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USDA RURAL DEVELOPMENT
PRELIMINARY ENGINEERING REPORT

ARCADIA TOWNSHIP
MANISTEE COUNTY, MICHIGAN

NEW PUBLIC
SANITARY SEWER COLLECTION SYSTEM &
WASTE WATER TREATMENT PLANT

March 2016
Revised Nov. 2016
Project No. 817670

FLEIS&VANDENBRINK
DESIGN. BUILD. OPERATE.

Village of Arcadia and Arcadia Township
Sanitary Sewer Feasibility
Preliminary Engineering Report
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GENERAL / BACKGROUND

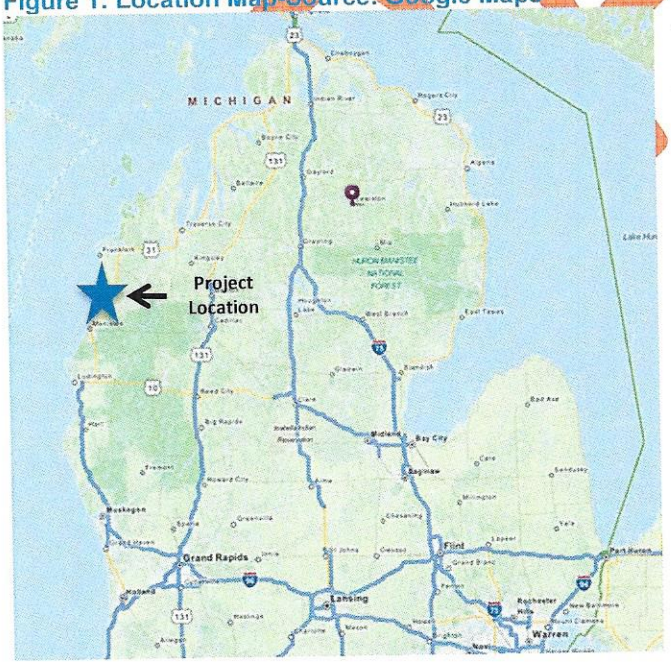
Arcadia Township *Preliminary Engineering Report (PER)* was prepared to fulfill the project planning requirements of the United States Department of Agriculture, Rural Development, Rural Utilities Service – Water and Wastewater Programs. This report will provide the basis for evaluation of the Township's proposed wastewater system construction for funding from the Water and Wastewater Loan and Grant program.

Arcadia Township applied for in 2013 and received in 2014 an MDEQ SAW Grant for Project Planning grant to be used to complete preliminary project planning and an environmental review for the potential construction of a new sanitary sewer collection and treatment system. This PER describes current wastewater facilities, evaluates need for improvements, examines alternatives and the feasibility of various collection and treatment alternatives and offers recommendations as to the most beneficial action for the Township.

As the study process was getting underway, the Township felt the opportunity to fund their project would be greater through the USDA Rural Development programs, so the format for this PER was selected to match Rural Development RUS Bulletin 1780-2. This report includes a summary of wastewater issues within the service area, a 20-year projection of the population to be served, and identification and screening of the principal alternatives necessary to meet the current and future wastewater needs of the service area. It also presents projected user costs for financing the selected alternative.

The Township of Arcadia is located in the northwest region of Michigan's Lower Peninsula on M-22 between Onekama and Frankfort. It lies in the northwest corner of Manistee County along Lake Michigan, approximately 20 miles north of Manistee. A map showing the location of Arcadia Township is shown below.

Figure 1: Location Map-Source: Google Maps



Arcadia Township was organized in 1870 and the unincorporated community of Arcadia was founded in 1880. Arcadia's early history was dominated by a lumber mill and thrived as a lumber town through the early 1900's. In 1906 the lumber mill burned to the ground and was replaced by the Arcadia Furniture Factory, which ran until 1953 when the doors closed.

The number of residents in Arcadia Township increases in the summer as people return to summer homes, as well as the amount of tourists. Residents and tourist alike enjoy the natural beauty of the area and remote peacefulness of Arcadia Dunes Nature Preserve, Camp Arcadia and Arcadia Bluffs Golf Course.

