NOTES TO USERS

This map is for use in administering the National Flood Insurance Program. It does not necessarily identify all areas subject to flooding, particularly from local drainage sources of small size. The **community map repository** should be consulted for possible updated or additional flood hazard information.

To obtain more detailed information in areas where **Base Flood Elevations** (BFEs) and/or **floodways** have been determined, users are encouraged to consult the Flood Profiles and Floodway Data and/or Summary of Stillwater Elevations tables contained within the Flood Insurance Study (FIS) report that accompanies this FIRM. Users should be aware that BFEs shown on the FIRM represent rounded whole-foot elevations. These BFEs are intended for flood insurance rating purposes only and should not be used as the sole source of flood elevation information. Accordingly, flood elevation data presented in the FIS report should be utilized in conjunction with the FIRM for purposes of construction and/or floodplain management.

Coastal Base Flood Elevations shown on this map apply only landward of 0.0' North American Vertical Datum of 1988 (NAVD 88). Users of this FIRM should be aware that coastal flood elevations are also provided in the Summary of Stillwater Elevations table in the Flood Insurance Study report for this jurisdiction. Elevations shown in the Summary of Stillwater Elevations table should be used for construction and/or floodplain management purposes when they are higher than the elevations shown on this FIRM.

Boundaries of the **floodways** were computed at cross sections and interpolated between cross sections. The floodways were based on hydraulic considerations with regard to requirements of the National Flood Insurance Program. Floodway widths and other pertinent floodway data are provided in the Flood Insurance Study report for this jurisdiction.

Certain areas not in Special Flood Hazard Areas may be protected by **flood control structures**. Refer to Section 2.4 "Flood Protection Measures" of the Flood Insurance Study report for information on flood control structures for this jurisdiction.

The **projection** used in the preparation of this map was Ohio State Plane South zone 5001 (FIPSZONE 3402). The **horizontal datum** was NAD83. Differences in datum, spheroid, projection or state plane zones used in the production of FIRMs for adjacent jurisdictions may result in slight positional differences in map features across jurisdiction boundaries. These differences do not affect the accuracy of this FIRM.

Flood elevations on this map are referenced to the North American Vertical Datum of 1988. These flood elevations must be compared to structure and ground elevations referenced to the same **vertical datum**. For information regarding conversion between the National Geodetic Vertical Datum of 1929 and the North American Vertical Datum of 1988, visit the National Geodetic Survey website at http://www.ngs.noaa.gov/ or contact the National Geodetic Survey at the following address:

NGS Information Services
NOAA, N/NGS12
National Geodetic Survey
SSMC-3, #9202
1315 East-West Highway
Silver Spring, Maryland 20910-3282
(301) 713-3242

To obtain current elevation, description, and/or location information for **bench marks** shown on this map, please contact the Information Services Branch of the National Geodetic Survey at **(301) 713-3242** or visit its website at http://www.ngs.noaa.gov/.

Base Map information shown on the FIRM was derived from the Greene County GIS Department at a scale of 1:800 with photography dated 2007 and from digital orthophoto quadrangles at a scale of 1:12,000 dated 1996 or later.

This map reflects more detailed and up-to-date **stream channel configurations** than those shown on the previous FIRM for this jurisdiction. The floodplains and floodways that were transferred from the previous FIRM may have been adjusted to conform to these new stream channel configurations. As a result, the Flood Profiles and Floodway Data tables in the Flood Insurance Study report (which contains authoritative hydraulic data) may reflect stream channel distances that differ from what is shown on this map.

Corporate limits shown on this map are based on the best data available at the time of publication. Because changes due to annexations or de-annexations may have occurred after this map was published, map users should contact appropriate community officials to verify current corporate limit locations.

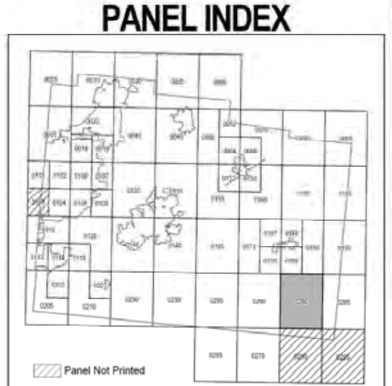
Please refer to the separately printed **Map Index** for an overview map of the county showing the layout of map panels; community map repository addresses; and a Listing of Communities table containing National Flood Insurance Program dates for each community as well as a listing of the panels on which each community is located.

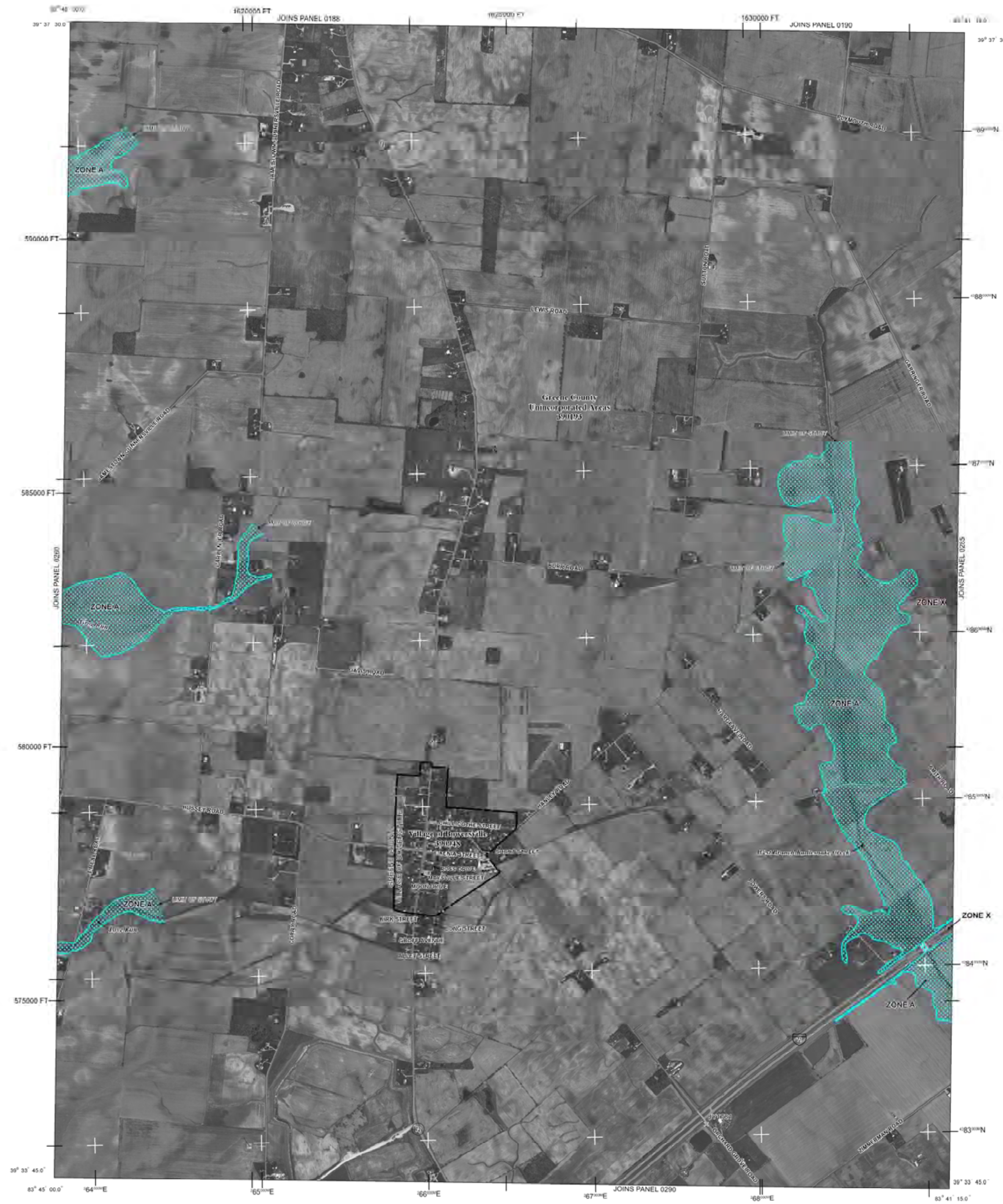
For information on available products associated with this FIRM visit the **Map Service Center (MSC)** website at http://msc.fema.gov. Available products may include previously issued Letters of Map Change, a Flood Insurance Study Report, and/or digital versions of this map. Many of these products can be ordered or obtained directly from the MSC website.

If you have **questions about this map**, how to order products, or the National Flood Insurance Program in general, please call the **FEMA Map Information eXchange (FMIX)** at **1-877-FEMA-MAP** (1-877-336-2627) or visit the FEMA website at http://www.fema.gov/business/nfip.

