

ENVIRONMENTAL ASSESSMENT OF THE PROPOSED DEVELOPMENT OF THE MILLARD SAND AND GRAVEL PIT

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Special acknowledgement is due Mr. Donald E. Berghammer, SEWRPC Senior Engineer, for his efforts in the conduct of this study and in the preparation of this report.

**MEMORANDUM REPORT
NUMBER 69**

**ENVIRONMENTAL ASSESSMENT OF THE PROPOSED
DEVELOPMENT OF THE MILLARD SAND AND GRAVEL PIT**

Prepared by the
Southeastern Wisconsin Regional Planning Commission
for the
Town of Sugar Creek, Walworth County

July 1992

Inside Region \$ 5.00
Outside Region \$10.00

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SOUTHEASTERN WISCONSIN REGIONAL PLANNING COMMISSION

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July 21, 1992

Mr. Craig A. Guthrie, Chairperson
Town of Sugar Creek
Rt. 2, Box 149
Elkhorn, Wisconsin 53121

Dear Mr. Guthrie:

In September of 1991, the Town of Sugar Creek requested the assistance of the Southeastern Wisconsin Regional Planning Commission in assessing the potential environmental impacts of the proposed development of the Millard sand and gravel pit operation located east of the unincorporated hamlet of Millard in the Northwest one-quarter of U. S. Public Land Survey Section 9, Township 3 North, Range 16 East, Town of Sugar Creek. In response to that request, the Commission staff met with the Town Board Chairman and the developers of the subject quarry operation on October 23, 1991, to discuss the proposed project and scope of the requested study, and reviewed the Town's files relating to this matter. The work on the study was initiated and largely completed in the first six months of this year.

As you know, the initial draft of the report was reviewed by the Town Board at its regular meeting held on July 20, 1992. The comments received at that meeting have been addressed in the report.

The report identifies those potential environmental impacts of significance which may be expected to be associated with the proposed sand and gravel pit operation, and identifies mitigative measures which can be considered to minimize those impacts. The Southeastern Wisconsin Regional Planning Commission is pleased to be of assistance to the Town in this matter.

Sincerely,



Kurt W. Bauer
Executive Director

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ENVIRONMENTAL ASSESSMENT OF THE PROPOSED DEVELOPMENT
OF THE MILLARD SAND AND GRAVEL PIT

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ENVIRONMENTAL ASSESSMENT OF THE PROPOSED DEVELOPMENT OF THE MILLARD SAND AND GRAVEL PIT

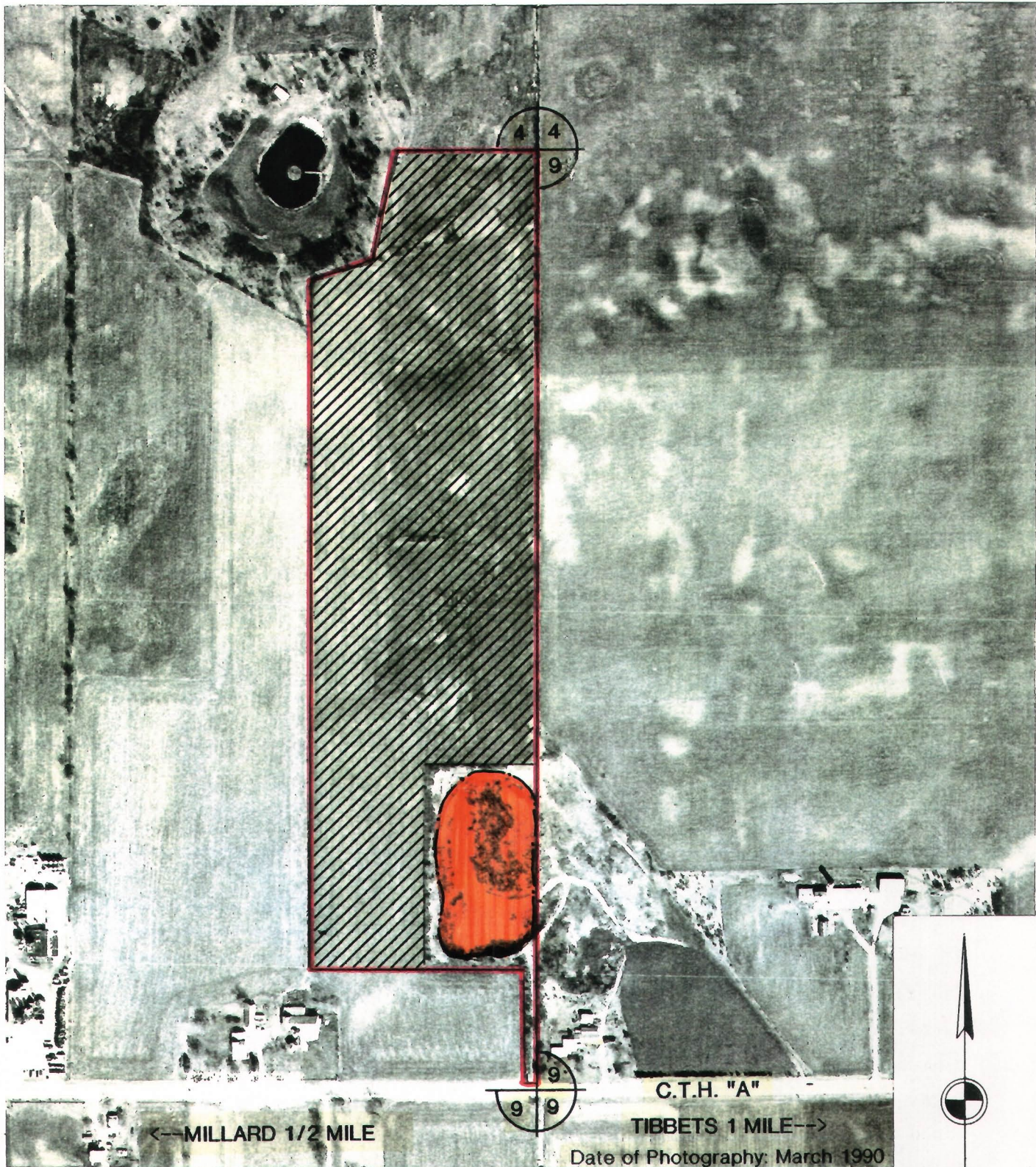
INTRODUCTION

By letter dated September 20, 1991, the Town of Sugar Creek Plan Town Board requested that the Regional Planning Commission staff assist the Town of Sugar Creek in assessing the potential environmental impacts of the proposed development of the Millard sand and gravel pit operations located west of the unincorporated hamlet of Millard in the Northwest one-quarter of U. S. Public Land Survey Section 9, Township 3 North, Range 16 East, Town of Sugar Creek. In response to that request, the Commission staff met with the Town Board Chairman and the developers of the subject quarry operation on October 23, 1991, to discuss the proposed project and scope of the requested study; reviewed the Town's files relating to this matter including the public comments received at the September 16, 1991, public hearing and the written comments.

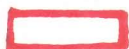


The specific action before the Town is the proposal to rezone approximately 27 acres of land from A-1 Prime Agricultural Land District to M-3 Mineral Extraction District, as shown on Figure 1. The proposed sand and gravel pit operation would include an adjacent four-acre area currently zoned M-3 which had been previously mined. The review and impact analysis conducted discusses some of the impacts of other similar existing operations in order to relate those impacts to the impacts expected to result from the proposed operation should the rezoning request be approved.

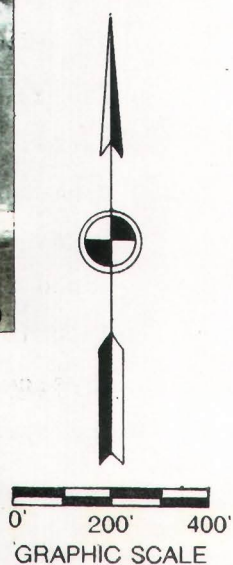
The findings and recommendations of the Commission's analysis regarding this matter are set forth in this report. The report summarizes the potential environmental impacts of the Millard sand and gravel pit operations at the Town of Sugar Creek site. Included in the report is a brief description of the proposed operation of the Millard sand and gravel facility, in addition to a description and evaluation of the impact of the proposed pit operations on the physical environment and socioeconomic environment of the surrounding area. The specific environmental features on which impacts have been considered in

Figure 1
PROPOSED MILLARD SAND AND GRAVEL PIT SITE



LEGEND

-  PROPOSED SAND AND GRAVEL PIT OPERATION LIMITS
-  AREA PROPOSED TO BE REZONED FROM A-1 PRIME AGRICULTURAL DISTRICT TO M-3 MINERAL EXTRACTION DISTRICT
-  APPROXIMATE LIMITS OF EXISTING EXCAVATION: 1990



this report were selected by the Commission staff in part based upon its independent review of the proposal and in part based upon a review of those issues and concerns raised by the Town officials and residents regarding the subject proposal. More specifically, environmental analyses are provided herein with regard to the physical environment of the study area, including floodplain, groundwater quantity and quality, surface water quality, hydrogeologic conditions, air quality, environmentally sensitive areas, wildlife habitat, the adjacent sanitary landfill; and on the socioeconomic environment, including current and planned land uses, zoning, traffic and transportation routes, and noise levels. As background, the report first presents a brief description of planned sand and gravel pit operations.

An initial draft of this report was reviewed by the Town Board at its July 20, 1992, meeting. A summary of the comments made by the public at that meeting is included in Appendix A. As appropriate, the comments have been addressed in the report.

EXISTING AND PROPOSED SAND AND GRAVEL PIT OPERATIONS

The Millard sand and gravel pit is proposed to be located northeast of Elkhorn, east of CTH "O", north of CTH "A", and west of CTH "H" in the central portion of the northern half of the Town of Sugar Creek. The pit is proposed to be located on the Theodore and Helene Junker farm which abuts CTH A approximately one-half mile east of CTH O in the vicinity of the unincorporated hamlet of Millard. As shown on Figure 1, the Millard sand and gravel pit operation, including buffer areas, is proposed to cover about 31 acres over an approximate 10- to 15-year period. Of this 31-acre area, approximately four acres, located in the Southeast corner of the proposed site, is currently zoned as an M-3 Mineral Extraction District and was previously operated as a quarry, with about three acres having been previously excavated, but no longer used as an active operation. The remaining 27 acres of the 31-acre site are included in the area proposed to be rezoned from A-1, Prime Agricultural use to M-3, Mineral Extraction use. Should the zoning change be granted, the area which is proposed to be actually mined would be about 14 acres.





The developer of the proposed quarry has prepared a plan for expanding and restoring the existing abandoned pit, covering the area shown on Figure 2. The sand and gravel pit is expected to be excavated down to an elevation of about 900 feet above National Geodetic Vertical Datum 1929 adjustment (NGVD), or to a depth of about 40 feet below the highest point on the existing ground surface at the site. The details of the proposed plan of operation have not been developed. However, it is expected that the initial construction would provide for the access roadway into the site at the southeast corner of the site and then the initial excavation of overlying top soil on a portion of the site would be used to construct the berms planned to be located along the south and west sides of the sand and gravel pit, as shown on Figure 2. The initial mining will be to the west of the existing pit and then proceed northward. As the mining operation proceeds to the north, the berms on the east side of the site will be constructed.

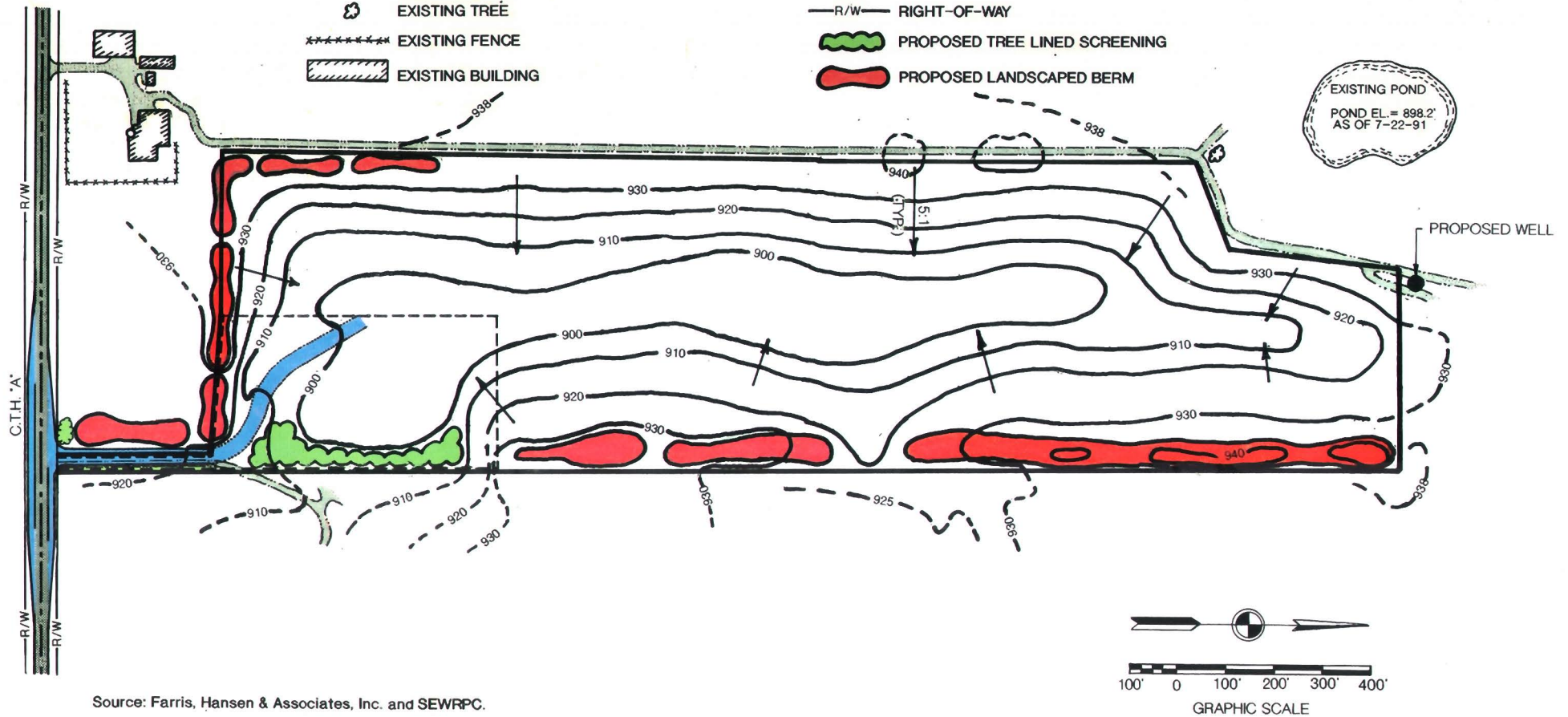
The proposed sand and gravel pit is expected to produce about one million tons of sand and gravel which would be mined at a rate of about 50,000 to 100,000 tons per year. It is expected that a portion of the gravel obtained will be crushed in some form to change its size. The sand and gravel products of this proposed pit would be used by the intended developer/operator, Mann Brothers, Inc., a contractor and construction materials supplier, for its own operations and would be used for sales to other local area users and local units of government.

It is envisioned that a permanent scale will be installed at the southeast portion of the site, near the entrance road. Portable rock crushing, conveyor, screening, and washing equipment is expected to be used intermittently at this facility for periods of up to three weeks. In addition, rubber tired front end loader(s) with a capacity of four to five cubic yards will be used to load trucks during all hours of operation. Photographs illustrating the type of equipment to be used are shown in Figures 3 and 4. The sand and gravel pit would be open year-round with the most activity occurring in the months of May through October. The normal hours of operation would be from 7:00 a.m. to 5:00 p.m. during which sand and gravel is transported from the facility. However, sand and gravel production is expected to be often continued beyond 5:00 p.m. during some periods of time. In addition, during peak use, the transportation

Figure 2
PROPOSED MILLARD SAND AND GRAVEL RECLAMATION PLAN

LEGEND

- | | | | |
|---|-------------------------------------|---|-------------------------------|
|  | EXISTING SAND AND GRAVEL PIT LIMITS |  | EXISTING ASPHALT PAVEMENT |
|  | PROPOSED SAND AND GRAVEL PIT LIMITS |  | PROPOSED ASPHALT PAVEMENT |
|  | EXISTING CONTOUR |  | EXISTING GRAVEL ROAD |
|  | PROPOSED CONTOUR |  | PROPOSED GRAVEL ROAD |
|  | EXISTING TREE |  | RIGHT-OF-WAY |
|  | EXISTING FENCE |  | PROPOSED TREE LINED SCREENING |
|  | EXISTING BUILDING |  | PROPOSED LANDSCAPED BERM |



Source: Farris, Hansen & Associates, Inc. and SEWRPC.