Arcadia Harbor is a year-round vital resource serving multiple purposes to the residents of Arcadia as well as the region and state. It is one of 16 Great Lakes shallow draft recreational harbors classified as a Harbor of Refuge, providing boater with safe haven during foul weather and offering safe, high quality public facilities to seasonal boaters. Based on the 2010 census, the Township had a population of 639 with a Median Household Income of $48,269.

The Township would like to explore the feasibility of constructing a sanitary sewer system to support the town and to protect and preserve their water quality. The proposed project area would serve less than 2,500 people.

PROJECT PLANNING AREA

LOCATION

The initial study area was the western portion of the township including sections 3,10,15,16,21,22,27,28,33, and 34, A map of the initial service area is included in Figure A1.

The service area for the wastewater collection system of this project includes the unincorporated community of Arcadia, from Arcadia Lake on the south, Sorrenson Rd to the north, Lake Michigan to the west and properties just east of M-22. There are many parcels within the township suitable for a treatment facility, but a single location has not been identified at this time. The township owns a 20-acre parcel southeast of the community which is heavily wooded but has well drained sandy soils. The collection system and Wastewater Treatment Facility (WWTF) will be designed to accommodate the sanitary sewer needs of the service area, it will also include modest projected future growth. A map of the service area is included in Figure A1.

Although there are many Commercial, Church and Township buildings situated within the community of Arcadia, a distinct business district runs north/south along M-22 corridor and is approximately 1 mile in length. Residential property within the community adjacent to the business district is platted in blocks in a conventional layout with parcels of various size ranging from 0.05 to 1 acre. Property beyond this residential area are primarily acreage parcels of varying size (1 – 40+ acres) and are a mix of residential and non-residential zoning.

Soil conditions in the service area are predominantly sandy, highly permeable, and moderately to excessively well drained. A small percentage of Arcadia Point, within the community, is Pipestone Sand, a somewhat poorly drained soil with a water table that fluctuates from near the surface to depths of 4 feet. A soils map of the service area is shown in Figure A2.

The Township of Arcadia borders the waters of Lake Michigan along the west coast. The chart datum water level of Lake Michigan and Arcadia Lake is 577.5 feet, with a maximum water level of 582.35 in November of 1986 and a minimum water level of 576.02 in January of 2013, the present water level is 579.4 (01/19/2016).
The topography in the community of Arcadia has no major elevation changes with the highest elevation at about 608 feet. The community has water to the south and the west, to the east is an area of predominately wetlands. Beyond the community to the north, the wetlands to the east, and Arcadia Lake to the south, the topography has sharp increase in elevation to as high as 1015 feet with grades as steep as 10%. South of the community and Arcadia Lake are bluffs overlooking Lake Michigan with grades upward of 50%. The topographical map of the service area is shown in Figure A3.

ENVIRONMENTAL RESOURCES PRESENT

A separate environmental report will be prepared by Michigan Rural Community Assistant Program for the selected alternative (if necessary). The Environmental Report will evaluate potential environmental impacts a municipal sanitary sewer system may have on the environment. This report will also identify any environmental mitigation needed.

GROWTH AREAS AND POPULATION TRENDS

Table 1 below summarizes the current and projected populations for Arcadia Township. Historical population data indicates an increase in population through 2010 with a slight decline through 2014, it is projected the Township population will remain steady.

It can be reasonably predicted that the implementation of a public sewer system will result in modest population growth to offset the projected steady population. The new system will be planned for a 10% total growth over the 20-year planning period (2016-2036) based on typical growth patterns of similar communities with new public sanitary sewer infrastructure. A 0.49% annual growth rate would equate to 10% growth over a 20-year period.

