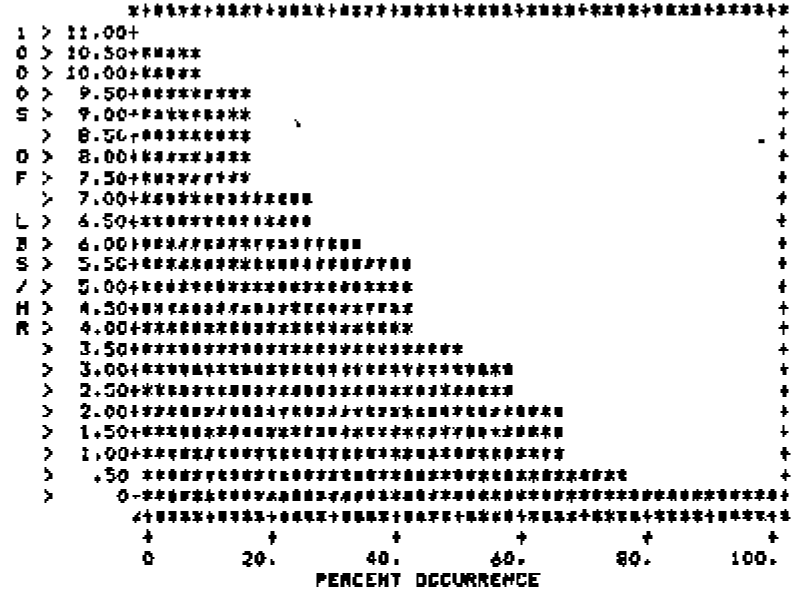
THOUSANDS OF LBS STEAM X 1.048 = MILLIONS OF BTU'S
THOUSANDS OF LBS STEAM X 7.396 = 1000'S OF LBS 300 F WATER
THOUSANDS OF LBS STEAM X .965 = 1000'S OF GALS 300 F WATER

WILLIAMS ARENA FIELD HOUSE COOKE HALL MEMORIAL STADIUM

MONTHLY ENERGY USE DATA



STEAM LOAD DURATION CURVE



CONVERSION FACTORS:

THOUSANDS OF LBS STEAM X 1.048 = MILLIONS OF BTU'S
THOUSANDS OF LBS STEAM X 7.396 = 1000'S OF LBS 300 F WATER
THOUSANDS OF LBS STEAM X .965 = 1000'S OF GALS 300 F WATER

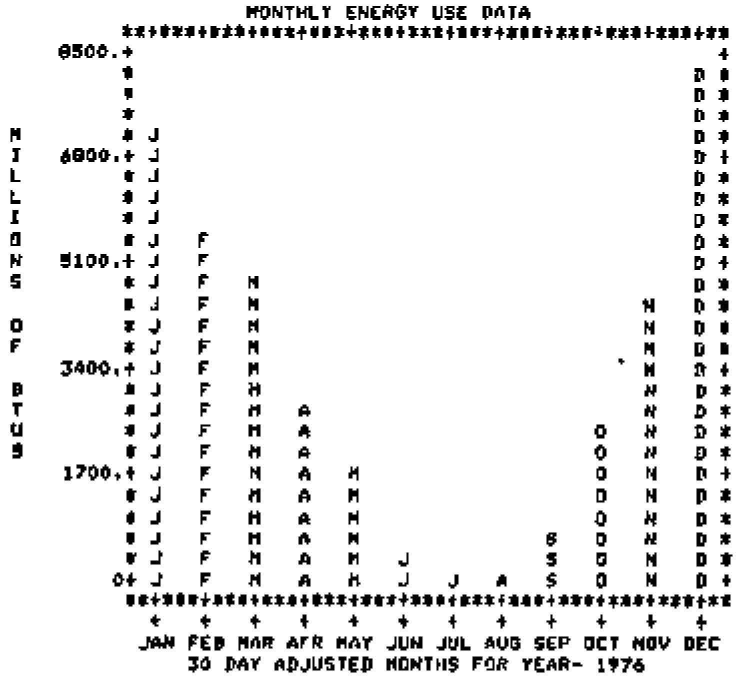
TABULAR DATA OF ENERGY REQUIREMENTS

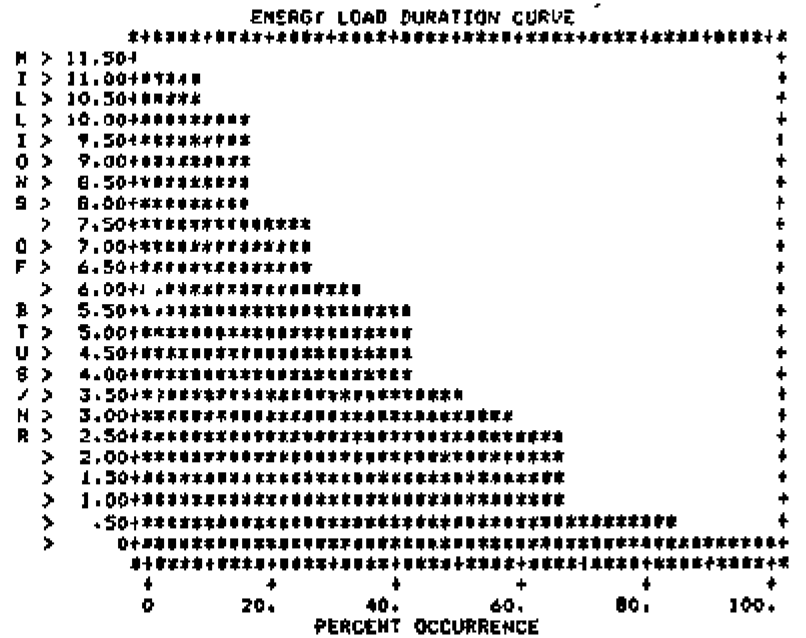
MONTH	STEAM LOAD(LBS)
JAN 1976	6,902,000.
FEB 1976	5,310,000.
MAR 1976	4,441,000.
APR 1976	2,599,000.
MAY 1976	1,750,000.
JUN 1976	357,000.
JUL 1976	111,000.
AUG 1976	120,000.
SEP 1976	584,000.
OCT 1976	2,360,000.
NOV 1976	4,073,000.
DEC 1976	7,888,000.

DATE OF COMPUTER RUN - 77/03/28.

ED ATHLETICS SERVICE DEMANDS AND LOAD DURATION FOR THE FOLLOWING BUILDINGS:

WILLIAMS ARENA FIELD HOUSE COOKE HALL MEMORIAL STADIUM





TABULAR DATA OF ENERGY REQUIREMENTS

MONTH	THOUSANDS OF BTU'S
JAN 1976	7,233,296.
FEB 1976	5,564,880.
MAR 1976	4,654,168.
APR 1976	2,723,752.
MAY 1976	1,834,000.
JUN 1976	374,136.
JUL 1976	116,328.
AUG 1976	125,760.
SEP 1976	612,032.
OCT 1976	2,473,280.
NOV 1976	4,249,504.
DEC 1976	8,266,624.

DATE OF COMPUTER RUN - 77/03/28.

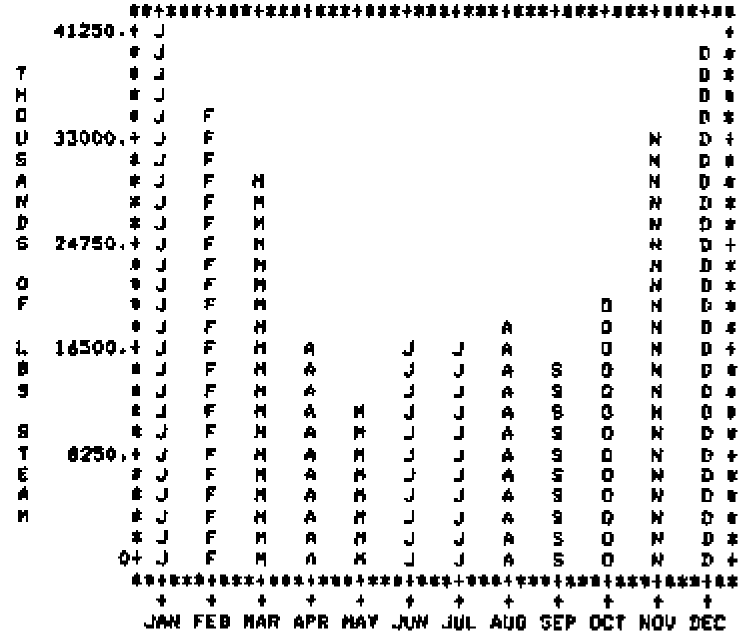
CONVERSION FACTORS:

THOUSANDS OF LBS STEAM X 1.048 = MILLIONS OF BTU'S
THOUSANDS OF LBS STEAM X 7.396 = 1000'S OF LBS 300 F WATER
THOUSANDS OF LBS STEAM X .965 = 1000'S OF GALS 300 F WATER

ED ACADEMIC SECTOR SERVICE DEMANDS AND LOAD DURATION FOR THE FOLLOWING BUILDINGS:

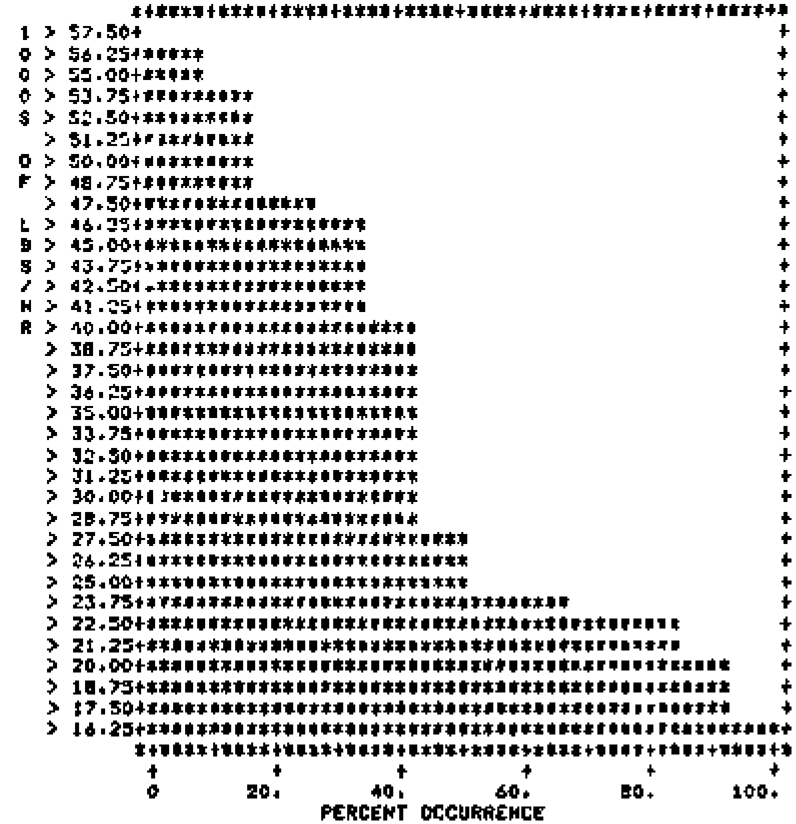
PILLSBURY HALL	PATTEE HALL	NICHOLSON HALL	WULLING HALL	WESBROOK HALL	ARMORY
CHILD DEVELOP(NEW)	CHILD DEVELOP(OLD)	ELLIOTT HALL	SHEVLIN HALL	MUSIC EDUCATION	SMITH HA..
APPLEBY HALL	ZOOLOGY	SCOTT HALL	WALTER LIBRARY	BOTANY	PHYSICS
FRASER HALL	NORTHROP AUD.	VINCENT HALL	BELL MUSEUM	MURPHY HALL	COFFMAN UNION
FORD HALL	JOHNSTON HALL	PEIK HALL	PEIK HALL GYM	SCIENCE CLASSROOM	KOLTHOFF HA..
KLAEBER COURT					

MONTHLY ENERGY USE DATA



30 DAY ADJUSTED MONTHS FOR YEAR- 1976

STEAM LOAD DURATION CURVE



TABULAR DATA OF ENERGY REQUIREMENTS

MONTH	STEAM LOAD(LBS)
JAN 1976	41,003,000.
FEB 1976	34,253,000.
MAR 1976	29,184,000.
APR 1976	16,848,000.
MAY 1976	11,827,000.
JUN 1976	16,330,000.
JUL 1976	17,304,000.
AUG 1976	17,751,000.
SEP 1976	14,943,000.
OCT 1976	19,068,000.
NOV 1976	33,453,000.
DEC 1976	39,134,000.

DATE OF COMPUTER RUN - 77/03/28.

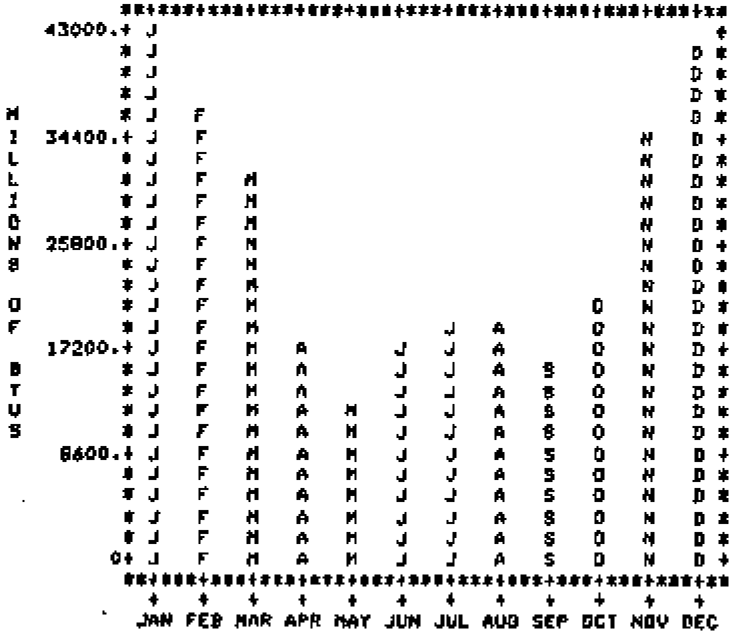
CONVERSION FACTORS:

THOUSANDS OF LBS STEAM X 1.048 = MILLIONS OF BTU'S
THOUSANDS OF LBS STEAM X 7.396 = 1000'S OF LBS 300 F WATER
THOUSANDS OF LBS STEAM X .965 = 1000'S OF GALS 300 F WATER

EN ACADEMIC SECTOR SERVICE DEMANDS AND LOAD DURATION FOR THE FOLLOWING BUILDINGS:

PILLSBURY HALL	PATTEE HALL	NICHOLSON HALL	WULLING HALL	WESBROOK HALL	ARMORY
CHILD DEVELOP(NEW)	CHILD DEVELOP(OLD)	ELLIOTT HALL	SHEVLIN HALL	MUSIC EDUCATION	SMITH HALL
APPLEBY HALL	ZOOLOGY	SCOTT HALL	WALTER LIBRARY	BOTANY	PHYSICS
FRASER HALL	NORTHRUP AUD.	VINCENT HALL	BELL MUSEUM	MURPHY HALL	COFFMAN UNION
FORD HALL	JOHNSTON HALL	PEIK HALL	PEIK HALL GYM	SCIENCE CLASSROOM	KOLTHOFF HALL
KLAEBER COURT					

MONTHLY ENERGY USE DATA



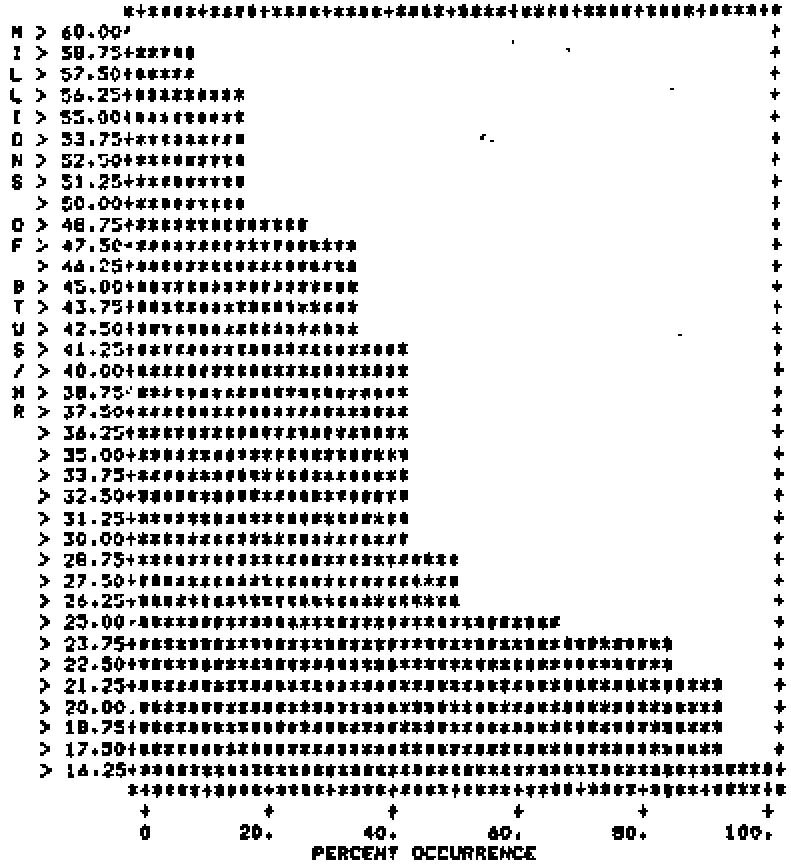
30 DAY ADJUSTED MONTHS FOR YEAR- 1976

TABULAR DATA OF ENERGY REQUIREMENTS

MONTH	THOUSANDS OF BTU'S
JAN 1976	42,971,144.
FEB 1976	35,897,144.
MAR 1976	30,584,832.
APR 1976	17,636,704.
MAY 1976	12,394,696.
JUN 1976	17,113,840.
JUL 1976	18,134,592.
AUG 1976	18,603,048.
SEP 1976	15,660,264.
OCT 1976	20,821,664.
NOV 1976	35,058,744.
DEC 1976	41,033,392.