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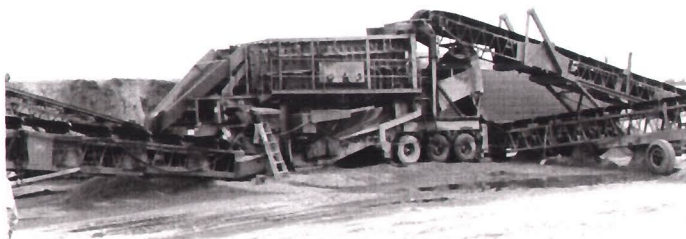
Figure 3
PHOTOGRAPHY OF EQUIPMENT EXPECTED TO BE LOCATED AND
USED INTERMITTANTLY AT THE PROPOSED MILLARD SAND AND GRAVEL PIT



a) Portable Primary Rock Crusher



b) Portable Secondary Rock Crusher



c) Portable Screening and Washing Equipment



d) Typical Conveyers

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Figure 4
PHOTOGRAPHY OF EQUIPMENT EXPECTED TO BE USED
CONTINUOUSLY AT THE PROPOSED MILLARD
SAND AND GRAVEL PIT



a) Rubber-Tired Front End Loader



b) Tri-axel Dump Truck

activities could extend to all daylight hours if permitted under the town-county approvals.

During the washing operations, it will be necessary to utilize a water source capable of providing up to 200 to 300 gallons per minute. The sand and gravel pit operation anticipates that most of this supply can be developed by utilizing surface and groundwater collected in a sump to be constructed in the lowest part of the quarry, which will also be utilized to recycle the wash water. However, it is expected that a groundwater well supply will be needed as a supplemental supply. For purposes of this assessment, it is estimated that a well with a capacity of 300 gallons per minute (gpm) will be constructed at the north end of the site and used in the washing operations.

There are no plans for and no approval is being requested for the siting of temporary ready-mix concrete or asphalt plants at this pit. Since there are no plans for any additional facilities of this type, it is assumed that such operations will be precluded in the permits and approvals given at this time.

The trucks which transport the sand and gravel products are typically tri-axle type vehicles which have a capacity to haul approximately 20 tons of material and typically have a gross total weight of from 70,000 to 75,000 pounds. A potential also exists for more limited use of trailer trucks having a capacity to haul up to about 25 tons of material and typically have a gross total weight of about 85,000 pounds.

The preliminary plan for restoring the sand and gravel pit facility is shown in Figure 2. The proposal calls for mining the sand and gravel in segments followed by the restoration of the site also in segments. It is ultimately envisioned to have ponds on the site with the land surface surrounding the ponds being sloped to the ponds with slopes typically being about one on five in the steeper sections and selected areas with flatter slopes as potential development sites. Details of the pond construction have not been developed.

Based upon review of the materials available and discussions with the proposed pit developer-operator, the following assumptions have been made in considering the environmental impacts of the operation of the expanded sand and gravel pit.

1. That the limits of the sand and gravel mining activity and other earth-moving activities would be approximately as shown on Figure 1.
2. That the stone crushing, classifying, and washing operations would be temporary in nature, occurring intermittently for periods of up to three weeks. In addition, the trucking would enter and exit the site at the southeast corner of the facility onto CTH A.
3. That the total sand and gravel output of the expanded facility would be about 1,000,000 tons over a 10- to 15-year period. However, it is recognized that the output of the site will be dictated by the demand for the material, which is difficult to predict. On an average basis, about 20 to 30 truckloads of material would be removed per day. The maximum number of truckloads of material removed from the site is estimated to be about 200 to 250 per day with the usage being experienced for limited periods of time over the construction season, which occurs from April to November.
4. That the depth of the sand and gravel mining operation is expected to be about 40 feet below the highest elevation of the existing grade on the site, that is, at about elevation 900 feet above National Geodetic Vertical Datum. However, this excavation level could vary due to groundwater conditions.

While the current rezoning approval is for the site size and capacity limits as set forth above, it should be recognized that once the facility is sited, there is no guarantee that subsequent expansion will not be requested. Expansion of a sand and gravel pit is normally considered to be more easily approved than siting a new facility. There are open lands adjacent to the proposed facility containing similar soil characteristics to the proposed pit site. Thus, this assessment is being developed recognizing that requests for the future expansion of the facility is a possibility.

POTENTIAL IMPACTS ON THE ENVIRONMENT

The primary environmental features which may be expected to potentially be impacted by the proposed Millard sand and gravel pit operation are floodlands, groundwater quantity and quality, surface water quality, air quality, environmentally sensitive areas and wildlife habitat, traffic and transportation routes, noise levels, land uses and zoning, and the adjacent sanitary landfill.

Floodlands

Floodplain impacts are a consideration in any major excavation and filling project located in the vicinity of a stream system. Floodplains have been delineated for this part of Walworth County in the Regional Planning Commission's Fox River watershed study and the Walworth County Flood Insurance Study. In this case, there are no lands designated as floodplain in the vicinity of the proposed sand and gravel pit. Therefore, the proposed sand and gravel pit development will have no floodplain impacts.

Groundwater Impacts

Groundwater quantity and quality considerations are an important factor to be considered in a project with relatively deep excavations and groundwater pumping. Under the present proposed land use and mining operations, the Millard sand and gravel pit excavation itself does not appear to have a potential to significantly impact the groundwater levels in the area. The sand and gravel excavation operations are carried out at elevations which are just above the local groundwater table in the area. Thus, the groundwater quantity impacts are expected to be limited to pumped water used in washing the sand and gravel. The proposed pit operation includes provision for a well to be constructed at the location shown on Figure 2, pumping approximately 250 to 300 gallons per minute for maximum periods of 12 hours per day during periods when gravel is being washed. As previously noted, this is expected to be used intermittently at the site for periods of up to three weeks. A maximum of approximately 200,000 gallons per day of groundwater would be pumped from the proposed well to be located on the north end of the quarry. Based upon the general soil characteristics in the area, this pumping rate is expected to result in a daily drawdown of up to 20 feet during the production periods of the day. The extent of the cone of depression of that drawdown extends out over a radius of about 300 feet, as shown on Figure 7. The calculations for this cone of depression are included in Appendix A. Recovery or recharge from this groundwater draw-

down to its original level is expected to occur quickly, due to the nature of the aquifer and the intermittent nature of the pumping.

The groundwater table in the area, as delineated in a U.S. Geological Survey report¹ and from well logs, is in the sand and gravel aquifer and is at approximately 880 to 900 feet above National Geodetic Vertical Datum (NGVD), 1929 adjustment, as shown on Maps 1 and 1A, and the cross sections shown on Figures 5, 6, and 7. The general regional groundwater flow in the vicinity is from west to east, from a groundwater divide located just west of North Lake.

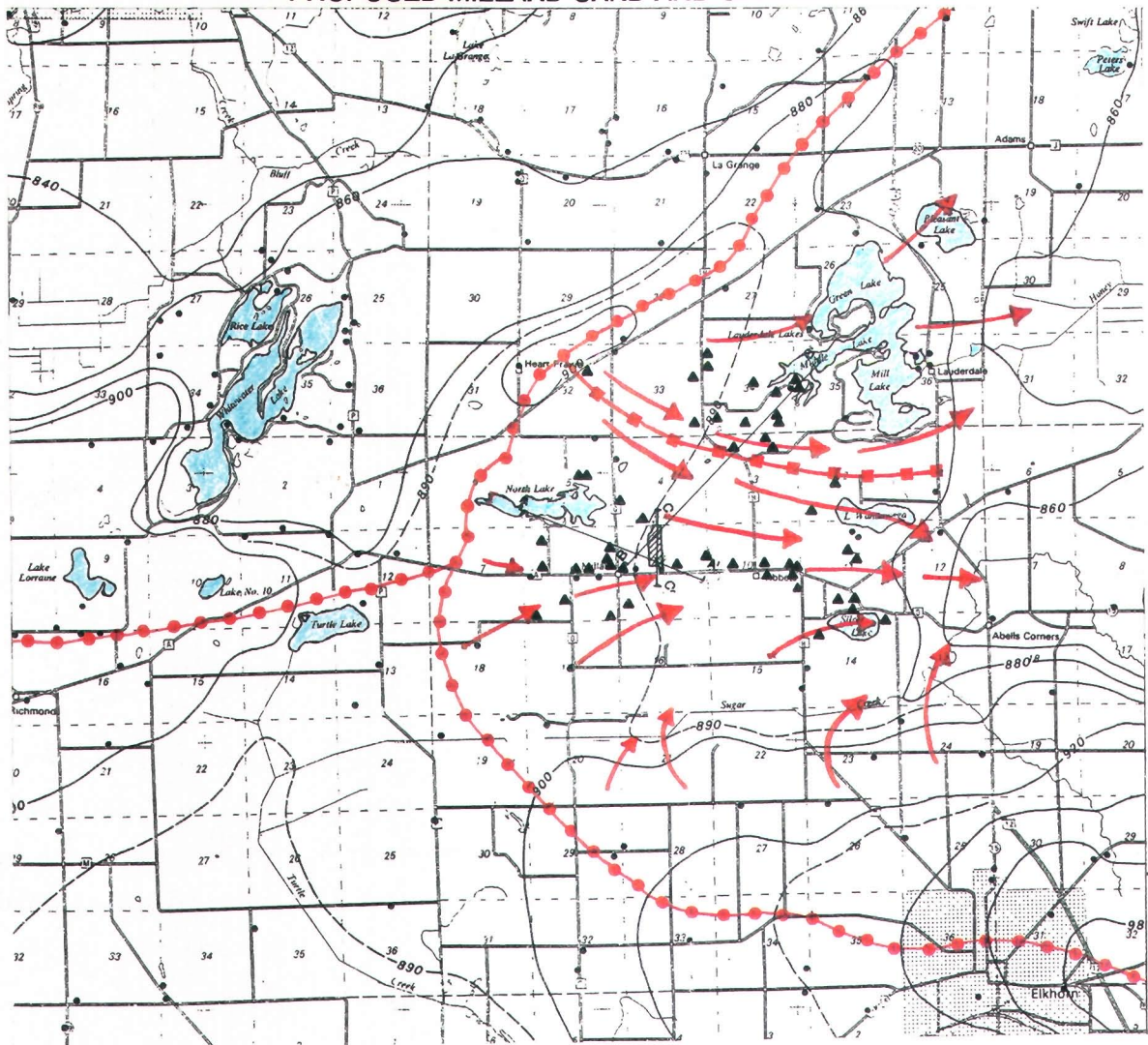
The proposed quarry is situated over a bedrock valley buried approximately 350 feet below the ground surface. The soil situated above the bedrock is essentially a glacial outwash resulting from the water of melting ice fronts. This outwash consists mostly of sand and gravel with some silt and clay, which is fairly well sorted and stratified in some areas, but not in others. This sand and gravel outwash plain is generally covered with several feet of topsoil and/or clay. This sand and gravel outwash plain is the upper aquifer in which the majority--approximately 80 percent--of the private wells of the area are completed. This sand and gravel aquifer is extremely permeable and capable of producing relatively large quantities of water. Although the hydraulic conductivity and transmissivity of the aquifer will vary laterally and vertically, it is much higher than it is in the underlying bedrock.

The bedrock underlying the sand and gravel aquifer is the dolomite of the Gale-na-Platteville formation overlying the deeper sandstone aquifer. Approximately 20 percent of the domestic wells in the area are finished in the dolomite aquifer and only a few in the sandstone aquifer. The depth of these lower aquifers is generally well over 150 feet below the anticipated bottom elevation of the proposed sand and gravel pit and that same distance below the water table. The cone of depression expected to be developed by the well for the subject pit in the sand and gravel aquifer groundwater table is estimated to extend only about 20 feet below the water table. Thus, domestic wells finished in the deeper aquifers will clearly be unaffected by the pit operations.








¹U.S. Geological Survey, Groundwater Resources and Geology of Walworth County, Wisconsin, November 1976.

Map 1
GROUNDWATER TABLE ELEVATIONS, REGIONAL FLOW
DIRECTION AND LOCATION OF WELLS

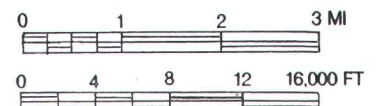
PROPOSED MILLARD SAND AND GRAVEL PIT



LEGEND

-  PROPOSED SAND AND GRAVEL OPERATION LIMITS
- WELL LOCATION WHERE DATA WAS OBTAINED BY USGS
- ▲ WELL LOCATION WHERE DATA WAS OBTAINED BY SEWRPC.
-  CROSS-SECTION LOCATION (SEE MAP 1A)
-  WATER-TABLE CONTOUR. ELEVATION IN FEET ABOVE NATIONAL GEODETIC VERTICAL DATUM (1929) AT 20 FOOT INTERVALS
-  SUPPLEMENTAL 10 FOOT WATER-TABLE CONTOUR. ELEVATION IN FEET ABOVE NATIONAL GEODETIC VERTICAL DATUM (1929)
-  GROUNDWATER DIVIDE (SHOWN ONLY WHERE SIGNIFICANTLY DIFFERENT FROM SURFACE WATER DIVIDE)
-  GROUNDWATER FLOWLINE DIVIDE
-  GROUNDWATER FLOW DIRECTION

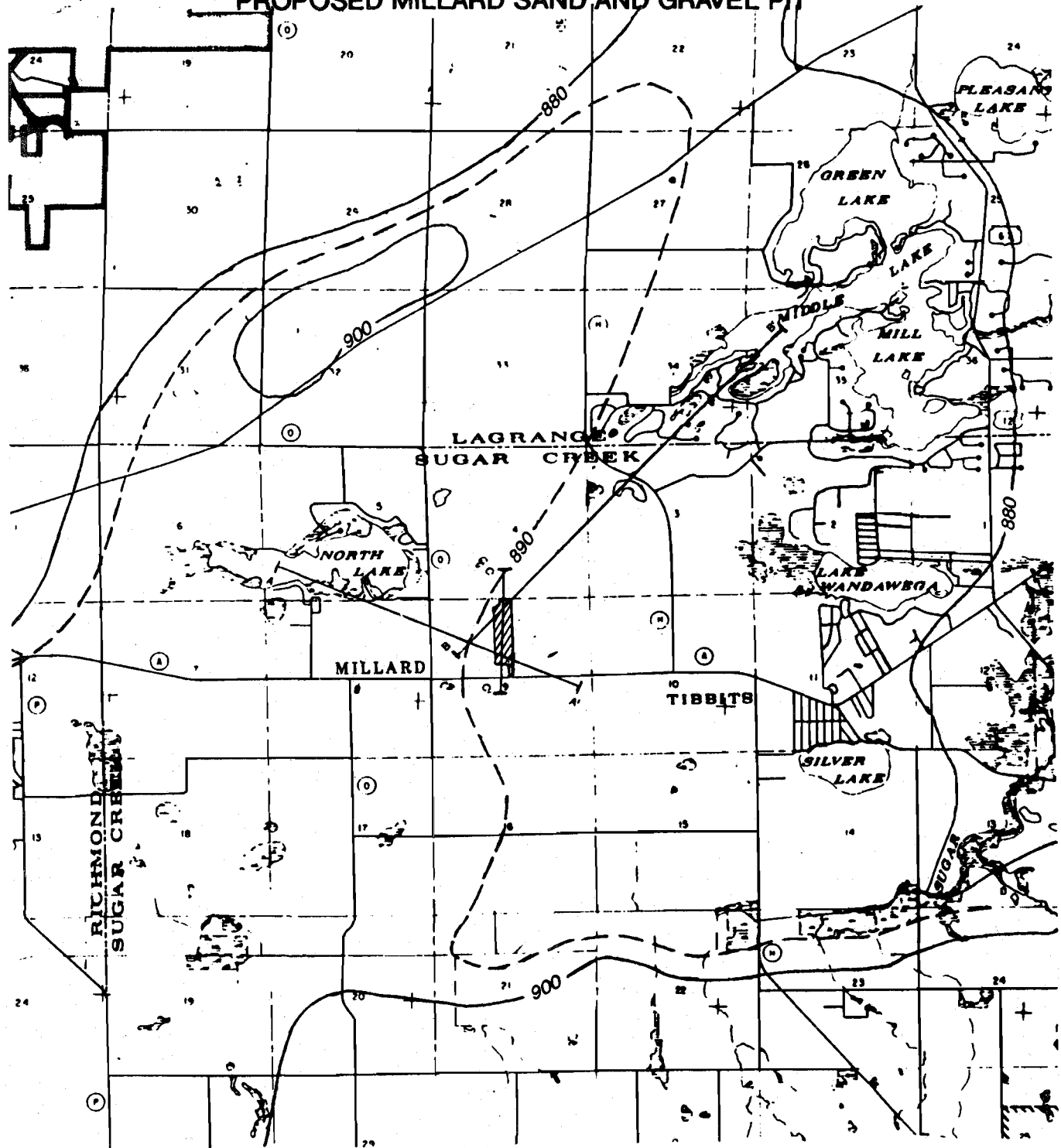
Source: U.S. Geological Survey and SEWRPC.