The **profile base lines** depicted on this map represent the hydraulic modeling baselines that match the flood profiles in the FIS report. As a result of improved topographic data, the **profile base line**, in some cases, may deviate significantly from the channel centerline or appear outside the SFHA.

PANEL INDEX





LEGEND

SPECIAL FLOOD HAZARD AREAS SUBJECT TO INUNDATION BY THE 1% ANNUAL CHANCE FLOOD

The 1% annual chance flood (100 year flood), also known as the base flood, is the flood that has a 1% chance of being equaled or exceeded in any given year. The Special Flood Hazard Area is the area subject to flooding by the 1% annual chance flood. Areas of Special Flood Hazard may include Zones A, AE, AH, AO, AR, A99, V, and VE. The Base Flood Elevation is the water-surface elevation of the 1% annual chance flood.

ZONE A	No Base Flood Elevations determined.
ZONE AE	Base Flood Elevations determined.
ZONE AH	Flood depths of 1 to 3 feet (usually areas of ponding); Base Flood Elevations determined.
ZONE AO	Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.
ZONE AR	Area of special flood hazard formerly protected from the 1% annual chance flood event by a flood control system that was subsequently decertified. Zone AR indicates that the former flood control system is being restored to provide protection from the 1% annual chance or greater flood.
ZONE A99	Area to be protected from 1% annual chance flood event by a Federal flood protection system under construction; no Base Flood Elevations determined.
ZONE V	Coastal flood zone with velocity hazard (wave action); no Base Flood Elevations determined.
ZONE VE	Coastal flood zone with velocity hazard (wave action); Base Flood Elevations determined

FLOODWAY AREAS IN ZONE AE

The floodway is the channel of a stream plus any adjacent floodplain areas that must be kept free of encroachment so that the 1% annual chance flood can be carried without substantial increases in flood heights.

OTHER FLOOD AREAS

ZONE X	Areas of 0.2% annual chance flood; areas of 1% annual chance flood with average depths of less than 1 foot or with drainage areas less than 1 square mile; and areas protected by levees from 1% annual chance flood.

OTHER AREAS

ZONE X	Areas determined to be outside of the 0.2% annual chance floodplain.
ZONE D	Areas in which flood hazards are undetermined, but possible.

COASTAL BARRIER RESOURCES SYSTEM (CBRS) AREAS

OTHERWISE PROTECTED AREAS (OPAs)

CBRS areas and OPAs are normally located within or adjacent to Special Flood Hazard Areas.

- 1% annual chance floodplain boundary
- 0.2% annual chance floodplain boundary
- Floodway Boundary
- Zone D Boundary
- CBRS and OPA boundary
- Boundary dividing Special Flood Hazard Areas of different Base Flood Elevations, flood depths or flood velocities.
- 513 — Base Flood Elevation line and value; elevation in feet*
- (EL 987) — Base Flood Elevation value where uniform within zone; elevation in feet*

*Referenced to the North American Vertical Datum of 1988

(A)———(A)	Cross section line
(23)- - - - -(23)	Transect line
85° 03' 45.0", 41° 24' 22.5"	Geographic coordinates referenced to the North American Datum of 1983 (NAD 83), Western Hemisphere
4587000 M	1000-meter Universal Transverse Mercator grid values, zone 17
2250000 FT	5000-foot grid ticks: Ohio State Plane South Coordinate System, 5001 zone (FIPSZONE 3402) Lambert Conformal Conic
KA0015 ×	Bench mark (see explanation in Notes to Users section of this FIRM panel)
• M1.5	River Mile

MAP REPOSITORY
Refer to listing of Map Repositories on Map Index

EFFECTIVE DATE OF COUNTYWIDE
FLOOD INSURANCE RATE MAP
MARCH 17, 2011

EFFECTIVE DATE(S) OF REVISION(S) TO THIS PANEL

For community map revision history prior to countywide mapping, refer to the Community Map History table located in the Flood Insurance Study report for this jurisdiction.

To determine if flood insurance is available in this community, contact your insurance agent or call the National Flood Insurance Program at 1-800-638-6620.

MAP SCALE 1" = 1000'

500 0 1000 2000 FEET

300 0 300 600 METERS

NFIP

NATIONAL FLOOD INSURANCE PROGRAM

PANEL 0280D

FIRM

FLOOD INSURANCE RATE MAP

GREENE COUNTY, OHIO

AND INCORPORATED AREAS

PANEL 280 OF 295
(SEE MAP INDEX FOR FIRM PANEL LAYOUT)

CONTAINS:

COMMUNITY	NUMBER	PANEL	SUFFIX
BOWERSVILLE, VILLAGE OF	390948	0280	D
GREENE COUNTY	390193	0280	D

Notice to User: The **Map Number** shown below should be used when placing map orders; the **Community Number** shown above should be used on insurance applications for the subject community.

MAP NUMBER
39057C0280D

EFFECTIVE DATE
MARCH 17, 2011

Federal Emergency Management Agency

GRAPHIC SCALE

0 1750 3500

(IN FEET)
1 inch = 3500 ft.

IBI GROUP
635 Brooksedge Boulevard
Westerville OH 43081 USA
tel 614 818 4900 fax 614 818 4901
ibigroup.com

REVISION:

SUBMISSION:

VILLAGE OF BOWERSVILLE
MVRPC
UNSEWERED COMMUNITIES

SHEET TITLE:

100 YEAR FLOOD MAP

FIGURE 3-5

IBI GROUP
635 Brooksedge Boulevard
Westerville OH 43081 USA
tel 614 818 4900 fax 614 818 4901
ibigroup.com

VILLAGE OF BOWERSVLLE

MVRPC UNSEWERED COMMUNITIES

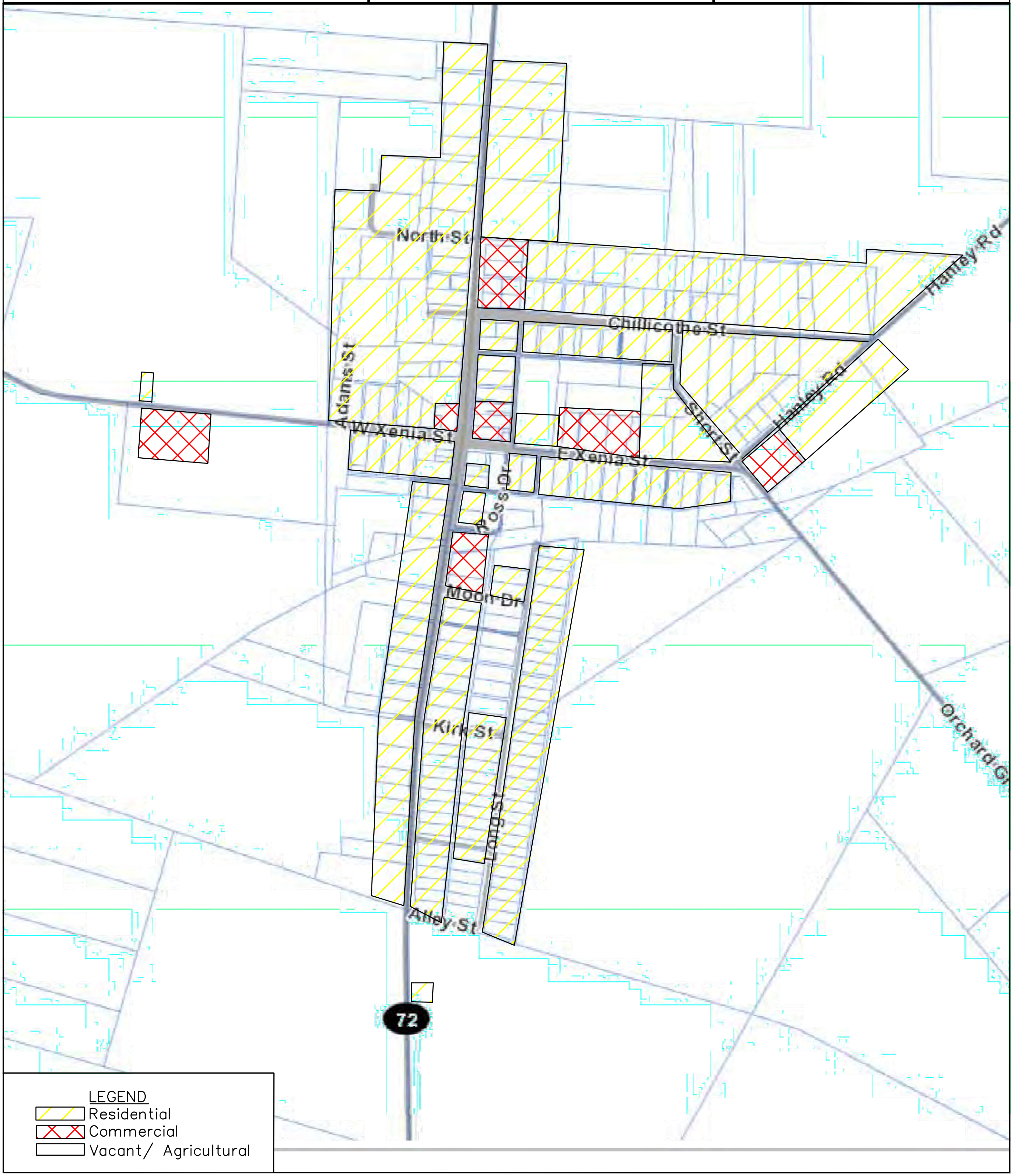
FIGURE 3-6: LAND USE MAP

GRAPHIC SCALE

0 375 750

(IN FEET)

1 inch = 750 ft.