DATE OF COMPUTER RUN - 77/03/28.

ENERGY LOAD DURATION CURVE



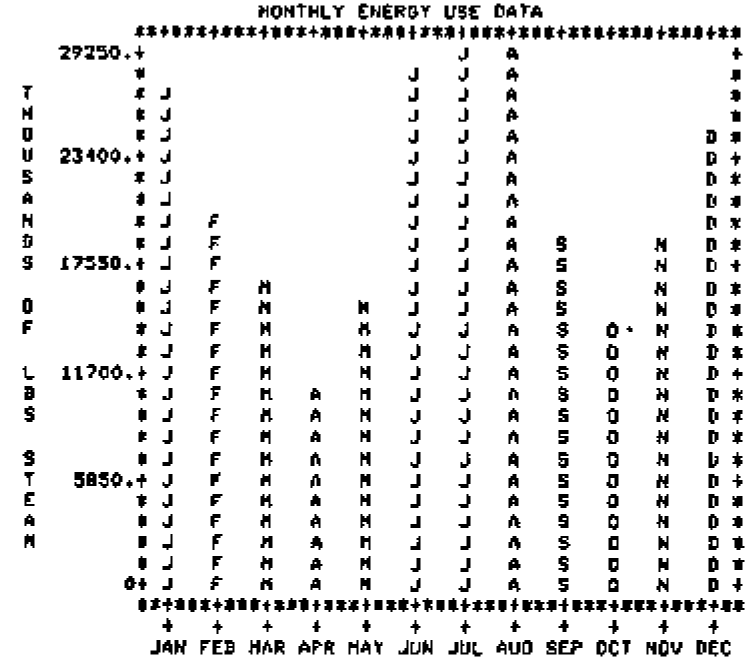
CONVERSION FACTORS:

THOUSANDS OF LBS STEAM X 1.040 = MILLIONS OF BTU'S
THOUSANDS OF LBS STEAM X 7.396 = 1000'S OF LBS 300 F WATER
THOUSANDS OF LBS STEAM X .965 = 1000'S OF GALS 300 F WATER

UO ACADEMIC SECTOR SERVICE DEMANDS AND LOAD DURATION FOR THE FOLLOWING BUILDINGS:

BUSINESS ADMINISTRAT SOCIAL SCIENCE BLEGEN HALL WILSON LIBRAR· ANDERSON HALL AUD. CLASSROOM
RARIG CENTER ART BLDG AUGSBURG COLLEGE

MONTHLY ENERGY USE DATA



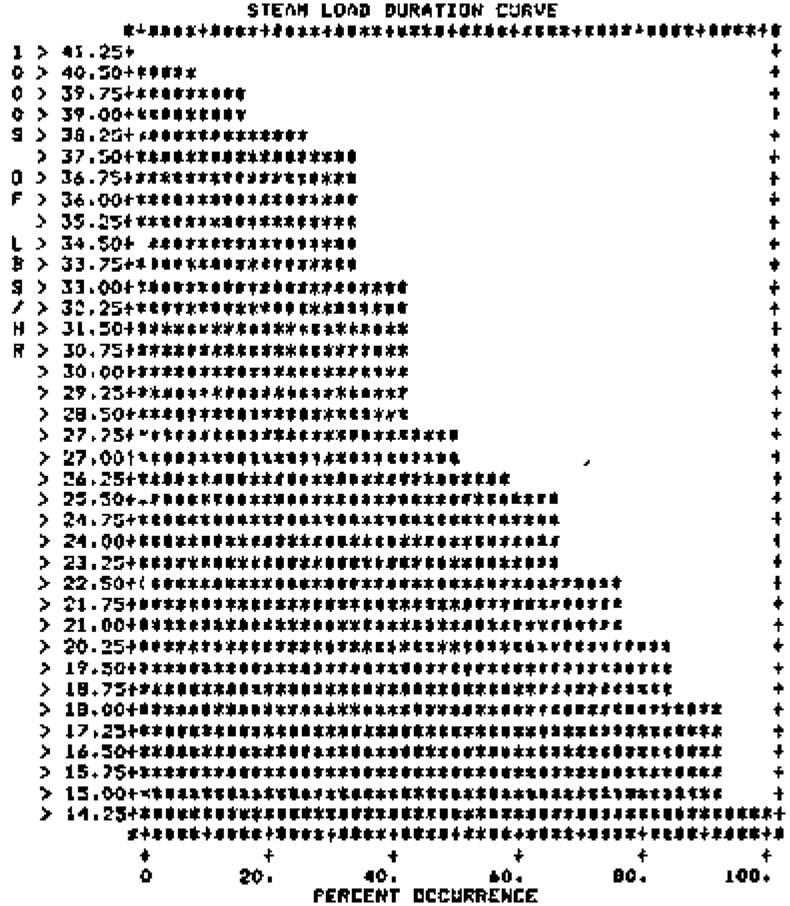
30 DAY ADJUSTED MONTHS FOR YEAR- 1976

TABULAR DATA OF ENERGY REQUIREMENTS

MONTH	STEAM LOAD(LBS)
JAN 1976	27,443,000.
FEB 1976	20,111,000.
MAR 1976	16,408,000.
APR 1976	10,490,000.
MAY 1976	14,994,000.
JUN 1976	27,591,000.
JUL 1976	29,188,000.
AUG 1976	29,073,000.
SEP 1976	18,573,000.
OCT 1976	13,408,000.
NOV 1976	19,100,000.
DEC 1976	24,111,000.

DATE OF COMPUTER RUN - 77/03/28.

STEAM LOAD DURATION CURVE



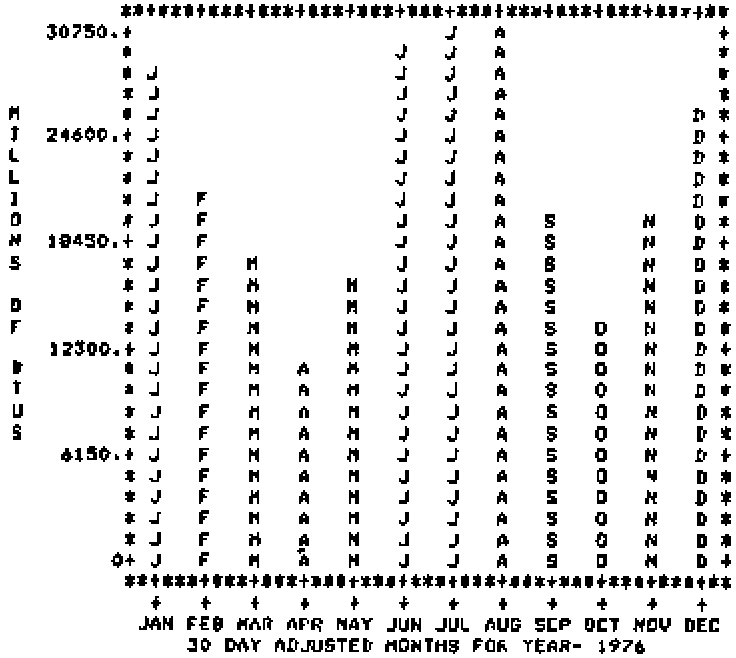
CONVERSION FACTORS:

THOUSANDS OF LBS STEAM X 1.048 = MILLIONS OF BTU'S
THOUSANDS OF LBS STEAM X 7.396 = 1000'S OF LBS 300 F WATER
THOUSANDS OF LBS STEAM X .965 = 1000'S OF GALS 300 F WATER

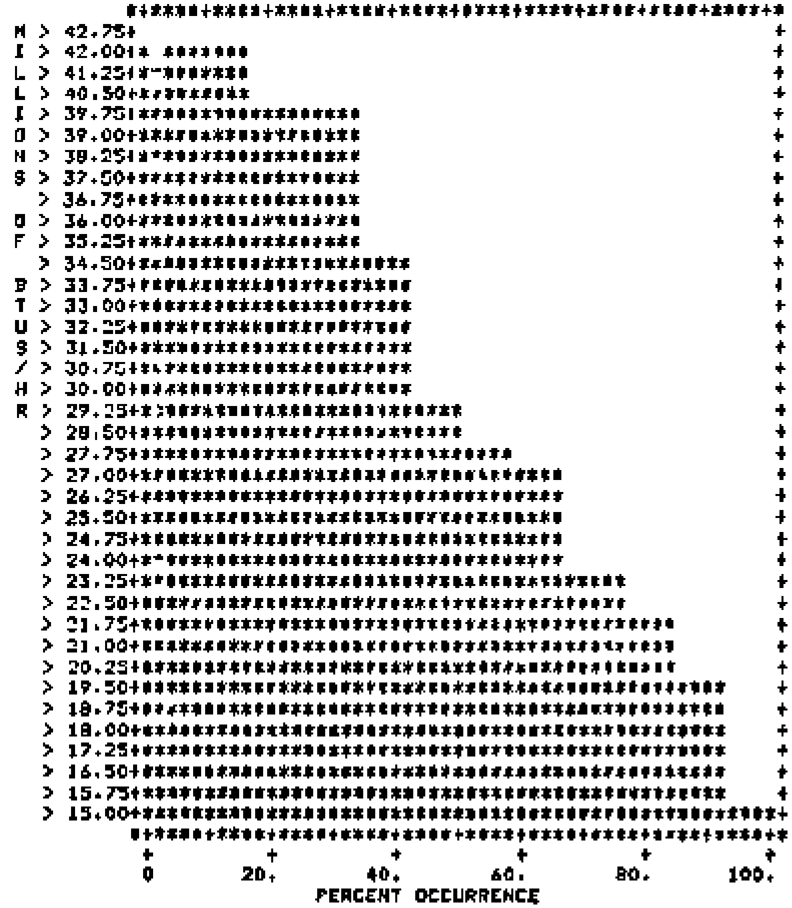
UB ACADEMIC SECTOR SERVICE DEMANDS AND LOAD DURATION FOR THE FOLLOWING BUILDINGS:

BUSINESS ADMINISTRAT	SOCIAL SCIENCE	BLEGEN HALL	WILSON LIBRARY	ANDERSON HALL	AUD. CLASSROOM
RARIG CENTER	ART BLDG	AUGSBURG COLLEGE			

MONTHLY ENERGY USE DATA



ENERGY LOAD DURATION CURVE



TABULAR DATA OF ENERGY REQUIREMENTS

MONTH	THOUSANDS OF BTU'S
JAN 1976	28,760,264.
FEB 1976	21,076,328.
MAR 1976	17,195,584.
APR 1976	10,993,520.
MAY 1976	15,713,712.
JUN 1976	28,915,368.
JUL 1976	30,389,024.
AUG 1976	30,468,504.
SEP 1976	19,464,504.
OCT 1976	14,135,424.
NOV 1976	20,016,800.
DEC 1976	25,268,328.

DATE OF COMPUTER RUN - 77/03/28.

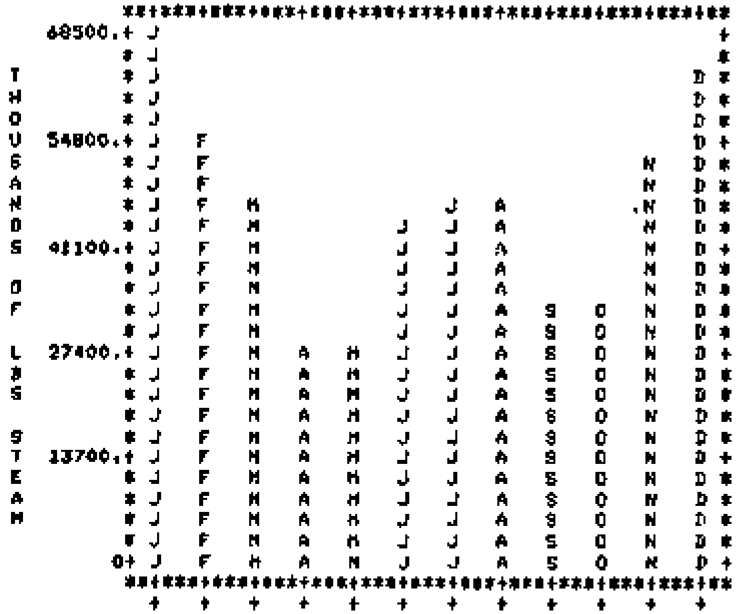
CONVERSION FACTORS:

THOUSANDS OF LBS STEAM X 1.048 = MILLIONS OF BTU'S
THOUSANDS OF LBS STEAM X 7.394 = 1000'S OF LBS 300 F WATER
THOUSANDS JF LBS STEAM X .965 = 1000'S OF GALS 300 F WATER

[illegible]

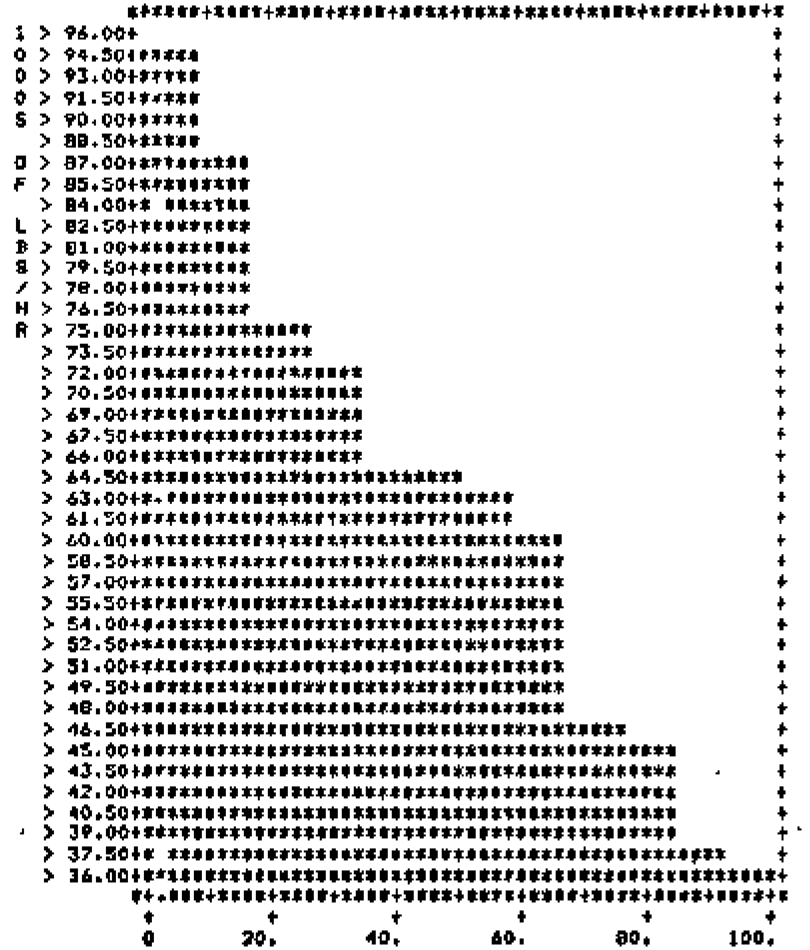
PILLSBURY HALL	PATTEE HALL	NICHOLSON HALL	WULLING HALL	WESBROOK HALL	ARMORY
CHILD DEVELOP(NEW)	CHILD DEVELOP(OLD)	ELLIOTT HALL	SHEVLIN HALL	MUSIC EDUCATION	SMITH HALL
APPLEBY HALL	ZOOLOGY	SCOTT HALL	WALTER LIBRARY	BOTANY	PHYSICS
FRASER HALL	NORTHRUP AUD.	VINCENT HALL	BELL MUSEUM	MURPHY HALL	COFFMAN UNION
FORD HALL	JOHNSTON HALL	PEIK HALL	PEIK HALL GYM	SCIENCE CLASSROOM	KOLTHOFF HALL
KLAEBER COURT	BUSINESS ADMIN.	SOCIAL SCIENCE	BLEGEN HALL	WILSON LIBRARY	ANDERSON HALL
AUD. CLASSROOM	RARIG CENTER	AUGSBURG COLLEGE	ART BLDG		

MONTHLY ENERGY USE DATA



30 DAY ADJUSTED MONTHS FOR YEAR- 1976

STEAM LOAD DURATION CURVE



TABULAR DATA OF ENERGY REQUIREMENTS

MONTH	STEAM LOAD(LBS)
JAN 1976	68,446,000.
FEB 1976	54,364,000.
MAR 1976	45,392,000.
APR 1976	27,330,000.
MAY 1976	26,821,000.
JUN 1976	43,921,000.
JUL 1976	46,492,000.
AUG 1976	46,824,000.
SEP 1976	33,516,000.
OCT 1976	33,356,000.
NOV 1976	52,553,000.
DEC 1976	63,265,000.

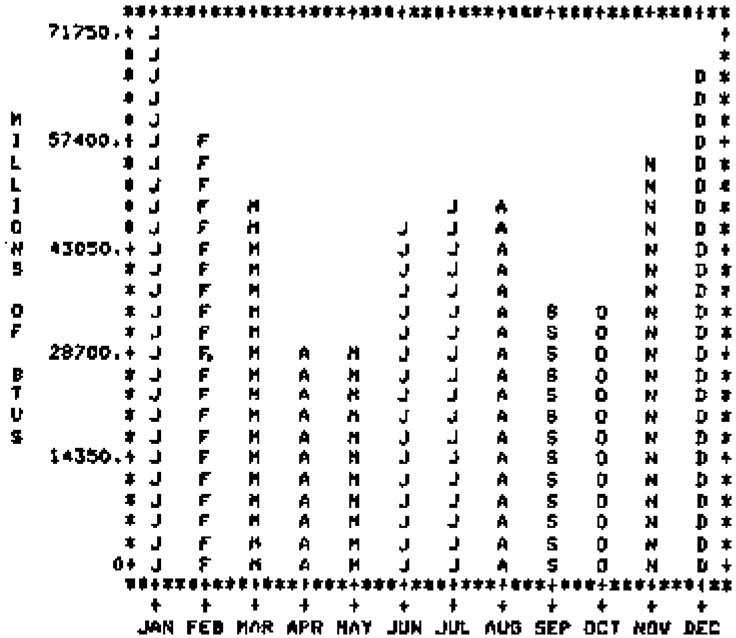
DATE OF COMPUTER RUN - 77/03/29.