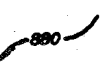
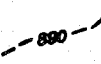
GRAPHIC SCALE

MAP 1A

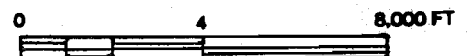
GROUNDWATER TABLE ELEVATIONS AND PROPOSED CROSS-SECTION LOCATIONS PROPOSED MILLARD SAND AND GRAVEL PIT



LEGEND

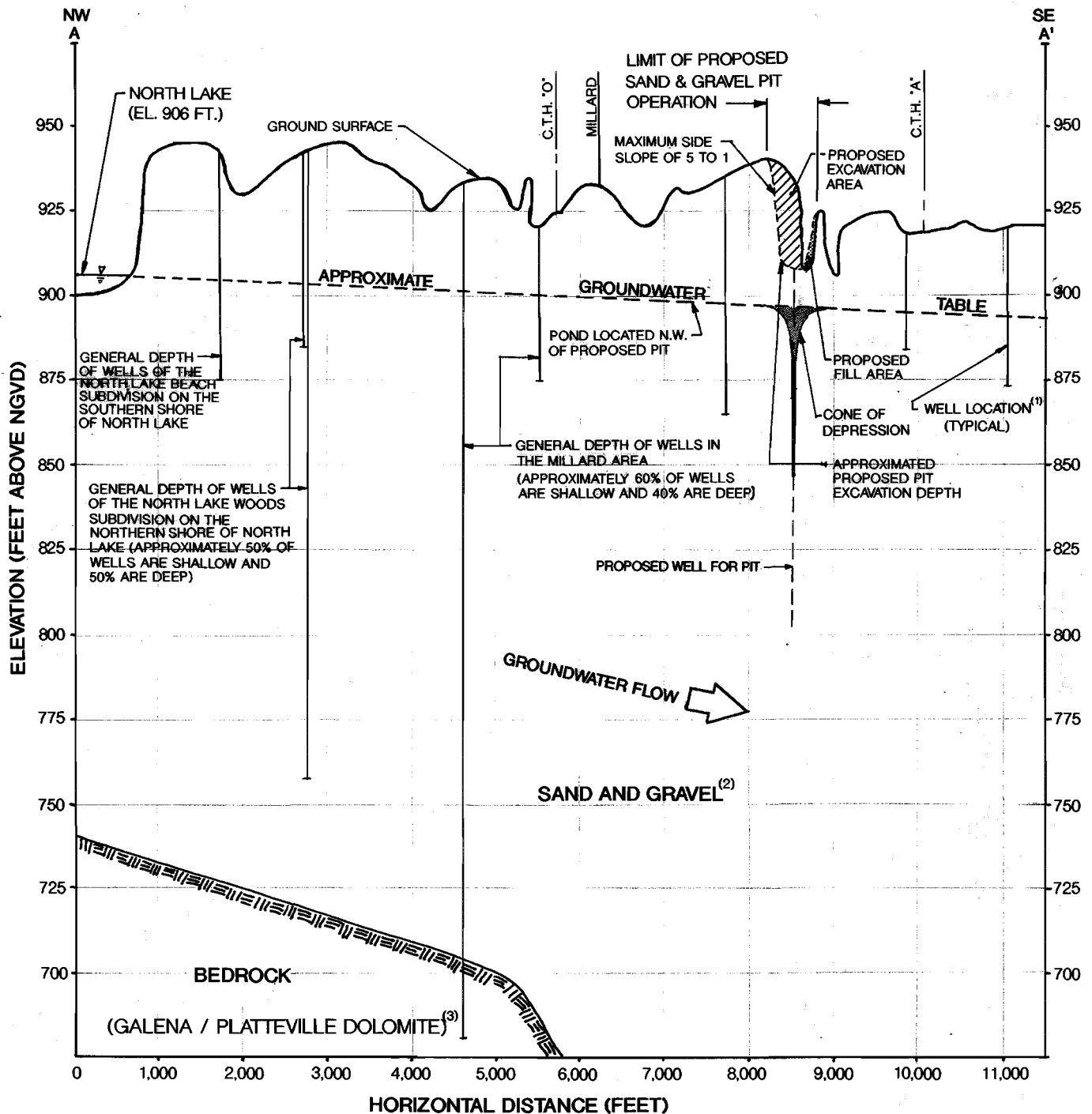
-  PROPOSED SAND AND GRAVEL PIT OPERATIONAL LIMITS
-  CROSS SECTION LOCATIONS
-  WATER TABLE CONTOUR. ELEVATION IN 20 FOOT INTERVALS ABOVE NATIONAL GEODETIC VERTICAL DATUM (1929)
-  SUPPLEMENTAL 10 FOOT WATER TABLE CONTOUR. ELEVATION IN FEET ABOVE NATIONAL GEODETIC VERTICAL DATUM (1929)

GRAPHIC SCALE



Source: U.S. Geological Survey and SEWRPC

Figure 5
CROSS-SECTION A-A'



NOTES:

1. THE WELLS WERE PROJECTED ONTO LINE OF CROSS SECTION
2. THERE ARE PERIODIC LENSES AND NONCONTINUOUS STRATA OF FIRM TO HARD CLAY CONTAINED WITHIN THE SAND AND GRAVEL AQUIFER
3. THE ELEVATION OF THE DOLOMITE BEDROCK DECREASES TO AN ELEVATION OF 500 FEET ABOVE NGVD AT A'
4. APPROXIMATELY 20% OF THE DOMESTIC WELLS IN THE STUDY AREA ARE FINISHED IN THE GALENA/PLATTEVILLE AQUIFER
5. THE GROUNDWATER TABLE IS APPROXIMATE AND VARIES SEASONALLY AND YEARLY

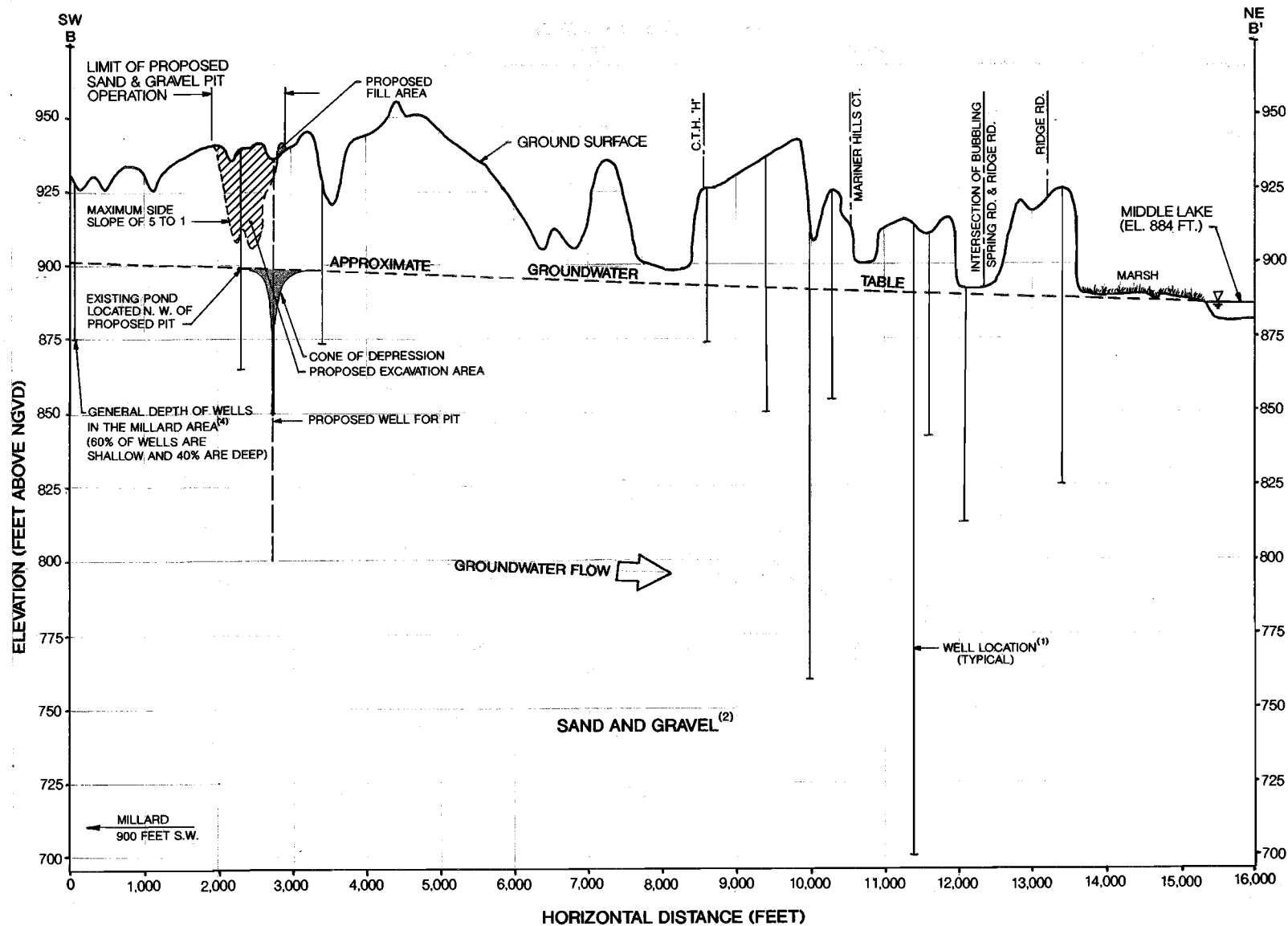


Figure 6
CROSS-SECTION B-B'

NOTES:

1. THE WELLS WERE PROJECTED ONTO THE LINE OF CROSS-SECTION
2. THERE ARE PERIODIC LENSES AND NONCONTINUOUS STRATA OF FIRM TO HARD CLAY CONTAINED IN THE SAND AND GRAVEL AQUIFER
3. THE ELEVATION OF THE DOLOMITE BEDROCK (GALENA/PLATTEVILLE FORMATION) DECREASES FROM AN ELEVATION OF 535 FEET ABOVE NGVD AT CROSS-SECTION POINT B TO AN ELEVATION OF 500 FEET ABOVE NGVD AT CROSS-SECTION POINT B'
4. THE WELL SHOWN REPRESENTS THE GENERAL DEPTH OF THE SHALLOW WELLS LOCATED IN THE MILLARD AREA THE DEEP WELLS ARE LOCATED TO THE SOUTHWEST OF MILLARD
5. APPROXIMATELY 20% OF THE DOMESTIC WELLS IN THE STUDY AREA ARE FINISHED IN THE GALENA/PLATTEVILLE AQUIFER
6. THE GROUNDWATER TABLE SHOWN IS ONLY APPROXIMATE AND VARIES SEASONALLY AND YEARLY. GROUNDWATER ELEVATION AT THE SUBDIVISIONS LOCATED SOUTHWEST OF LAUDERDALE LAKES MAY BE LOWER THAN SHOWN DUE TO THE LARGE NUMBER OF WELLS

Source: SEWRPC.

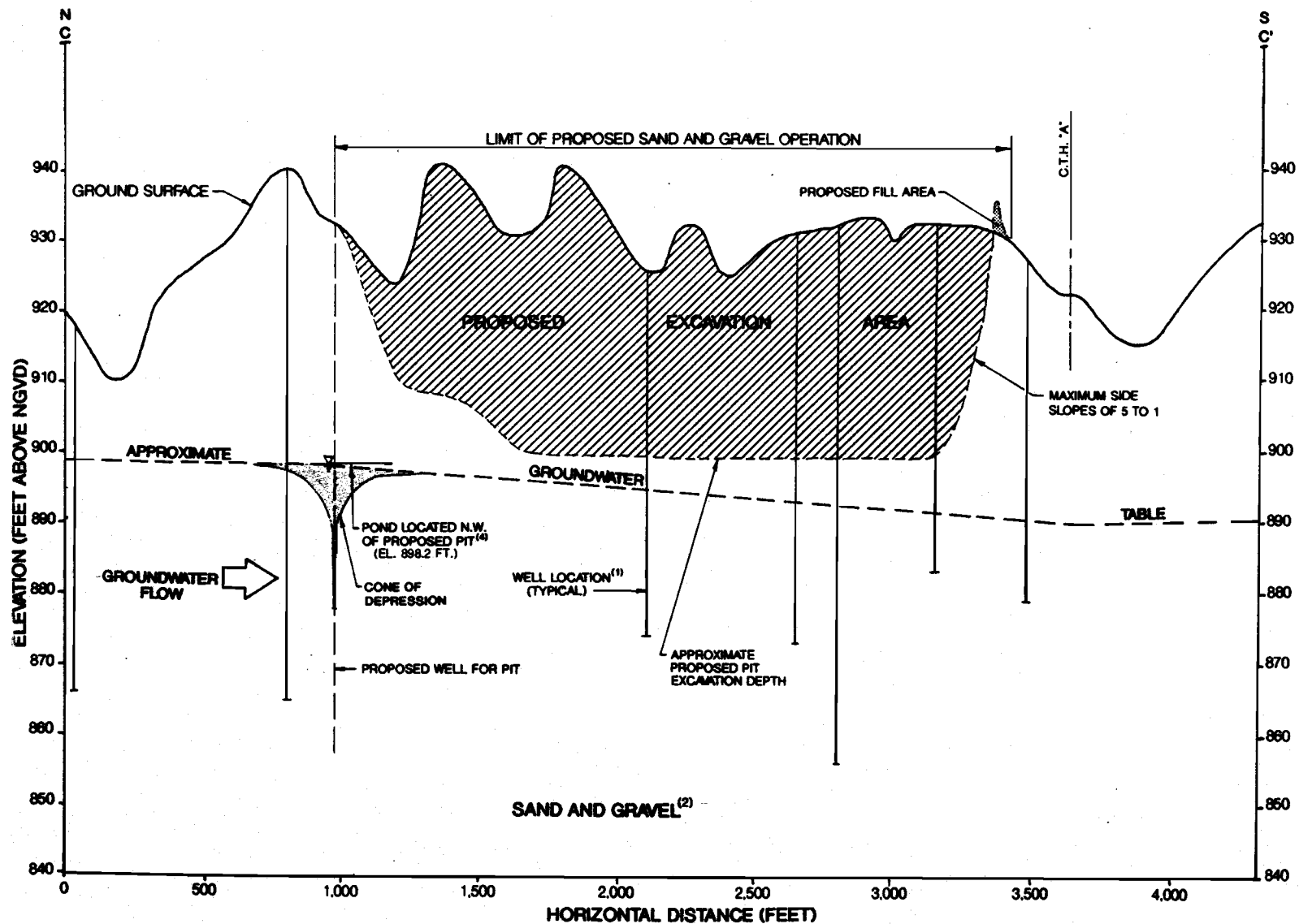


Figure 7
CROSS-SECTION C-C'

NOTES:

1. THE WELLS WERE PROJECTED ONTO THE LINE OF CROSS-SECTION
2. THERE ARE PERIODIC LENSES AND NONCONTINUOUS STRATA OF FIRM TO HARD CLAY CONTAINED WITHIN THE SAND AND GRAVEL AQUIFER
3. THE ELEVATION OF THE DOLOMITE BEDROCK (GALENA/PLATTEVILLE FORMATION) DECREASES FROM AN ELEVATION OF 800 FEET ABOVE NGVD AT CROSS-SECTION POINT C TO AN ELEVATION OF 550 FEET ABOVE NGVD AT CROSS-SECTION POINT C'
4. THE ELEVATION OF THE EXISTING POND LOCATED NORTHWEST OF THE PROPOSED SAND AND GRAVEL PIT WAS OBTAINED PER FARRIS, HANSEN & ASSOCIATES, INC. IN JUNE OF 1991
5. APPROXIMATELY 20% OF THE DOMESTIC WELLS IN THE STUDY AREA ARE FINISHED IN THE GALENA/PLATTEVILLE AQUIFER
6. THE GROUNDWATER TABLE SHOWN IS ONLY APPROXIMATE AND VARIES SEASONALLY AND YEARLY

Source: SEWRPC.

In addition, the operation of the Millard sand and gravel pit itself is not expected to impact the neighboring wells in the sand and gravel aquifer, or the neighboring lakes, since the bottom of the sand and gravel pit is expected to be maintained above the local groundwater water table. The only potential impact is due to the operation of the well planned to provide was water. The cone of depression from that well extends only about 300 feet from the proposed well and the maximum depth of that cone is about 20 feet. Thus, the well draw-down would be expected to only impact wells located near the top of the current water table or above about elevation 870 feet above mean sea level and within about 300 feet of the proposed well serving the pit. Data was obtained on the depth of selected wells in the area as shown on Map 1. It appears that only one well in the vicinity could potentially be affected by the pit operations. The one well is located adjacent to the pond on the Junker property--the property on which the proposed pit site is leased--to the west of the proposed well. The degree of impact on this well is uncertain. However, the well is not the primary well for the residence on the site and appears to be associated with the use and maintenance of the pond on the site. Thus, groundwater quantity concern for private water supply systems is not considered a significant major negative impact since it would be possible to deepen any well which might be impacted, or drill a new well for a relatively low cost. In such a case, it would be assumed that the operator of the sand and gravel pit would cover the cost if it were shown that the cause of the well problems was the pit operation.

In addition, there should be no impact on the water levels in the lakes in the vicinity--North Lake, Silver Lake, and the three Lauderdale Lakes--based upon the modest size of the pumped cone of depression expected and its distance from these lakes.

With regard to groundwater quality, there exists the potential for the accidental spillage of contaminants in an area where large machinery is working. This is particularly important due to the high susceptibility of the soils in the area (high permeability) to transmit surface contamination to the groundwater. It should be noted that this site is also located in the recharge area for the deep sandstone aquifer which provides the water supply for a large

population to the east and south. These factors should make the use of special storage and other contaminant control measures important considerations.

It is noted that spillage of certain contaminants, such as fuel oil, should be apparent on the water surface of the pond which collects surface water runoff for the sand and gravel washing. Thus, with proper surveillance, the operator could effect a cleanup operation as soon as a problem occurred for some potential contaminants. While the possibility of contamination occurring and impacting the groundwater supply in the area is limited, it is desirable to require that the owner develop, as part of the plan of operation, a plan to minimize the potential for spillage of contaminants including specific storage procedures and a plan of action which could be carried out if an emergency occurred through spillage of contaminants. Such a plan should include the timely provision of any equipment needed to contain and remove the spilled materials.

