DRINKING WATER SOURCE PROTECTION PLAN

For

The Village of Camden

Village Hall
56 N. Main Street
Camden, OH 45311

PWS ID#
6800112

Date Submitted: November 27, 2013

Planning Team Consultant:

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This document presents the Drinking Water Source Protection Plan for the Village of Camden in Preble County Ohio. The 1996 Amendments to the Safe Drinking Water Act established the Source Water Assessment and Protection Program. The Source Water Assessment and Protection Program was established to help public water systems develop plans to protect their drinking water resources. This document is based on Ohio EPA's "Developing Local Drinking Water Source Protection Plans in Ohio (2003)."

INTRODUCTION

Source water protection planning is an important tool to keep water safe to drink and treatment costs low. A source water protection plan is a locally designed and implemented plan to mitigate current and potential contaminants. Plans identify potential threats to drinking water supplies and strategies to alleviate those threats. The protection plan may be implemented as a completely voluntary effort, or if necessary, local enforcement can be used to enforce certain measures.

> *The key to source water protection is to prevent costly contamination in order to save the health and financial resources of communities, while ensuring a long-term supply of safe and affordable drinking water remains available for future generations.*

Why should a community do a source water protection plan?
It is essential for communities to complete a source water protection plan because of the vital role water plays in all facets of our communities. Water is a basic building block for all life on earth. In addition, clean, affordable, water can be an important economic driver. Many manufacturing plants use significant amounts of water and can make decisions about plant location based on the availability of good water. Clean water, provided at a reasonable cost, can attract new business and residents which help fuel economic growth and prosperity.

What if your water is already clean? Governments already invest a significant amount of money and time in their water treatment and distribution, *so keeping the water source clean keeps costs as low as possible*. When contamination occurs, it can have a huge financial impact on governments and communities. Contaminations also disrupt lives and businesses, creating a negative economic effect for the local community. Most importantly, however, when drinking water is contaminated, the health of our families and fellow citizens is put at risk.

Because it only takes one major event to drastically change the quality of your water source, it is critical to plan ahead. Protection planning can prevent a future event entirely, minimize a potential threat, or simply prepare the community for when something does happen to the water supply. A source water protection plan can also be used when evaluating potential development opportunities that may affect drinking water supplies in the future.

- ✓ It helps the district provide the safest and highest quality drinking water to its customers at the lowest possible cost.

- ✓ It establishes strategies to minimize the potential threats to the source of drinking water.

- ✓ It helps to plan for expansion, development, zoning, and emergency response issues.

- ✓ It can provide more opportunities for funding to improve infrastructure, purchase land in the protection area, and other improvements to the water system.

Program History

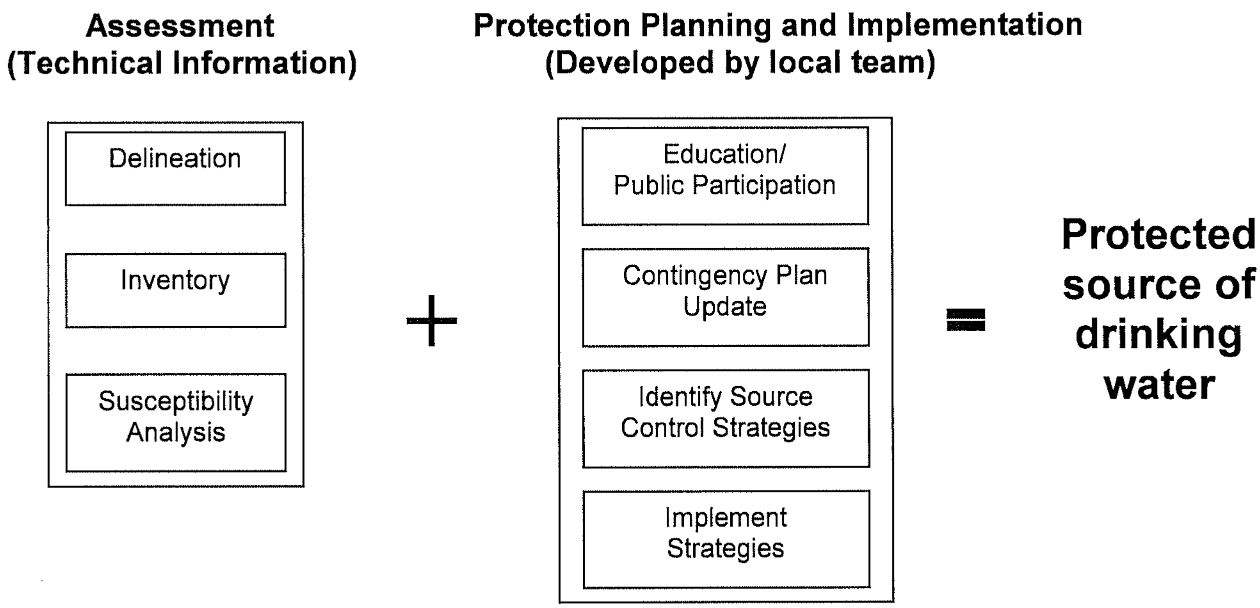
Source water assessment and protection (SWAP) is a non-regulatory state program administered by the Ohio Environmental Protection Agency. The program started as the Wellhead Protection Program, which was part of the 1986 amendments to the federal Safe Drinking Water Act. These amendments required states to administer a source water protection program for their systems using ground water. In 1992 Ohio's Wellhead Protection Program was approved by the U.S. Environmental Protection Agency. The wellhead protection program provided guidance and technical assistance to public water systems, who were encouraged to complete assessments and protection plans using their own resources. Ohio EPA staff reviewed the assessments and formally endorsed them.