CONVERSION FACTORS:

THOUSANDS OF LBS STEAM X 1.048 = MILLIONS OF BTU'S
THOUSANDS OF LBS STEAM X 7.396 = 1000'S OF LBS 300 F WATER
THOUSANDS OF LBS STEAM X .965 = 1000'S OF GALS 300 F WATER

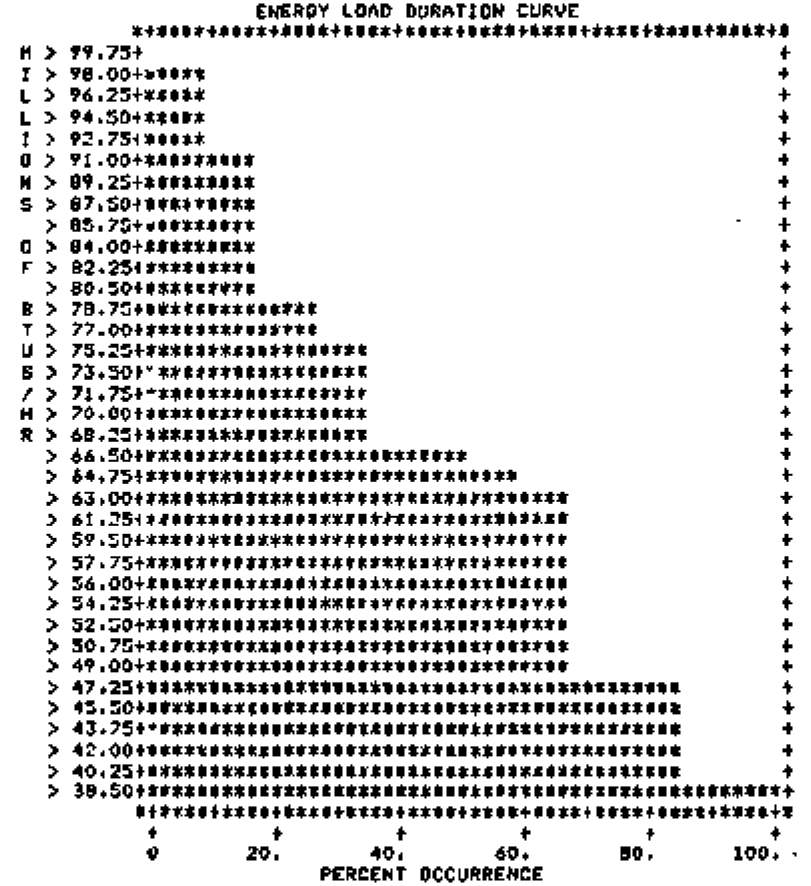
PILLSBURY HALL	PATTEE HALL	NICHOLSON HALL	WULLING HALL	WESBROOK HALL	ARMORY
CHILD DEVELOP(NEW)	CHILD DEVELOP(OLD)	ELLIOTT HALL	SHEVLIN HALL	MUSIC EDUCATION	SMITH HALL
APPLEBY HALL	ZOOLOGY	SCOTT HALL	WALTER LIBRARY	BOTANY	PHYSICS
FRASER HALL	NORTHRUP AUD.	VINCENT HALL	BELL MUSEUM	MURPHY HALL	COFFMAN UNION
FORD HALL	JOHNSTON HALL	PEIK HALL	PEIK HALL GYM	SCIENCE CLASSROOM	KOLTHOFF HALL
KLAEBER COURT	BUSINESS ADMIN.	SOCIAL SCIENCE	BLEGEN HALL	WILSON LIBRARY	ANDERSON HALL
AUD. CLASSROOM	RARIG CENTER	AUGSBURG COLLEGE	ART BLDG		

MONTHLY ENERGY USE DATA



30 DAY ADJUSTED MONTHS FOR YEAR- 1976

ENERGY LOAD DURATION CURVE



TABULAR DATA OF ENERGY REQUIREMENTS

MONTH	THOUSANDS OF BTU'S
JAN 1976	71,731,408.
FEB 1976	56,973,472.
MAR 1976	47,780,416.
APR 1976	28,650,224.
MAY 1976	28,108,408.
JUN 1976	46,029,208.
JUL 1976	48,723,616.
AUG 1976	49,071,552.
SEP 1976	35,124,768.
OCT 1976	34,957,088.
NOV 1976	55,075,544.
DEC 1976	64,301,720.

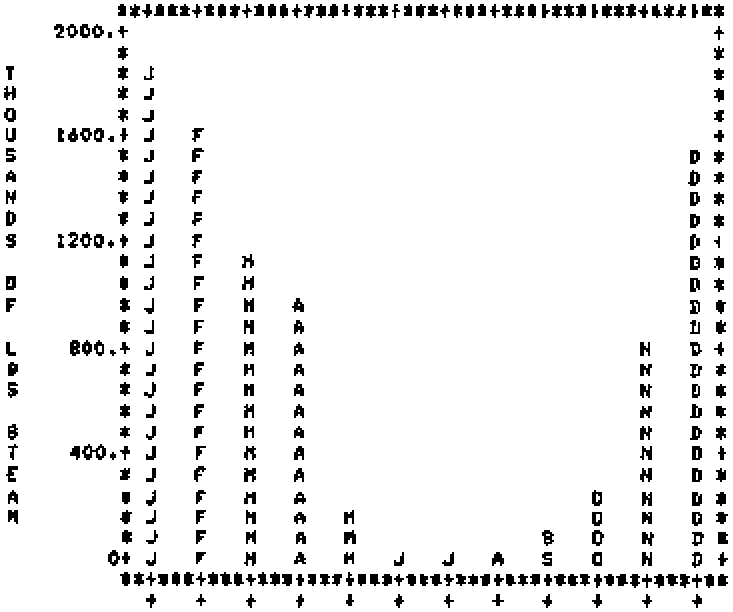
DATE OF COMPUTER RUN = 77/03/29.

CONVERSION FACTORS:

THOUSANDS OF LBS STEAM X 1.048 = MILLIONS OF BTU'S
THOUSANDS OF LBS STEAM X 7.396 = 1000'S OF LBS 300 F WATER
THOUSANDS OF LBS STEAM X .965 = 1000'S OF GALS 300 F WATER

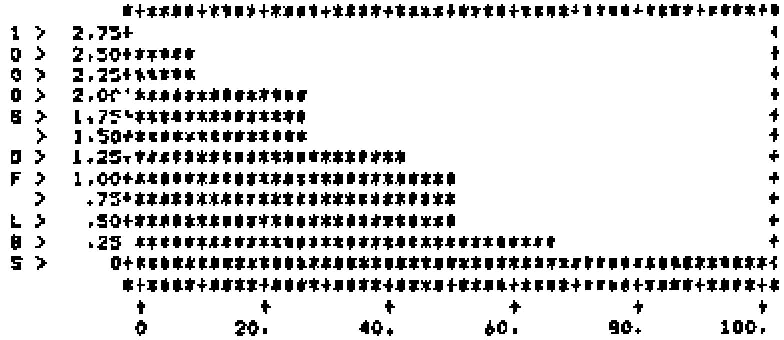
MAYO GARAGE   NOLTE GARAGE   COFFMAN GARAGE

MONTHLY ENERGY USE DATA



30 DAY ADJUSTED MONTHS FOR YEAR- 1976

STEAM LOAD DURATION CURVE



CONVERSION FACTORS:

THOUSANDS OF LBS STEAM X 1.048 = MILLIONS OF BTU'S
THOUSANDS OF LBS STEAM X 7.396 = 1000'S OF LBS 300 F WATER
THOUSANDS OF LBS STEAM X .965 = 1000'S OF GALS 300 F WATER

TABULAR DATA OF ENERGY REQUIREMENTS

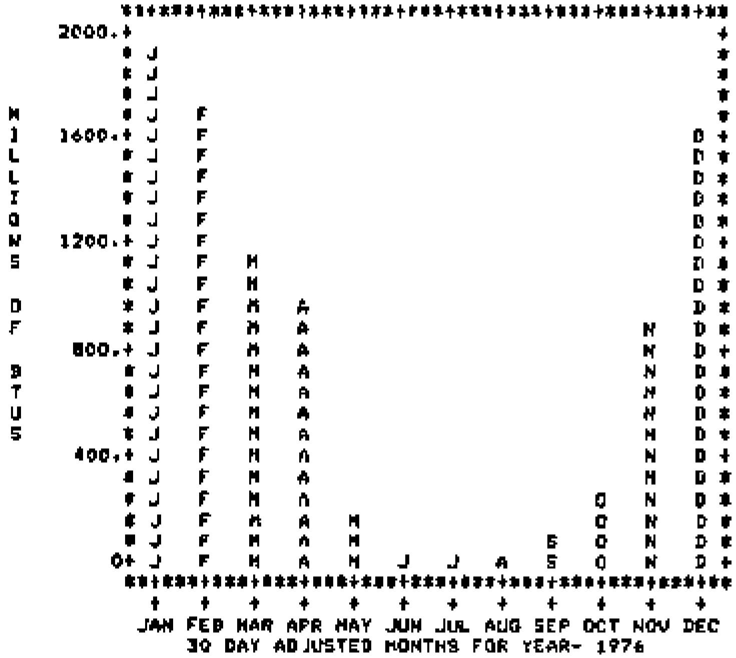
MONTH	STEAM LOAD(LBS)
JAN 1976	1,861,000.
FEB 1976	1,605,000.
MAR 1976	1,080,000.
APR 1976	954,000.
MAY 1976	188,000.
JUN 1976	38,000.
JUL 1976	27,000.
AUG 1976	28,000.
SEP 1976	74,000.
OCT 1976	216,000.
NOV 1976	827,000.
DEC 1976	1,545,000.

DATE OF COMPUTER RUN - 77/03/28.

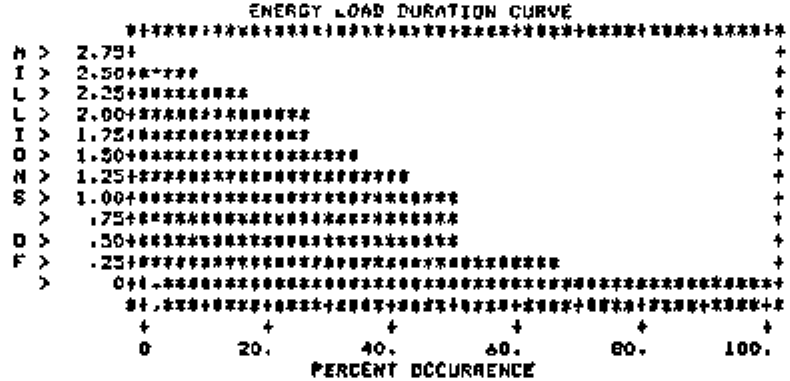
CU GARAGES [illegible] SERVICE [illegible] FOR THE FOLLOWING BUILDINGS

MAYO GARAGE NOLTE GARAGE COFFMAN GARAGE

MONTHLY ENERGY USE DATA



ENERGY LOAD DURATION CURVE



CONVERSION FACTORS:

THOUSANDS OF LBS STEAM X 1.048 = MILLIONS OF BTU'S
THOUSANDS OF LBS STEAM X 7.396 = 1000'S OF LBS 300 F WATER
THOUSANDS OF LBS STEAM X .965 = 1000'S OF GALS 300 F WATER

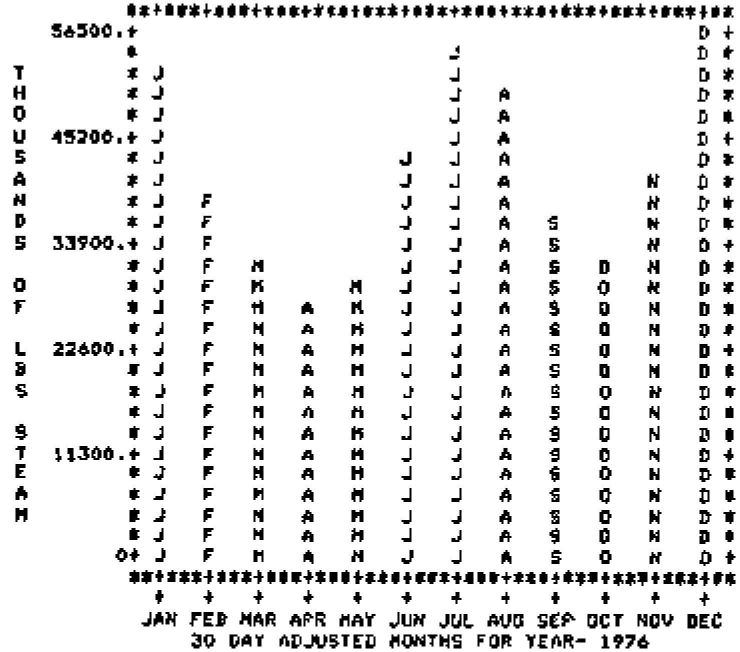
TABULAR DATA OF ENERGY REQUIREMENTS

MONTH	THOUSANDS OF BTU'S
JAN 1976	1,950,328.
FEB 1976	1,682,040.
MAR 1976	1,131,840.
APR 1976	999,792.
MAY 1976	197,024.
JUN 1976	39,824.
JUL 1976	28,296.
AUG 1976	29,344.
SEP 1976	77,552.
OCT 1976	226,368.
NOV 1976	866,496.
DEC 1976	1,619,160.

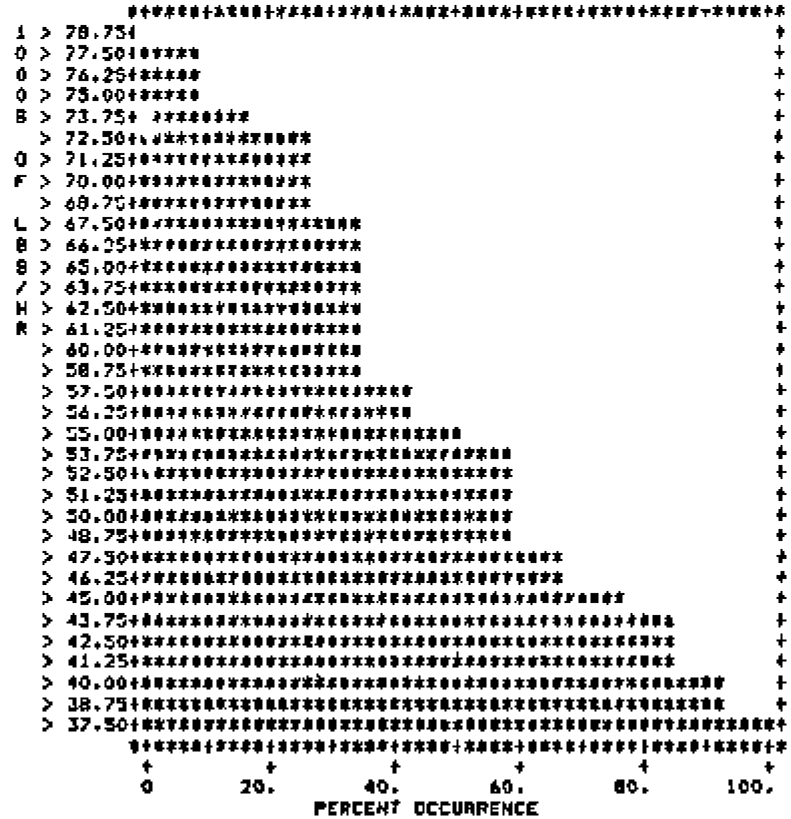
DATE OF COMPUTER RUN - 77/03/28.

JACKSON HALL	JACKSON-OWRE	MILLARD HALL	OWRE HALL	UNIT A	UNIT KE
MAYO HOSP.	UNIV. HOSP.	CHILD REHAB CENTR	DIEHL HALL	POWELL HALL	VFW HOSP
HEART HOSP.	HEALTH SER.				

MONTHLY ENERGY USE DATA



STEAM LOAD DURATION CURVE



TABULAR DATA OF ENERGY REQUIREMENTS

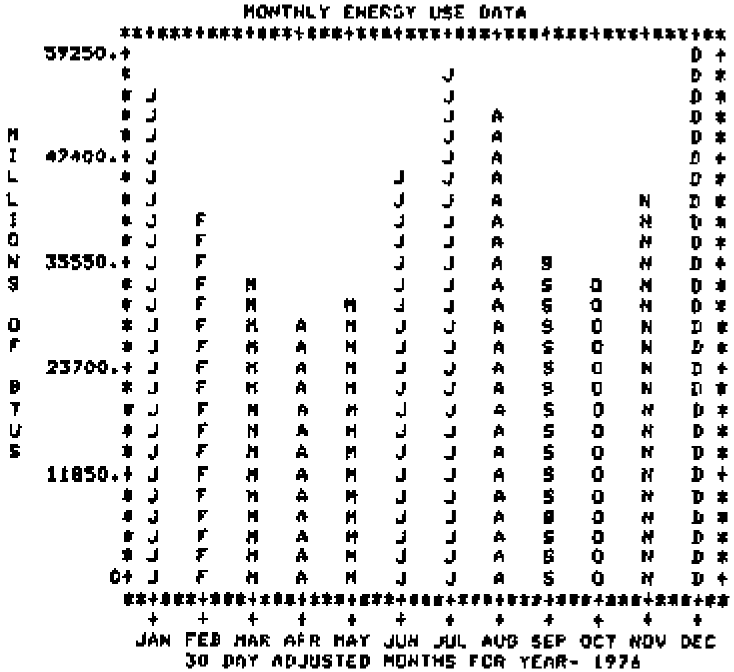
MONTH	STEAM LOAD(LBS)
JAN 1976	52,351,000.
FEB 1976	38,852,000.
MAR 1976	32,558,000.
APR 1976	27,760,000.
MAY 1976	29,244,000.
JUN 1976	42,266,000.
JUL 1976	53,488,000.
AUG 1976	49,319,000.
SEP 1976	35,035,000.
OCT 1976	32,288,000.
NOV 1976	40,449,000.
DEC 1976	56,460,000.