Another potential groundwater quality concern relates to the discharge of spent process water. As previously noted, wash water used for the sand and gravel pit operation is to be pumped from a proposed well at the north end of the pit using a pumping system with a capacity of 200 to 300 gallons per minutes (gpm). The estimated daily water usage is between 50,000 and 200,000 gallons per day. The spent wash water as well as local runoff from the pit and internal seepage is proposed to be discharged into an onsite retention pond where the suspended solids will be filtered out and the water evaporated and returned to the groundwater through percolation. The water discharged to the pond would contain particulate matter picked up by contacting the sand and gravel products. This material should be readily settled out and then filtered as the excess water is percolated into the groundwater system. Thus, there are not expected to be any significant groundwater quality impacts due to the discharge of spent process water.

Surface Water Quality

As shown on Map 2, the only surface waters within one-half mile of the proposed quarry is a small pond located near the northwest corner of the proposed site. The nearest major surface water system is North Lake located about one mile to the northwest of the subject site. The quarry operations will have no effect

on the quality of local watercourses in the area because the water used in the quarry operations will not be discharged to them. All runoff and process waters will be collected in the onsite retention pond and excess water percolated into the groundwater.

As part of the proposed pit development and restoration plan, filling and stockpiling of soil materials is expected to occur along the limits of the proposed site with steep side slopes potentially causing soil erosion. Therefore, it is recommended that an erosion control plan be developed and implemented for any potential surface water sheet flow leaving the site.

With proper erosion controls, the development, operation and restoration of the proposed pit is not expected to have negative surface water quality impacts.

Air Quality and Dust

During dry weather periods, sand and gravel pit operations result in increased quantities of fugitive dust in the atmosphere of the immediately adjacent areas and areas impacted significantly by truck traffic, thereby potentially degrading air quality conditions. In addition, the initial and continuing construction of the pit during which the topsoil overburden of the sand and gravel are removed will lead to emissions of dust. Concerns with the impacts of dust due to the subject pit operation and associated truck traffic have been raised by citizens during the consideration of the proposed rezoning request.

Particulate matter may be generated by each phase of the operation--excavation, processing, storage, and the loading and transportation of material--depending on the amount of material processed, the method of processing, the moisture content of the material, the method of transfer of the material, the climatic conditions, and the use of any air quality control measures.

The area is not located in a particulate matter non-attainment area. Thus, no special requirements are in place due to that designation. No current air quality monitoring data are available in the vicinity of the proposed Millard sand and gravel pit, or in the vicinity of similar pits in Walworth County. Information obtained at other similar operations indicate the use of sound air pollution control practices can be effectively utilized to prevent violations of

the air quality standards. Air pollution control measures which may be applied in the proposed sand and gravel pit to control fugitive dust include sweeping of access roads and adjacent public streets, paving of haul roads, water or chemical control of dust at material handling operations, control of dust from storage piles, and application of calcium chloride solution to haul roads and the pit floor. Table 1 sets forth Reasonable Available Control Technology (RACT) practices which can be required by the Wisconsin Department of Natural Resources in certain instances. In this regard, it should be noted that the proposed access road into the quarry and the turning and bypass lanes at the entrance are proposed by the pit developer to be paved. In addition, the proposed pit operator has the capability to carry out other operational-related air emission control measures.

Due to the nature of sand and gravel pit operations, it is not practical to capture all of the dust generated. Even with sound pollution control, some dust will be dissipated to the atmosphere and be tracked onto roadways. Excessive suspended particulate levels can cause respiratory problems in humans and animals, form a dust layer on plants, corrode materials, reduce atmospheric visibility, and increase cleaning costs for nearby residential, commercial, and industrial property owners.

Based upon the foregoing, the suspended particulate or dust levels resulting from the proposed sand and gravel pit operations would not be expected to have a significant adverse impact on human or animal health, on vegetation, or on corrosion of materials, if proper air pollution control measures are utilized at the proposed pit. Especially stringent control measures should be used to reduce the emissions of dust to the elderly care center located on the Junker Farm. Air quality standards can be achieved with such control measures. However, based upon inspection of similar facilities, there could be limited potential impacts on atmospheric aesthetics and on increased cleaning costs to remove deposited dust for residences in the immediate vicinity of the proposed operation at some times. Overall, atmospheric contributions from the expanded pit operation may thus be expected to have some limited impact on the quality of life in the immediate vicinity. However, only about five residences and one agricultural related business are located within one-quarter mile of the site, which is the area where the impacts are considered to be most significant. One

Table 1

REASONABLE AVAILABLE CONTROL TECHNOLOGY (RACT)
AIR QUALITY CONTROL PRACTICES FOR QUARRY OPERATIONS REQUIRED
BY THE WISCONSIN DEPARTMENT OF NATURAL RESOURCES

Operation	Required Practices
Storage piles having a material transfer greater than 100 tons per year.	<ol style="list-style-type: none"> 1. Material silt content 5-20 percent: Pile to be treated with water, surfactants, stabilizers, or chemicals; draped; or enclosed on three sides. 2. Material silt content greater than 20 percent: Pile to be completely enclosed or draped except any part being worked, loaded, or unloaded. 3. Access areas surrounding storage piles to be watered, cleaned, or treated with stabilizers as needed to prevent fugitive dust from vehicle traffic.
Handling operations for material with at least a 5 percent silt content: crushing, drilling, blasting, grinding, mixing, screening, compacting, conveying, or loading.	<ol style="list-style-type: none"> 1. To be controlled to 20 percent opacity (a measure of opaqueness) when wind speeds are less than 25 miles per hour except for three minutes in any one hour when fugitive emissions may equal 50 percent opacity.
Process fugitive emissions to the atmosphere.	<ol style="list-style-type: none"> 1. To be controlled to an exhaust concentration equal to less than 0.20 pounds of particulates per 1,000 pounds of exhaust gas. 2. Visible emissions shall not exceed 20 percent opacity except for three minutes in any one hour when fugitive emissions may equal 50 percent opacity.
Trafficable roads	<ol style="list-style-type: none"> 1. To be paved with asphalt, concrete, or other material approved by the DNR, or to use other approved methods of dust control. 2. If paved, to be kept reasonably free of material through a program of periodic cleaning.

Source: Wisconsin Department of Natural Resources

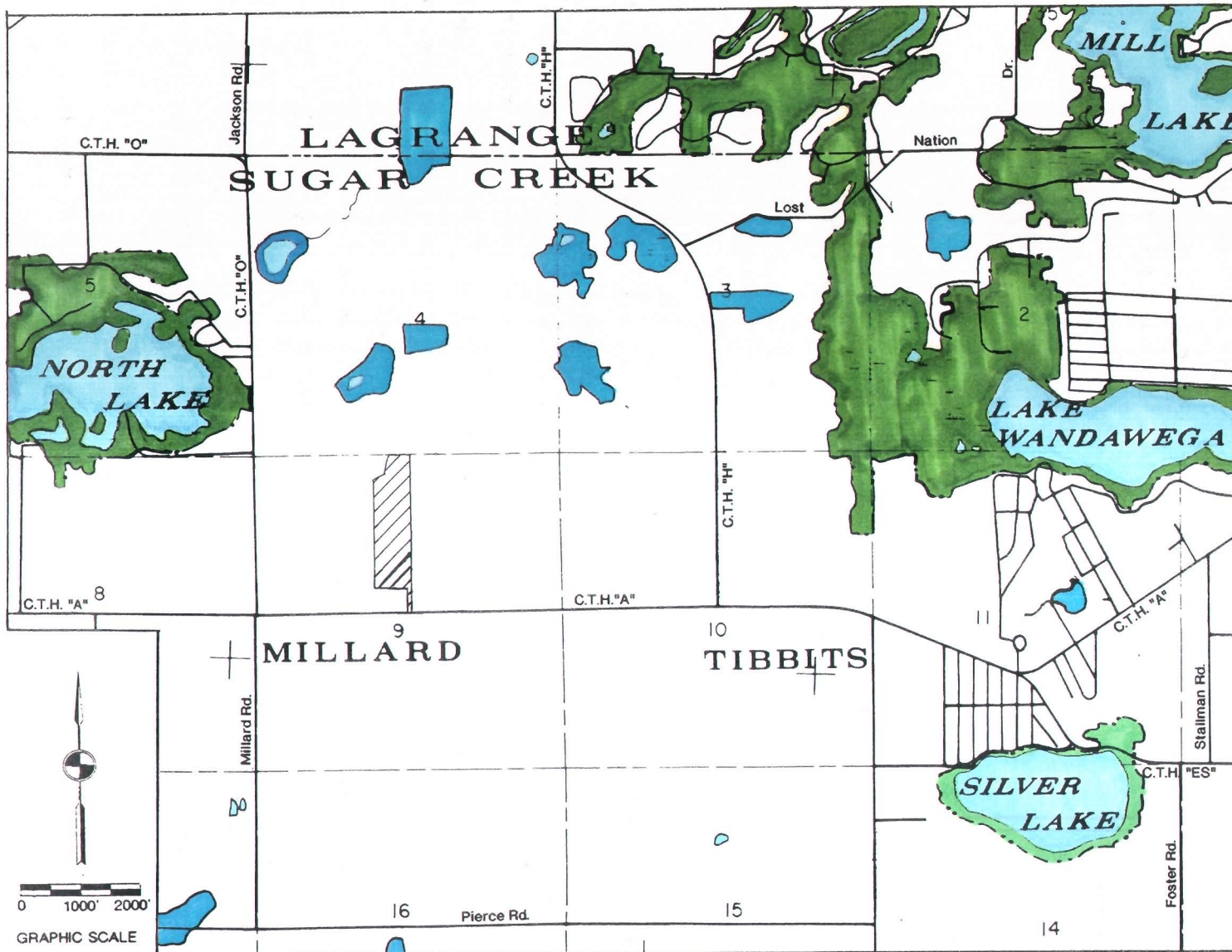
of these residences is the owner of the property which includes the proposed pit site. This residence is the Junker Farm which operates an elderly care center, as previously mentioned. Two of the other residences are located on farmsteads and two are private residences.

Environmentally Sensitive Areas

Environmentally sensitive areas can be categorized as primary environmental corridors, secondary environmental corridors, and isolated natural areas. These lands can include wetlands, woodlands, and wildlife habitat areas. Environmentally sensitive areas within the study area are shown on the Map 2. Any sound evaluation of a major land use change such as the operation of the proposed sand and gravel pit must consider the potential impact on these environmentally sensitive areas.

As shown on Map 2, there are two isolated natural areas located just north of the proposed sand and gravel pit area. The two isolated natural areas consist of a 1.5-acre wetland and a 10.5-acre woodland in the isolated area northwest of the proposed site, and a 7.5-acre woodland in an isolated natural area directly north of the proposed pit site. The development and operation of the proposed sand and gravel pit is not expected to reduce the area contributing surface water runoff nor is it expected to reduce the quality of the surface water runoff to the wetlands area. The elevation of the wetland is near the elevation of the water table. The operation of the proposed pit well is not expected to significantly affect the wetland due to the minor drawdown and cone of depression associated with the periodic operation of the proposed pit well, coupled with the relatively quick recharge nature of the upper sand and gravel aquifer.

The location and extent of primary environmental corridors within the proximity of the proposed expanded sand and gravel pit are also shown on Map 2. There are no primary or secondary environmental corridors located within the limits of the proposed quarry operation. The environmental corridor in closest proximity to the proposed site is the primary environmental corridor surrounding North Lake. This corridor is located approximately one-half mile northwest of the proposed pit site. Therefore, the proposed Millard sand and gravel pit



operation would have no significant negative impact on this high value natural resource.

Prime Agricultural Lands

Development of the proposed sand and gravel pit would result in the loss of about 27 acres of lands currently designated in the Walworth County Agricultural Land Preservation Plan as prime agricultural lands if the proposed sand and gravel pit is developed. The use of the land as a sand and gravel pit is a valuable but conflicting use with prime agricultural land uses. The acreage which would be lost represents approximately 0.01 percent of the 201,000 acres of land designated in 1991 as prime agricultural lands within Walworth County. Thus, this loss of prime agricultural lands is not considered a significant negative impact which would preclude the proposed use.

Traffic and Transportation System Impacts

Two potential traffic and transportation system-related impacts were identified as a result of the proposed sand and gravel pit operation. These two potential impacts include effects on the proposed relocation of STH 12; and potential impacts of truck traffic traveling to and from the proposed sand and gravel pit.

The first potential transportation system-related impact of the proposed sand and gravel pit operations is its potential to provide the long proposed relocation of USH 12 on a more direct alignment between USH 12 north of Elkhorn and USH 12 southeast of Whitewater, as shown on Figure 8. The proposed relocation of USH 12 is currently described in the Amendment to the Walworth County Jurisdictional Highway System Plan--2010. This plan was prepared by the Regional Planning Commission in cooperation with Walworth County, the Wisconsin Department of Transportation, Federal Highway Administration, and the municipal units of government in Walworth County. The proposed sand and gravel pit and the final restoration plan is located over one-half mile west of the proposed relocation of USH 12, as shown on Figure 8. Thus, there is no expected negative impact to jeopardize the implementation of the USH 12 relocation.

There is, however, a possible positive impact with regards to the relocation. Construction materials required to build the relocated USH 12 may be acquired

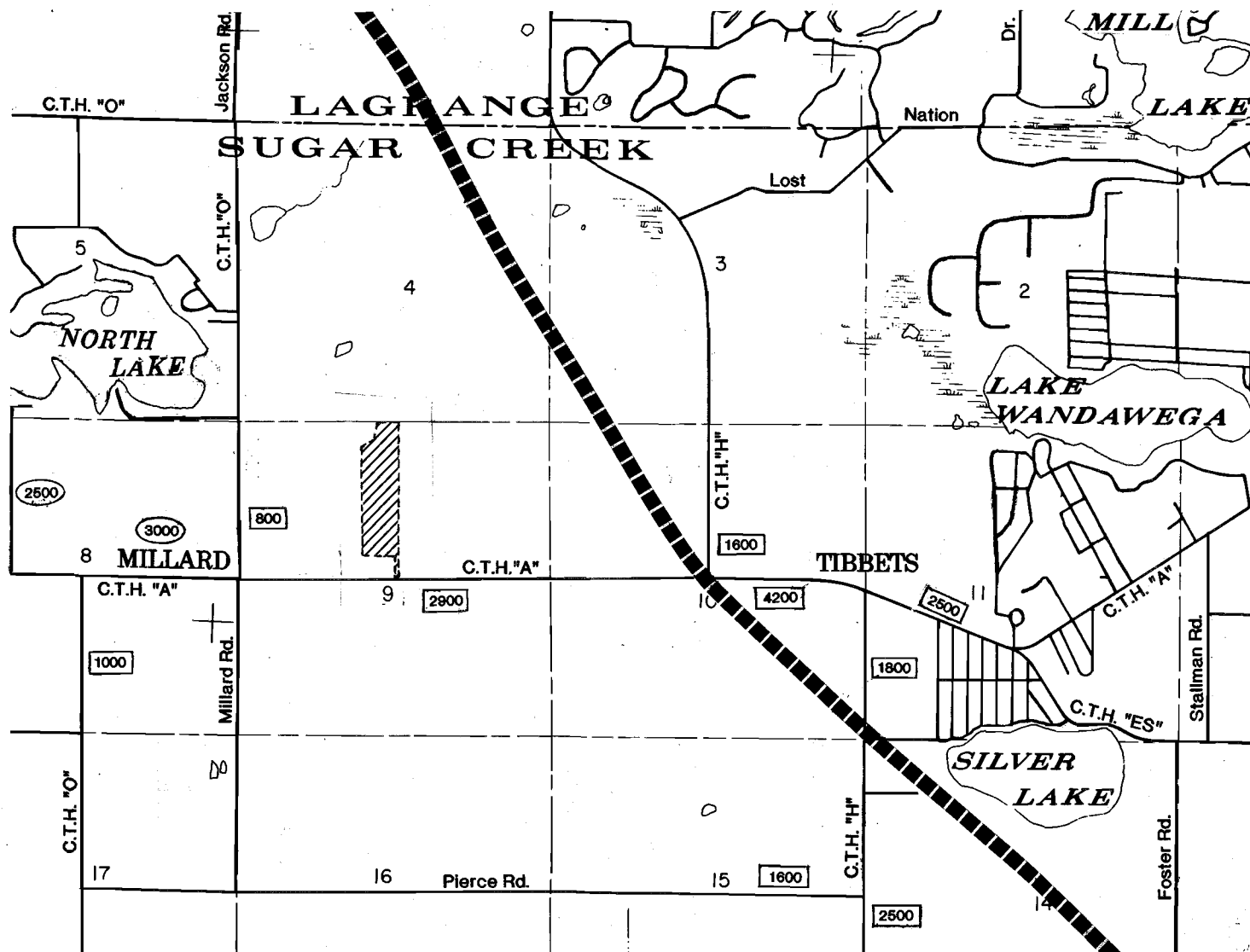




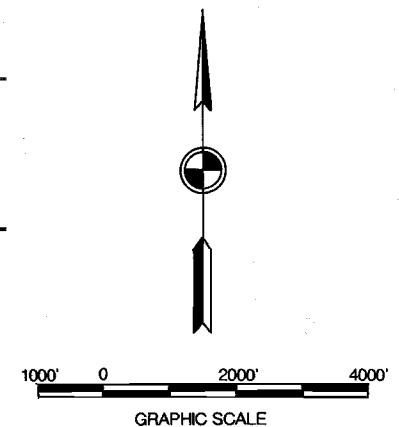


Figure 8
PROPOSED MILLARD
SAND AND GRAVEL PIT:
TRANSPORTATION ROUTES

LEGEND

-  Proposed Sand and Gravel Pit Operation
-  Proposed Location of U.S.H. 12 Extension (4 Traffic Lanes)
-  1990 Annual Average Daily Traffic
-  1990 Estimated Annual Average Daily Traffic

Source SEWRPC and WI D.O.T.



from the proposed Millard sand and gravel pit. It is possible that because of the close proximity of the proposed pit to the planned USH 12 relocation, a slight cost savings might be experienced on a portion of the USH 12 relocation.