Chapter 4 - Future Conditions

A 25-year planning period will be used and all forecasts on population, land use, economics, flows, and loads will be trended from the most recent available data to the year 2040.

Development

Demographic and economic projections are vital to the planning of wastewater facilities in that they permit proper sizing of both collection and treatment systems. Over estimating these projections can result in oversized facilities which are not utilizing their maximum capacities. Under estimating these projections can result in an undersized facility, which would need expensive upgrades to reach the desired degree of treatment. As a result, a need for accurate projections cannot be overstressed.

There is a potential for population and industrial growth just outside of the corporation limits of the Village. These possibilities need to be taken into consideration when designing a new wastewater system. The proposed system needs to be able to with stand the additional amount of collection needed.

Population Trends

The development of an area is directly related to changing population over time. In general, population growth trends create the basis for changing demand for various housing and commercial development. Population growth also has implications for demands on community facilities and infrastructure.

Determining population trends for smaller areas is more unreliable and erratic than for larger urban areas because small area growth is influenced by local political factors and social economic changes. Historically, the provision of adequate water and sewage facilities remains a major influence on future growth.

The following table shows the population of Greene County and the Village of Bowersville between 1960 and 2010. The population of Bowersville decreased dramatically between 1980 and 1990 and increased dramatically between 1990 and 2000. Since 2000, there has been a steady increase in population.

Table 4-1: Population Trends

Year	Greene County Population	% Change	Bowersville Population	% Change
1960	94,642	-	327	-
1970	125,057	32.1%	358	9.5%
1980	129,769	3.8%	329	-8.1%
1990	136,731	5.4%	225	-31.6%
2000	147,886	8.2%	290	28.9%
2010	161,573	9.3%	312	7.6%

To generate future population projections through the year 2050, it is assumed that the population of Bowersville will continue to increase steadily. As mentioned earlier, there are 26 homes within Jefferson Township that are not included in the Bowersville population. These homes are multiplied by the U.S. Census average of 2.8 persons per home and combined with the Bowersville population. From there, we have assumed the study area will grow at a geometric gradient of approximately 5 percent for every 10 years or 1/2 percent annually.

The following table shows the projected population for the study area and a theoretical sanitary flow based on EPA's typical 100 gallons per capita per day.

Table 4-2: Projected Population

Year	Bowersville Population	Jefferson Twp Population	Combined	% Change	Sewage Flow (gpcd)	Total Theoretical Sanitary Flow (gpd)
2010	312	73	385	-	100	38,500
2020	328	77	405	5.1%	100	40,500
2030	345	81	425	5.1%	100	42,500
2040	362	85	447	5.1%	100	45,000
2050	381	89	470	5.1%	100	47,000

In addition to the residential design flows, allowable clean water infiltration quantities should be considered in the projections for sanitary flow. This is the clean ground water that seeps into a sewer collection system through pipe joints creating larger volumes of wastewater to transport and treat. Based on current design criteria, a leakage allowance rate of 100 gallons per day per inch diameter per mile of pipe of sewer is used. For an 8 inch diameter pipe based on the layout of the proposed system, an allowable infiltration is estimated to be 1,800 GPD.

In addition, an allowance for future industrial development should be made. 10% will be used for the service area.

Table 4-3: Design Flow

Year	Base Residential Sanitary Flow (gpd)	Allowable Infiltration (gpd)	Summation of Flows (gpd)	Commercial and Industrial Allowance (gpd)	Total Design Flow (gpd)
Present - 2050	47,000	1,800	48,800	5,000	53,800

We recommend that the proposed wastewater treatment facility be designed for a minimum of 60,000 GPD.

Design peak flows for treatment will be based on 4.0 times the average daily flows. Therefore the peak flows will be 0.240 MGD (240,000 GPD).

Chapter 5 - Wastewater System Alternatives

The primary goal of all wastewater management systems is to remove waste products from water and to safely return the water back into the environment. Wastewater management involves:

- Collection and transport of wastewater from the source to a treatment process
- Removal of all or most of the waste products that are suspended and/or dissolved in the water
- Returning the water back to the environment
- Management of these processes to ensure that a wastewater system is fully functional

The primary public health concern in wastewater management is to substantially reduce the risk of transferring pathogens into the environment and minimize negative impacts on public health. The following sections describe different alternatives for each of these collection and treatment processes.

Collection System Alternatives

The first stage for managing wastewater is collection. Several alternatives were reviewed to provide a centralized collection system. These options are: gravity sewer system, Septic Tank Effluent Pump (STEP) sewer system, grinder pump sewer system, and a vacuum sewer system.

Gravity Sewer System

Gravity sewers are ideal for populated urban areas that create large volumes of flow. In conventional gravity collection systems the wastewater flows by gravity and except where pumping stations are required, the system is devoid of moving parts. Pump stations are added to the gravity system to overcome elevation problems within areas of rolling terrain or to avoid extremely deep installation requirements when transporting sewage over long distances. The system eliminates private septic tanks and leeching systems and replaces them with a sewer pipe that connects the building to the main sewer line. Gravity sewer systems require little maintenance in comparison to pressure systems such as the STEP or leaching type systems. The primary operation and maintenance costs for this type of system are generally associated with the pump stations within the system. Operation and maintenance demands generally increase with age, but in well constructed systems, costs associated with this can be minimal. Due to larger pipe diameters, blockages within the system are rare and are generally easily removed when they do occur. With the simplicity of design and many years of application, conventional gravity sewer systems are a reliable and economical means of conveying wastewater from multiple sources to a central treatment facility. The following is a list of advantages and disadvantages for a conventional gravity sewer system.

Advantages

- Design standards and procedures well established
- Reliable operation
- Handle grit and solids
- At minimum velocity lower production of hydrogen sulfide
- Higher excess capacity for future growth

Disadvantages

- Slope requirements can require deeper excavation
- Pumping and lift stations may be required to overcome slope and elevation requirements
- Deeper manholes that require confined space entry
- Higher inflow and infiltration
- High bedrock could increase construction cost

Conventional gravity sewers are generally 8 to 15 inches in diameter and constructed of polyvinyl chloride (PVC) pipe with construction depths ranging from 7 to 20 feet. All sewers are designed and constructed to develop velocities not less than 2.0 feet per second when flowing full. Also, manholes are installed at the end of each line, at all changes in grade and/or alignment, at all intersections, and at distances not greater than 400 feet (for sewer up to 15 inches in diameter).

Residential and non-residential flows along with allowable clean water infiltration quantities must be considered in the design of a gravity wastewater collection system. Infiltration is identified as clean ground water that seeps into a sanitary collection system through pipe joints and other minor openings and mixes with sanitary flows creating larger volumes of wastewater to transport and treat. The allowable infiltration rate limit of 100 gpd per inch diameter per mile is based on current sanitary sewer construction technology. However, this amount would be expected to increase over the years mainly due to sewer extensions and the age of the collection system. Conventional gravity sewers shall also be designed on a peak flow basis with a peak factor of 3.33 times the average daily flow for municipalities as required by the EPA.

The minimum size of new conventional sanitary sewers is generally eight inches unless otherwise approved by the reviewing authority. Whenever possible, sanitary sewers shall be sufficiently deep to prevent freezing and to receive gravity flow from basements. Alternatives to the conventional gravity sewer system involve using grinder pump stations or septic systems. These are used to provide service to areas where the cost or the means of constructing a gravity system becomes dangerous or prohibitive.

Generation of the gravity collection system assumes that service laterals would be constructed from the main sewer line (usually located within public right-of-way) to the property lines (assumed 30 feet). From the property line to the house connection, individual property owners are typically required to construct the service line as well as abandon the existing septic tank or other on-lot disposal system. Figure 5-1 shows the standard house connection for a gravity collection system.