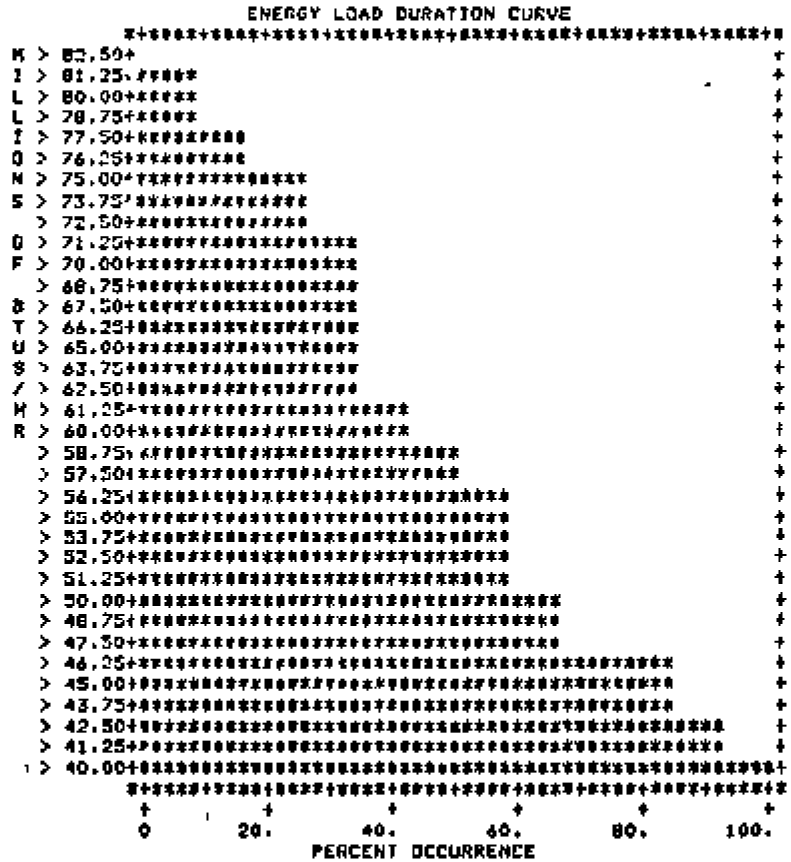
DATE OF COMPUTER RUN - 77/03/29.

CONVERSION FACTORS:

THOUSANDS OF LBS STEAM X 1.048 = MILLIONS OF BTU'S
THOUSANDS OF LBS STEAM X 7.396 = 1000'S OF LBS 300 F WATER
THOUSANDS OF LBS STEAM X .963 = 1000'S OF GALS 300 F WATER

JACKSON HALL	JACKSON-OWRE	MILLARD HALL	OWRE HALL	UNIT A	UNIT KE
MAYO HOSP.	UNIV. HOSP.	CHILD REHAB CENTR	DIEHL HALL	POWELL HALL	VFW HOSP
HEART HOSP.	HEALTH SER.				





TABULAR DATA OF ENERGY REQUIREMENTS

MONTH	THOUSANDS OF BTU'S
JAN 1976	54,863,848.
FEB 1976	40,716,896.
MAR 1976	34,120,784.
APR 1976	29,100,864.
MAY 1976	30,647,712.
JUN 1976	44,294,768.
JUL 1976	56,055,424.
AUG 1976	51,686,312.
SEP 1976	36,716,680.
OCT 1976	33,837,624.
NOV 1976	42,390,552.
DEC 1976	59,170,080.

DATE OF COMPUTER RUN - 77/03/29.

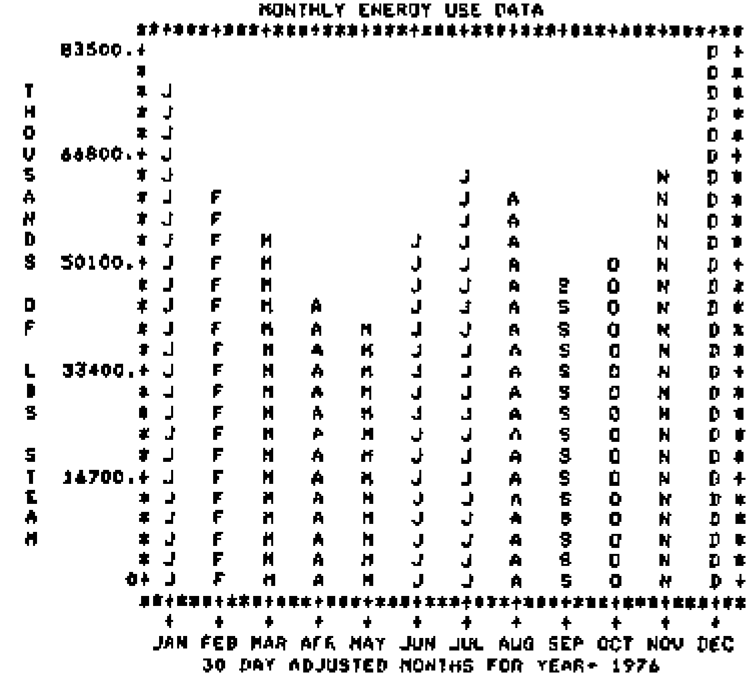
CONVERSION FACTORS:

THOUSANDS OF LBS STEAM X 1.048 = MILLIONS OF BTU'S
THOUSANDS OF LBS STEAM X 7.396 = 1000'S OF LBS 300 F WATER
THOUSANDS OF LBS STEAM X .965 = 1000'S OF GALS 300 F WATER

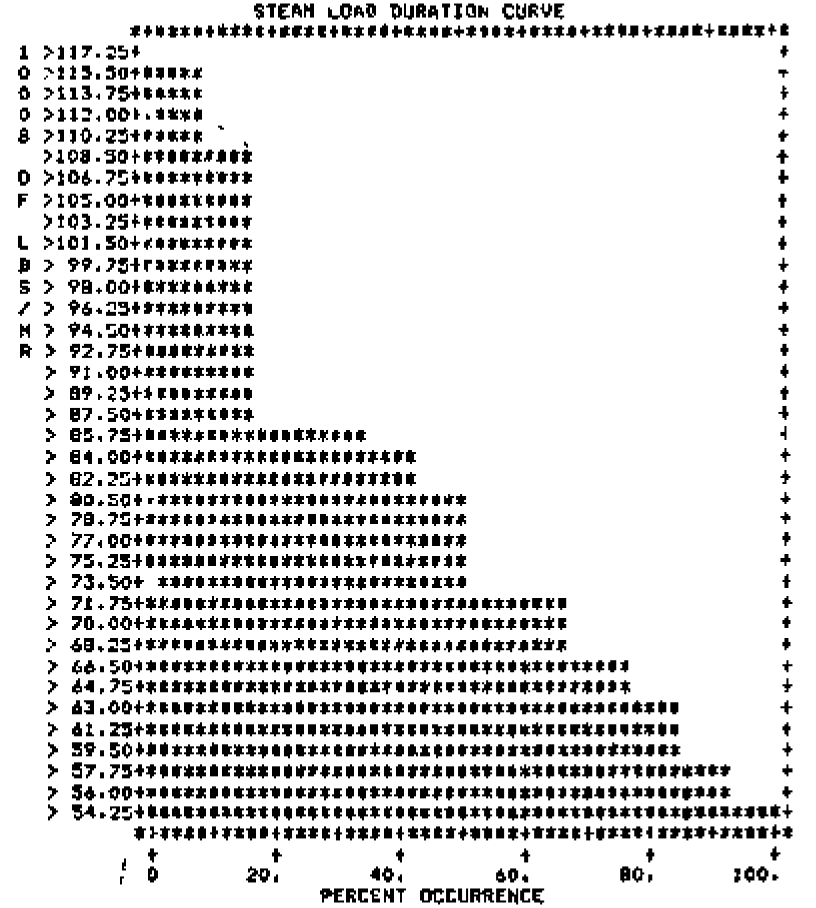
COMBINED HEATING SERVICE FIGURES AND LOAD DURATION FOR THE FOLLOWING BUILDINGS.

JACKSON HALL	JACKSON-OWRE	MILLARD HALL	OWRE HALL	UNIT A	UNIT KE
MAYO HOSP.	UNIV. HOSP.	CHILD REHAB CENTR	DIEHL HALL	POWELL HALL	VFW HOSP
HEART HOSP.	HEALTH SER.	ST MARYS - FAIRVIEW			

MONTHLY ENERGY USE DATA



STEAM LOAD DURATION CURVE



TABULAR DATA OF ENERGY REQUIREMENTS

MONTH	STEAM LOAD(LBS)
JAN 1976	78,434,000.
FEB 1976	60,967,000.
MAR 1976	52,839,000.
APR 1976	42,430,000.
MAY 1976	40,137,000.
JUN 1976	51,909,000.
JUL 1976	62,905,000.
AUG 1976	58,641,000.
SEP 1976	45,609,000.
OCT 1976	48,636,000.
NOV 1976	42,971,000.
DEC 1976	83,449,000.

DATE OF COMPUTER RUN - 77/03/29.

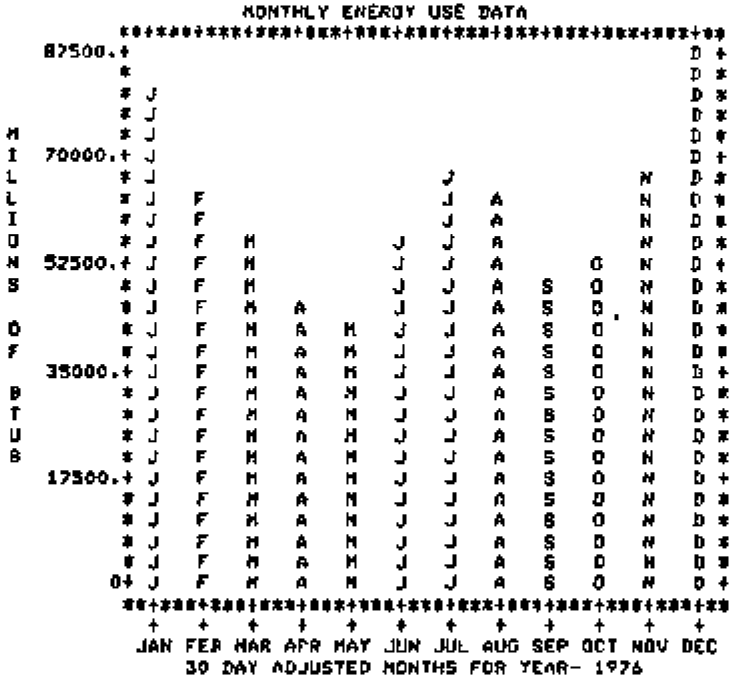
CONVERSION FACTORS:

THOUSANDS OF LBS STEAM X	1.048 =	MILLIONS OF BTU'S
THOUSANDS OF LBS STEAM X	7.396 =	1000'S OF LBS 300 F WATER
THOUSANDS OF LBS STEAM X	.965 =	1000'S OF GALS 300 F WATER

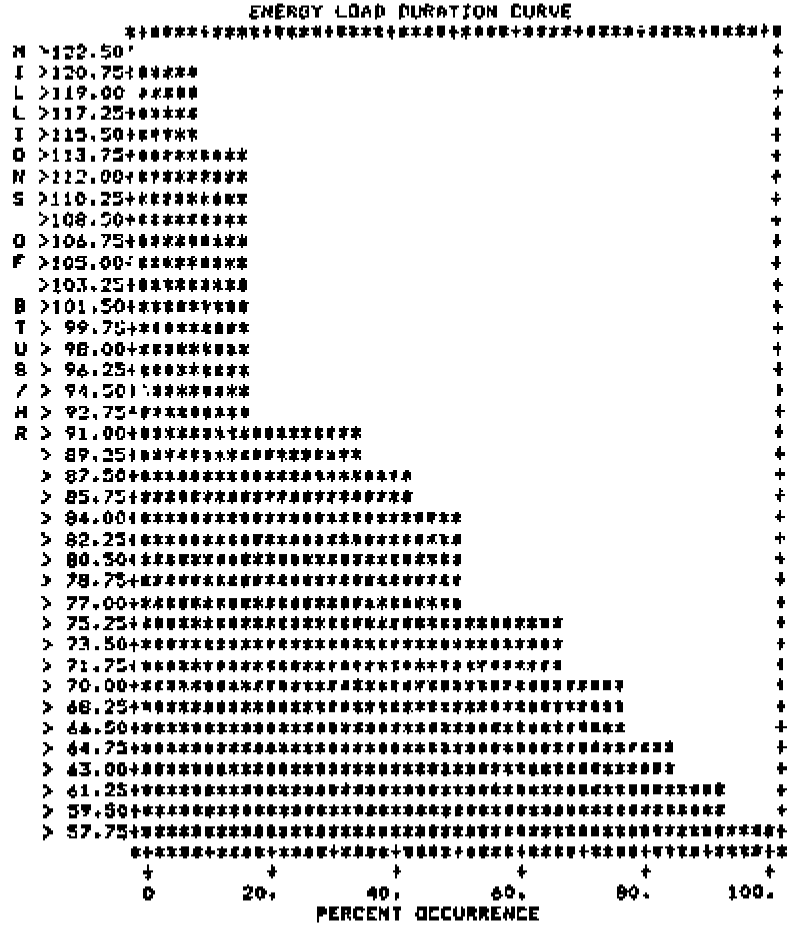
COMBINED REPORT   SERVICE DEMANDS AND LOAD DURATION FOR THE FOLLOWING BUILDINGS:

JACKSON HALL	JACKSON-OWRE	MILLARD HALL	OWRE HALL	UNIT A	UNIT KE
MAYO HOSP.	UNIV. HOSP.	CHILD REHAB CENTR	DIEHL HALL	POWELL HALL	VFW HOSP
HEART HOSP.	HEALTH SER.	ST MARYS - FAIRVIEW			

MONTHLY ENERGY USE DATA



ENERGY LOAD DURATION CURVE



TABULAR DATA OF ENERGY REQUIREMENTS

MONTH	THOUSANDS OF BTU'S
JAN 1976	82,198,832.
FEB 1976	63,893,416.
MAR 1976	55,375,272.
APR 1976	44,466,440.
MAY 1976	42,063,576.
JUN 1976	54,400,632.
JUL 1976	65,924,440.
AUG 1976	61,455,768.
SEP 1976	47,798,232.
OCT 1976	50,970,528.
NOV 1976	65,993,608.
DEC 1976	87,454,552.

DATE OF COMPUTER RUN = 77/03/29.

CONVERSION FACTORS:

THOUSANDS OF LBS STEAM X 1.048 = MILLIONS OF BTU'S
THOUSANDS OF LBS STEAM X 7.396 = 1000'S OF LBS 300 F WATER
THOUSANDS OF LBS STEAM X .965 = 1000'S OF GALS 300 F WATER

1.7.1 SPECIAL BUILDING STUDY

The following study is presented for supplying information only. This study as well as all computer program development used throughout the Phase I feasibility study were wholly financed and developed prior to any ERDA involvement.

Requests for further development of such studies or background information must be made with the prior understanding that ERDA will finance the program.

CONSERVATION OF ENERGY STUDY

ELECTRICAL FACILITIES

ALDERMAN HALL

ST. PAUL CAMPUS

PRELIMINARY

Physical Planning Office
Engineering and Construction Division

David B. Kerkow, P.E.
Assistant Supervising Engineer

William Gould
Junior Engineer

April, 1977

TABLE OF CONTENTS

INTRODUCTION

This report is the result of an analysis of building and electrical systems intended to determine potential energy conservation measures for Alderman Hall. Other benefits resulting from this work were obtaining information on which to base design criteria relating to conservation of energy, developing procedures for analysis of electrical energy utilization and defining areas for further study.

Ideally, all building electrical services would be metered concurrently for a minimum of one (1) year. This was not feasible in terms of funding available and probably no warranted without more knowledge of the value of information which could be obtained. The procedure used relied on recordings of selected services, spot checks of demand, and surveys of facility usage. While the results cannot be claimed completely accurate, they do indicate much about the utilization of electrical energy in the building.

Alderman Hall is occupied by the Department of Horticulture Science and Landscape Architecture. The building is a combination of lab, office and classroom spaces. Laboratory space accounts for approximately 34 percent of the usable space, office 19 percent and classrooms 12 percent. Corridors, stairs, elevators, storage and mechanical spaces comprise the balance of the usable area.

SCOPE

A brief description of the Alderman Hall electrical systems and equipment is followed by data and graphs which illustrate system characteristics.

Energy usage is separated into classifications of research facilities and equipment, light, ventilation, miscellaneous building equipment, airconditioning and distribution system losses. The part each classification plays in the building electrical demand and consumption is illustrated by graph.

Conservation potentials for Alderman Hall are discussed and a tabulation indicating various conservation of energy actions for consideration is provided.

An evaluation of the building in terms of present conservation of energy codes and what might have been accomplished had a more energy conserving design approach been used is provided.

The conclusion summarizes significant points and suggests action which might be taken.

DESCRIPTION OF BUILDING ELECTRICAL FACILITIES

Alderman Hall obtains electrical supply from the St. Paul Campus primary electric distribution system. This is a 13,800/8,000 volt, 3 phase, 4 wire system. Two primary feeder cables from this system terminate in the building primary switchgear.