Another potential impact of the mineral extraction operation is with respect to the truck traffic to and from the sand and gravel pit. As noted earlier, the maximum number of truckloads exiting the pit is anticipated to be about 250, resulting in about 500 truck trips per day. The number of days that this level of trucking will occur is dependent upon the market demand for sand and gravel construction materials. Normal truck traffic is expected to be significantly less than 250 truckloads exiting the site per day.

Concerns with the impacts of noise, dust, traffic congestion, and concerns of road maintenance and repair problems associated with this type of truck traffic have been raised by citizens during the consideration of the proposed rezoning request. The impacts due to noise will be discussed in the next section entitled Noise Impacts. The impacts due to dust were previously discussed in the section entitled Air Quality and Dust. The impacts concerning traffic congestion and road maintenance and repairs are discussed below.

The transportation system in the area of the proposed sand and gravel pit is comprised mostly of two-lane rural roadways which have design capacities of 7,000 vehicles per day. County Trunk Highway "A" is classified as a Class B highway. The volume of traffic on the local roadways is depicted on Figure 8 by the 1990 annual average daily traffic counts. The volume of traffic ranges from 800 vehicles per day--on CTH "O", north of Millard--to 4,200 vehicles per day--on CTH "A", between CTH "H" to the north and south of CTH "A"--with the average daily traffic volume being approximately 2,300 vehicles per day for the roadways shown on Figure 8. The current traffic volumes are below and may be expected to remain below the design capacity of these roads with the addition of the maximum 500 truck trips resulting from the operation of the proposed Millard sand and gravel pit. Furthermore, there is currently truck traffic from other sand and gravel operations in the area on the subject roadways. Thus, the trucking impacts will be at least partially offset by reductions in truck traffic from other operations.

Traffic impacts due to the proposed operation have the highest potential of occurring at the access point to the proposed sand and gravel pit. The development of lane modifications should minimize this potential problem, with the most effective changes being the following: acceleration lanes, which allow the trucks more time to accelerate to the normal operating speed of the roadway while remaining out of the traffic flow; deceleration lanes which allow trucks to exit a roadway and the associated traffic flow before significantly reducing their speed; and bypass lanes which allow the traffic flow on a particular roadway to go around a slow or stopped truck making a left-hand turn and crossing the opposing lane of the roadway. All three of these measures are proposed by the pit developer at the CTH A entrance to the proposed Millard pit, as shown in blue on Figure 2. The design of these specialized lanes should be developed in conjunction with the Walworth County Highway Department if the project proceeds.

Another potential traffic-related impact is damage to the roadways caused by heavy trucks. Although most county trunk highways are designed to accommodate truck traffic, the heavy weight of the loaded trucks will accelerate the deterioration and increase long-term road maintenance costs. Vehicle loads can lead to fatigue cracking, permanent deformations, and rutting of bituminous concrete or asphalt roadways on county trunk highways such as "A", "H", and "O". Fatigue cracking results from the repeated tension occurring at the underside of the stabilized pavement layers. Fatigue cracking of this type of pavement is typically manifested by the common "alligator cracking" pattern. Permanent deformation of bituminous concrete pavement results from compression and shear occurring in the various layers of pavement. Rutting is a type of pavement distress where longitudinal grooves or ruts are worn into the bituminous concrete pavement surface by heavily loaded vehicles, especially when accelerating or decelerating. This type of action increases erosion of shoulder areas and loss of pavement subgrade material.

The truck traffic generated by the proposed pit operation may result in higher road maintenance and repair costs and/or higher reconstruction costs in order to accommodate the truck traffic in the immediate vicinity. However, this impact cannot be quantified due to the impacts of other vehicles and due to the offsetting reduction in truck traffic traversing the area from other sand and

gravel pits which will be eliminated. It is possible that the overall truck traffic hauling sand and gravel within the Town of Sugar Creek and Walworth County will be largely unchanged because of the offsetting reduction in trucks from other sand and gravel pit operations.

There are some additional measures which can be taken to minimize the impacts of the trucking such as reducing traffic speeds, the provision of paved shoulders, merging lanes, and routing trucks in accordance with an approved routing plan. In this regard, it is recommended that consideration be given to developing a plan for reducing truck-related impacts in the area. Such a plan could be developed cooperatively with the operator of the proposed sand and gravel pit, the Town of Sugar Creek, Walworth County, and local citizen input.

Two other traffic concerns were raised by citizens during the July 20, 1992, Town of Sugar Creek Town Board meeting. One of the concerns related to the safety aspects of the sight lines at the location of the entrance road to the proposed sand and gravel pit operation indicating traffic on CTH A would not be able to readily see entering truck traffic. The other concern related to safety impacts of the increased truck traffic at the Tibbets grade school located about three miles east of the proposed site. It is recommended that, if the proposed project is approved, that the joint planning effort noted above to reduce traffic-related impacts include consideration of these two specific potential impacts and develop appropriate safety measures. The measures noted above can be used to address the concerns raised.

Noise Impacts

Excessive noise is potentially one of the most directly unpleasant impacts of sand and gravel pit operations, especially when located near residential areas. High noise levels may annoy persons residing or working near the sand and gravel pit, and interfere with wildlife nesting and movement habits. Noises associated with sand and gravel pit operations include those generated by trucking, the use of heavy equipment, including stone crushing, washing, classifying, and conveyance operations. Blasting operations which produce the loudest noises, as well as potentially damaging vibrations, will not be conducted at the Millard sand and gravel pit operation.

The most widely accepted unit of noise measurement is the decibel (dBA), which is a logarithmic measure of sound pressure. The higher the decibel level, the more intense the noise. Decibel levels below 20 dBA are difficult to perceive by humans, while levels exceeding 125 dBA frequently cause pain. The effects of decibel levels ranging from 20 to 140 dBA on humans are listed in Table 2.

The effects of noise on the surrounding environment depend on the ambient noise levels, climate conditions, the land uses, and the time of day. Table 3 presents the ambient noise levels and the sensitivity of different land uses to various noise levels. Residential areas and wildlife habitats can be considered to be moderately to highly sensitive to intense noises, while agricultural land, open land, and industrial land would be relatively insensitive.

In general, decibel levels less than 55 dBA are considered to have little impact on residential areas, parks, schools, and churches, which are all sensitive to high noise levels. About 5 percent of the population may be expected to be significantly annoyed by this noise level. However, at 75 dBA, noise levels would have a major adverse impact, generating many complaints. About 37 percent of the population would be significantly annoyed at a decibel level of 75 dBA. At decibel levels of about 80 to 85 dBA, mammals and birds are usually frightened.

It is envisioned that heavy equipment such as front-end loaders and trucking will be used on a normal basis at the proposed pit and that portable rock crushing, conveyor, screening, and washing equipment will be used intermittently at this facility for periods of up to two weeks. Photographs of this type of equipment are shown in Figures 3 and 4.

Noise levels for heavy equipment commonly used in sand and gravel pit operations are shown on Figure 9. The figure indicates that, in the absence of noise controls, such operations would be expected to be at annoyance levels for persons in residential areas located within about 500 feet of the site. In general, noises can be assumed to decrease at a level of 6 dBA for every doubling of distance, plus an atmospheric adsorption rate of about 0.1 dBA per 100 feet.

Table 2
EFFECTS OF NOISE ON HUMANS

dBA Level	Potential Effect
20	No sound perceived
25	Hearing threshold
30	--
35	Slight sleep interference
40	--
45	--
50	Moderate sleep interference
55	Annoyance (mild)
60	Normal speech level
65	Communication interference
70	Smooth muscles/glands react
75	Changed motor coordination
80	Moderate hearing damage
85	Very annoying
90	Affect mental and motor behavior
95	Severe hearing damage
100	Awaken everyone
105	--
110	--
115	Maximum vocal effort
120	--
125	Pain threshold
130	Limit amplified speech
135	Very painful
140	Potential hearing loss high

Source: Jack Golden, et al, Environmental Impact Data Book, and SEWRPC.

Table 3

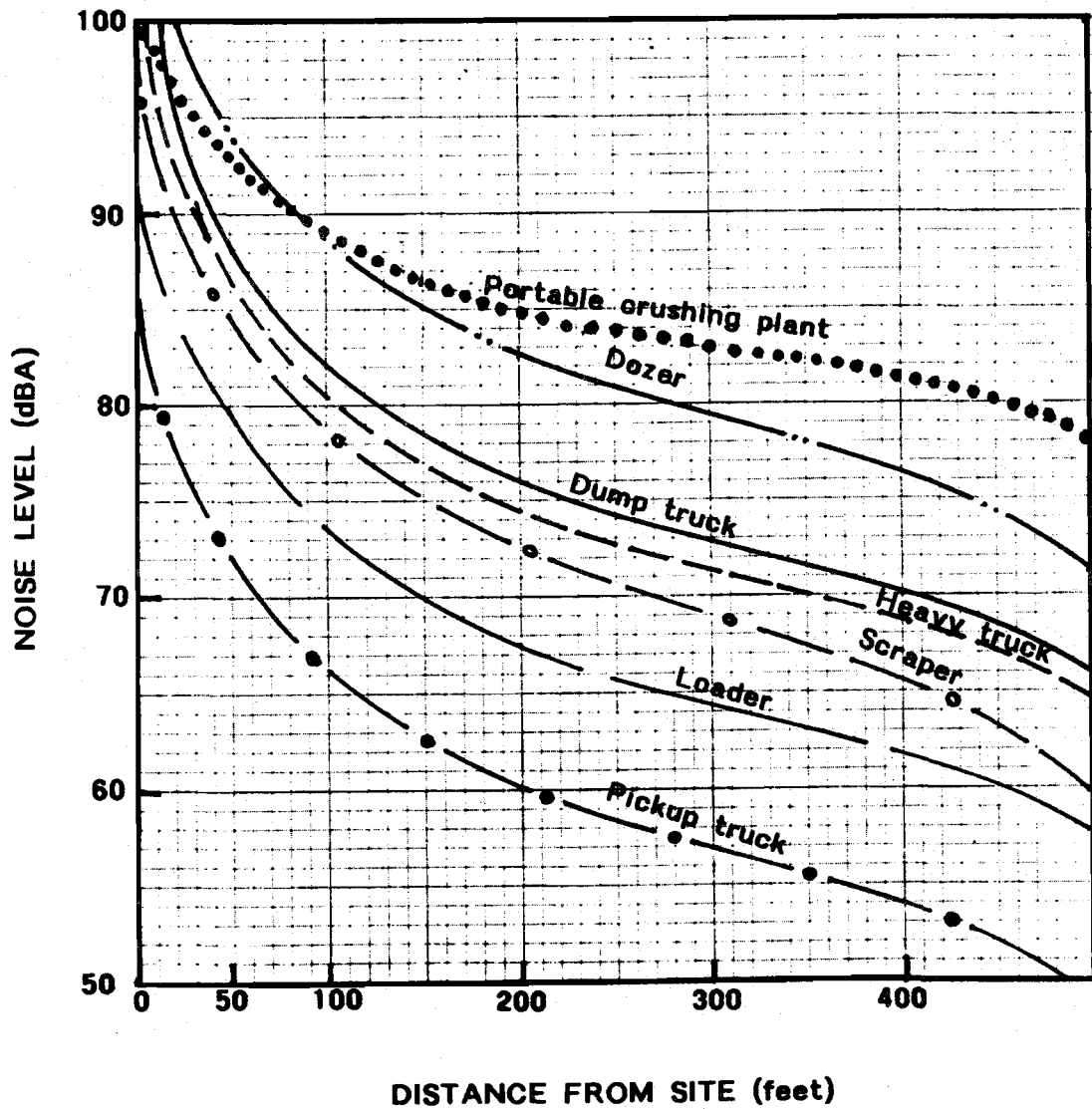
IMPACT OF LAND USE ON SENSITIVITY TO NOISE LEVELS

Land Use	<u>Ambient Noise Levels</u>		Potential Sensitivity To Noise Levels Produce By Quarrying Operations
	Relative	Level (dBA)	
1. Agricultural	Low	30-40	Insensitive
2. Open (No Wildlife Habitat)	Low	25-35	Insensitive
3. Open (Wildlife Habitat)	Low	25-35	Moderately Sensitive
4. Residential	Low-Moderate	40-50	Highly Sensitive
5. Commercial	Moderate	55-65	Slightly Sensitive
6. Industrial	High	60-70	Insensitive

Source: Jack Golden, et al, Environmental Impact Data Book, and SEWRPC.

Figure 9

HEAVY EQUIPMENT NOISE LEVELS



In addition to the noises generated from the sand and gravel pit itself, truck traffic to and from the site can produce noises which affect the environment located along the transport routes. Figure 10 shows the noise levels for truck traffic both with and without a 20-foot high earthen berm sound barrier based on traffic flow and distance. During periods when trucks are entering and exiting the proposed sand and gravel pit at rates of about 50 per hour, noise levels would normally be at the annoying level within about 100 feet of the site access road without a berm and 60 feet of the site access road with a berm; and at about 70 feet from the adjacent streets which do not have berms but are used extensively to transport the material. The truck noise would be noticeable within a much greater distance from the streets and roadways.