A gravity sewer system works well with the Village of Bowersville. The average depth of the gravity sewer system is 13’. The system will allow for service to the owners basement, if applicable. The only location in the Village which could not be serviced by the gravity sewer is on the eastern end of Chillicothe Street. These two services will require a grinder pump for their system.

As noted earlier, the lowest elevation in the Village of Bowesville is on the west end. The wastewater collected from the system will gather at this point. A pump station would be constructed in this location to then transport the collected wastewater via a force main (pressurized sewer line similar to a waterline) to a location to be treated. Figure 5-2 illustrates the layout of the gravity collection system. Treatment options will be discussed in the following sections.

A detailed construction cost analysis of this system is presented below in Table 5-1.

Table 5-1: Gravity Sewer Cost Analysis

ITEM	DESCRIPTION	QTY.	UNIT	COST/UNIT	TOTAL
1	CLEARING & GRUBBING	1	LS	$5,000	$5,000
2	TEMPORARY SOIL EROSION CONTROL	1	LS	$5,000	$5,000
3	ASPHALT PAVEMENT REMOVAL & REPLACEMENT, COMPLETE	3,674	SY	$30	$110,220
4	CONCRETE PAVEMENT, REMOVAL & REPLACEMENT	1,940	SF	$7	$13,580
5	8” GRAV SEWER PIPE, COMPLETE W/ BEDDING & BACKFILL	11,366	LF	$80	$909,280
6	6” SAN SERVICE PIPE, COMPLETE W/ BEDDING & BACKFILL	4,650	LF	$45	$209,250
7	8X6 WYE FITTING, COMPLETE	155	EA	$150	$23,250
8	3” SAN FORCE MAIN, COMPLETE W/ BEDDDING & BACKFILL	400	LF	$35	$14,000
9	MANHOLE, COMPLETE	34	EA	$3,200	$108,800
10	GRINDER PUMP, COMPLETE	1	EA	$3,000	$3,000
11	PUMP STATION, COMPLETE*	1	EA	$180,000	$180,000
12	CONCRETE CURB, REMOVED & REPLACED, COMPLETE	485	LF	$20	$9,700
13	MAINTAINING TRAFFIC	1	LS	$10,000	$10,000
14	CONSTRUCTION LAYOUT STAKING	1	LS	$10,000	$10,000
15	MOBILIZATION/DEMOBILIZATION	1	LS	$20,000	$20,000
16	SEEDING & MULCHING, COMPLETE	10,448	SY	$1	$10,448
17	PERMITTING	1	LS	$15,000	$15,000
SUBTOTAL					$1,656,529
10% CONTINGENCY					$165,653
20% NON-CONSTRUCTION					$364,436
TOTAL					**$2,186,617**

* Forcemain for pump station is not included. Will depend on treatment plant location.

STEP Sewer System

A Septic Tank Effluent Pump (STEP) collection system combines the traditional septic tank system with a small pump and force main or a small diameter gravity system. The STEP system collects only the effluent off of septic tanks which can be located at each customer's building or a group of customers can be on one septic tank. The STEP system then uses small effluent pumps and a network of force mains, usually 2 inch to 4 inch pipe, to collect the effluent and send it to a small package treatment plant.

This collection system conducts different stages of treatment at different locations. The solids are collected in a septic tank, where primary treatment takes place, before the sewage is discharged into a central collection system. Wastewater then flows from the pressurized collection system to a small package plant where the effluent is treated and disinfected. The following is a list of advantages and disadvantages for the STEP system.

Advantages

- Connect multiple residents to septic tank
- Infiltration reduced
- Cleanouts and valve assemblies less expensive than manholes.
- Pipe size and depth requirements reduced

Disadvantages

- Mechanical components require greater institutional involvement
- O&M costs higher due to number of septic tanks and pumps
- Annual preventative maintenance for septic tanks and pumps
- Life cycle replacement costs are higher
- Power outages can result in limited use for pumps
- Required solids removal as part of septic tank maintenance

Advantages of a STEP system over a conventional gravity system are smaller pipe sizes and shallower pipe depths within the collection network. Smaller pipes have lower material costs and maybe less expensive to install.

The STEP network uses all force mains and the depth of the pipes will be shallower than a conventional gravity system, thus further reducing the installation costs. On the other hand, the septic tanks and effluent pumps can drive up the initial cost of installation. The effluent pumps will need regular maintenance and repairs, and the septic tanks will require regular cleaning to remove the solids collected within them. Thus, the operation and maintenance cost of the system will go up as well.

A STEP system can be an effective means of collecting sewage from a small collection of homes, subdivisions, schools, and industrial parks, but it is not usually the preferred means of treatment for large communities or facilities that generate large flows. Bowersville would be considered a small system.

The connection at the house will be similar to Figure 5-3. This Figure shows the typical connection for a STEP system where either the existing or new septic tank is installed on the property with an effluent pump where it is transported to the pressure main through a 1 ½ " pressure service line. Figure 5-4 shows the layout for the STEP collection system.

A detailed construction cost analysis of this system is presented below in Table 5-2.

Table 5-2: STEP Sewer Cost Analysis

ITEM	DESCRIPTION	QTY.	UNIT	COST/UNIT	TOTAL
1	1,000 GAL SEPTIC TANK W/ PUMP	154	EA	$5,700	$877,800
2	1,500 GAL SEPTIC TANK W/ PUMP	1	EA	$6,500	$6,500
3	2" DIA. FORCEMAIN	9,612	LF	$30	$288,360
4	3" DIA. FORCEMAIN	1,748	LF	$35	$61,180
5	4" DIA. FORCEMAIN	7,380	LF	$40	$295,200
6	AIR RELEASE VALVES	3	EA	$2,500	$7,500
7	CLEANOUTS	6	EA	$950	$5,700
8	1.25" DIA. SERV LAT & CONNECTION	155	EA	$1,000	$155,000
9	SEEDING & MULCHING	6,247	SY	$1	$6,247
10	ASPHALT PAVEMENT REPLACEMENT	7,588	SY	$30	$227,640
11	MAINTAINING TRAFFIC	1	LS	$10,000	$10,000
12	CONSTRUCTION LAYOUT STAKING	1	LS	$10,000	$10,000
13	MOBILIZATION/DEMOBILIZATION	1	LS	$20,000	$20,000
14	CLEARING & GRUBBING	1	LS	$5,000	$5,000
15	TEMPORARY SOIL EROSION CONTROL	1	LS	$5,000	$5,000
16	PERMITTING	1	LS	$15,000	$15,000
SUBTOTAL					$1,996,127
10% CONTINGENCY					$199,613
20% NON-CONSTRUCTION					$439,148
TOTAL					**$2,634,888**

Grinder Pump Sewer System

The Grinder pump system utilizes a prefabricated pump and basin configuration. Wastewater from the house flows into the grinder pump station basin until liquid level controls turn on the pump. The grinder pump simultaneously grinds the waste into a slurry while pumping into the collection mains. Individual services are usually 1 ¼" PVC pipe with collection mains usually 2" to 6" PVC pipe.

The layout for the typical grinder system here is similar to those generated for the STEP system in this report. A low-pressure force main sewer system will follow the existing topography with the addition of isolation valves at intersections of mains, in-line cleanouts, terminal cleanouts, air release valves, and pressure monitoring stations. Main sewer lines would be constructed ranging in size from 4 inches to 6 inches in diameter.

The following is a list of advantages and disadvantages for a conventional grinder pump sewer system.

Advantages

- Slope and pipe alignment not as critical as gravity sewers
- Pipe size and depth requirements reduced
- Cleanouts and valve assembles less expensive than manholes

Disadvantages

- Less- flexibility for expansion, operation, and maintenance concerns
- Less range of flow capacity
- Power outages can result in limited use for pumps
- Periodic maintenance

Another operating concern with low pressure systems is power outage. A typical power outage lasts less than two hours. Grinder pump basins are designed with several hours' worth of holding capacity. However, in power outage conditions individuals would need to avoid showers and other heavy water usage activities.

The Grinder Pump conventional sewer connection and collection layout would be very similar to that of the STEP system with the exception that the existing septic tank would be removed and a grinder pump would replace the effluent pump, thus eliminating the primary treatment component associated with a step system. The design for each of these can be seen in Figures 5-3 and 5-4.

A detailed construction cost analysis of this system is presented below in Table 5-3.