The primary switchgear provides control for alternate services from either feeder. It also provides fault protection, overcurrent protection, and control of the primary supply to building transformers.

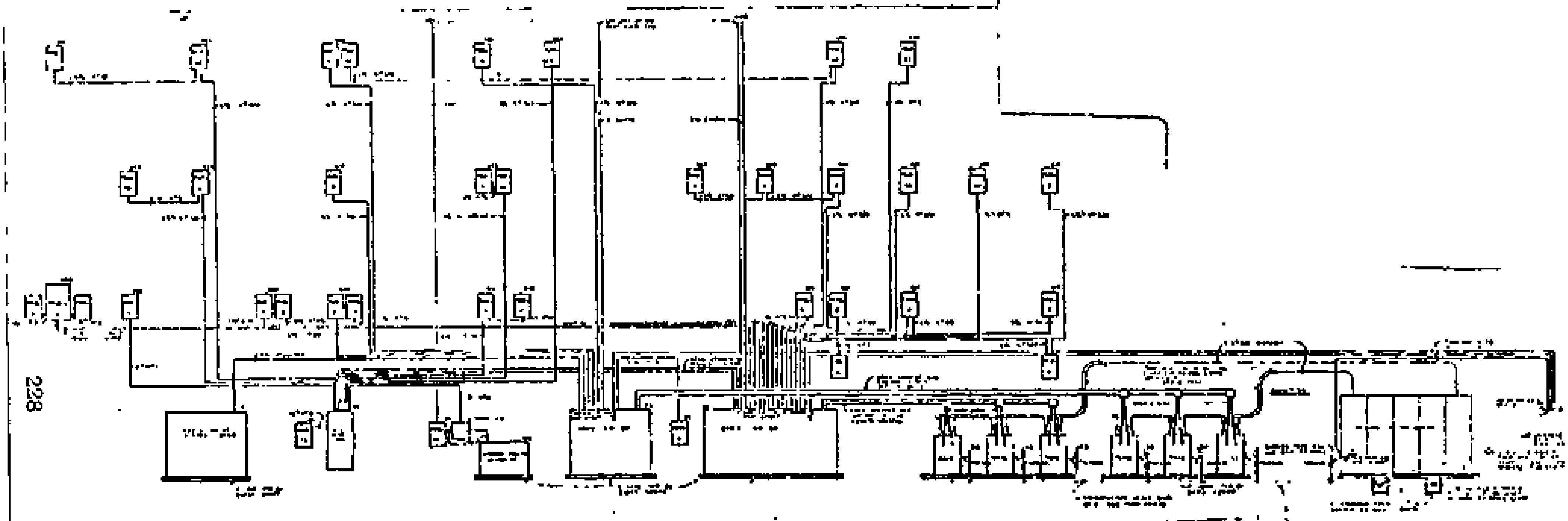
Transformation of the 13,800 volt campus system supply to utilization voltage is accomplished by two banks of transformers.

One 500 KVA bank of transformers furnishes 3 phase, 4 wire, 120/208 volt supply. This serves building receptacles, incandescent lighting including exit lights, 120/208 volt motor loads and laboratory equipment. Laboratory equipment includes items such as freezers, coolers, growth chambers, dryers, dishwashers, sterilizers and ranges.

A second 500 KVA bank of transformers supplies a 3 phase, 4 wire, 277/480 volt system. This serves fluorescent lighting operation at 277 volts. Approximately 115 motors power equipment such as ventilation, air conditioning, elevators, air compressors, fumehoods, freezers, growth chambers and unit heaters. These range in size from fractional h.p. motors to 40 h.p. units.

Secondary electrical supply is conducted by busduct from transformers to two main building switchboards. At these switchboards services are broken down into insulated copper feeder cables in steel conduit which distribute power to sub-distribution switchboards and panelboards throughout the four floors of the building.

The electrical distribution system riser diagram is shown on Drawing #1.



ELECTRICAL DISTRIBUTION SYSTEM RISER DIAGRAM

ALDERMAN HALL

DRAWING I

BUILDING ELECTRICAL DEMAND AND CONSUMPTION CHARACTERISTICS

Monthly demand and energy consumption readings for a two year period are shown in tabulations 1A, 1B, and 1C. Tabulation 1C represents total building characteristics. This is actually the sum of the 1A tabulation on 120/208 volt services and 1B on 277/480 volt services.

These characteristics are imposed on the St. Paul Campus primary distribution systems and represented 5.3 percent of the annual electrical energy consumed on this campus for the 1974-1975 July to July period.

Following are breakdowns of two annual periods from the above tabulations.

YEAR	KWHRS CONSUMED ANNUALLY	MAXIMUM KW DEMAND
1974-1975	1,889,840	416
1975-1976	1,872,800	400

From this data the consumption and demand per square foot area are derived. These values are indicated below:

	ANNUAL KWHRS/sq.ft.		WATTS/sq.ft.	
YEAR	GROSS	USABLE	GROSS	USABLE
1974-1975	29.04	33.67	6.39	7.41
1975-1976	28.78	33.36	6.15	7.13

Bldg. Alderman Hall 394

Demand and Energy Records on 120/208 Volt Service Meter No. 30857165

Date of Meter Reading	Days in Period	KW Max. Demand	Average KWHRS Per Day	KWHRS CONSUMED
7/23/74	29	136	2289	66,400
8/23/74	30	144	2373	71,200
9/24/74	32	128	2250	72,000
10/23/74	29	152	2276	66,000
11/22/74	30	136	2307	69,200
12/20/74	28	120	2229	62,400
1/24/75	35	120	1988	69,600
2/25/75	32	128	2250	72,000
3/21/75	24	160	2450	58,800
4/23/75	33	152	2416	81,200
5/22/75	29	152	2331	67,600
6/23/75	32	136	2250	72,000
7/28/75	35	128	2149	75,200
8/22/75	25	128	2240	56,000
9/23/75	32	144	2250	72,000
10/24/75	31	135	2155	66,800
11/25/75	32	152	2250	72,000
12/23/75	28	120	1957	54,800
1/22/76	30	148	1960	58,800
2/20/76	29	136	2165	62,800
3/23/76	32	160	2488	79,600
4/23/76	31	152	2426	75,200
5/24/76	31	152	2348	72,800
6/23/76	30	140	2253	67,600
			TOTAL	1,642,000

Bldg. Alderman Hall 394

Demand and Energy Records on 277/480 Volt Service Meter No. 30857166

Date of Meter Reading	Days in Period	KW Max. Demand	Average KWHRS. Per Day	KWHRS Consume
7/23/74	29	256	3807	110,400
8/23/74	31	240	3437	106,560
9/24/74	32	208	3425	109,600
10/23/74	29	240	2775	80,480
11/22/74	30	200	2688	80,640
12/20/74	28	192	2606	72,960
1/24/75	35	192	2414	84,480
2/25/75	32	160	2630	84,160
3/21/75	24	200	2693	64,640
4/23/75	33	208	2759	91,040
5/22/75	29	240	2731	79,200
6/23/75	32	256	3040	97,280
7/28/75	35	240	4114	144,000
8/22/75	25	237	3693	92,320
9/23/75	32	224	3160	101,120
10/24/75	31	240	2456	76,160
11/25/75	32	192	2485	79,520
12/23/75	28	192	2355	66,240
1/22/76	30	192	2400	72,000
2/20/76	29	162	2532	73,440
3/23/76	32	192	2735	87,520
4/23/76	31	176	2581	80,000
5/24/76	31	176	2565	79,520
6/23/76	30	232	3579	107,360
			TOTAL	2,120,640

Tabulation 1C

BLDG. Alderman Hall 394

COMPOSITE DEMAND AND ENERGY RECORDS BASED

ON ADDITION OF 120/208 VOLT AND 277/480 VOLT READINGS

DATE OF METER READING	DAYS IN PERIOD	KW MAX. DEMAND	AVERAGE KWHRS. PER DAY	KWHRS CONSUMED
7/23/74	29	392	6096	176,800
8/23/74	30	384	5810	177,760
9/24/74	32	336	5675	181,600
10/23/74	29	392	5051	146,480
11/22/74	30	336	5082	149,840
12/20/74	28	312	4917	135,360
1/24/75	35	312	4402	154,080
2/25/75	32	288	4880	156,160
3/21/75	24	360	5143	123,440
4/23/75	33	360	5175	172,240
5/22/75	29	392	5062	146,800
6/23/75	32	392	5290	169,280
7/28/75	35	368	6263	219,200
8/22/75	25	365	5933	148,320
9/23/75	32	368	5410	173,120
10/24/75	31	376	4611	142,960
11/25/75	32	344	4735	151,520
12/23/75	28	312	4322	121,040
1/22/76	30	340	4360	130,800
2/20/76	29	298	4696	136,240
3/23/76	32	352	5223	167,120
4/23/76	31	328	5007	155,200
5/24/76	31	328	4913	152,320
6/23/76	30	372	5832	174,960
			TOTAL	3,762,640

Graphs 1 and 2 were derived from recording charts and indicate variation in demands during the twenty-four hour periods indicated. The area of the graph relates to the amount of energy consumed. Maximum or peak demands are not shown.

These graphs show a relatively large twenty-four hour a day base load. This is due to research equipment which is operating around the clock.

Graph 3 is a bar-graph breakdown of electrical consumption and demand characteristics for various classifications of usage and periods of time. The power factors indicated are for periods of maximum demand. The bar-graphs are self-explanatory particularly if reference is made to classification explanations which follow.

The electrical energy use classifications employed in this section have been chosen because they represent basic requirements and yield to analysis more readily than other available classification options. Following are descriptions of the five classifications selected:

1. Research Facilities and Equipment

   This category covers electrically powered components of equipment specifically required for research and includes built-in facilities and portable equipment. Examples would be fumehoods, environmental control boxes, refrigerators, hot plates and instrumentation.

2. Light

   Illumination required for general task perception. It does not include that used for experimental purposes.

3. Ventilation

   General building ventilation.

4. Miscellaneous Building Equipment

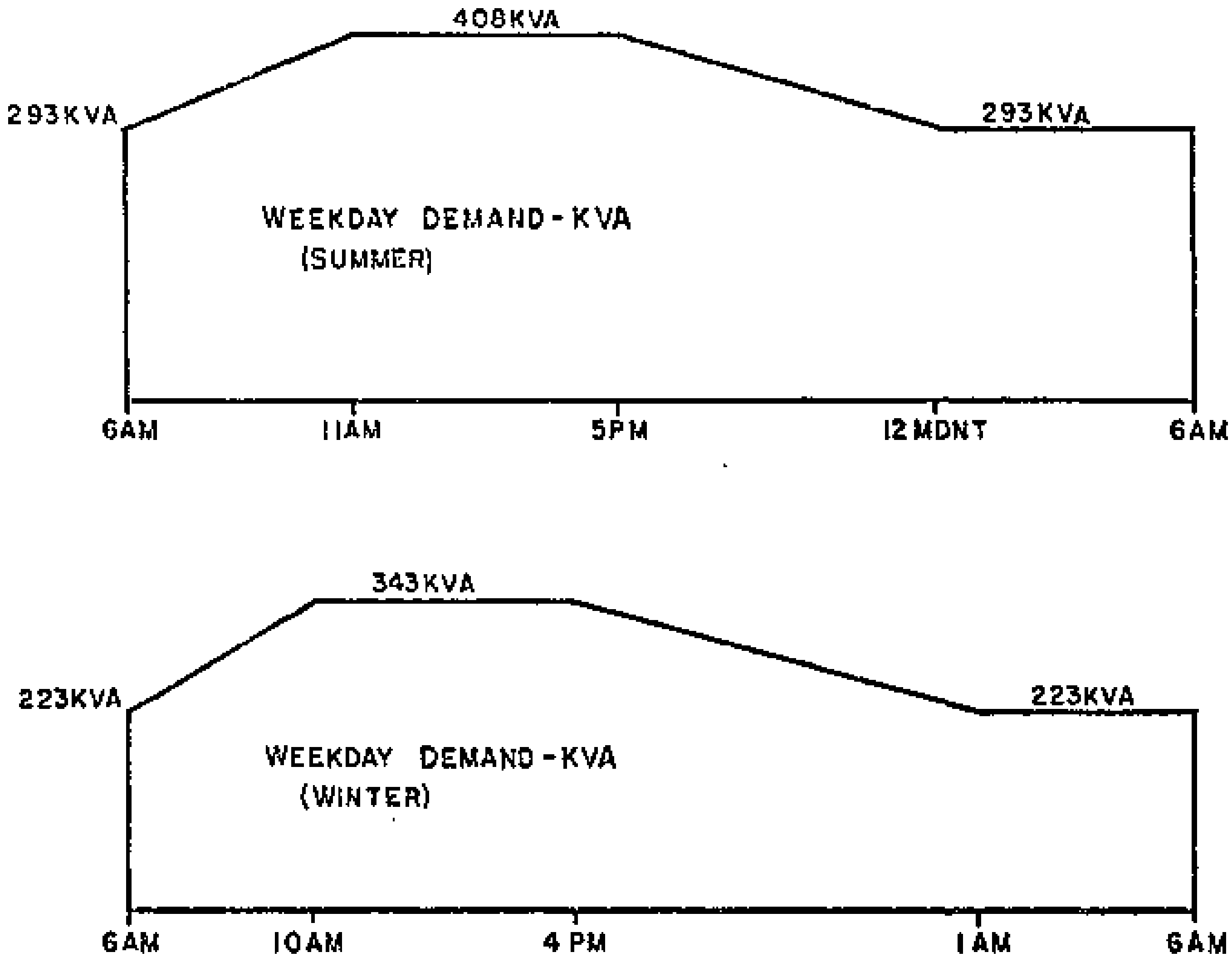
   This includes such items as office equipment, refrigerated drinking fountains and sump pumps.

5. Air Conditioning Equipment

   The equipment used to maintain desired temperatures generally associated with reduction of ambient temperatures to comfortable levels. This equipment handles normal building heat loads, personnel heat loading and research equipment generated heat loads.

6. Electrical Distribution System Losses

   This classification is included in recognition of the gact that electrical energy is expended in the distribution system. In Alderman Hall, these losses were estimated at 1/4 of a percent. These losses have negligible affect on the results of this study.