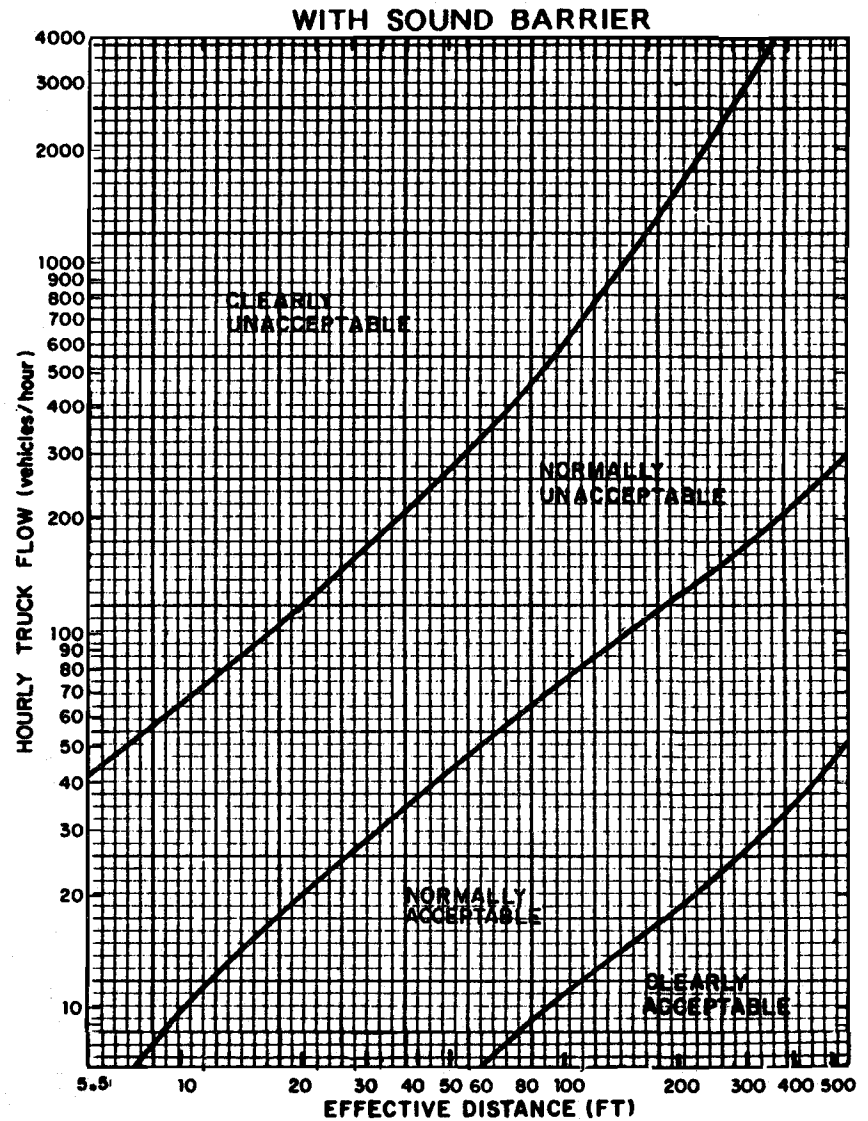
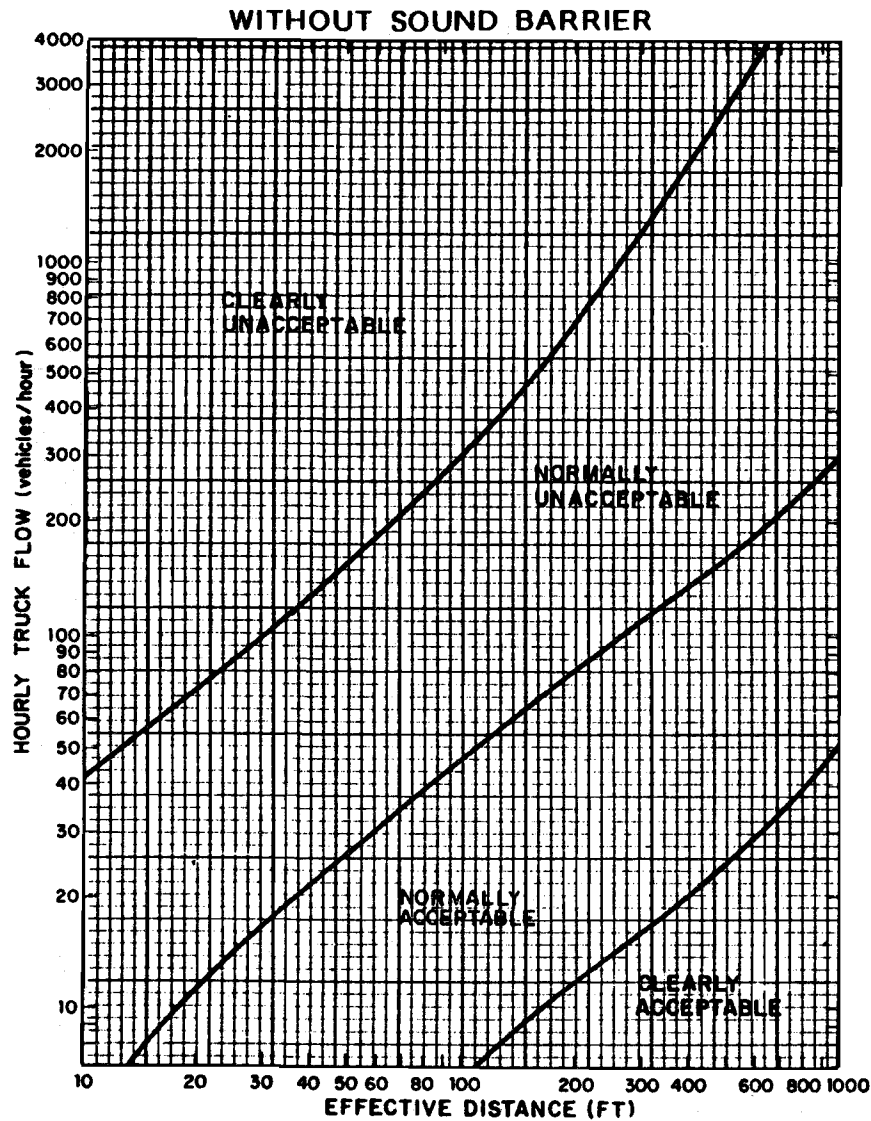
Berms can effectively reduce both noise and visual impacts. Berms have been constructed at other mineral extraction operations to minimize noise impacts. Such berms could be considered to reduce noise levels outside the pit at selected locations adjacent to the more sensitive urban areas. The earthen berms proposed for the Millard pit are not designed to specifically reduce noise, due to their relatively small size, but rather are intended to reduce visual impacts.

The noise levels which may be expected in the areas surrounding the proposed expanded sand and gravel pit operation were estimated based upon the following assumptions:

1. The noise level within the sand and gravel pit during active periods would be about 90 dBA. The loudest noises would be generated by the portable stone crushing and washing facilities, which are able to be moved to various locations throughout the site. This level was calculated by using the estimated noise levels produced by heavy equipment, as shown in Figure 9.
2. The solid barrier provided by geometry and elevation differential of the proposed pit will provide about a 10 dBA attenuation--noise reduction. The proposed landscaping berms are aesthetic in nature and are not expected to significantly reduce noise levels due to their relatively low heights and short finite lengths.

Figure 10

EFFECT OF DISTANCE ON ACCEPTABLE TRUCK NOISE LEVELS WITH AND WITHOUT A 20-FOOT HIGH EARTHEN BERM SOUND BARRIER



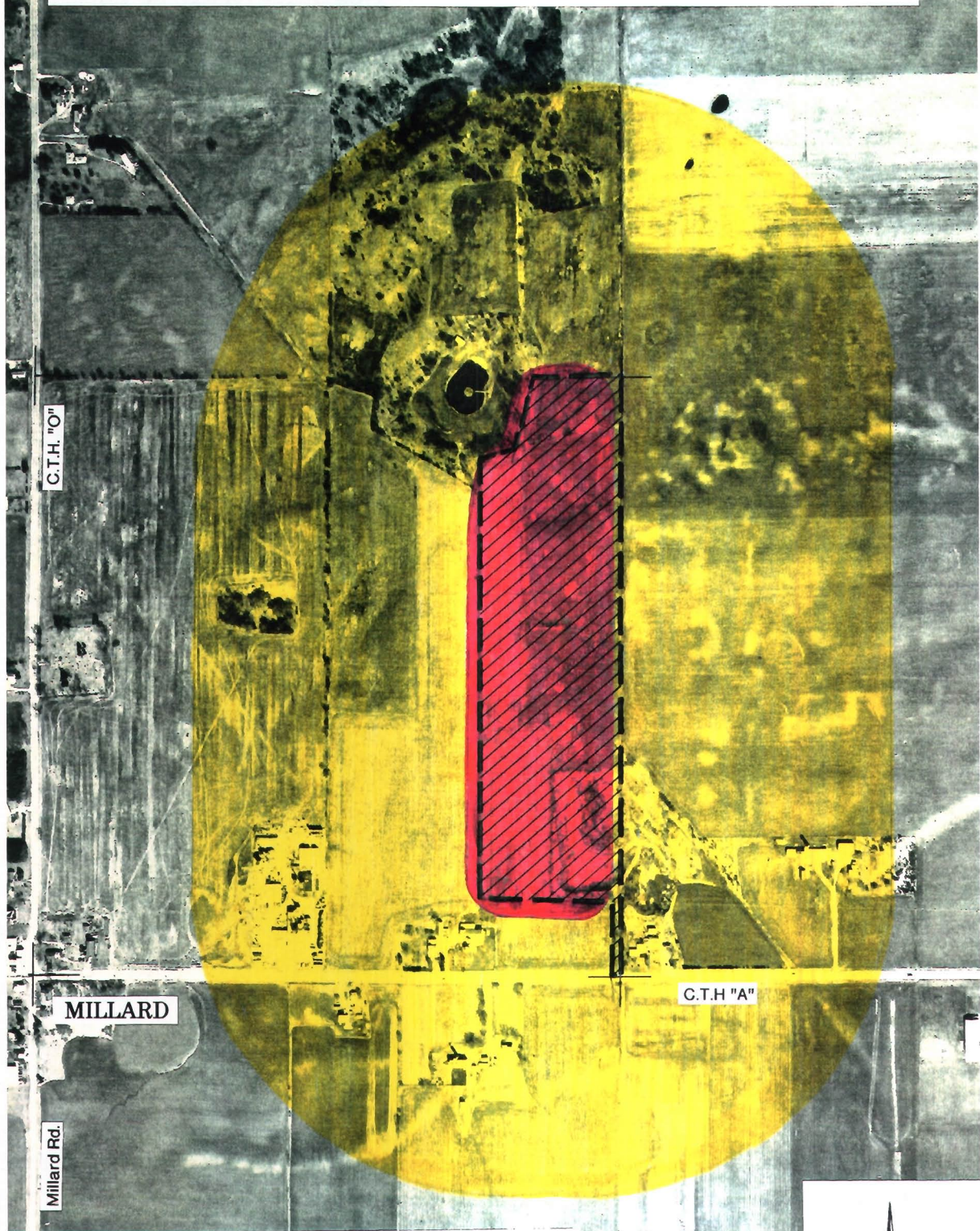
3. Noise levels were estimated using a simplified model which provides decreasing noise levels at a rate of 6 dBA for every doubling of distance from the pit, beginning at 100 feet. In addition, noise levels are expected to be decreased due to atmospheric absorption, the rate varying with the sound frequency and the temperature and humidity of the air, but approximating 0.1 dBA per 100 feet.
4. Trees and shrubs would provide little reduction of noise levels. Although foliage may provide a good visual shield, it provides significant noise reduction only at high sound frequencies, generally greater than 2,000 hertz. Sand and gravel operations produce maximum noise levels at sound frequencies much less than 2,000 hertz.

The areas which are expected to be impacted by the noise produced by the proposed sand and gravel pit operation were estimated assuming the proposed pit is developed, and are delineated as shown on Map 3. The map delineates those areas where the noise levels from the pit operations would be considered to be a severe annoyance--greater than 75 dBA, and areas considered to be a slight to moderate annoyance--from 55 to 75 dBA. Severely annoying noise levels may be expected to range within about 0 to 65 feet of the pit. These severely annoying noise levels would be perceived over an area of about 4 acres, excluding the proposed pit itself, if the zoning change is granted. The slight to moderate annoyance range noise levels may be expected within about 1,425 feet of the sand and gravel pit, impacting an additional area of about 278 acres, if the proposed pit is developed. The noise from the pit will be noticeable for much greater distances than those noted above.




About five residences and one commercial property would be affected by slight to moderately annoying noise levels produced by the proposed Millard sand and gravel pit operation. These properties do not include those impacted by truck traffic related noise. Based upon the new regional land use plan, no significant new urban development is expected to occur by the year 2010 within the area expected to be affected by slightly or severely annoying noise levels.

The potentially affected areas shown on Map 3 would not be continuously impacted, nor would the entire area be impacted at the same time. The areas

MAP 3
ESTIMATED NOISE IMPACTS UNDER PROPOSED SAND AND GRAVEL PIT
OPERATIONS IF THE REQUESTED ZONING CHANGE IS GRANTED



LEGEND

-  SEVERE NOISE ANNOYANCE (>75 dBA)
-  SLIGHT TO MODERATE NOISE ANNOYANCE (55-75 dBA)
-  PROPOSED SAND AND GRAVEL PIT OPERATION

Source: SEWRPC.



affected at any one time would depend upon the particular activity being undertaken, and upon the location of that activity within the pit. Thus, the areas shown on Map 3 represent the maximum areas which may be expected to be affected at the noise levels indicated on a long-term basis.

The noise level estimates set forth herein have been calculated using the model criteria set forth earlier in this section. Field observations by the Commission staff at similar sites indicated that the calculated noise level estimates are reasonable.

In addition to the noise impacts caused by activities within the sand and gravel pit itself, truck traffic to and from the expanded pit may be expected to generate noise along the transport routes. At an estimated maximum truck traffic flow of 500 truck trips per day, noise levels would be annoying within about 100 feet of the access roadway and within about 70 feet of the adjacent public roadways.

A number of measures could be implemented to mitigate some of the most severe noise impacts. These measures, which include structural facilities, operation procedures, and adjacent area measures, are listed in Table 4. It is recommended that earthen berm sound barriers be designed and constructed in place of the proposed landscaping berms located to the west of the pit access road on the south boundary of the site and the southerly portion of the west boundary of the site, as shown on Figure 2, thereby mitigating the noise impacts on the elderly care center. It is further recommended that the measures listed in Table 4 be carefully considered by the pit operator and that a specific noise mitigating plan be developed as part of the pit operational plans. It should be noted that the pit operation equipment is currently regulated and monitored for noise levels by Mine Safety Health Administration and the Wisconsin Department of Industry, Labor, and Human Relations for noise impacts on the personnel working in the pit. This provides one measure of noise control.

Land Use and Zoning

The land use pattern within the immediate vicinity of the proposed sand and gravel pit area, as of 1985, consists largely of agricultural land uses. In addition, there is the existing small sand and gravel pit at the southeast

Table 4

MITIGATIVE MEASURES WHICH MAY REDUCE THE ADVERSE IMPACTS
OF EXCESSIVE NOISE FROM QUARRY OPERATIONS

Type	Description
Structural Facilities	1. Earthen Berms (or similar noise barriers)
Quarry Operation Procedures	<ol style="list-style-type: none"> 1. Schedule noisiest activities for mid-day and rush hour periods. 2. Reduce truck traffic and truck speed. 3. Construct smooth, gently-sloped haul roads, where possible. 4. Require noise control features on heavy equipment and comply with vehicle codes and regulations concerning noise emissions from heavy equipment.
Adjacent Area Measures	<ol style="list-style-type: none"> 1. Develop setbacks from the pit for new urban development and only allow land uses in impacted areas which are compatible with the expected noise levels. 2. Soundproof buildings in impacted areas. 3. Reduce speed limits on, and carefully maintain, roadways used by trucks and heavy equipment.

Source: SEWRPC

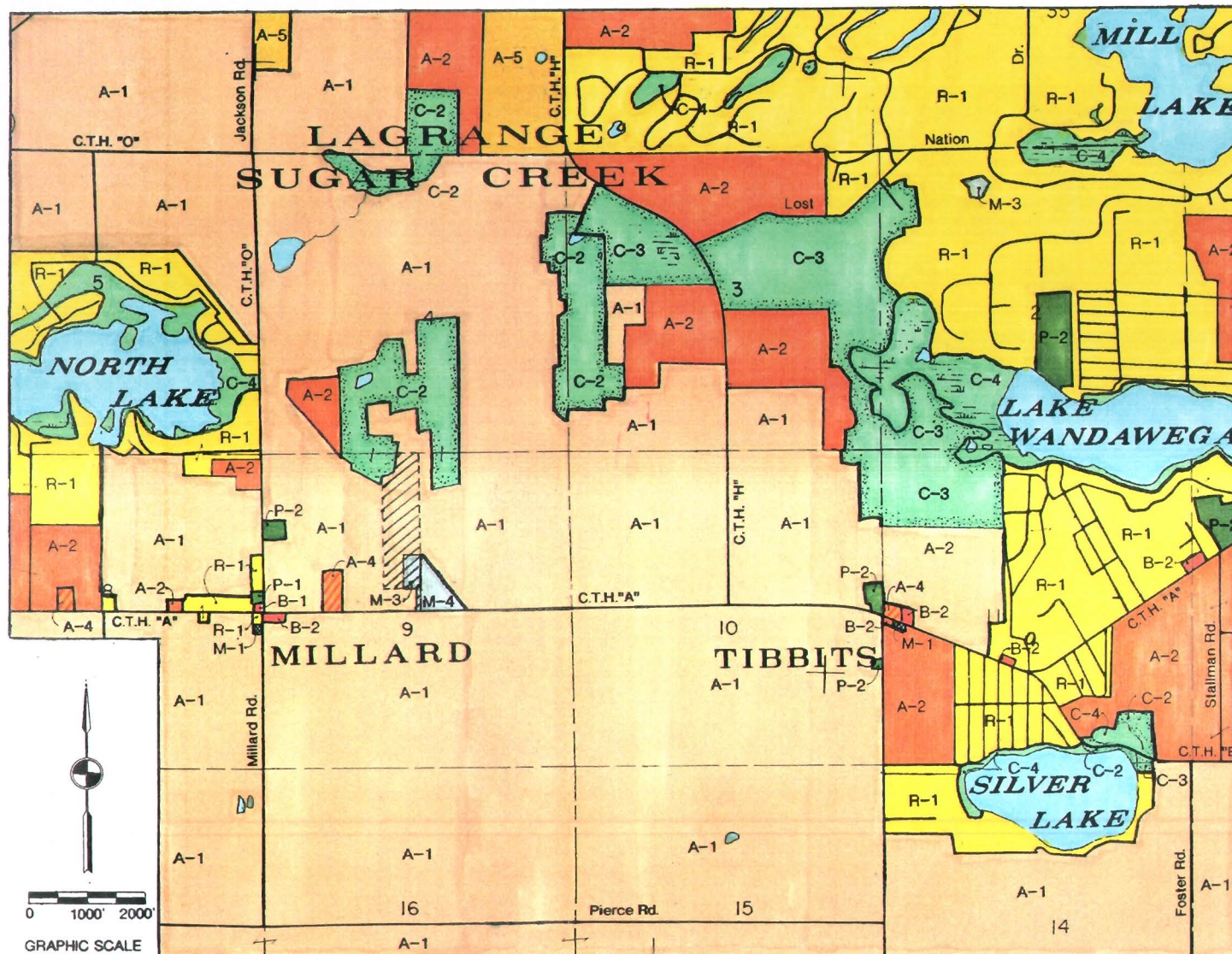
corner of the proposed site; an abandoned landfill; scattered single-family residential land parcels; one agricultural-related commercial business; and rural open space uses including woodlands, one small wetland, and a private pond. Nearly all of the agricultural land has been designated in the Walworth County Farmland Preservation plan as prime agricultural land, which includes the most productive remaining croplands. There is no significant new urban development planned to occur in the immediate vicinity of the proposed pit area within the next 20 years, based upon the recently completed year 2010 regional land use plan.

The various zoning districts and attendant district regulations within the study area are set forth in the shoreland zoning ordinance of Walworth County, Wisconsin, dated August 13, 1974, and amended October 15, 1991. This current zoning is shown on Map 4.