Table 5-3: Grinder Pump Sewer Cost Analysis

ITEM	DESCRIPTION	QTY.	UNIT	COST/UNIT	TOTAL
1	SIMPLEX GRINDER PUMP UNITS	155	EA	$6,000	$930,000
2	2" DIA. FORCEMAIN	9,612	LF	$30	$288,360
3	3" DIA. FORCEMAIN	1,748	LF	$35	$61,180
4	4" DIA. FORCEMAIN	7,380	LF	$40	$295,200
5	AIR RELEASE VALVES	3	EA	$2,500	$7,500
6	CLEANOUTS	6	EA	$950	$5,700
7	1.25" DIA. SERV LAT & CONNECTION	155	EA	$1,000	$155,000
8	SEEDING AND MULCHING	6,247	SY	$1	$6,247
9	ASPHALT PAVEMENT REPLACEMENT	7,288	SY	$30	$218,640
10	MAINTAINING TRAFFIC	1	LS	$10,000	$10,000
11	CONSTRUCTION LAYOUT STAKING	1	LS	$10,000	$10,000
12	MOBILIZATION/DEMOBILIZATION	1	LS	$20,000	$20,000
13	CLEARING & GRUBBING	1	LS	$5,000	$5,000
14	TEMPORARY SOIL EROSION CONTROL	1	LS	$5,000	$5,000
15	PERMITTING	1	LS	$15,000	$15,000
SUBTOTAL					$2,032,827
10% CONTINGENCY					$203,283
20% NON-CONSTRUCTION					$447,222
TOTAL					**$2,683,332**

Vacuum Sewer System

Vacuum sewer systems are a mechanized system of wastewater transport where, unlike gravity flow, differential air pressure is used to move the wastewater. It requires a central source of power to run vacuum pumps which maintain a vacuum on the collection system. The system requires a normally closed vacuum/gravity interface valve at each entry point to seal the lines so that vacuum is maintained. These valves, located in a pit, open when a predetermined amount of wastewater accumulates in the collecting sump. The resulting differential pressure between atmosphere and vacuum becomes the driving force that propels the wastewater towards the vacuum station. A vacuum system is similar to a rural water distribution system in that it is a dendriform shape. The following is a list of advantages and disadvantages of a vacuum sewer system.

Advantages

- Installed following the existing topography
- Pipe size and depth requirements reduced

Disadvantages

- Less- flexibility for expansion, operation, and maintenance concerns
- A broken main line can cause substantial operating problems
- Few vacuum sewer systems are in use

The layout for the typical Vacuum Sewer system here, again, is similar to those generated for the Gravity collection system in this report. A Vacuum Sewer system will follow the existing topography with the addition of vacuum valves, auxiliary vents, valve pits/sump pits, vacuum stations, and lift stations. Main sewer lines would be constructed ranging in size from 4 inches to 6 inches in diameter.

The connection at the house will be similar to Figure 5-5. This Figure shows the typical connection for a Vacuum system where the existing septic tank is abandoned and wastewater from the home flows by gravity to a valve pit, which is then transported to the main via 3 inch vacuum service line. A potential layout of the vacuum collection system can be found in Figure 5-6.

A detailed construction cost analysis of this system is presented below in Table 5-4.

Table 5-4: Vacuum Sewer System Cost Analysis

ITEM	DESCRIPTION	QTY.	UNIT	COST/UNIT	TOTAL
1	6.0' - 2PC HYBRID VALVE PIT	154	EA	$3,100	$477,400
2	AIR TERMINALS	154	EA	$230	$35,420
3	TRAILER MOUNTED VACUUM PUMP	1	EA	$40,000	$40,000
4	PACVAC 165M-10	1	LS	$350,000	$350,000
5	6" VACUUM MAIN, COMPLETE	1,850	LF	$45	$83,250
6	4" VACUUM MAIN, COMPLETE	9,500	LF	$40	$380,000
7	3" SERVICE LATERAL, COMPLETE	1,600	LF	$35	$56,000
8	6" ISOLATION VALVE, COMPLETE	4	EA	$1,500	$6,000
9	4" ISOLATION VALVE, COMPLETE	7	EA	$1,200	$8,400
10	VALVE PIT - INSTALL	154	EA	$1,600	$246,400
11	VAC STA - SITE WORK	1	LS	$30,000	$30,000
12	VAC STA - BUILDING/FOUNDATION	1	LS	$10,000	$10,000
13	VAC STA - TANK INSTALLATION	1	LS	$25,000	$25,000
14	VAC STA MECHANICAL/ELECTRICAL (BLDG TO TANK)	1	LS	$30,000	$30,000
15	VAC STA - VALVE VAULT(S)	1	LS	$5,000	$5,000
16	VAC STA - ODOR CONTROL	1	LS	$20,000	$20,000
17	VAC STA - GENERATOR	1	LS	$35,000	$35,000
18	CLEARING AND GRUBBING	1	LS	$5,000	$5,000
19	TEPMORARY SOIL CONTROL	1	LS	$5,000	$5,000
20	MAINTAINING TRAFFIC	1	LS	$10,000	$10,000
21	CONSTRUCTION LAYOUT STAKING	1	LS	$10,000	$10,000
22	SEEDING AND MULCHING	5,206	SY	$1	$5,206
23	ASPHALT PAVEMENT REMOVAL & REPLACEMENT, COMPLETE	4,590	SY	$30	$137,700
24	CONCRETE CURB, REMOVED & REPLACED, COMPLETE	485	LF	$20	$9,700
25	CONCRETE PAVEMENT, REMOVAL & REPLACEMENT, COMPLETE	1,940	SF	$7	$13,580
26	PERMITTING	1	LS	$15,000	$15,000
SUBTOTAL					$2,049,056
10% CONTINGENCY					$204,906
20% NON-CONSTRUCTION					$450,792
TOTAL					**$2,704,754**

Treatment System Alternatives

The treatment of wastewater is the second stage in managing wastewater. Four scenarios were reviewed for the Village of Bowersville. Three scenarios include the construction of a new wastewater treatment facility in Bowersville or a shared wastewater treatment facility including the adjacent Village of Port William. These treatment options include an extended aeration plant, a lagoon system or a packed bed media system. One additional scenario includes transporting wastewater to the Village of Jamestown's existing wastewater treatment facility and contracting with Jamestown for treatment operations.

Given that the proposed wastewater treatment facilities are new, there are currently no specific effluent parameters for the Village of Bowersville. Without having specific effluent limitation parameters, effluent will need to comply with the EPA's Best Available Demonstrated Control Technology for new sources discharging sanitary wastewater which is identified as follows:

Table 5-5: Design Effluent

Parameter	30 Day Limit	Daily or 7 Day Limit	Max/Min Limit
CBOD5	10 mg/l	15 mg/l	n/a
Total Suspended Solids	12 mg/l	18 mg/l	n/a
Ammonia (summer)	1.0 mg/l	1.5 mg/l	n/a
Ammonia (winter)	3.0 mg/l	4.5 mg/l	n/a
Dissolved Oxygen	n/a	n/a	6.0 mg/l (min.)
Total Residual Chlorine	n/a	n/a	0.038 mg/l (max.)
E. Coli	126 / 100 ml	235 / 100 ml	n/a

In addition, a final decision upon the amount of residual treated wastewater constituents requires a formal study of the receiving water, in this case Love Run.

For the purpose of this study, it will be assumed that any new wastewater treatment facility will consist of primary, secondary and tertiary treatment. In the three scenarios evaluated, the extent of each component i.e. primary, secondary and tertiary treatment will be described briefly and used to evaluate the alternatives.

New Wastewater Treatment Plant – Extended Aeration

The first alternative for a new wastewater treatment plant utilizes extended aeration. Extended Aeration is a modified form of the activated sludge treatment process and is ideal for smaller flows. For purpose of this study, it will be assumed that the proposed treatment facility would consist of mechanical screening and grit removal as primary treatment. Secondary treatment would be the extended aeration process and clarification. This would be followed by tertiary filtration, ultra violet (UV) disinfection, post aeration and sludge treatment for land application.

Treatment of the wastewater will begin with the removal of large pieces of debris and any materials carried through the collection system using a bar screen followed by a mechanical fine screen. The bar screen will need to be manually cleaned by an operator. Mechanical fine screens typically have an automated self cleaning system. The screenings will be collected and disposed of appropriately.

Following the screening process the wastewater will then proceed to secondary treatment which in this alternative is the extended aeration process. The proposed Biolac System is an activated sludge biological treatment system that is suitable for many municipal wastewater applications. It is an extended aeration system with internal final clarification. The system utilizes low-loaded activated sludge technology, single basin operation, simple basin construction, and high-efficiency aeration chains with suspended fine –bubble diffusers. These features make the system very effective and cost efficient. The treatment process is presented in the diagram in Figure 5-7.