TYPICAL WEEKDAY PROFILE OF COMPOSITE BUILDING ELECTRICAL DEMANDS
ALDERMAN HALL – ST. PAUL CAMPUS

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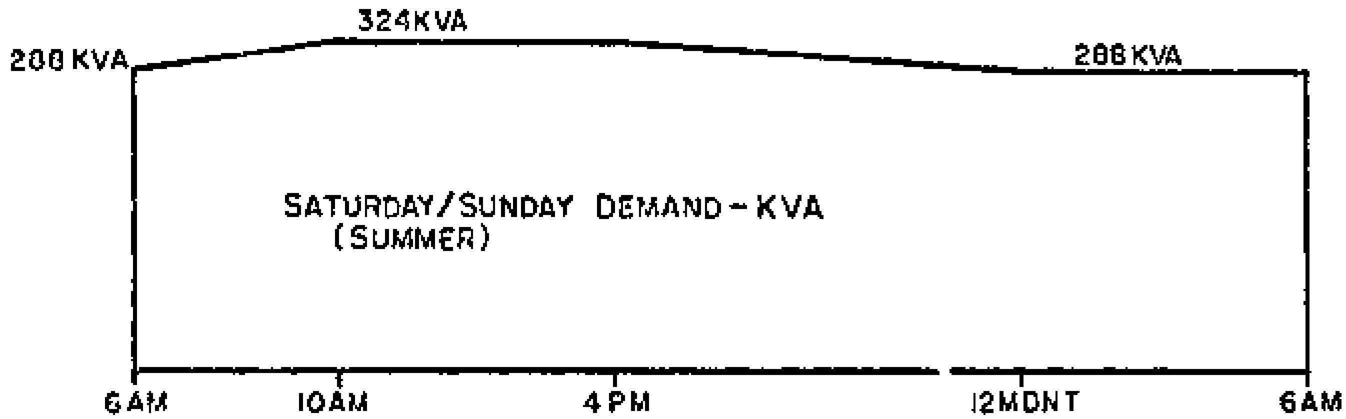
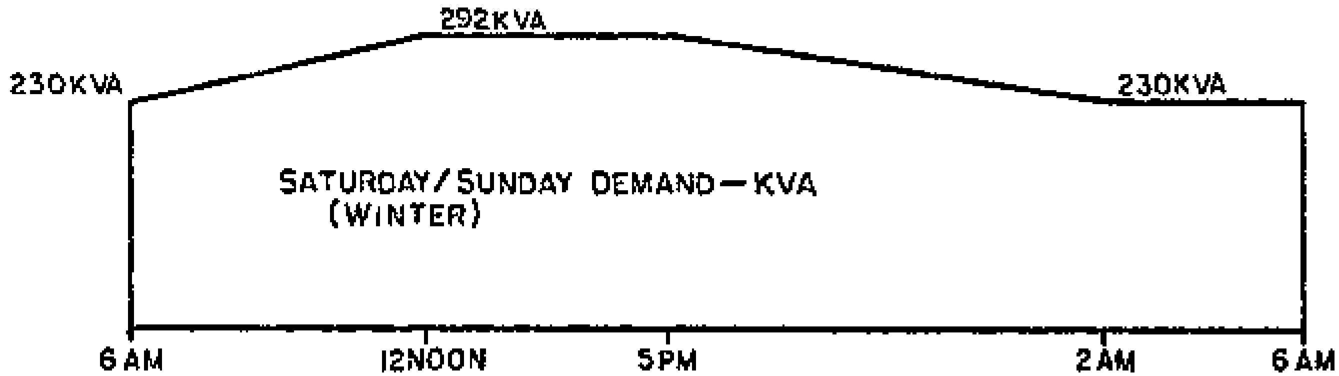
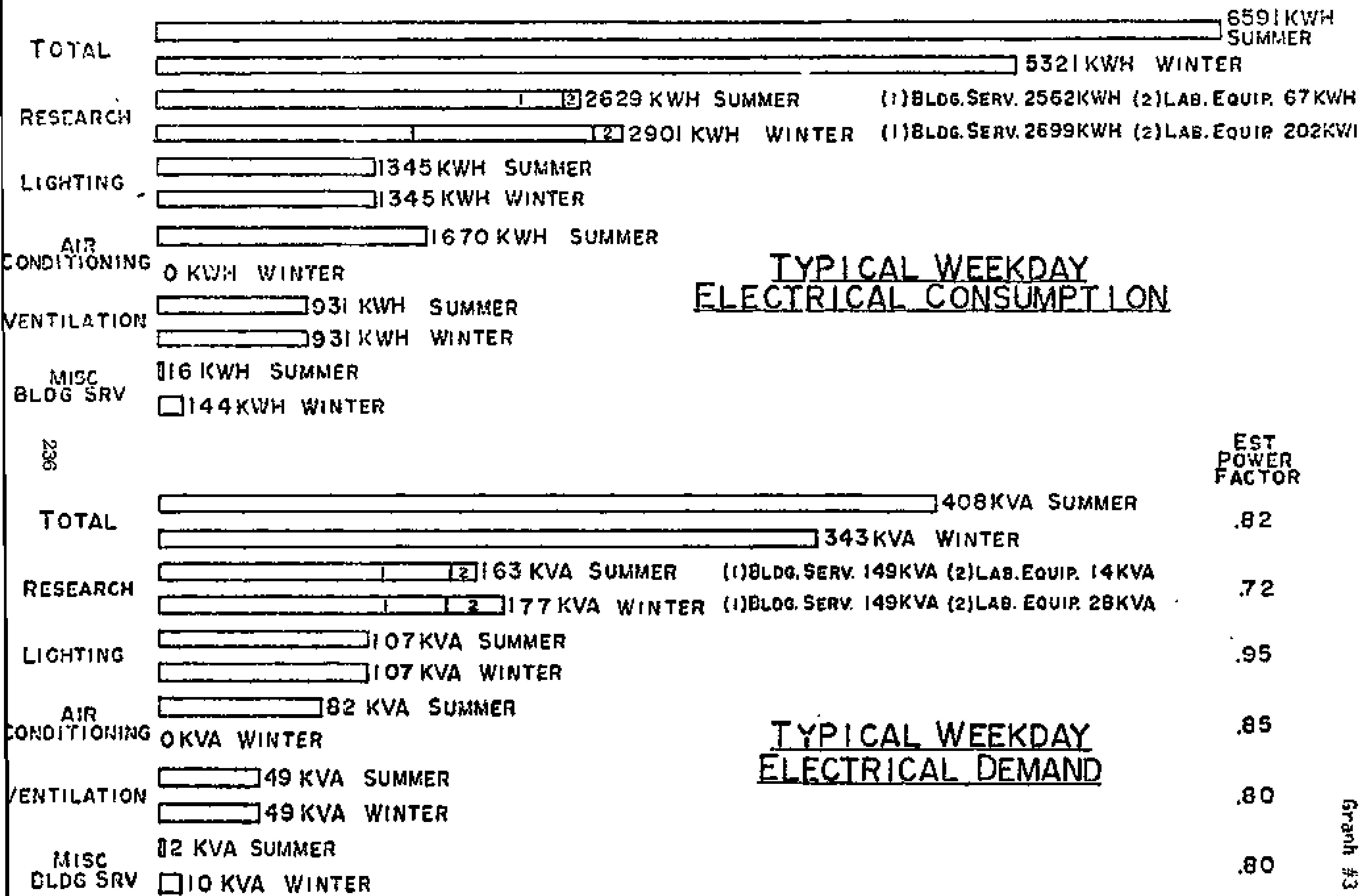




Graph #2

TYPICAL WEEKEND DAY PROFILE OF COMPOSITE BUILDING ELECTRICAL DEMANDS
ALDERMAN HALL – ST. PAUL CAMPUS



Graph #3

TYPICAL DIVISION OF WEEKDAY ELECTRICAL DEMAND AND CONSUMPTION
ALDERMAN HALL – ST. PAUL CAMPUS

CONSERVATION POTENTIALS AND TECHNIQUES FOR ALDERMAN HALL

A. MANAGEMENT OF FACILITIES UTILIZING ELECTRICAL ENERGY

1. Program Changes:

The scope of this report did not include in-depth analysis of program changes which would effectively conserve energy. Programs carried on by departments using the facility are an internal staff and administrative responsibility. However, as the nation's energy problems become more critical, costs continue to rise and government constraints are legislated, the use of energy by a given program may become a major factor in making intelligent program decisions.

Close cooperation between the Physical Planning Office and Departmental staff responsible for programs will be necessary in the future to evaluate the energy impact of a program.

Graphs 1, 2, and 3 on Alderman Hall showing electrical demand and consumption for typical days indicate the following:

A large basic load of research equipment that operates almost around the clock.

A relatively long day of occupancy indicated by increasing loadings starting at 6:00 a.m., rising until 10:00 a.m., decreasing at 4:00 p.m. and dropping to a night-time level at 12:00 midnight or later.

Program changes which would affect these characteristics might be as follows:

Reduction of hours of occupant activity. Surveys indicate laboratory space is not being highly utilized. More persons using labs concurrently would reduce the number of hours of illumination and other basic building services required.

Consolidation of activities to give a higher utilization factor to some areas while allowing minimal service to other areas. This might be effective during particular times of a year such as the air conditioning season.

2. User Conservation:

a. Research Equipment:

The Graph 3, bar-graph, "Typical Division of Weekday Electrical Demand and Consumption - Alderman Hall, St. Paul Campus" indicates that research equipment uses the largest amount of electrical energy and creates the largest electrical demand of any of the energy use classifications designated for this building. Following are percentages for a typical weekday demand and consumption during summer and winter:

Summer: 40% of total demand - 40% of total consumption

Winter: 52% of total demand - 55% of total consumption

Added to this is a part of the air conditioning electrical requirements which correlate with the amount of research facilities involved.

This suggests that a close review of scheduling, usage, and design of equipment used might produce appreciable conservation of energy results. This may not be the case, but it appears to have considerable potential.

b. Lighting

Surveys of use of lighting in the building indicate that approximately 43% of the connected lighting load is on during regular daytime hours. Many spaces not being used did have lights off and lighting in corridors was minimum.

The survey shows, however, that on an average, 51% of the wattage for lighting on was being expended in rooms without occupants. Other figures were as follows:

Lighting wattage per person (Based on total watts in use for occupied and unoccupied spaces)	2207 watts
Lighting wattage per person (Based on watts in use in occupied space only.)	1133 watts

If all of the lighting which was on in spaces not occupied was eliminated, a savings in energy of approximately 225,860 Kilowatt hours per year could be effected. This amounts to 12% of the total annual building consumption. The dollar savings would be: $ 6,776.00. (At present rate of 3¢ per KWH).

c. Miscellaneous Building Equipment

The turning off of office equipment not in use would contribute some energy savings. This category, however, contributes less than 1% of the building load under maximum use.

d. Ventilation

This classification is more of a maintenance and operation function, and the user impact is negligible.

e. Air Conditioning

There is a direct relationship between the amount of electrical power consumed for air conditioning and the amount of air conditioning required. A reduction in electrical consumption would accrue if higher temperatures were tolerated wherever possible. The study of mechanical systems will determine the feasibility of this.

B. MODIFICATIONS OF EQUIPMENT AND SYSTEMS

1. Research Equipment

Very little can be done to modify most of the existing research equipment without expending unreasonable amounts of energy and funding to accomplish the modification.

Any equipment which requires replacement due to failure or absolescence should be replaced with the most energy efficient units available.

2. Lighting:

The previous comments under the heading "User Conservation" and the tabulations of occupants per room versus room lighting-on, indicates that much lighting is on that is not needed. Additional switching to provide control of smaller blocks of lighting in each laboratory is one modification which could be considered. The effectiveness of this, however, depends on occupants utilizing the switching to minimize the amount of lighting in use.

Surveys indicate that much of the time only one or two people occupied rooms where all the lighting was on.

One room (335) was analyzed as a typical case. In this instance, dividing lighting into four (4) separately controlled sections was considered. In this case, wiring modification to affect the change was estimated to cost $ 1,100. The annual energy saved, if only the quarter section occupied were lighted, would average 3,312 Kilowatt hours per year based on a ten hour day, five day week and fifty week year. At 3¢/KWH, this amounts to $ 99 annually. This leads to the conclusion that switching modifications are not viable solutions to conservation of energy in this building at present. As rates increase, this may not continue to be true. It is also questionable that occupants would always use the switches available.

The lighting fixtures are arranged in a symetrical pattern for a uniform illumination throughout the room. The average level of illumination throughout the room is 80 foot candles. The minimum I.E.S. value for a laboratory task is 100 foot candles. It would appear lighting levels are not excessive if full use was being made of the laboratory.

Room 201 houses a large number of growth chambers, temperature control boxes, freezers and refrigerators. Most of the activity involved in this room appears to be limited to checking items in these units. Since the illumination in this room is rather heavy for this type of use, lighting should be reduced. This can be accomplished by removing about 66 percent of the lamps and disconnecting ballasts for these units. This would save 15,666 KWHRS annually on a 2,500 hour per year base. Annual dollar savings at 3¢ per KWHR would be $ 470.

In other lab areas, it appears that approximately 20% of lamps and ballasts could be deactivated with little affect on lighting needed for tasks. This would save 19,542 KWHRS and $ 586 per year.

3. Ventilation:

Any modifications resulting in electrical energy savings will be detailed in the mechanical system study.

4. Miscellaneous Building Equipment:

Equipment in this classification is not generally adaptable to modification. When selecting replacements, energy saving units should be requisitioned. As previously indicated, this classification contributes only a small amount to total energy used.

5. Air Conditioning:

Any reduction in the amount of air conditioning required, would result in electrical energy savings. Reference to the mechanical systems study, report should be made for any modifications to the air conditioning systems recommended.

While air conditioning represents approximately 25% of the electrical energy used during a typical summer day, no air conditioning is used during the winter. It is estimated that the air conditioning system uses about 8% of the annual electrical energy consumption for Alderman Hall.

C. MAINTENANCE AND OPERATION

Over one half the electrical energy demand for research equipment is created in room 232. This is a space occupied by growth chambers, temperature control boxes, freezers and similar equipment. Temperatures of 75°F were observed during winter months. If ambient temperature was reduced to 65°F in this area, a reduction of approximately 13% in electrical energy necessary to operate equipment could be obtained. This would save 65,000 KWHRS annually at a cost-savings of $ 1,300.

Other areas of conservation of electrical energy are dependent on the control and operation of ventilation and air conditioning systems. These will be treated in the report on mechanical systems.

Electrical motors with higher efficiencies and better power factor characteristics are now available in integral ratings. When replacing motors, consideration should be given to using this type of unit.

Efficiency improvement runs from 2% on a twenty horsepower motor to 6% on a one horsepower unit. Power factor improvement increases from 71% for a conventional motor to 84% for the newer units on one horsepower motors. This decreases to a 3% difference at the 20 horsepower rating. These units are also less sensitive to high voltage which causes drops in any motor power factor.

While these motors are slightly more expensive than conventional units, the pay-back based on a 4,000 hour per year use and 3¢/KWHR, runs from less than a year for a 3 hoursepower unit to three years on a 25 horsepower unit. Energy pay-backs on the copper, iron and aluminum range from 800 to 2,000 hours of running time.

D. SUMMARY OF CONSERVATION POTENTIALS FOR ALDERMAN HALL

Tabulation 2 summarizes conservation of energy options. These relate basically to electrical usage not greatly influenced by mechanical systems. Conservation of electrical energy as it applies to such systems as ventilation, and air conditioning will be covered under the study of mechanical systems.

It is apparent from the tabulation that the greatest energy savings potential is in the management of facilities category. If people can be motivated to use electrical energy efficiently, this will accomplish more than any other option.

The assumption that a 10 percent improvement in efficiency may be used for research facilities and equipment is based on discussions with occupants and observations of existing procedures.

The replacement of equipment and motors which became obsolete or fail with more efficient units, will also increase energy savings. As previously mentioned, it would not be cost effective or conserve energy to replace these outright at this time. These items have not been included in the tabulations.

Power factor correction has not been tabulated since it does not affect the energy consumption in this building to any appreciable degree. On the basis of reduction in the KVA demand charges by the utility company, it would be economically justified. Correction to 95 percent is estimated to cost \$ 3845 and result in a \$ 2,787 annual reduction in KVA demand charges.

EVALUATION OF ALDERMAN HALL ELECTRICAL DESIGN BASED ON CONSERVATION OF ENERGY CODES AND TECHNIQUES FOR NEW BUILDINGS

The existing building meets, to a fair degree, the electrical requirements of SBC 6010 and lighting requirements of SBC 6011 of the Design and Evaluation Criteria for Energy Conservation in Buildings which was adopted by the State of Minnesota Department of Administration Building Code Division and became effective January 30, 1976.

Greater electrical energy conservation could have been achieved by more restrictive codes and better conservation design techniques with minimal affect on programs.

The electrical distribution system meets the requirements for efficient distribution of energy. Feeder systems have light to moderate loading which results in minimal losses and voltage drops within code requirements.

TABULATION OF POTENTIAL CONSERVATION OF ENERGY OPTIONS - EXISTING BUILDING

ELECTRICAL UTILIZATION CLASSIFICATION	ACTION	ANNUAL KWH SAVING	% OF TOTAL CONSUMPTION	ANNUAL SAVINGS AT 3¢/KWH	COST OF ACTION	COST EFFECTIVE
MANAGEMENT OF FACILITIES UTILIZING ELECTRICAL ENERGY						
Research Facilities and Equipment	Improve use and Scheduling of Equipment (Estimated 10% improvement)	100,016	5.3%	$ 3,003	Staff time to institute changes and to Administer.	Probably
Lighting	Institute program to turn off lighting not in use.	225,800	12%	$ 6,776	Staff time to motivate and to promote use of switching. Possible use of custodial personnel.	Yes
MODIFICATION OF EQUIPMENT AND SYSTEMS						
Research Facilities and Equipment	Re-wire Room 335 to provide more effective switching.	3,312	.2%	$ 99	$ 1,100 to re-wire	No
Lighting	Remove 66% of lamps and disconnect ballasts in Room 201	15,666	.8%	$ 470	$ 226	Yes
	Remove 20% of Lamps and deactivate ballasts in 9 Lab areas.	19,542	1%	$ 586	$ 283	Yes
MAINTENANCE AND OPERATION						
Ventilation and Air Conditioning	Reduce Room temperature from 75° To 65°F	15,000	.8%	$ 450	Negligible	Yes

The type of over-design of distribution system that occurs in this case should be avoided in any future facility, since it uses more materials than can be justified to accomplish any operational energy savings that may accrue.

The power factor of the overall electrical distribution system in the building does not meet the 90 percent requirement of the present code. Since building electrical feeder loading is not heavy, the correction of power factor at utilization equipment will not result in any appreciable energy savings within the building distribution system.

The problem is that a lower power factor is reflected as a larger amperage (or KVA) in the utility generation and distribution systems. The rates applied by the utility company on KVA demand are now high and power factor correction becomes economically necessary. The University is installing power factor equipment at the campus sub-station. Further studies should be done to evaluate the benefits of applying power factor equipment in existing buildings versus campus system correction. At this point, correction at the sub-station appears most cost-effective. Graph 3 indicates the most beneficial application of power factor equipment within the building would be at switchboards supplying research equipment. This constitutes the largest individual load and has a power factor of only 72 percent.

In the design of new facilities, the existing code would require correction anywhere within the building. ASHRAE 90-75 is now being considered by the State of Minnesota for incorporation in the conservation of energy code. Under these requirements, power factor correction would be required at equipment utilizing electrical power. In most cases, this would give the most automatic power factor correction but might not be the most cost-effective. If properly designed, it will reduce the capacity of electrical distribution system required.

The lighting load for installed lighting does not exceed the code lighting budget requirements. Lamp efficiencies are greater than required by code. Levels of illumination in the larger number of cases are less than code maximums. In some areas, illumination levels are greater than minimums for tasks involved. The net result is, however, within budget. This is also true of luminaire efficiency.

Efficiency of lighting systems could have been improved by 25 percent using more efficient luminaires.

Room reflectance factors could be improved. Further reduction in energy requirements for illumination could be made by localizing task lighting, particularly in office areas. In some areas levels of illumination can be reduced and still provide adequate task lighting.

In many cases, the building lighting design does not meet code requirements for switching. Choices of switching to provide varying levels of illumination and localized lighting are almost non-existent. Any future design should incorporate techniques which provide switching options to allow minimal lighting required for a given task.

Use of more efficient motors would also provide a reduction in the amount of energy consumed in the building. To date, the use of more efficient, higher power factor motors in mechanical equipment design has been almost non-existant. One manufacturer who specializes in the design of such motors indicates slow acceptance of these units. Both mechanical and electrical design must encourage the use of these units.

The building transformers are only one half loaded. Future design should aim at matching transformers more closely with demand. This again, would reduce the no-load loss of the transformers which contribute to wasted energy.

In the future, a careful review of facility equipment requirements with a goal of reducing duplication and improving efficiency should be made in the early design development stage. This should be done with using departments participating.

An estimated reduction of 16 percent in annual kilowatt consumption would have been affected if energy conserving design elements indicated had been employed. An additional 8 percent electrical energy savings could then have been achieved by turning lights off which were not in use. This reduction does not include any savings which might occur due to mechanical system design changes.

CONCLUSION

The areas of greatest electrical energy saving potential in Alderman Hall are in the management of facilities which utilize electrical energy.

The development of an Energy Education Program to motivate occupants to conserve in their use of electrical energy and better relate their needs to design and operating staffs at the University is needed.