Table 1: Population Data and Projections

	1960	1970	1980	1990	2000	2010	2014	2016	2036
Arcadia Township	610	592	641	553	621	639	631	630	693
Annual % Change		-3.0%	8.3%	-13.7%	12.3%	2.9%	-1.3%	-0.2%	10.0%
Manistee County	19,042	20094	23,019	21,265	24,527	24,733	24,420		
Annual % Change		5.5%	14.6%	-7.6%	15.3%	0.8%	-1.3%		

Source: US Census Bureau

COMMUNITY ENGAGEMENT

The Arcadia Township Sewer Committee has held a number of meetings providing assistance in the planning process for this feasibility study and the proposed service district area is a result of those meetings. It is the Council's desire to engage the public through future public information meetings as the project progresses through the planning and funding stages.

EXISTING FACILITIES

HISTORY AND CONDITION

There are no public sewer or wastewater treatment system for Arcadia Township. Residents and businesses rely solely on privately owned septic systems. Records of parcels within the initial study area were evaluated for issues that do not meet current District 10 Health Department or other public health requirements, such as:

Isolation distance - the current standard per District 10 Health Department is minimum 50' isolation from a well to a septic field. The isolation distance requirements from the sanitary code for (DHD #10) for single and two family dwellings are in Table 2 below.

Drywells - the current standard per District 10 Health Department allows drywells in lieu of a bed style septic system at the Health Officer's discretion when **all** of the following conditions are found to exist:

1) The installation of a conventional drainfield is restricted by area in that required isolation distances for sewage disposal systems cannot be obtained or the area is severely sloped.
2) The permeability rate of the surrounding soils is less than 20 minutes/inch and the seasonal high water table, bedrock or other limiting layer is not less than four feet below the bottom of the drywell.
3) Replacement area equal to the area of the initial installation is available and reserved for future installations.

Undersized septic tank - the current standard per District 10 Health Department is 1,200 gallons for a 3 bedroom home.

The following information was returned by District 10 Health Department:

The total number of parcels within the initial study area was 902
Of 902 total parcels, 551 (61%) parcels were reported to have been "developed" by Manistee County
Of 551 "developed" parcels, 438 (79%) permit records were returned
Of 551 "developed" parcels, 113 (21%) did not have permit records
Of 551 "developed" parcels, 36 (7%) did not meet current isolation distance requirements
Of 551 "developed" parcels, 136 (25%) have drywell septic systems
Of 551 "developed" parcels, 176 (32%) have undersized septic tanks per current code

~~A map that allows easier visualization of the extent of the properties that are lacking records or do not meet current standards is shown in Figure AX.~~ The majority of issues reported by (DHD #10) records occurred within the unincorporated Village area and along the Lake Arcadia and Lake Michigan shorelines where there is a concentration of small, residential properties.

In regards to the septic system data, the properties that do not have permit records were likely installed before the Health Department began keeping records, which indicates that the systems are old and likely not built to current standards. It is easy to see that the vast majority of septic systems in the community clearly do not or likely do not meet current public health standards.

Table 2: Required Isolation Distances in Feet

From	To Septic Tank	To Drain field – Bed or Trench	To Dry Well or Block Trench (see section 5.3.09)	To Sewer Line (closed pipe, sealed joints)
Wells	50	50	75	10
Property Lines	5	10	10	5
Basement Walls	10	10	15	--

Lakes/ Streams	50	100	100	10
Pressurized Water Lines	10	10	10	5
Ravines, Banks, Drop-offs	10	15	20	5
Swimming Pools	10	10	10	10

The above table is only for single and two family dwellings.

~~A review of the Water Well and Pump Records shows over 70 percent of the Township businesses and residents rely on shallow wells to supply drinking water. These records show wells range from 26' to 105' deep with over 60% having a static water level less than 20' which is outside of a protected aquifer. Shallow private wells are at a higher risk for contamination. There is concern that cross contamination may be occurring due to the close proximity of the septic systems to the shallow water wells.~~

FINANCIAL STATUS (O&M)

There is no wastewater collection or treatment systems in the project area, therefore, no existing debts or reserve funds are in place related to wastewater systems.

WATER, ENERGY, WASTE AUDITS

This section is not applicable to the existing facilities in the project planning area.