The system also offers a longer activated sludge age than most treatment systems. This provides excellent BOD removal, complete nitrification, and nutrient removal in warm and cold climates. The process incorporates a wave-oxidation process, which simplifies biological nutrient removal. Air distribution can be adjusted to vary the dissolved oxygen content and promotes alkalinity recovery. It also promotes nitrification, denitrification, and biological phosphorous removal.

Clarification is the next step in the treatment process and this occurs in a chamber that is integral to the extended aeration basin. The clarified wastewater then proceeds to the rapid sand filters where the tertiary filtration occurs. The rapid sand filters will be utilized as a polishing step to improve the quality of the wastewater prior to discharge.

After tertiary filtration, the wastewater is then disinfected as it proceeds through the UV disinfection unit. This is the followed by post aeration to meet the dissolved oxygen requirements. The treated effluent is then discharged to the receiving stream i.e. Love run.

Sludge that is collected at the bottom of the clarifier flows to a sludge holding tank. From the sludge holding tank, some of the sludge can be pumped and returned to be mixed with the influent. This can be either upstream of the screening process or combined with the influent to the aeration basin. Any remaining sludge in the sludge holding tank can be held for extended periods of time without aeration. Air can be easily introduced into the sludge if required via the diffused air piping in the sludge holding tank. No further digestion is required and the large quantity of biomass can treat fluctuating loads with minimal operational changes. It also minimizes excess sludge and makes the process very stable. Excess sludge can be pumped to sludge drying beds for dewatering and further processing prior to land application.

A building will also be provided for the blowers, electrical equipment, process controls and other appurtenances necessary for the operation of the plant. A sludge building will also be considered for sludge processing equipment as required.

Advantages

- Modular – ready for installation
- Routinely maintains good effluent quality
- Highest capacity to accept increased wastewater flows
- Relatively odorless and noiseless operation
- Less indicative to site selection

Disadvantages

- Increased power consumption
- Increased operation and maintenance
- More frequent sludge handling

Under this scenario, the Village of Bowersville would construct, own, operate, and maintain a wastewater treatment plant which would be designed to handle wastewater flows of 60,000 GPD. The location of the wastewater treatment plant would be west of the Village of Bowersville along the north end of the Love Run stream.

Listed below in Table 5-6 is a construction cost estimate for an extended aeration plant.

Table 5-6: Extended Aeration Treatment System Cost Analysis

ITEM	DESCRIPTION	QTY.	UNIT	COST/UNIT	TOTAL
1	BARS/SCREEN UNIT	1	LS	$40,000	$40,000
2	BIOLAC SYSTEM	1	LS	$250,000	$250,000
3	SAND FILTER	2	LS	$20,000	$40,000
4	SLUDGE DRYING BED	2	LS	$20,000	$40,000
5	SLUDGE BUILDING	1	LS	$25,000	$25,000
6	UV DISINFECTION UNIT	1	LS	$40,000	$40,000
7	POST AERATION TANK/FLOW METERS	1	LS	$25,000	$25,000
8	OFFICE/BLOWERS BUILDING	1	LS	$100,000	$100,000
9	YARD PIPING	1	LS	$70,000	$70,000
10	SITE WORK	1	LS	$40,000	$40,000
11	ELECTRICAL AND CONTROL	1	LS	$40,000	$40,000
12	6" SANITARY FORCE MAIN, COMPLETE	2500	LF	$18	$45,000
13	LAND ACQUISITION	2	AC	$5,000	$10,000
SUBTOTAL					$765,000
10% CONTINGENCY					$ 76,500
20% NON-CONSTRUCTION					$168,300
TOTAL					**$1,009,800**

New wastewater treatment plant - Facultative Lagoon System

The second alternative for the new wastewater treatment plant for the Village of Bowersville considered in this study is a facultative lagoon system. The primary treatment for wastewater in this case is also screening. This will help to minimize floatables that could potentially accumulate in the lagoon.

A lagoon is a passive method of providing treatment by retaining wastewater for many months allowing microbes to break down the waste. In this process, sludge will be produced as a by-product which settles to the bottom until dredged.

Lagoons are used for residential, small commercial and small community applications that have suitable, available land. Lagoons provide treatment at a slow rate. Large volume and slow treatment are tradeoffs for little to no external energy requirements. Lagoons provide treatment through physical and biological processes.

Two types of lagoon systems commonly used for small communities include flow-through and controlled discharge lagoons which is dependent upon the stream size and characteristics for discharge. Flow-through systems require larger streams to minimize impact to the water quality. In this case, large streams are not immediately available, thus a controlled discharge lagoon would be considered.

In cold climates, lagoons which treat strong wastewater may require aerated lagoon systems. In an aerated lagoon, oxygen is supplied by means of surface aerators or diffused air units. The turbulence in a basin created by aeration keeps solids in suspension and aids in microbial growth to break down components in the wastewater. In this case, since wastewater is primarily residential, aeration will not be considered a necessary design addition.

Lagoon type systems are one of the most commonly used type system for small communities. The advantages of this type of system are the low O&M cost and minimum maintenance requirements. However, this type of system requires a large area for construction and treatment parameters of the effluent can't be controlled by operational means, which might require construction of additional treatment units.

Ten States Standards requires construction of three lagoons as a minimum and retaining the average daily flow for 180 days using an average depth of 4 feet in the ponds because of sludge accumulation. With an average daily flow of 60,000 GPD, a surface area of 8.3 acres would be needed to meet the storage requirements. In order to construct dikes to contain the water surface, an additional 80% of the water surface land size is needed. Thus site requirements would approach 15 acres (1.8 x 8.3 = 14.94 acres).

Advantages

- Easy to operate
- Requires little energy
- Smaller quantity of removed material

Disadvantages

- Difficult to control or predict ammonia levels
- Require large areas of land
- Burrowing animals

Listed below in Table 5-7 is a construction cost estimate for a lagoon treatment system.

Table 5-7: Lagoon Treatment System Cost Analysis

ITEM	DESCRIPTION	QTY.	UNIT	COST/UNIT	TOTAL
1	EXCAVATION & EMBANKMENT	1	LS	$300,000	$300,000
2	PROCESS PIPING	1	LS	$30,000	$30,000
3	CONTROLS	1	LS	$60,000	$60,000
4	INFLUENT CHAMBERS	1	LS	$30,000	$30,000
5	OUTFALL STRUCTURE	1	LS	$30,000	$30,000
6	SITE WORK	1	LS	$60,000	$60,000
7	GROUNDWATER CONTROL	1	LS	$50,000	$50,000
8	LAND ACQUISITION	20	AC	$5,000	$100,000
9	6" SANITARY FORCE MAIN, COMPLETE	2,500	LF	$18	$45,000
SUBTOTAL					$705,000
10% CONTINGENCY					$70,500
20% NON-CONSTRUCTION					$155,100
TOTAL					**$930,600**

New wastewater treatment plant - Packed Bed Media

Packed bed media filters are a secondary treatment option and designed to follow primary treatment, as achieved in the STEP collection system. If a different collection system is utilized then some other primary treatment process will have to be provided. Some of the media options for the packed bed media filter are sand/gravel, peat, foam, and textile (AdvanTex). The textile filter operates in the recirculating mode, similar to a recirculating sand or gravel filter and is the proposed media for this alternative.

Wastewater first enters an anoxic tank and then is applied over the top of the filter in small, uniform doses several times per hour. This process provides maximum holding time for the water within the fabric. Effluent is then collected at the bottom of the filter and returns to the recirculation /dilution (R/D) tank. The effluent is typically recirculated four times before being discharged. A diagram of the packed bed media process can be found in Figure 5-10.

Periodic maintenance by a trained service provider is critical to maintaining high quality effluent from the filter. If the biomat builds on top of the textile configuration, it will need to be periodically removed. The land size requirement for a packed bed media filter is smaller than most treatment systems. The land size requirement for this project would approximately be 1 acre.

Disinfection in this alternative will be achieved using UV disinfection and the treated effluent can be discharged.

A building will be provided for the electrical components, process controls and appurtenances as required.

Advantages

- Limited operator involvement
- Low power costs
- Able to handle seasonal or increasing flows
- Easy to expand

Disadvantages

- Needs Primary Treatment First
- Occurrence of clogging
- Media requires cleaning

Listed below in Table 5-8 is a construction cost estimate for a packed bed media treatment system.