Approximately 27 acres, or most of the land proposed for the Millard sand and gravel pit, is currently zoned A-1, Prime Agricultural Land District. Permitted uses include: grazing, produce and livestock farming, recreational uses, and one or two family dwellings. The minimum lot size is 35 acres. The operator of the proposed pit has requested that the zoning of this parcel be changed to M-3, Mineral Extraction District.

The southeastern approximately four acres of the proposed sand and gravel pit operation limits are currently zoned M-3, Mineral Extraction District. The zoning requirements specify yard requirements that all excavations shall be at least 200 feet from the right-of-way of any public or approved private street or property line or shoreline. Also, all accessories such as offices, parking areas, and stockpiles, shall be at least 100 feet from any right-of-way or property line or shoreline.

There is an existing stockpile of sand located in the northeast corner of the four acres currently zoned M-3, Mineral Extraction District. This stockpile is in violation of the zoning ordinance with regard to yard requirements in that it is closer than 100 feet to the east property line. It is anticipated that said stockpile will be removed by the proposed pit operator in accordance with the market demand for that product.



Map 4
 EXISTING ZONING DISTRICTS IN THE TOWN OF SUGAR CREEK AND THE TOWN OF LAGRANGE: 1990

LEGEND

- A-1 Prime Agricultural Land
- A-2 Agricultural Land
- A-4 Agricultural-Related Business
- A-5 Agricultural-Rural Residential
- R-1 Single Family Residential
- C-2 Upland Conservancy
- C-3 Conservancy-Residential
- C-4 Lowland Conservancy
- P-1 Park District
- P-2
- B-1 Local Business
- B-2 General Business
- M-1 Industrial
- M-3 Mineral Extraction
- M-4 Sanitary Landfill
- Proposed Sand and Gravel Operation Limits

Source: SEWRPC.

A variance to the zoning ordinance in regard to the yard requirements may be required if the proposed new pit excavation is carried out as planned. Approximately six acres, located within the 200-foot property line setback as set forth in the zoning ordinance, are proposed to be excavated to depths of 2 to 20 feet below the existing ground surface. This excavation is proposed along the eastern property line of the proposed pit, north of the lands currently zoned M-3, and immediately adjacent to the parcel of land owned by Yursden Farm's, Inc. The excavation is proposed to occur within approximately 50 feet of the aforementioned property line. The only purpose of this excavation within this 200-foot property line setback is to implement the proposed restoration plan.

The Commission has reviewed the plan map entitled, "Topographic Survey for Reclamation Plan" developed by Ferris, Hansen & Associates, Inc. for the Theodore Junker Farm, submitted to the Town Board of the Town of Sugar Creek. While this reclamation plan does not completely meet all of the submittal requirements of the restoration plan cited in Article 4.10 of the zoning ordinance, it does represent an acceptable final restoration topographic grading plan. It is recommended that a conditional use permit be granted only after the final restoration plan is submitted and approved in accordance with Section 4.0-Conditional Uses of the Shoreline Zoning Ordinance, Walworth County, Wisconsin, and found to conform to the standards specified by the County Conservation Standards.

The land immediately adjacent to the proposed sand and gravel pit area is zoned A-1, Prime Agricultural, as shown on Map 4, with the exception of approximately 400 feet, or 15 percent of the northwest limits of this boundary, which is zoned C-2, Upland Conservancy; and the exception of the land east of the current M-3, Mineral Extraction District included in the proposed pit area, which is zoned M-4, Sanitary Landfill. The single land use in the vicinity which is inconsistent with the proposed landfill is the existing scattered residential areas, including the elderly care facility on the Junker Farm.

The current zoning is consistent with the recommended regional land use plan which provides for no significant urban development in this vicinity within the next 20 years. The current zoning districts would allow such development to

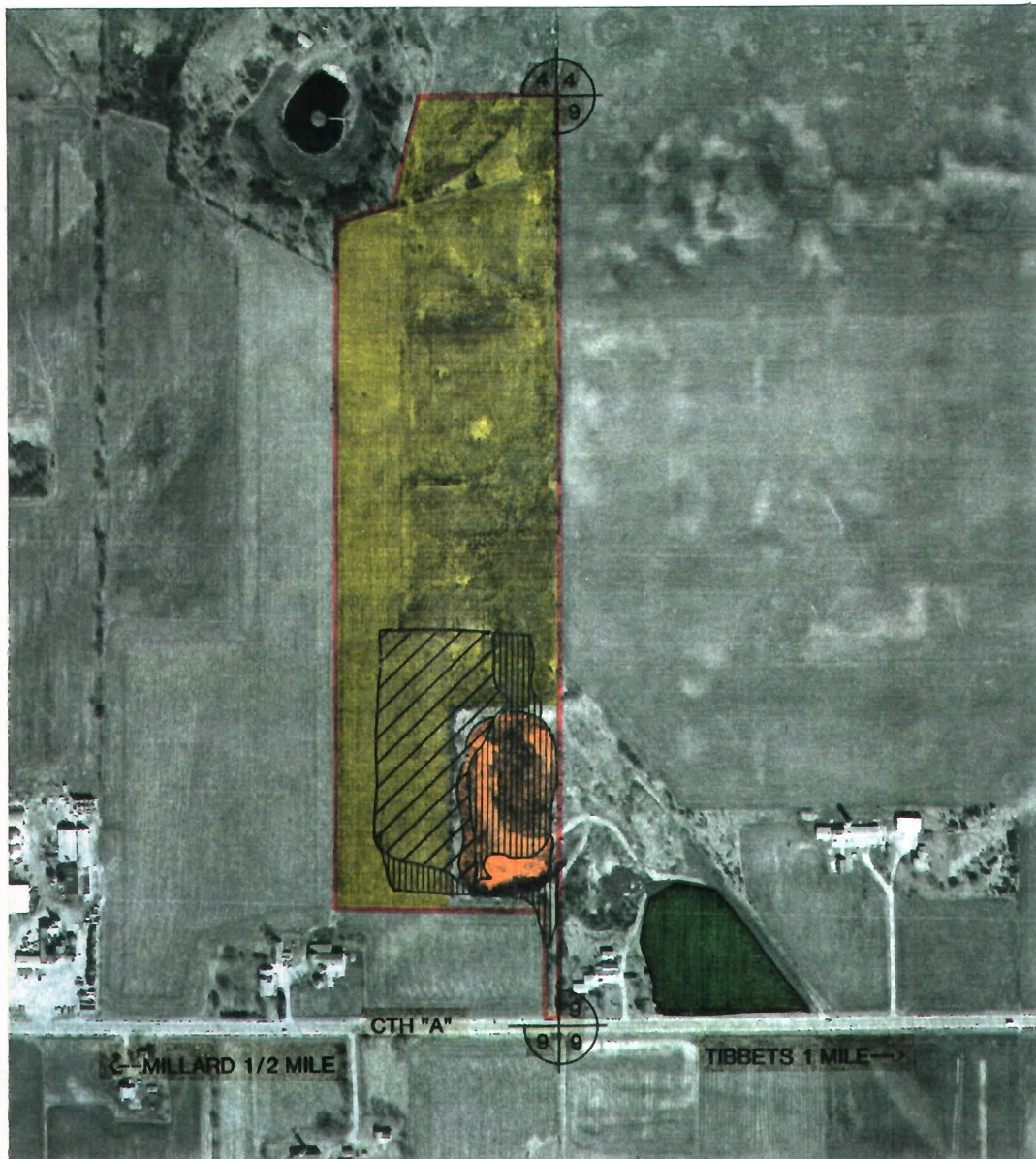
occur only on 35-acre parcels. The zoning districts currently in place are those which would be most compatible with the operation of a sand and gravel pit. Few existing residents are expected to be significantly affected by the noise and air quality impacts, although traffic impacts will be more widespread. While the proposed sand and gravel pit operation is anticipated to have a useful economic life of about 10 to 15 years, it is possible that requests for pit expansion could occur, making the site a longer term operation. It would be desirable for the Town of Sugar Creek to seek to preclude, to the maximum extent practicable, the establishment of additional residential subdivisions within at least one-quarter mile of the boundary of the proposed sand and gravel pit operation until such time that the excavation is nearly completed. The current zoning provides for such restriction.

Adjacent Sanitary Landfill Site Impact







There is a closed sanitary landfill owned by the Town of Sugar Creek located immediately adjacent to the land proposed to be rezoned, as shown on Figure 11. The actual area used for sanitary landfilling is approximately three acres in size and is located in the southeastern one-half of the parcel currently zoned M-4 Sanitary Landfill District. The closest area used for landfilling to any area planned to be disturbed for the proposed sand and gravel pit is 250 feet. The closest areas are being disturbed for the access road, bank stabilization and restoration, and landscaping. The closest actual pit sand and gravel excavation to the area landfilled is about 500 feet. The landfill facility was licensed to accept only typical non-hazardous residential waste. No known hazardous wastes were accepted at this site. The exact depth of the landfill is not known. However, the bottom of the landfill is expected to be above the water table, which is located at about elevation 900 NGVD. The landfill was abandoned March 1, 1987, and covered by November of 1987. The final landfill closure activities were completed, including the placement of a clay cap and the provision of topsoil and seeding of the area in the Spring of 1991. A closure report was submitted to the Wisconsin Department of Natural Resources in August 1991.

The operations of the proposed sand and gravel pit would not be expected to significantly change the current conditions at the abandoned sanitary landfill because of the distance between the limits of the landfill and proposed pit

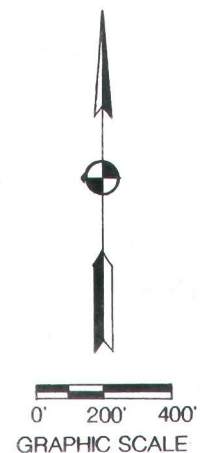
Figure 11
LOCATION OF ABANDONED LANDFILL SITE
PROPOSED MILLARD SAND AND GRAVEL PIT



LEGEND

-  AREA OF SANITARY LANDFILL
-  PROPOSED SAND AND GRAVEL PIT OPERATION LIMITS
-  AREA PROPOSED TO BE REZONED FROM A-1 PRIME AGRICULTURAL DISTRICT TO M-3 MINERAL EXTRACTION DISTRICT
-  APPROXIMATE LIMITS OF EXISTING EXCAVATION: 1990
-  SITE OF PROPOSED SIGNIFICANT EXCAVATION IN CLOSE PROXIMITY OF THE SANITARY LANDFILL
-  SITE OF PROPOSED MINOR EXCAVATION IN CLOSE PROXIMITY OF THE SANITARY LANDFILL

Source: Crispell-Snyder Inc and SEWRPC.



operations. In addition, the elevation of the existing four-acre sand pit is currently near the same elevation as the proposed pit and is between the proposed pit and the landfill. Another consideration is the direction of the groundwater flow. The general groundwater flow pattern as discussed earlier is from west to east and would transmit groundwater impacted by the landfill easterly, away from the proposed pit location. Thus, the groundwater impacts from the landfill will be unchanged in this regard.

The existing landfill closure activities were designed to minimize infiltration of surface water into the landfill in order to minimize leachate formation. It is recommended that the grading for the proposed sand and gravel pit, if it is approved, be designed to improve the drainage patterns to route any surface water away from the landfill site.

Potential Future Expansion Impacts

The previously discussed impacts related specifically to the current rezoning approval and the associated site size and capacity limits documented earlier. However, it should be recognized that once the facility is sited, there is no guarantee that subsequent expansion will not be requested. Expansion of a sand and gravel pit is normally considered to be more easily approved than siting a new facility. There are open lands adjacent to the proposed facility containing similar soil characteristics to the proposed pit site. Should such expansions be approved in the future, the impacts of a sand and gravel pit will become much more long term. No detailed analysis of future proposals has been made. However, it is expected that the impacts associated with floodplains, groundwater quantity and quality, surface water quality, prime agricultural lands, and the adjacent abandoned sanitary landfill would not be significantly different. However, the impacts of noise and air quality could become more significant in that the length of time the impacts would be experienced would be increased and the areas most directly impacted would be different and could be extended to impact additional urban land uses. In addition, the impacts on the environmentally sensitive areas could also be more significant if the expansion were to take place in the isolated natural areas to the north. However, this consideration may not necessarily be fatal to a future proposal because of the isolated nature of the natural areas. The concerns related to land use and zoning could be different if the expansion covered significantly

larger areas in the direction of residential land development. All of these concerns would have to be considered for each expansion proposal along with the record of how the currently proposed pit was operated and restored. However, it is important to realize that the approval of the current proposal will open up the potential for incremental expansion of the pit operations in the adjacent areas.

CONCLUSIONS

Two conclusions may be drawn from the study concerning the potential environmental impacts of the proposed Millard sand and gravel pit operation. First, the expanded operation may be expected to have no, or relatively minor impacts on eight of the environmental factors considered. These environmental factors include floodlands, groundwater quantity and quality, surface water quality, environmentally sensitive areas, prime agricultural lands, land use and zoning, the adjacent abandoned sanitary landfill, and traffic. The impacts which were found to be expected on these eight environmental factors are either insignificant or readily mitigated.

Secondly, the impacts of the proposed sand and gravel pit expansion on air quality and noise may be considered to be moderate. These impacts can be partially but not fully mitigated. Human health and the ecological resources within the study area are not expected to be significantly affected by these environmental factors, although the overall quality of life and the desirability of the area for other urban use development could be affected. These impacts could be manifested in ways such as to potentially lower property values, increased cleaning and maintenance requirements, and disturbance of sleep and relaxation periods. There are five residences and an agricultural-related business which are expected to be most directly impacted located within about one-quarter mile of the proposed pit. Beyond that area, the impacts may be expected to be minimal. As noted previously, two of the six most directly affected properties are on farmsteads and one is the residence of the owner of the property on which the proposed pit is to be located. The impacts in this area are partially mitigated since the adjacent agricultural operations tend to be more compatible since they cause some of the same types of impacts as would the proposed mining operation. However, as previously noted, the Junkers,

owners of the property in question, operate an elderly care center at their residence. The elderly people residing at the care center could be moderately impacted.

There is a need to develop sand and gravel deposits as an important element of the economy of the area. The products provide a resource needed for construction uses of a much larger area than that immediately impacted.

In summary, it appears that there is no overriding environmental concerns which would preclude the expansion plans from being approved, provided the mitigative actions recommended herein are carried out. There are, however, some limited negative impacts associated with the expansion proposal which cannot be fully mitigated and which must be weighed by the Town officials considering the approval--with the most significant being concerns regarding noise and dust conditions. In addition, the local community opinion must be weighed.

RECOMMENDATIONS

Should the Town and County decide to approve the subject sand and gravel pit expansion, the following recommendations are offered for consideration as means to minimize the potential environmental impacts of the proposed Millard sand and gravel pit operation and to enhance the acceptability of the operation by existing and future nearby residents and by the local communities concerned.

Town of Sugar Creek

1. To minimize noise, air quality and traffic impacts, it is recommended that the public land use controls exercised jointly at the County and Town levels discourage the location of any new residential land uses within at least one-quarter mile of the proposed sand and gravel pit site until the mining operation is completed. The current zoning is consistent with this recommendation.
2. The operator of the proposed sand and gravel pit will require approval from the Town and County of the rezoning and the issuance of a conditional use permit by the County needed for site development. It is recommended that the conditional use permit require the operator of the

proposed pit provide to the Town and County a site development, operations, and restoration plan of the pit. The site plan should include at least the following information in addition to the requirements set forth of Section 4.0, Article 4.10 of the County Zoning Ordinance:

- o A description and topographic map of the proposed staged mining and restoration plan, including the recommended earthen berm sound barriers, the location and extent of the areas to be mined, the amount of materials to be removed, the depths to which such removal is expected to occur, and a statement as to the intentions of the pit operator as to the future plans of expansion of the proposed sand and gravel pit. The topographic base map should be at a scale of no more than 1 inch equals 200 feet with contours at a two-foot vertical interval. The elevations should be based upon National Geodetic Vertical Datum of 1929.
- o Identification of the specific means to be employed to mitigate environmental impacts. In this regard, particular emphasis should be given to mitigative measures relating to: noise, air quality, and traffic. A summary of the mitigative measures recommended to be considered is set forth in Table 5.
- o Operations description that would, for example, identify where unused materials which are excavated on the site and the generated wastes are to be deposited.
- o An erosion control plan by which soil erosion would be controlled during the development and restoration of the quarry site.

Walworth County

1. It is recommended that Walworth County in cooperation with the pit developer/operator agree on a plan to pave the shoulders of CTH A and provide acceleration and turning lanes to properly service the pit entrance road to reduce fugitive dust levels and prolong the useful life of the roadway by reducing erosion of the shoulder and loss of subgrade material.

2. It is recommended that the County Highway Department work cooperatively with the pit developer/operator, the Town of Sugar Creek, and local citizen representatives to develop a traffic safety plan specifically addressing the roadway sight lines at entrance locations and the safety in the Tibbets school area.
3. It is recommended that the County Zoning Administrator establish a procedure for monitoring the proposed operations and assume responsibility for compiling and recording complaints from citizens related to the pit operations; to provide for corrective actions by the pit owners and operators, if needed; and to forward complaints to the appropriate State regulatory agencies when necessary.