NEED FOR PROJECT

HEALTH, SANITATION, AND SECURITY

The proposed sanitary sewer service areas are located around Arcadia Lake, as shown in Figures A5 & A7. This is a densely-populated area with small parcels that dispose of sanitary flows using private septic systems. Groundwater testing in the proposed sewer service area has revealed instances of high nitrate presence in the groundwater. It is believed that sanitary effluent from private septic systems entering the groundwater table is causing high nitrates in the groundwater. In some cases, the high nitrates in groundwater have resulted in property owners being unable to obtain a permit to install a drinking water well. A sanitary sewer system is needed for the service area to properly treat sanitary flows and ensure that sanitary effluent from private septic fields does not continue to deteriorate groundwater quality.

As stated above, it is believed that the groundwater quality of the areas adjacent to Arcadia Lake has been deteriorated due to contact with sanitary effluent from private septic systems. If the water quality of the sanitary effluent is not addressed, the sanitary effluent will degrade the water quality of nearby surface waters (Arcadia Lake and Lake Michigan). The Township would like to install a sanitary sewer system to ensure that sanitary effluent is properly treated, which will protect the water quality of nearby surface waters.

Many of the vacant lots in Arcadia are too small to support both onsite water and sanitary disposal while meeting current Health Department regulations. Because of this, many of the lots are unbuildable or require expensive alternate treatment methods.

The primary focus of Arcadia Township and the ongoing regional planning efforts have been to encourage growth and promote an economically vibrant community. It is believed that by having a public sewer system, business can flourish and be unhindered by onsite sewage disposal requirements. There have been specific instances of businesses closing and new businesses being unable to relocate or start in Arcadia due to the lack of a public sewer system.

A primary goal for Arcadia Township is the protection of the drinking water supply. Records of parcels within the initial study area were evaluated for issues that do not meet current District 10 Health Department or EPA requirements, such as:

Nitrates- US EPA guidance allows a maximum of 10 mg/L in public drinking water. A common source of nitrate in groundwater is inadequately treated wastewater. In addition to the maximum levels indicated in the drinking water standards, any level of nitrate may be an indication of septic problems. In that regard, it is an indicator only, not a conclusion.

Coliform- Total coliform is not a health threat in itself; however, it is used to indicate the potential for other harmful bacteria to be present. Any indication of coliform in drinking water can indicate the potential for other harmful bacteria to be present. As with nitrate, a common source is poorly treated wastewater. We also noted well depth when recorded and verified that these depths correlated with groundwater elevations reported and mapped through State of MI data.

The following information was returned by District 10 Health Department:

The total number of parcels within the initial study area was 902
Of 902 total parcels, 551 (61%) parcels were reported to have been "developed" by Manistee County
Of 551 "developed" parcels, 263 (48%) had associated water sample records
Of 551 "developed" parcels, 288 (52%) did not have water sample records
Of 263 water sample reports, 181 (69%) had "non -detect" for nitrates or coliform
Of 263 water sample reports, 72 (27%) tested positive for nitrates
Of 263 water sample reports, 10 (4%) tested positive for coliform bacteria

~~From this data, a map was created, shown in Figure A7, that allows easier visualization of the extent of the properties with public drinking water that do not meet (DHD #10) or EPA current standards.~~ The

majority of issues recorded, occurred within the unincorporated community and along the Lake Arcadia and Lake Michigan shorelines where there is a concentration of small, residential properties.

Looking at the tests that were performed on drinking water wells, there are a number of positive nitrate and coliform test results. As noted above, these tests do not conclusively represent where the sources of groundwater pollution are coming from, but they do demonstrate that over 30% of the drinking water well records on file are impacted by contaminants commonly associated with wastewater.

A trend toward larger, new and re-built homes is limited by sub-standard lot sizes that limit the land area to provide required isolation distance between water wells and septic systems and for properly sized drain fields with required replacement area. The viability of the business district and re-development/enhancement in Arcadia Township is negatively impacted by limited land area for the construction of new on-site septic systems or the expansion of existing systems.