Table 5-8: Packed Bed Media Treatment System Cost Analysis

ITEM	DESCRIPTION	QTY.	UNIT	COST/UNIT	TOTAL
1	42 ft AX-MAX	4	EA	$85,000	$340,000
3	RNE PUMP	1	EA	$550	$550
4	DUPLEX PUMPING PACKAGE	6	EA	$2,100	$12,600
6	28ft AX-MAX	2	EA	$60,000	$120,000
7	PRE-ANOXIC TANK	1	EA	$35,000	$35,000
8	DISCHARGE PUMPING PACKAGE	1	LS	$1,200	$1,200
9	ALKALINITY WATER FEED PUMP	1	EA	$550	$550
10	ALKALINITY FEED SYSTEM	1	LS	$12,500	$12,500
11	INSTRUMENTATION/ FLOW METER	1	EA	$10,000	$10,000
12	DISINFECTION (UV)	1	EA	$40,000	$40,000
13	CONTROLS BUILDING	1	EA	$70,000	$70,000
14	TELEMETRY CONTROL PANEL	7	EA	$8,000	$56,000
SUBTOTAL					$698,400
10% CONTINGENCY					$69,840
20% NON-CONSTRUCTION					$153,648
TOTAL					**$921,888**

Port William

All of the above options have the ability to provide treatment service for the Village of Bowersville only or can be expanded to serve a larger area including the Village of Port William in neighboring Clinton County. Port William is currently unsewered. They, like Bowersville, rely on private, on-lot septic systems and are interested in regionalizing with a shared treatment system between the two communities.

The proposed treatment facility can be located either near Bowersville using Love Run as a discharge point or in Port William using Anderson Fork as a discharge point. The total distance between the two communities is approximately 5 miles. A forcemain would need to be constructed between the Villages of Bowersville and Port William with the likely route being Hussey Road to Beal Road to Port William Road as shown in Figure 5-8.

The Village of Port William has a 2010 Census population of 254. Using the same wastewater generation projections as used for Bowersville, the following Tables 5-9 and 5-10 generally show the combined wastewater flow projections for both communities.

Table 5-9: Projected Port William Population

Year	Bowersville Population	Port William Population	Combined	Sewage Flow (gpcd)	Total Theoretical Sanitary Flow (gpd)
2010	385	254	639	100	63,900
2020	405	267	672	100	67,200
2030	425	281	706	100	70,600
2040	447	295	742	100	74,200
2050	470	310	780	100	78,000

Table 5-10: Port William Design Flow

Year	Base Residential Sanitary Flow (gpd)	Allowable Infiltration (gpd)	Summation of Flows (gpd)	Commercial and Industrial Allowance (gpd)	Total Design Flow (gpd)
Present - 2050	78,000	4,000	82,000	8,000	90,000

With an average daily flow of 90,000 GPD, design peak flows for treatment will be based on 4.0 times the average daily flow or 360,000 GPD (0.36 MGD).

Each of the above treatment systems will be expanded in size accordingly. Rather than provide detailed estimates of each treatment option, the following table summaries the cost difference for the increased size.

Table 5-11: Bowersville Treatment and Combined Treatment Costs

Treatment System	Construction Cost – Bowersville Only	Construction Cost – Combined System
Extended Aeration	$1,009,800	$1,413,800
Lagoon	$930,600	$1,302,900
Packed Bed Media	$921,888	$1,290,700

Transport Wastewater to Jamestown

Another treatment option is to have a pump station transport the wastewater through a force main from Bowersville to the Village of Jamestown's WWTP. The proposed force main would travel north along state route 72. The Village of Jamestown's WWTP is approximately 5 miles away located on the south side of the Village nearest to the Village of Bowersville. Figure: 5-9 illustrates the path of the force main from Bowersville to Jamestown. The design capacity for the Jamestown WWTP is 0.9 MGD and the average daily flow is 0.33 MGD. The Village of Jamestown has shown interest in receiving the wastewater from Bowersville. Under this option, the Village of Port William is not included.

Listed below in Table 5-12 is a construction cost estimate for transporting wastewater to Jamestown.

Table 5-12: Transport to Jamestown Cost Analysis

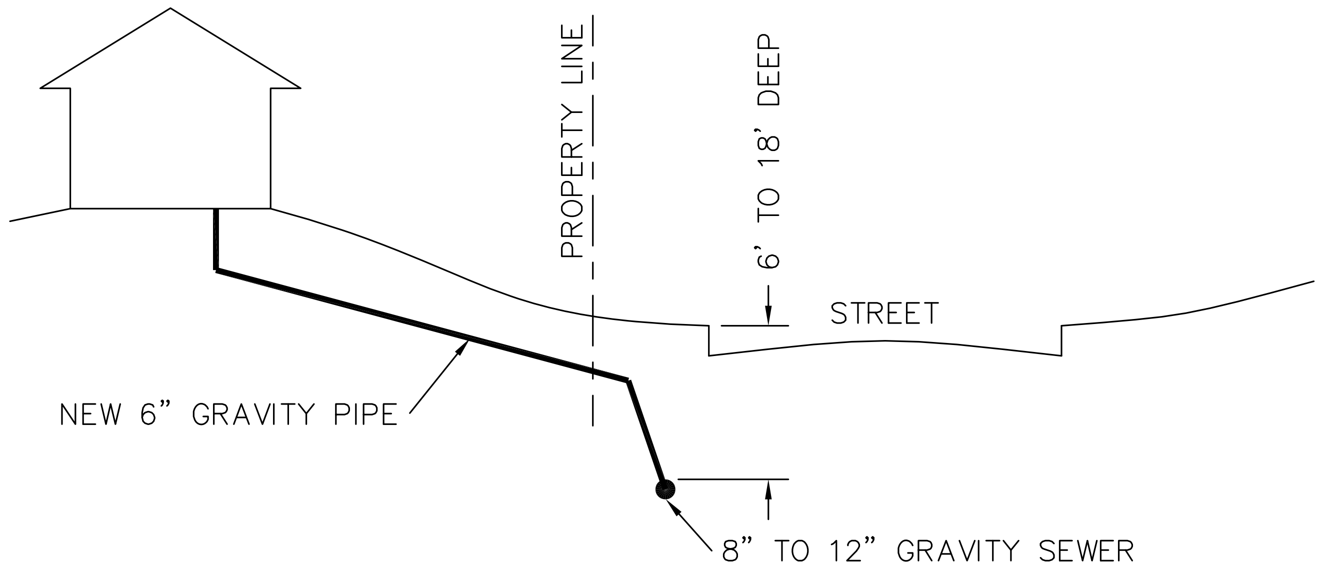
ITEM	DESCRIPTION	QTY.	UNIT	COST/UNIT	TOTAL
1	6" SANITARY FORCE MAIN, COMPLETE	26,400	LF	$20	$528,000
2	AIR RELEASE MANHOLE AND VALVE	2	EA	$6,000	$12,000
3	PAVEMENT REMOVAL & REPLACEMENT	4,928	SY	$30	$147,840
4	SEEDING & MULCHING, COMPLETE	22,995	SY	$1	$22,995
5	MAINTENANCE & PROTECTION OF TRAFFIC	1	LS	$10,000	$10,000
SUBTOTAL					$720,835
10% CONTINGENCY					$72,084
20% NON-CONSTRUCTION					$158,584
TOTAL					**$ 951,502**

IBI GROUP
635 Brooksedge Boulevard
Westerville OH 43081 USA
tel 614 818 4900 fax 614 818 4901
ibigroup.com