Pit Developer/Operator

1. It is recommended that the pit developer/operator prepare a site development, operations, and restoration plan for the proposed pit; to mitigate the identified problems relating to fugitive dust, noise, and traffic. This plan should be submitted to the Town and the County for approval and include, but not be limited to, the following:
 - o A contaminant management plan to include the disposition of wastes, provision for storage and containment facilities for hazardous materials, and an emergency plan of action to contain and remove accidental spillage of contaminants, including the timely provision of any equipment to accomplish this.
 - o Air quality control measures to include such plans as regular street sweeping; provisions for paving of roadway shoulders; and the implementation of the appropriate air quality control measures listed in Table 1.
 - o Plan of implementation of noise control measures to include operating machinery as close to the pit sidewall embankments as practically possible to use their natural geometries as berms and/or noise barriers; the design and construction of the earthen berm sound barriers previously recommended for the southwest portion of the

Table 5

**RECOMMENDED MEASURES TO MINIMIZE THE ENVIRONMENTAL IMPACTS
OF THE PROPOSED MILLARD SAND & GRAVEL PIT**

Recommended Measures	Implementing Agencies			
	Town of Sugar Creek	Walworth County	Millard Sand and Gravel Pit	Private Property Owners
<u>Administrative Measures</u>				
1. Require preparation of site development, operations, and restoration plan and preparation of an erosion control plan	X	X	--	--
<u>Mitigative Measures</u>				
1. Implement noise control measures (see Table 4).....	--	--	X	--
2. Implement air quality control measures (see Table 1).....	--	--	X	--
3. Prepare and implement with development, operation, and restoration plan	--	--	X	--
4. Prepare and implement erosion control plan.....	--	--	X	--
5. Construct the required acceleration and turning lanes on CTH CTH A at the pit access road...	--	--	X	--
6. Pave shoulder of CTH A near pit	--	--	X	--
7. Reduce speed limits on CTH A near pit	--	X	--	--
8. Develop traffic safety plan including consideration of sight lines at merging points and school area safety.....	X	X	X	--
<u>Monitoring Program</u>				
1. Carefully record nuisance conditions and forward complaints to County zoning administrator.	--	--	--	X
2. Establish program to compile complaints, coordinate corrective actions, and forward complaints to regulatory agencies as needed	--	X	--	--

site; and the implementation of the appropriate mitigative measures listed in Table 4.

- o Develop a truck haul route plan and design the needed shoulder paving and turning lane improvements on CTH A.
 - o Develop construction erosion control measures to be implemented during the development of the proposed pit.
2. It is also recommended that arrangements be made to mitigate the minor impact on the one well, identified as being potentially impacted by the operation, by establishing an agreement to cover the cost to deepen that water supply well or drill a new well if it were shown that the cause of any problem with the well was the pit operation.
 3. It is recommended that the pit developer/operator work cooperatively to develop a traffic safety plan as described above.

Private Property Owners

1. It is recommended that private property owners located in the vicinity of the pit carefully record a description, the date, and the time of the occurrence of any annoying or nuisance conditions related to the pit operation. Complaints should be forwarded to the County Zoning Administrator for consideration and action.

APPENDICES

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APPENDIX A

ENVIRONMENTAL ASSESSMENT OF THE PROPOSED DEVELOPMENT OF THE MILLARD SAND AND GRAVEL PIT, TOWN OF SUGAR CREEK

Summary notes from the July 20, 1990, Town Board Meeting

At the regular meeting of the Town Board held on July 20, 1990, the agenda included a presentation of the preliminary findings of the environmental assessment of the proposed Millard Sand and Gravel Pit. During that meeting, a presentation on the findings was made to the Board and the public in attendance by the Regional Planning Commission staff. The Town Board did allow questions and comments on the environmental assessment during and after the presentation. The following summarizes those comments which relate most directly to the findings of the environmental assessment:

1. Several people in attendance raised concerns about the traffic impacts on CTH A. In addition to the concerns regarding the volume of trucking, one person specifically indicated that safety considerations relating to the sight lines in the vicinity of the proposed access road to the gravel pit should be a consideration. Other people raised the traffic-related safety concerns regarding the Tibbets school which is located about three miles east of the proposed entrance road to the proposed sand and gravel pit on CTH A.

Mr. Biebel of the Commission staff indicated that based on the traffic volumes on CTH A, the increased truck traffic, which could add as much as 500 truck trips per day during peak use, would still be well below the estimated 7,000-vehicle-per-day capacity of this Class B highway. He also noted that there are currently a significant number of sand and gravel trucks which utilize Highway A in the vicinity of the proposed sand and gravel pit. The existing sand and gravel trucking from other sites would be reduced due to the presence of the proposed pit and thus would at least partially offset the additional trucking in the area due to the proposed pit. Mr. Biebel also indicated that the report would be refined to reflect the concerns relating to the Tibbits School and to the sight lines on the roadway.

2. There were several comments made relating to the abandoned Town of Sugar Creek landfill located just east of the proposed sand and gravel pit operation. There were concerns raised with regard to potential that hazardous materials had been placed in that landfill; the manner in which the landfill was capped; and the relationship of the landfill to the proposed sand and gravel pit. The Town Board members explained the details of the landfill abandonment plan, including the capping procedure used on the landfill. They also indicated that based on personal observations over many years, they were not aware of any hazardous material which had been placed in the landfill.

Mr. Biebel stated that the findings of the assessment indicated that the proposed sand and gravel operation would not be expected to significantly impact the landfill because of the separation distance of about 250 feet and because there already was an excavation to the expected depth of the new pit at the four-acre existing sand and gravel pit which was the pit's closest point to the landfill site. The concerns regarding the potential for groundwater contamination from the abandoned landfill were answered, with the conclusion that the assessment does indicate that the proposed sand and gravel pit operation is not expected to significantly change the situation with regard to that landfill site. It was also noted that if leachate was discharging from the landfill toward the proposed pit, it would be better to be able to see it at the proposed excavation than to have it continue unnoticed underground.

Mr. Biebel also agreed to add a brief discussion to the report indicating that the grading plan for the sand and gravel pit should, where possible, be designed to improve the surface drainage in the vicinity of the landfill site, thus, reducing the potential for infiltration into that site.

3. There was also considerable discussion regarding the current lack of compliance with zoning regulations and conditional use permit requirements at other sand and gravel pits in the County. Questions were raised with regard to the responsible parties for monitoring and surveillance of the proposed sand and gravel pit and at other sand and

gravel operations in the County. Chairman Guthrie indicated that monitoring was the responsibility of Walworth County. Mr. Biebel indicated that recent discussions and concerns raised regarding sand and gravel pit operations had resulted in the County reviewing the monitoring and compliance assurance procedures for such operations. He indicated that it was his understanding that the County was in the process now of developing a policy relating to sand and gravel pit operations and the County's role in monitoring those operations. That policy is being designed to address many of the concerns raised.

4. There was considerable comment from the meeting attendees indicating their opposition to the proposed sand and gravel pit for a variety of reasons. However, the concerns raised noted above were those which required consideration of modification to the environmental assessment.

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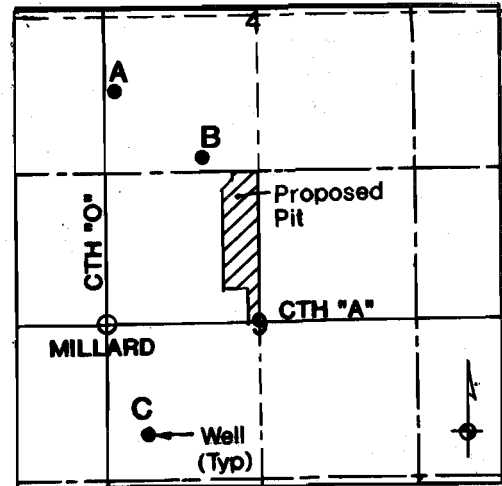
APPENDIX B

ESTIMATION OF THE CONE OF DEPRESSION
IN THE SAND AND GRAVEL AQUIFER
RESULTING FROM THE PROPOSED MILLARD PIT WELL

Transmissivity (T) and hydraulic conductivity (K), are measures of the ability of the earth to transmit water according to a method presented by Bradbury and Rothschild (1985)⁽¹⁾. Well completion data from four wells in the study area were analyzed. The location of these wells are shown in figure to the right. The well data included total depth of well, well radius, screen length, static and pumping water levels, time length of pump test and pumping rate. Other parameters included aquifer thickness, storage coefficient and well loss coefficient. The equations used to calculate the transmissivity and hydraulic conductivity are shown below.

Terms:

- T = Transmissivity (square feet per second)
 Q = Pumping rate (cubic feet per second)
 s = Drawdown (feet)
 s_w = Well loss (feet)
 t = Time length of pump test (seconds)
 r_w = Inner radius of well (feet)
 S = Storage coefficient (unitless)
 sp = Partial penetration factor (unitless)
 L = Length of well screen (feet)
 b = aquifer thickness (feet)
 C = well loss coefficient (unitless)



Well	Elev.	Calculated Values
A	866	T=5.43x10 ⁻² ft. ² /sec. K=6.03x10 ⁻⁴ ft./sec.
B	865	T=3.41x10 ⁻² ft. ² /sec. K=3.79x10 ⁻⁴ ft./sec.
C	873	T=2.73x10 ⁻² ft. ² /sec. K=1.82x10 ⁻⁴ ft./sec.

EQUATIONS:

$$s_w = C \times Q^2$$

$$G_{L/b} = 2.948 - (7.363 \times \frac{L}{b}) + (11.447 \times (\frac{L}{b})^2) - (4.675 \times (\frac{L}{b})^3)$$

$$s_p = \frac{1-L/b}{L/b} \times ([\ln(\frac{b}{r_w})] - G \times \frac{L}{b})$$

$$T = \frac{Q}{4 \times \pi \times (s - s_w)} \times ([\ln(\frac{2.25 \times T \times t}{(r_w^2 \times S)})] + 2 \times s_p)$$

$$K = \frac{T}{b}$$

The aquifer thickness varies from approximately 50 to 200 feet in the study area. Storage coefficient and well-loss coefficient were taken from the article by Bradbury and Rothschild⁽¹⁾.

The reliability of the estimate by this method is highly dependent on the quality of the information provided on the well completion reports. These reports are filled out by well drillers after installation of a well, as required by the State of Wisconsin. In order to increase confidence in the results, only wells with report completion tests of four or more hours and drawdowns greater than zero were analyzed.

The Jacob distance-drawdown method was used to estimate the cone of depression which is anticipated to occur as a result of the operation of the proposed well of the proposed Millard sand and gravel pit. In the Jacob distance-drawdown method, drawdowns are plotted on the vertical (arithmetic) axis versus distance on the horizontal (logarithmic) axis. The slope of the straight line is proportional to the pumping rate and to the transmissivity. The cone of depression was estimated using the transmissivity values which were calculated above. In this method the following equations are used for the determination of the transmissivity and storage coefficient from distance-drawdown graphs:

$$S = \frac{T \times t}{640 \times r_o^2}$$

$$T = \frac{70 \times Q}{\Delta s}$$

(where T is the transmissivity, in feet squared per day; Q is the pumping rate, in gallons per minute (gpm); Δs is the drawdown of one log cycle (also the slope of the straight line), in feet; t is the time at which the estimated drawdowns can be measured, in minutes; and r_o is the distance from the pumping well to the point where the straight line intersects the zero-drawdown line, in feet). The values used are the following: Q = 300 gpm, t = 720 min. or (12 hours), S = 0.3

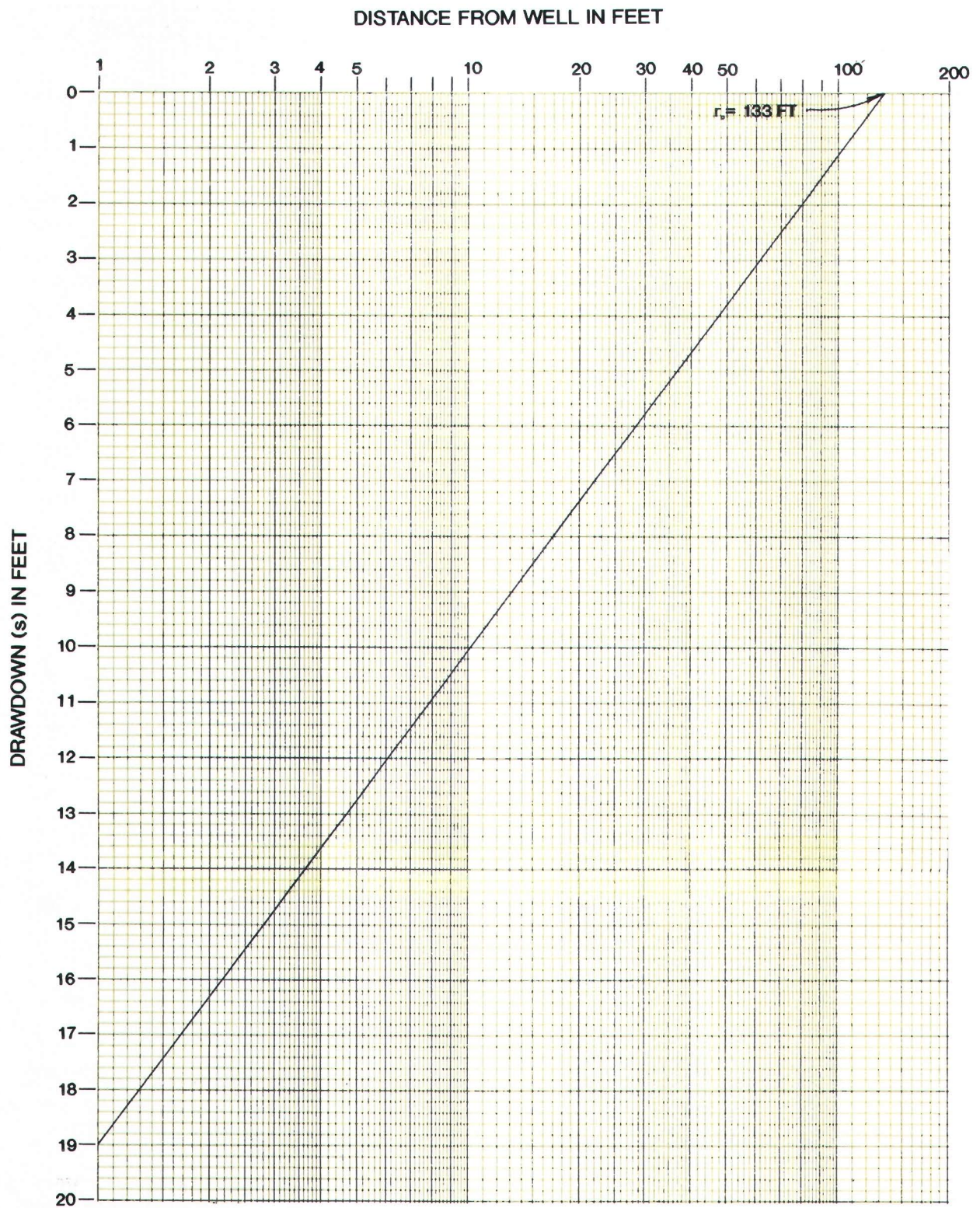
These equations can be rearranged to solve for Δs and r_o as shown below.

$$r_o = \sqrt{\frac{T \times t}{640 \times S}}$$

$$\Delta s = \frac{70 \times Q}{T}$$

Due to the range of the transmissivity and conductivity values, which were computed for the soil in this area, as shown above; the two extreme transmissivity values will be used to arrive at conservative estimates of the cone of depression. The two extreme transmissivity values are associated with wells A and C. Well A is shallower than well C and therefore can be used to estimate the largest extent of the cone of depression as it relates to the drawdown areal dimension or cone radius. Well C is the deeper well and therefore can be used to estimate the largest extent of the cone of depression as it relates to depth of drawdown. Therefore r_o will be calculated for both wells A and C, and the depth of drawdown relating to the value of Δs will only be graphed for well C. The calculations shown below and the distance-drawdown graph shown on figure B-1 on the following page show that a conservative estimate of the cone of depression, which can be anticipated to occur as a result of the operation of the proposed Millard sand and gravel pit well, will effect an area with a radius of approximately 300 feet and drawdown of approximately 20 feet.

Figure B-1
DISTANCE-DRAWDOWN GRAPH



Source: SEWRPC.

Calculations of r_o :⁽²⁾

well A

$$r_o = \sqrt{\frac{4,691.5 \text{ ft}^2/\text{day} \times 720 \text{ min.}}{640 \times 0.3}}$$

= 132 feet use 300 feet

well C

$$r_o = \sqrt{\frac{2,359.6 \text{ ft}^2/\text{day} \times 720 \text{ min.}}{640 \times 0.3}}$$

= 94 feet

Calculation of Δs :⁽²⁾

well C

$$\Delta s = \frac{70 \times 300 \text{ gpm}}{2,359.6 \text{ ft}^2/\text{day}}$$

= 8.90 feet/ cycle

⁽¹⁾Source: Bradbury and Rothschild, 1985, A computerized technique for estimating the hydraulic conductivity of an aquifer from specific capacity data: Ground Water, Vol. 23, No. 2, pp. 240 - 246.

⁽²⁾The transmissivity values shown on the first page of this appendix were given in $\text{ft}^2/\text{sec.}$, therefore a conversion factor of 86,400 was used to covert them to ft^2/day .