For these health and sanitation reasons, construction of a public sanitary sewer collection and wastewater treatment system is proposed. Once in place the wastewater within the community would be controlled, minimizing a threat to the Township's drinking water aquifer and nearby Arcadia Lake and Lake Michigan.

AGING INFRASTRUCTURE

Since there are no municipality-owned wastewater systems, there are not current O&M, managerial, design or operational problems to address. The opportunity to undertake this project from conception provides an opportunity to minimize O&M concerns by designing the most efficient system and establishing appropriate managerial and financial controls from the beginning.

REASONABLE GROWTH

The 20-year project planning is based on a 0.49% annual residential growth through 2036. Business users are expected to increase wastewater flows by the same rate as residential users over the 20-year planning period. Because the collection system will be new, infiltration and inflow is expected to be nominal in 2016 and is anticipated to increase slightly over the 20-year period.

The following Table 3 provides REU projections for the proposed feasibility area.

Table 3: REU Determination

User	Number	REU factors	REU
Single Family Residence	332	1.00 per residence	332
Marina, Restroom only	2	2.5	5
Boat & Marine Service	1	1	1
Campground	1	10	10
Churches	2	1.5	3
Gas Station	1	1	1
Summer Camp	1	4	4
Restaurant	2	2	4
Retail	5	1.5	7.5
Motel	1	6	6
Bed & Breakfast	2	1.5	3

Community Center	1	1.5	1.5
Misc. Commercial	44	1.5	66
		Total Residential	332
		Total Commercial	112
		Project Total	**444**

Table 4 summarizes the projected wastewater flows for the planning area and planning period.

Table 4: Projected Wastewater Flows

Location	REU[a,b] (2016 est.)	Population (2016 est.)	% Growth (20-year)	Estimated REUs (2036)	Flow[c] (gpd/REU)	Avg. Daily Initial Flow (gpd)	Avg. Daily Design Flow (gpd)
Residential	332	630	10	366	167	55,444	61,122
Commercial	112	--	10	124	167	18,704	20,708
School	0	--	--	0	167	0	0
Industrial	0	--	--	0	167	0	0
Infiltration	--	--	--	--	--	N/A	10,000
Projected Flow	444	630	--	490	167	74,148	91,830

a. Census 2010 data indicates 2.2 people per household for Arcadia Township
b. 1.0 REU per residential dwelling
c. The value of 100 GPCD shown in Section 6 is a general value and may not be appropriate for many rural systems financed with WWD funds, so in the absence of reliable data, a value of 5000 gallons per EDU per month (approximately 67 GPCD or 167 GPD per EDU) should be used. (From USDA RUS Bulletin 1780-2 04/04/13) - rev. 9/29/14

The area's growth is currently constrained by the lack of municipal utility infrastructure. As with many older platted communities, many lots do not allow for expansion or development given modern setback requirements and isolation distances required between water well and septic systems. Addressing these conditions has been identified as a critical factor in maintaining the area's economy. The lack of municipal sewer has prevented the retention and expansion of both residence and businesses in Arcadia Township.

Installation of a sanitary sewer system would eliminate the concerns over required isolation distances between the water wells and septic systems, as well as unencumber open space to allow for potential development in the Unincorporated Village.

ALTERNATIVES CONSIDERED

SUMMARY DESCRIPTION

Alternatives for a new wastewater collection and treatment system were developed based on ability to meet the needs for the project while remaining within financial, regulatory, and technical constraints. Project objectives include:

- Provide facilities capable of treating 20-year projected loading at 91,830 GPD.
- Provide a WWTP designed to comply with anticipated discharge limits.
- Provide flexibility in operations; accommodate changes for potential regulatory changes.
- Mitigate financial burden to Arcadia Township residents.
- Mitigate environmental impact of WWTP operation and discharge.