One of the elements of an Energy Education Program should be a procedure for informing staff members on how energy is being used in their building and methods of using it more efficiently. The use of light in the home and place of employment is so commonplace that few people probably understand the impact turning a light switch off will have on energy consumption. Information based on data from this report would be helpful in illustrating the significance of such action.

Participation by staff in a program which presents reasons and asks for suggestions, should give better results. In the preliminary stages of this study, presentation of some of the initial data to staff members generated considerable discussion and some good suggestions for possible reduction in the use of energy in the building. Past studies on campus have indicated the provision of switching options does not always assure they will be used. Asking people to turn off lighting or having custodians do this is helpful, but has limited effectiveness. Education of staff would produce long-term benefits both within the University Community and outside by providing citizens with greater energy conscience and knowledge.

Better utilization of space, equipment and building facilities are other areas that should be treated in a similar manner in an Energy Education Program.

Energy Education Programs should include personnel from the following areas:

The Department occupying the facility.

Physical Planning Office, Space Programming and Management.

Physical Planning Office, Engineering and Construction.

Physical Plant, Maintenance and Operation.

Modification to equipment and systems within the building are minimal in cost to accomplish and in energy savings. Replacement of existing facilities as required should be done with emphasis upon more efficient equipment.

Future surveys and building studies will be simplified as a result of procedures developed for this report.

Information gained will be used in further development of design criteria and improved procedures to affect and review both in-house design and that by outside Architects and Engineers.

INTERIM REPORT ON
ENERGY CONSERVATION
HORTICULTURE SCIENCE (ALDERMAN HALL)
ST. PAUL CAMPUS

I. Acknowledgements

Recognition must be given to the excellent cooperation and assistance received from the staff of the Department of Horticulture. Dr. Mark Brenner has been particularly helpful in identifying space use and utilization, and pointing out possible problem areas. Physical Plant has been of assistance in providing steam consumption figures for Alderman Hall and data on control and monitoring capabilities of the Honeywell DELTA 2000.

II. Building Envelope Analysis

The evaluation of wall and roof construction indicates that Alderman Hall has average "U" values of:

$$U_{av} \text{ (wall)} = 0.342$$

$$U \text{ (roof)} = 0.110$$

The values exceed state energy code maximum values of 0.22 and 0.10 for walls and roof respectively.

The exposed walls are 15% glass, single sheet, heat absorbing type. The balance of the wall is masonry construction, vermiculite filled concrete block and 4" face brick.

Adding insulation to the masonry walls and/or providing insulating glass will be analyzed further in terms of economic justification.

III. Methods of Reducing Energy Consumption - Alderman Hall

Th following operational techniques may be employed to reduce energy consumption without cost to the University:

1) Reduce temperature of circulated domestic hot water to 105°F from 140°F design.

   Domestic hot water temperatures have been lowered in numerous University buildings by Physical Plant. However, this has not been verified with regard to Alderman Hall.

2) Change temperature reset schedule on radiation water to effectively reduce water temperature.

   Radiation water temperature can be reset if overheating is being experienced. Indications are that the existing systems should be rebalanced before attempting reductions in water temperature.

3) Shut off ventilation systems during periods of no occupancy.

At present, systems S-1 (1st floor) and S-4 (4th floor) are being shut down from 2200 to 0700 daily. These systems totaling 36,000 CFM account for approximately 40% of the design requirements for the building. Consideration should be given to extending daily down time.

The following potential methods of reducing energy consumption in Alderman Hall, each of which represent a capital investment, will be investigated further:

4) Reduction of outside and exhaust air quantities.

Space use in Alderman Hall can, in general, be categorized as laboratories requiring continuous operation, and offices, conference rooms, and laboratories being used intermittently.

A preliminary analysis of the 2nd floor, served by S-2 (24,000 CFM) indicated that design air qualities for each category are:

a) Continuous operation (13,800 CFM)

b) Intermittent operation (10,200 CFM)

It is significant that the original design generally required ventilation air for peripheral areas only to satisfy cooling requirements. For this reason, it would seem appropriate to add dampers and necessary controls to shut off air to these areas (specifically areas served by reheat zones 2-1, 2-2, 2-7, 2-8, 2-9, 2-11, 2-13, 2-14, & 2-15) during the heating season.

Further, during summer operation, these zones could be shut down nights and weekends.

Zone 2-6, serving room 201, requires 8550 CFM. Indications are that this zone could be modified from the present reheat control to variable air volume with reheat control.

The balance of the reheat zones serve laboratories requiring continuous operation. Recognizing the fact that each fume hood is designed to be an integral part of the overall ventilation system, but having a local on-off switch, additional study (in conjunction with Environmental Health & Safety) is necessary to insure maximum energy conservation without sacrificing health and safety.

5) Energy recovery for continuous exhaust air systems.

Further analysis will be made regarding energy recovery from continuous exhaust systems, principally exhausts from fume hoods.

6) Code compliant envelope construction.

Although improving the building envelope to comply with the state energy code will involve high first costs, it may be cost effective over the life of the building.

7) Temperature control modification.

Control modifications primarily relate to units S-2 and S-3, serving 2nd and 3rd floor respectively. These modifications will include enthalpy control, variable air volume control on supply and return exhaust fans, and added controls to achieve variable air colume to various conditioned spaces.

8) Heat recovery from process and air conditioning condenser water.

The continuous-duty process cooling tower (60 ton) used in conjunction with water cooled condensers on various growth chambers, cold rooms and freezers provides an attractive possibility for heat recovery. Continuous heat recovery could be achieved by the installation of a storage tank and water-to-water heat exchanger ahead of the existing domestic hot water heater. An alternative for winter operation would be a water-to-air exchanger ahead of the preheat coils on the ventilating units.

9) Variable speed chilled water pump drives.

The cost effectiveness of variable speed drives on the chilled water pumps will be determined, based on building requirements and data relating to a similar installation contemplated by Physical Plant for Health Science, Unit A.

10) Replacement of steam generated still with reverse osmosis unit.

The use of "pure" water as provided by reverse osmosis equipment in lieu of distilled water has not been reviewed with users in Alderman Hall. If it is acceptable, the cost effectiveness of such an installation, based on present distilled water consumption and related steam consumption will be determined.

1.7.2 ELECTRICAL DEMAND

The following tabulation is a listing of East and West Bank Campus building service transformer ratings, and measured instantaneous demand and power factor. These readings were taken between the hours of 10 A.M. and 2 P.M. on a normal work day and provides a reasonable indication of transformer loading.

East Bank 1975-1976 Fiscal Year

Building No.	Transformer Location	Transformer Capacity KVA	HV,KV	LV	Measured Demand KVA	Measured Power Factor
008	Burton Hall	500	13.8	208	126	.95
019	Child Development (New Half)	225	13.8	208	45	.88
020	Elliot-West	575	13.8	208	86	.93
	Elliot-N.W.	500	13.8	208	144	.80
	Elliot-S.W.	500	13.8	208	149	.85
	Elliot-S.E.	500	13.8	208	150	.81
030	Exp. Engr. North	575	13.8	208	102	N.L.
033	Millard-East	500	13.8	208	230	.93
	Millard-West	10	13.8	120	.65	N.L.
034	Heating Plant Sub 1-A	750	13.8	480	43	N.L.
	Heating Plant Sub 1-B	1000	13.8	480	368	N.L.
035	Smith B1T1	575	13.8	208	270	.93
	Smith B1T2	575	13.8	208	180	.78
036	Norris Gym. East	501	13.8	208	205	N.L.
037	Appleby Hall-West	500	13.8	208	142	.86
038	Zoology-Botany W.	999	13.8	208	447	.9
041	Mineral Res. North	501	13.8	240	N.L.	N.L.
042	Walter Lib. N.E.	575	13.8	208	203	N.L.
	Walter Lib. S.E.	575	13.8	208	126	N.L.
043	Elect. Engr. Unit Sub.	500	13.8	208	81.8	N.L.
	Elect. Engr. North	575	13.8	208	88	N.L.
046	Morrill Hall-South	501	13.8	208	285	.92
	Morrill Hall-North	501	13.8	208	45	.87
049	Physics-North	500	13.8	208	417	N.L.
	Physics-South	500	13.8	208	108	N.L.
051	Fraser Hall-West	500	13.8	208	124	N.L.

N.L. = Not Listed

Building No.	Transformer Location	Transformer Capacity KVA	HV,KV	LV	Measured Demand KVA	Measured Power Factor
053	Northrop-West	575	13.8	208	182	.96
	Northrop-East	575	13.8	208	158	.93
054	Owre Hall-N.	576	13.8	208	118	.85
055	Powell Hall-E.	300	13.8	208	N.L.	N.L.
060	Vincent Hall-N.	501	13.8	208	282	.91
061	Bell Museum-N.	575	13.8	208	207	N.L.
	Bell Museum-S.	575	13.8	208	91	N.L.
063	Comstock-North	576	13.8	208	125	N.L.
064	Coffman Memorial-N	750	13.8	480	N.L.	N.L.
	Coffman Memorial-S.	750	13.8	480	299	N.L.
065	Mech-Aero.-East	500	13.8	208	236	.88
	Mech-Aero-West	500	13.8	208	0	N.L.
	Mech-Aero-Furnace	150	13.8	2.4	0	N.L.
	Mech-Aero-Wind Tunnel	225	13.8	480	N.L.	N.L.
066	Chem. Engr.-South	575	13.8	208	131	N.L.
069	Heart Hosp-South	501	13.8	208	N.L.	N.L.
	Heart Hosp-Nest X-Ray	501	13.8	208	N.L.	N.L.
070	Health Service-W.	501	13.8	208	147	N.L.
072	Bierman Field-A	300	13.8	480	1.8	N.L.
	Bierman Field-B	300	13.8	480	295	N.L.
074	Mayo-East	560	13.8	208	162	.86
	Mayo-West	560	13.8	208	210	N.L.
	Mayo-S.E.	500	13.8	208	186	.90
	Mayo-N.E.	500	13.8	208	0	N.L.
	Mayo-S.W.	1000	13.8	208	203	.67
	Mayo-East			FUTURE		
	Mayo-Center			FUTURE		
	Mayo-North			FUTURE		

Building No.	Transformer Location	Transformer Capacity KVA	HV,KV	LV	Measured Demand KVA	Measured Power Factor
074	Mayo-South	-		FUTURE		
	Mayo-X-Ray			FUTURE		
	Mayo-South	561	13.8	208	184	.83
	Mayo-North	561	13.8	208	234	.82
	Mayo-#9A	750	13.8	208	224	.92
	Mayo-#9B	1000	13.8	208	0	.72
	Mayo-#9C-X-Ray	500	13.8	480	25	N.L.
076	Linac-N.E.	75	13.8	208	18	.80
077	Peik Hall	501	13.8	208	73	.95
079	Lyon Lab-Middle	500	13.8	208	285	.78
104	Mines & Metal.-East	575	13.8	208	246	.95
107	Masonic-West	300	13.8	208	224	N.L.
108	Diehl Hall-South	1500	13.8	208	N.L.	.95
109	V.F.W.-South	300	13.8	208	N.L.	N.L.
112	Architecture-East	500	13.8	208	143	.98
114	Jackson-Owre-West	864	13.8	208	320	.87
115	Child Rehab.-North	750	13.8	208	327	.89
116	Science Classroom-E.	501	13.8	208	91	.92
118	Tandem Acc.-North	300	13.8	208	53	N.L.
	Tandem Acc.-Middle	300	13.8	208	30	N.L.
	Tandem Acc.-South	150	13.8	208	1.25	N.L.
122	Kolthoff A1T1	575	13.8	480	443	.79
	Kolthoff-A2T2	575	13.8	480	229	.86
	Kolthoff-A2T1	575	13.8	480	254	.86
123	Science Class.-S.	86	13.8	4.16	19	N.L.
124	Ramp B-Middle	501	13.8	460	244	.86

Building No.	Transformer Location	Transformer Capacity KVA	HV,KV	LV	Measured Demand KVA	Measured Power Factor
125	Space Sci. Cntr.-E-SS1A	500	13.8	208	210	.97
	Space Sci. Cntr.-W-SS1B	500	13.8	208	27	N.L.
	Space Sci. Cntr.-N-SS2B	500	13.8	208	184	.88
	Space Sci. Cntr.-S-SS2A	500	13.8	208	56	.85
132	Klaeber Court-S.	150	13.8	208	N.L.	N.L.
139	Bierman Building Pad.	750	13.8	208	275	N.L.
142	Unit A-US #1 Left	2300	13.8	480	N.L.	N.L.
	Unit A-US #1-Right	2300	13.8	480	N.L.	N.L.
	Unit A-US #1A	1725	13.8	480	313	.5
	Unit A-US #2	1725	13.8	480	319	.65
	Unit A-US #2A	1725	13.8	480	790	.83
	Unit A-US #3	1725	13.8	480	N.L.	N.L.
	Unit A-US #3A	1725	13.8	480	N.L.	N.L.
143	Unit K/E-West	1725	13.8	480	207	N.L.
	Unit K/E-N.E.	575	13.8	208	262	N.L.
	Unit K/E-Middle	1725	13.8	480	N.L.	N.L.
152	East Bank Bookstore-E	750	13.8	480	N.L.	N.L.
134	Printing & Graph. Art	500	13.8	208	256	.9
027	Fairmount St. & 29th Ave.	75	13.8	2.4	N.L.	N.L.
119	Heavy Equip. Yard	25	2.4	240	N.L.	N.L.
098	Chem. Storehouse-N.E.	225	13.8	208	91	.98
113	Food Stores-North	501	13.8	208	228	.86

East Bank 1976-1977 Fiscal Year

Building No.	Transformer Location	Transformer Capacity KVA	HV,KV	LV	Measured Demand KVA	Measured Power Factor
008	Burton Hall	500	13.8	208	130	.87
019	Child Development	225	13.8	208	25	N.L.
020	Elliot-West	575	13.8	208	54	N.L.
	Elliot-N.W.	500	13.8	208	189	N.L.
	Elliot-S.W.	500	13.8	208	159	.82
	Elliot-S.E.	500	13.8	208	179	.87
028	Sanford Hall	501	13.8	208	186	N.L.
031	Main Engr.	575	13.8	208	N.L.	N.L.
033	Millard-East	575	13.8	208	403	N.L.
	Millard-West	10	13.8	120	.875	N.L.
	Millard-Middle	575	13.8	120	391	.88
034	Heating Plant-Sub 1-A	750	13.8	480	113	.84
	Heating Plant-Sub 1-B	1000	13.8	480	N.L.	.86
035	Smith-B1T1	575	13.8	208	225	N.L.
	Smith-B1T2	575	13.8	208	169	N.L.
036	Norris Gym.-E	501	13.8	208	271	N.L.
037	Appleby Hall-West	500	13.8	208	142	.86
038	Zoology-Botany-W	999	13.8	208	165	N.L.
041	Mineral Res.-North	501	13.8	240	50	.85
042	Walter Lib.-N.E.	575	13.8	208	192	.94
	Walter Lib.-S.E.	575	13.8	208	117	.88
043	Elect. Engr.- Unit Sub	500	13.8	208	91	.88
	Elect. Engr.-North	575	13.8	208	99	.89
044	Shops Building	450	13.8	208	169	N.L.
045	Memorial Stadium-020	225	13.8	208	83	.97
Rm. 268	Memorial Stadium-050	150	13.8	208	46	.82

N.L. = Not Listed

Building No.	Transformer Location	Transformer Capacity KVA	HV,KV	LV	Measured Demand KVA	Measured Power Factor
046	Morrill Hall-S.	501	13.8	208	238	.87
	Morrill Hall-N	501	13.8	208	39	.98
049	Physics-North	500	13.8	208	189	N.L.
	Physics-South	500	13.8	208	88	.87
050	Williams Arena-014	500	13.8	208	0	.85
	Williams Arena-016	150	13.8	208	0	.85
	Williams Arena-018	150	13.8	208	12	N.L.
	Williams Arena-020	100	13.8	240	46	.86
	Williams Arean-022	500	13.8	208	233	N.L.
051	Fraser Hall-W.	500	13.8	208	127	N.L.
052	Pioneer Hall & Court	300	13.8	208	150	.87
053	Northrop-West	575	13.8	208	222	N.L.
	Northop-East	575	13.8	208	120	.97
054	Owre Hall-North	576	13.8	208	149	N.L.
055	Powell Hall-East	300	13.8	208	201	N.L.
056	Cooke Hall	300	13.8	208	152	N.L.
057	Nolte Center-030	575	13.8	208	196	N.L.
	Nolte Center-031	575	13.8	208	132	.86
060	Vincent Hall-N.	501	13.8	208	230	.88
063	Comstock-North	576	13.8	208	126	.94
064	Coffman Memorial-North	750	13.8	480	127	.85
	Coffman Memorial-South	750	13.8	480	581	N.L.
065	Mech-Aero-East	500	13.8	208	180	N.L.
	Mech-Aero.-West	500	13.8	208	0	N.L.
	Mech-Aero.-Furnace	150	13.8	24	0	N.L.
	Mech-Aero.-Wind Tunnel	225	13.8	480	0	N.L.
066	Chem. Engr.-South-30	575	13.8	208	137	.80
	Chem. Engr.-South-31	575	13.8	208	131	N.L.