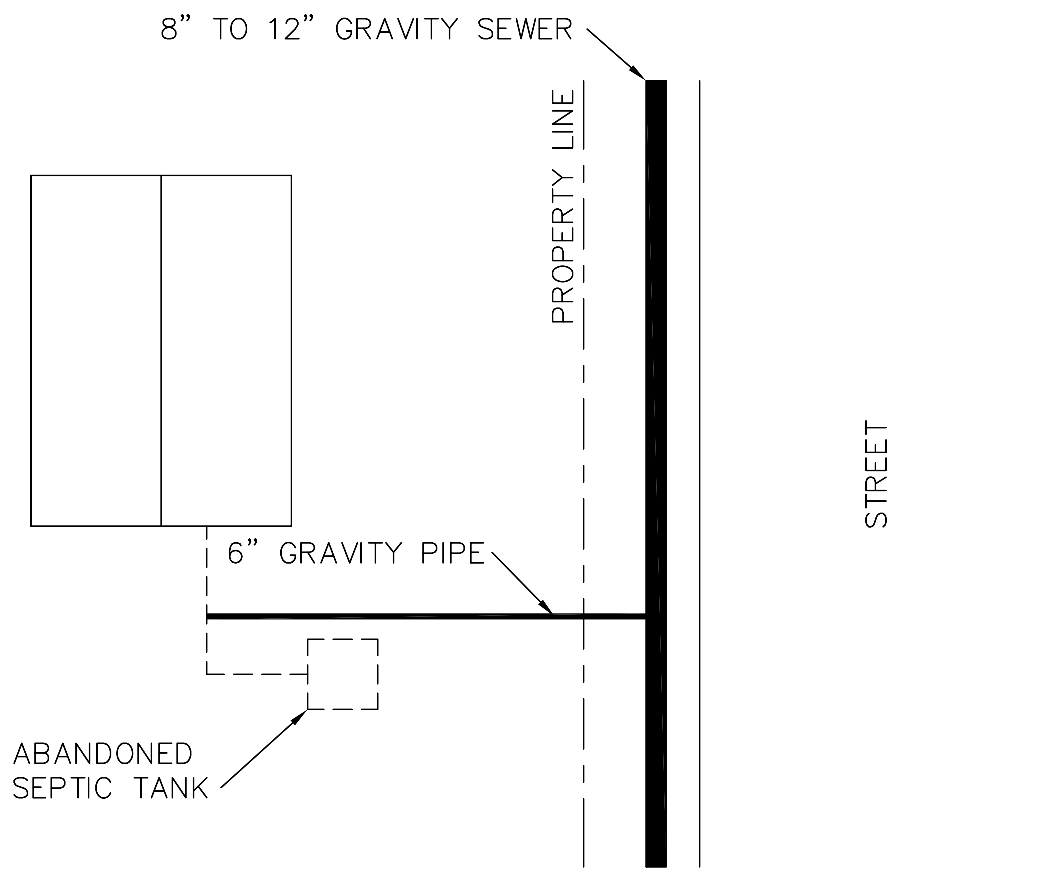
VILLAGE OF BOWERSVILLE

MVRPC UNSEWERED COMMUNITIES

FIGURE 5-1: CONVENTIONAL GRAVITY SEWER CONNECTION



SECTION (TYP.)



PLAN VIEW (TYP.)

GRAPHIC SCALE

0 250 500

(IN FEET)
1 inch = 500 ft.

IBI

IBI GROUP
635 Brooksedge Boulevard
Westerville OH 43081 USA
tel 614 818 4900 fax 614 818 4901
ibigroup.com

REVISION:

SUBMISSION:

VILLAGE OF BOWERSVILLE

MVRPC SEWER FEASIBILITY STUDY

SHEET TITLE:

GRAVITY SEWER LAYOUT

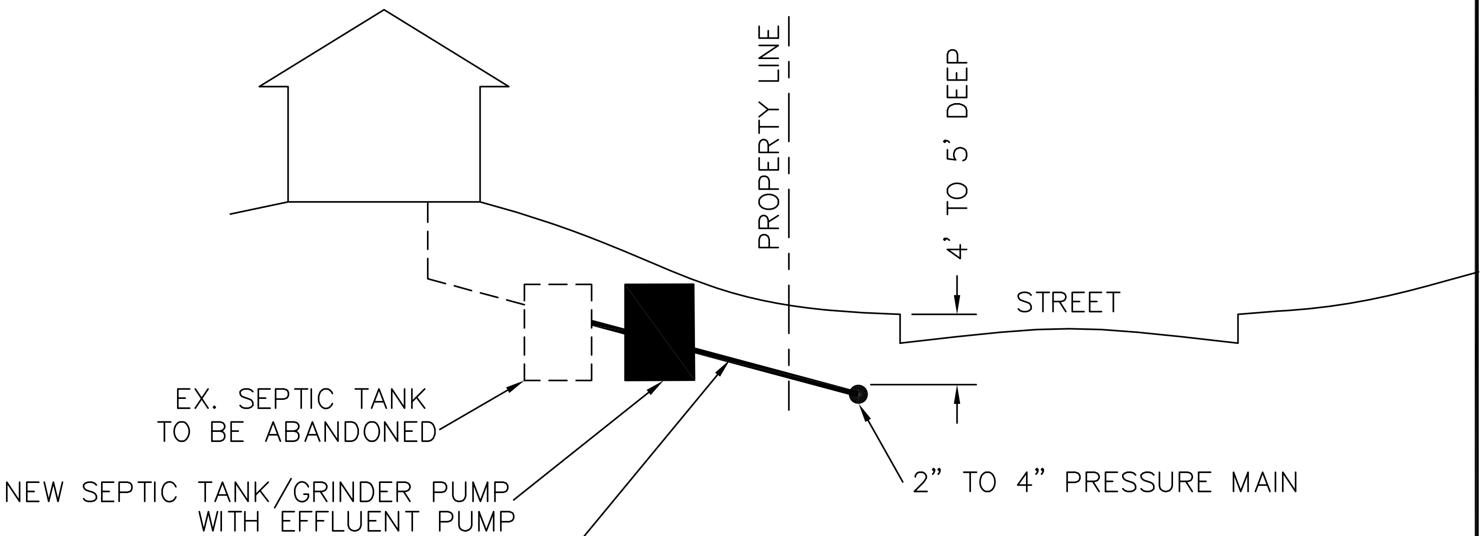
FIGURE 5-2

IBI GROUP
635 Brooksedge Boulevard
Westerville OH 43081 USA
tel 614 818 4900 fax 614 818 4901
ibigroup.com

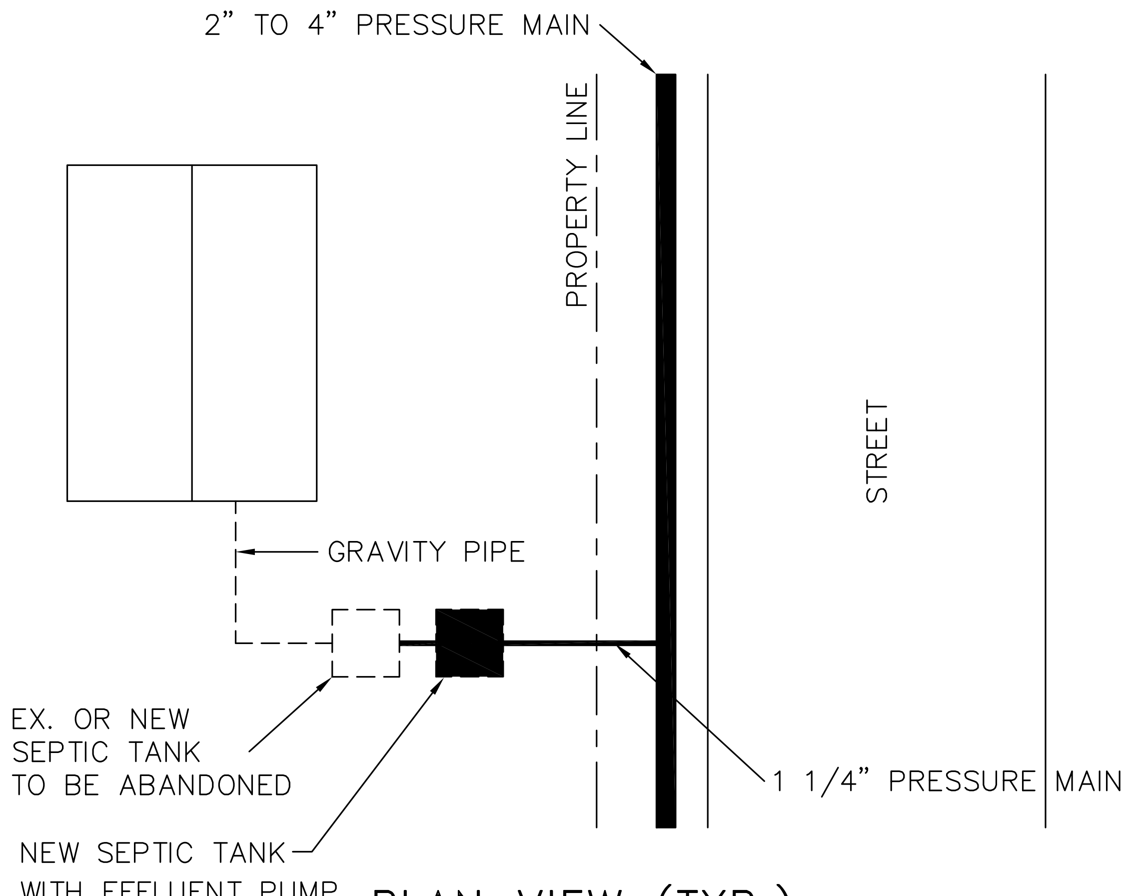
VILLAGE OF BOWERSVILLE

MVRPC UNSEWERED COMMUNITIES

FIGURE 5-3: CONVENTIONAL STEP/GRINDER SEWER CONNECTION



SECTION (TYP.)



PLAN VIEW (TYP.)