Five alternatives were developed for the collection system, including:

1. No Action (required to be evaluated)
2. Optimizing Performance of Existing Systems
3. Conventional Gravity Sewer*
4. Low Pressure Force Main / Grinder Pump System*
5. Small Diameter Sewer System, or Septic Tank Effluent Pump (STEP) Pressure Sewer

Four alternatives were developed for the Township WWTP Project, including:

1. No Action (required to be evaluated)
2. Regional Treatment
3. Facultative Lagoon Facility*
4. Aerated Lagoon Facility*
5. Mechanical Treatment Facility – Sequencing Batch Reactor*

* denotes Principal Alternative

Each alternative was initially screened for feasibility (effectiveness in meeting objectives, implementability, relative cost). Surviving feasible alternatives were then subjected to a comprehensive evaluation with attention to economic, technical, environmental, potential public concerns and other criteria.

Financial analysis of alternatives followed a present worth methodology. Capital costs, cumulative operations, and maintenance costs (over 20 years), and salvage values are determined separately and discounted back to present value. The sum of these costs represents the current worth of the project that must be financed.

Although capital costs represent a large portion of the total project present worth, they do not necessarily control the present worth of a project. For example, incremental differences in annual OM&R can more than make up for a higher capital cost.

WASTEWATER COLLECTION SYSTEM ALTERNATIVES

No Action

With this alternative, no public wastewater collection system or treatment will be provided and the Township will continue to depend upon the individual septic systems for wastewater disposal.

This alternative may be acceptable in the short term but it is not a viable long term solution. This alternative does not address any of environmental concerns detailed within the facility description or facility needs section of the PER. This alternative does not address the growth goals of the Township.

There is not an economically feasible method to monitor which systems are failing that contribute to water quality issues. Due to these criteria, the No Action alternative is deemed not feasible, as it does not address the objectives of the project, and will not be further evaluated as a principle alternative.

Optimizing Performance of Existing Systems
Optimizing performance of existing individual septic systems and drain fields is not a feasible alternative. Many parcels within the project area, especially in the residential district do not have land available to accommodate a new or upgraded septic system and/or drain field. Required isolation distances from water wells further constrain development on the small lots.

Due to failure to meet the project objectives, this alternative is not feasible and will not be considered further as a principle alternative.

Wastewater Collection System Alternatives
There are three types of sanitary collection systems that have been considered in this study:

- Conventional Gravity Sewer
- Low Pressure Force Main / Grinder Pump System
- Small Diameter Sewer System, or Septic Tank Effluent Pump (STEP) Pressure Sewer

Each system has advantages and disadvantages, which are further discussed below.

Gravity Sewer
Description
A conventional gravity sewer collection system would utilize 8-inch diameter pipe to carry wastewater. They are installed at no less than minimum 0.4% slope to maintain pipe self-cleansing velocity. Construction of sewers would be by direct bury (open cut) and will include manholes and lateral lines to individual homes and businesses. Due to the relatively flat terrain within the unincorporated community of Arcadia four pump stations are necessary to maintain a manageable depth.

Conventional gravity sewers could serve most of the project area. Low Pressure Forcemain/Grinder Pump Systems are planned for the parcels along Starkey Rd, between Arcadia Lake and Lake Michigan and within the condo development Valleywood Cove at Point Arcadia. Due to predominantly sandy soils, direct bury construction will require wider trenches and removal/replacement of paved surfaces (streets, sidewalks and parking areas) to keep construction within right of way limits. Also, due to the proximity of the project to Arcadia Lake and Lake Michigan dewatering will be necessary in many areas of the project limits.

Design Criteria
Guidelines established in the Recommended Standards for Wastewater Facilities were used to design the wastewater collection system. The collection system was designed so that the maximum flow conditions based on the potential ultimate Township population could be accommodated.

Map
See Figures A6 & A8 for the proposed gravity sewer collection system layouts.

Environmental Impacts
The environmental impacts of this alternative will be reviewed when the study is complete.

Land Requirements
All gravity collection system improvements would be made in existing public road right-of-ways or with permitted access along M-22. It is anticipated that a limited number of easements would be required to connect existing septic systems.

Sustainability Considerations
A conventional gravity sewer system is the least complicated form of collection system to operate in the long term.