Building No.	Transformer Location	Transformer Capacity KVA	HV,KV	LV	Measured Demand KVA	Measured Power Factor
067	U of M Field House	501	13.8	208	192	.88
068	Centennial Hall	300	13.8	208	208	.90
069	Heart Hospital-South	501	13.8	208	242	N.L.
	Heart Hosp- Nest X-Ray	501	13.8	208	0	N.L.
070	Health Service-W	501	13.8	208	210	N.L.
072	Bierman Field "A"	300	13.8	480	180	.93
	Bierman Field "B"	300	13.8	480	256	.94
073	Johnston Hall	345	13.8	480	118	N.L.
074	Mayo-East	560	13.8	208	95	N.L.
	Mayo-West	560	13.8	208	148	N.L.
	Mayo-S.E.	500	13.8	208	141	N.L.
	Mayo-N.E.	500	13.8	208	0	N.L.
	Mayo-S.W.	1000	13.8	208	0	N.L.
	Mayo-East	Future	13.8	208	0	N.L.
	Mayo-Center	Future	13.8	208	0	N.L.
	Mayo-North	Future	13.8	208	0	N.L.
	Mayo-South	Future	13.8	208	0	N.L.
	Mayo-X-Ray	Future	13.8	208	0	N.L.
	Mayo-South	561	13.8	208	151	N.L.
	Mayo-North	561	13.8	208	216	N.L.
	Mayo-9A	750	13.8	208	190	N.L.
	Mayo-9B	1000	13.8	208	0	N.L.
	Mayo-9C-X-Ray	500	13.8	480	6	N.L.
	Mayo-315	500	13.8	480	289	N.L.
	Mayo-325	500	13.8	480	206	N.L.
076	Linac-N.E.	75	13.8	208	9	N.L.
077	Peik Hall	501	13.8	208	194	.86

Building No.	Transformer Location	Transformer Capacity KVA	HV,KV	LV	Measured Demand KVA	Measured Power Factor
090	Dept. Police Building	75	13.8	240	0	N.L.
098	Chemical Storehouse-N.E.	225	13.8	208	102	N.L.
100	Poucher Building	500	13.8	208	310	.88
103	Ramp A	25	13.8	208	0	N.L.
104	Mines & Metal.-East	575	13.8	208	254	N.L.
105	Territorial Hall	300	13.8	208	144	N.L.
107	Masonic-West	300	13.8	208	184	N.L.
108	Diehl Hall-S.	1500	13.8	208	734	N.L.
109	V. F. W. - South	300	13.8	208	65	N.L.
110	Frontier Hall	300	13.8	208	75	N.L.
112	Architecture-East	500	13.8	208	168	.97
113	Food Stores	167	13.8	208	152	.87
114	Jackson-Owre-West	864	13.8	208	456	N.L.
115	Child. Rehab.-North	750	13.8	208	199	N.L.
116	Science Classroom-East	501	13.8	208	87	N.L.
118	Tandem Acc.-North	300	13.8	208	108	N.L.
	Tandem Acc.-Middle	300	13.8	208	108	N.L.
	Tandem Acc.-South	150	13.8	208	23	N.L.
122	Kolthoff-A1T1	575	13.8	480	203	N.L.
	Kolthoff-A2T2	575	13.8	480	209	N.L.
	Kolthoff-A2T1	575	13.8	480	243	N.L.
123	Science Classroom-South	86	13.8	4.16	71	N.L.
	Science Classroom-East	25	13.8	240	.023	0
	Science Classroom-Center	25	13.8	240	9	N.L.
	Science Classroom-West	25	13.8	240	7	N.L.
124	Ramp B-Middle	501	13.8	460	203	N.L.
125	Space Sci. Ctr.-East-SS1A	500	13.8	208	209	.87
	Space Sci. Ctr.-West-SS1B	500	13.8	208	118	.85

Building No.	Transformer Location	Transformer Capacity KVA	HV,KV	LV	Measured Demand KVA	Measured Power Factor
125	Space Sci. Ctr.-N-SS2B	500	13.8	208	249	.84
	Space Sci. Ctr.-S-SS2A	500	13.8	208	55	N.L.
130	Inventory Warehouse	112.5	13.8	208	2	N.L.
131	Std. Oil Bldg. - A	112.5	13.8	208	N.L.	N.L.
	Std. Oil Bldg. - B		13.8	208	N.L.	N.L.
132	Klaeber Court-South	150	13.8	208	N.L.	N.L.
134	Printing & Graphic Art	500	13.8	208	335	.84
139	Bierman Field	750	13.8	208	321	.95
	Athletic Building					
142	Unit A-US #1 Left	2300	13.8	480	838	.70
	Unit A-US #1 Right	2300	13.8	480	602	.76
	Unit A-US #1A	1725	13.8	480	641	.72
	Unit A-US #2	1725	13.8	480	392	N.L.
	Unit A-US #2A	1725	13.8	480	818	.82
	Unit A-US #3	1725	13.8	480	380	N.L.
	Unit A-US #3A	1725	13.8	480	540	N.L.
143	Unit K/E-West	1725	13.8	480	262	N.L.
	Unit K/E-N.E.	575	13.8	208	166	N.L.
	Unit K/E-Middle	1725	13.8	480	242	N.L.

West Bank – 1975-1976 Fiscal Year

Building No.	Transformer Location	Transformer Capacity KVA	HV,KV	LV	Measured Demand KVA	Measured Power Factor
202	Social Sci.-East	501	13.8	208	N.L.	N.L.
203	Blegen Hall-N.	750	13.8	240	N.L.	N.L.
204	Wilson Lib.-A1T1-East	500	13.8	480	N.L.	N.L.
	Wilson Lib.-A2T2-Mid.	500	13.8	480	N.L.	N.L.
	Wilson Lib.-A2T1-West	500	13.8	480	N.L.	N.L.
	Wilson Lib.-B1T1-East	500	13.8	480	N.L.	N.L.
	Wilson Lib.-B2T2-Mid.	500	13.8	480	N.L.	N.L.
	Wilson Lib.-B2T1-West	500	13.8	480	N.L.	N.L.
205	Anderson Hall-N	501	13.8	208	175	.96
207	Auditorium Classrom-N.E.	999	13.8	480	N.L.	N.L.
208	Middlebrook "A"-W-Add-E	501	13.8	208	135	.97
	Middlebrook "C"-E-Add-N	501	13.8	208	84	.96
	Middlebrook "C"-E-Add-S	999	13.8	480	186	.61
209	Rarig-North-U.S. #1	750	13.8	208	N.L.	N.L.
	Rarig-South-U.S. #2	500	13.8	208	N.L.	N.L.
	Rarig-East-U.S. #3	500	13.8	208	N.L.	N.L.
211	Law			FUTURE		

N.L. = Not Listed

West Bank 1976-1977 Fiscal Year

Building No.	Transformer Location	Transformer Capacity KVA	HV,KV	LV	Measured Demand KVA	Power Factor
202	Social Science-East	501	13.8	208	253	N.L.
203	Blegen-North	750	13.8	240	441	.93
204	Wilson Lib-A1T1-East	500	13.8	480	202	N.L.
	Wilson Lib-A2T2-Middle	500	13.8	480	237	N.L.
	Wilson Lib-A2T1-West	500	13.8	480	244	N.L.
	Wilson Lib-B1T1-East	500	13.8	480	154	.93
	Wilson Lib-B2T2-Middle	500	13.8	480	160	N.L.
	Wilson Lib-B2T1-West	500	13.8	480	153	N.L.
205	Anderson Hall-North	501	13.8	208	162	.95
207	Auditorium-Classroom-NE	999	13.8	480	267	.93
208	Middlebrook "A"-W-Add-E	501	13.8	208	142	N.L.
	Middlebrook "C"-E-Add-N	501	13.8	208	90	.97
	Middlebrook "C"-E-Add-S	999	13.8	480	239	.51
209	Rarig-North-US #1	750	13.8	208	248	N.L.
	Rarig-South-US #2	500	13.8	208	122	N.L.
	Rarig-East-US #3	500	13.8	208	0	N.L.
210	Sportsfield Serv. Bldg.				53	.97

N.L. = Not Listed

1.8 SPECIAL SERVICE SECTORS

Services are provided within the Demonstration Community which have a direct influence upon steam distribution. The major services provided are laundry service at the University and St. Mary's Hospital. Fairview Hospital and Augsburg College contract for this service.

Since neither the University nor St. Mary's reads the laundry steam meters on a daily basis the University undertook this assignment and read the University laundry steam meters on an hourly basis for the period, March 3, 1977 through March 6, 1977. This data was then computerized to form the following duration and hourly profiles.

It can be observed from the hourly profile there are definite periods during the working day when there are high steam demands. These peaks are caused by large mangles. The laundry mangles present a steam requirement that must be thoroughly investigated in Phase II of ICES. We will discuss and offer solutions to satisfying the laundry requirement.

The laundry becomes a problem with ICES distribution because of a reduction in system distribution pressure and the pressure losses associated with long distribution runs to St. Mary's Hospital.

In addition to the daily readings the steam billing computer program periods monthly steam usage for the University laundry.

By extrapolation from St. Mary's steam usage records the following data was obtained about St. Mary's laundry.

St. Mary's uses a converter to provide hot water from the steam distribution system. Minimum steam pressure for the flatwork ironer is 125 psig.

Hot Water to Laundry - 1976

3,941,070 gallons @ 170° F.

1,131,900 gallons @ 120° F.

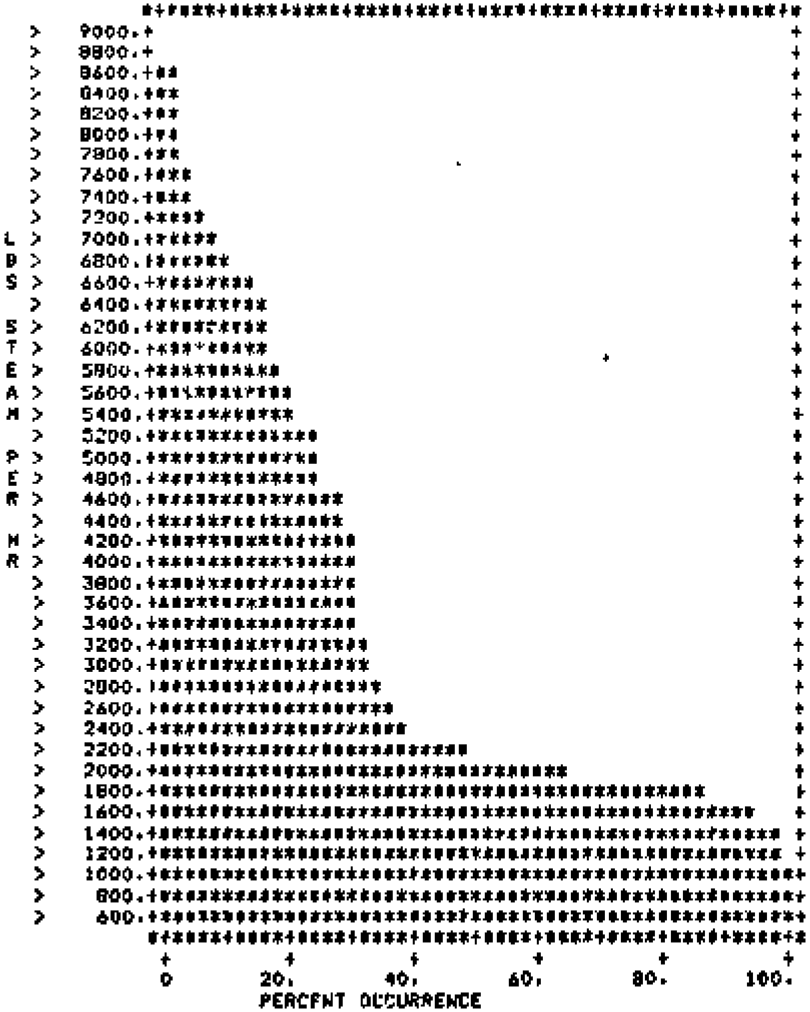
648,270 gallons @ 95° F.

The above data is based on washing 3,087,000 lbs. of material at an average load of 300 lbs. with 556 gallons of water per cycle and 10,290 loads washed during 1976.

There is no record of steam used by the flatwork ironer. Consultants will be able to make a determination during Phase II from the amount of material ironed during 1976. This was 1,487,000 lbs. pressed.

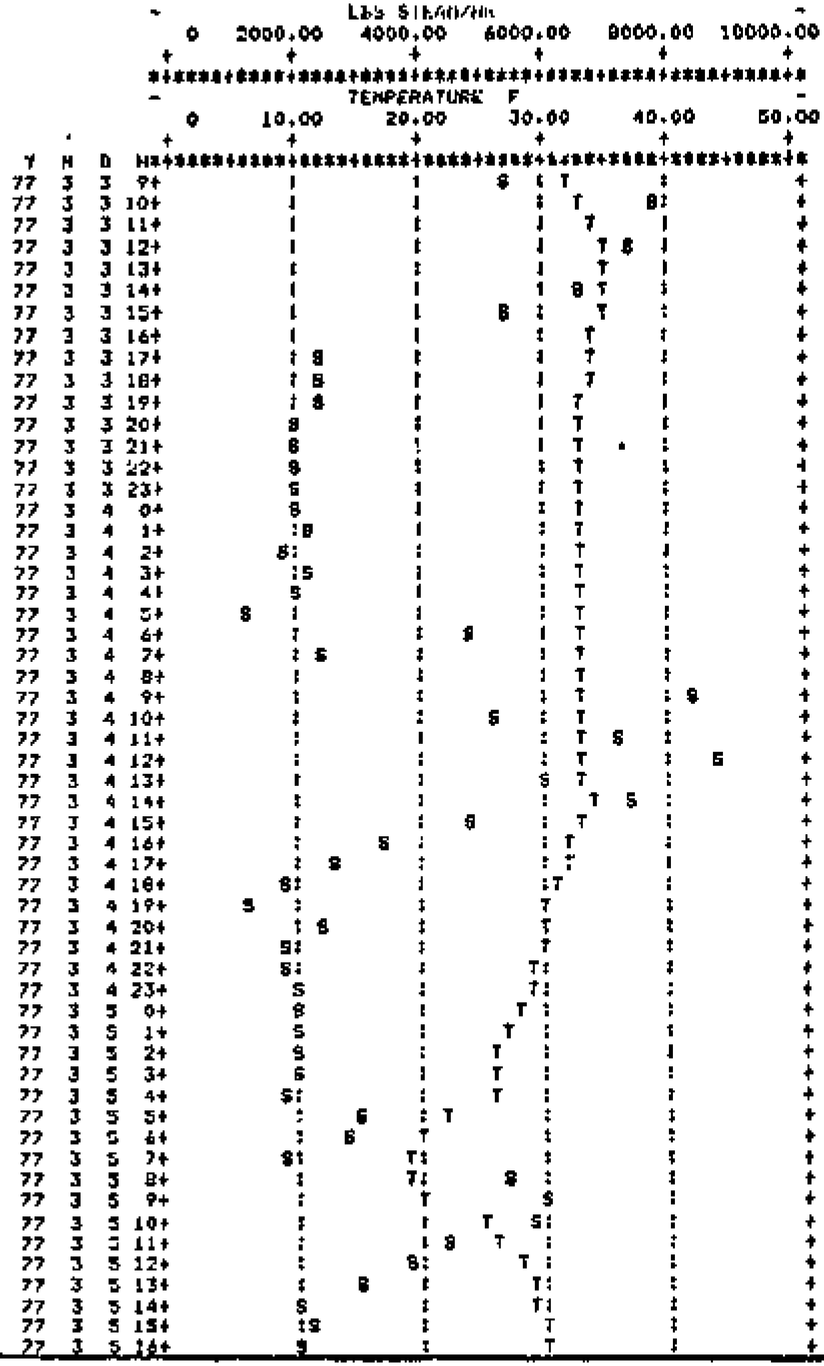
UNIVERSITY HOURLY

LAUNDRY STEAM LOAD DURATION CURVE
FOR 3/3/77 TO 3/6/77



SYMBOL	DEFINITION
*	LAUNDRY STEAM LOAD

UNIVERSITY LAUNDRY
HOURLY STEAM PROFILE



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77  3  5 19+         S          .    I    I          I          +
77  3  5 20+       S I          IT        I          I          +
77  3  5 21+         IS         IT        I          I          +
77  3  5 22+         IS       T I         I          I          +
77  3  5 23+         S     T    I         I          I          +
77  3  6  0+         IS     T   I         I          I          +
77  3  6  1+         IS    T    I         I          I          +
77  3  6  2+         IS    T    I         I          I          +
77  3  6  3+         IS    T    I         I          I          +
77  3  6  4+         IS    T    I         I          I          +
77  3  6  5+         S   T      I         I          I          +
77  3  6  6+         I  ST      I         I          I          +
77  3  6  7+         IS T       I         I          I          +
77  3  6  8+         IS    T    I         I          I          +
            *+*****+*****+*****+*****+*****+*****+*****+*****+*****+*
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SYMBOL DEFINITIONS

SYMBOL	DEFINITION
S	LAUNDRY STEAM USE
T	OUTSIDE AIR TEMPERATURE

DATE OF RUN- 77/03/28.

UNIVERSITY OF MINNESOTA LAUNDRY

Dates	Hours	LBS/Cond.	Temp.
770303	09	5400	32
770303	10	7700	33
770303	11	6700	34
770303	12	7300	35
770303	13	6900	35
770303	14	6600	35
770303	15	2600	35
770303	16	6800	34
770303	17	2300	34
770303	18	2300	34
770303	19	2300	33
770303	20	1900	33
770303	21	2000	33
770303	22	1900	33
770303	23	1900	33
770303	00	1900	33
770304	01	2100	33
770304	02	1600	33
770304	03	2500	33
770304	04	2000	33
770304	05	1100	33
770304	06	4800	33

Dates	Hours	LBS/Cond.	Temp.
770304	07	2400	33
770304	08	6800	33
770304	09	8400	33
770304	10	5100	33
770304	11	7100	33
770304	12	8700	33
770304	13	6000	33
770304	14	7400	34
770304	15	4700	33
770304	16	3400	32
770304	17	2500	32
770304	18	1700	31
770304	19	1100	30
770304	20	1300	30
770304	21	2800	30
770304	22	1800	29
770304	23	1100	29
770304	00	2800	28
770305	01	1900	27
770305	02	2000	26
770305	03	1900	26
770305	04	1800	26
770305	05	3000	22
770305	06	2700	20
770305	07	1700	19
770305	08	5300	19