In 1996, the Safe Drinking Water Act was amended again. Section 1453 was added, providing states with the necessary federal funding to complete source water assessments for their public water systems. At that time, the program was extended to include surface water systems and was renamed "Source Water Protection." Starting in 2000, Ohio EPA staff began assessing Ohio's water systems and by January 2006, this phase was complete for almost all of Ohio's public water systems. It was the intent of Congress that public water systems use the information in their source water assessment to develop a drinking water source protection plan. It is currently a requirement by the Ohio EPA to have a plan in place within two years of installing a new well for public drinking water.

SOURCE WATER PROTECTION PLANNING PROCESS

Process Outline

1. *Assessment*: Completed by the Ohio EPA in May, 2012 and attached as Appendix (B). It includes:
    - Delineation: This is a map of the portion of the watershed that drains into the area around the well field.
    - Potential contaminant source inventory: This identifies potential contaminant sources within the delineated area that could pose a threat to drinking water.
    - Susceptibility analysis: This is a determination of the susceptibility of the source water to contamination. (Camden is a *High Susceptibility system)*
2. *Development of Protection Plan*: The plan may be completed by the system or in consultation with the Ohio EPA, Ohio Rural Water Association, or a private consultant.
    - Start a planning team: The first step to effective planning is to collect the proper people to help design it and do future implementation. Team members can include local government officials, community members, other government agency representatives, consultants, business representatives, watershed groups, or other interested parties.
    - Update protection area and potential contaminant list: The planning team should review the assessment and see if any additions or corrections need to be looked at. They should also prioritize which potential contaminants pose the greatest threat.
    - Identify protective strategies: For each prioritized contaminant source, a protective strategy should be identified with implementable goals.
    - Design local outreach and public education effort: All good protection planning requires public participation. An outreach and education effort can help instil good environmental stewardship and ensure the plan addresses all the community's needs.
    - Create an emergency plan and contingency plan: An emergency plan provides information and procedures for local responders in case something happened to the drinking water supply. A contingency plan looks at alternative drinking water supplies to ensure water is available during an emergency.
    - Seek Ohio EPA endorsement.
3. *Implement Protection Plan*: Implemented by the district with assistance from state agencies and the Ohio Rural Water Association.
    - Work with contaminant sources to mitigate threats.
    - Continue outreach and education efforts.
    - Apply for potential funding sources.
    - Update plan at least every five years.



Assessment
(Technical Information)
Delineation
Inventory
Susceptibility Analysis
+
Protection Planning and Implementation
(Developed by local team)
Education/ Public Participation
Contingency Plan Update
Identify Source Control Strategies
Implement Strategies
=
Protected source of drinking water

DESCRIPTION OF SOURCE WATER AREA

The Village of Camden is located in the southern portion of Preble County in the south western part of Ohio. The Village of Camden serves just over 2000 people with water service. The water supply comes from two wells located just west of Sevenmile Creek off Barnett's Mill Road north of town. The wellfield pumps about 250,000 gallons of water per day from a sand and gravel aquifer (water-rich zone) within the Sevenmile Creek Alluvial Aquifer System. The aquifer is covered by less than 10 feet of low-permeability material, which provided minimal protection from contamination. Depth to water in this aquifer is approximately 15 feet below the ground surface. Soils in the area are silty loams which are moderately well-drained, meaning that much of the rainfall and snowmelt will infiltrate into the soil, instead of running off or ponding. The topography is generally flat. Ground water in this area is replenished by the gradual flow of water underground from higher to lower elevations and by approximately 7 inches per year of precipitation that infiltrates through the soil. At the Village of Camden's Barnett's Mill Road wellfield, ground water flows generally toward the southwest.

The original assessment was completed in 2002, but revised because ground water contamination from a former salt pile forced the Village to abandon their original wellfield and drill new wells (now referred to as the Barnett's Mill Road wellfield). The revised drinking water source protection area for the Village of Camden's wells is illustrated in Figure 2. The new wellfield became operational in June, 2012.

The Ohio EPA has determined the Village of Camden to be highly susceptibility to contamination because:

- The presence of a relatively thin protective layer of clay overlying the aquifer
- The shallow depth (less than 20 feet below ground surface) of the aquifer
- The presence of significant potential contaminant sources in the protection area

The Village of Camden has a Class I water treatment plant. Raw water enters through the floor in the water plant and goes up to the filter at the top. The water passes through an aerator and is chlorinated as it enters the detention tank. The water is then distributed to four cells inside the iron and manganese filter. Water is collected at the bottom and pumped into the distribution system by two high service pumps.

The well field is part of the Sevenmile creek watershed (HUC 0508000205) which is part of the Lower Great Miami watershed (HUC 05080002). The Lower Great Miami is part of the Great Miami River Basin (5330 sq. mi., HUC 0508) and part of the Ohio River Basin.

Figure 1: Lower Great Miami River Watershed (From the Miami Conservancy District)

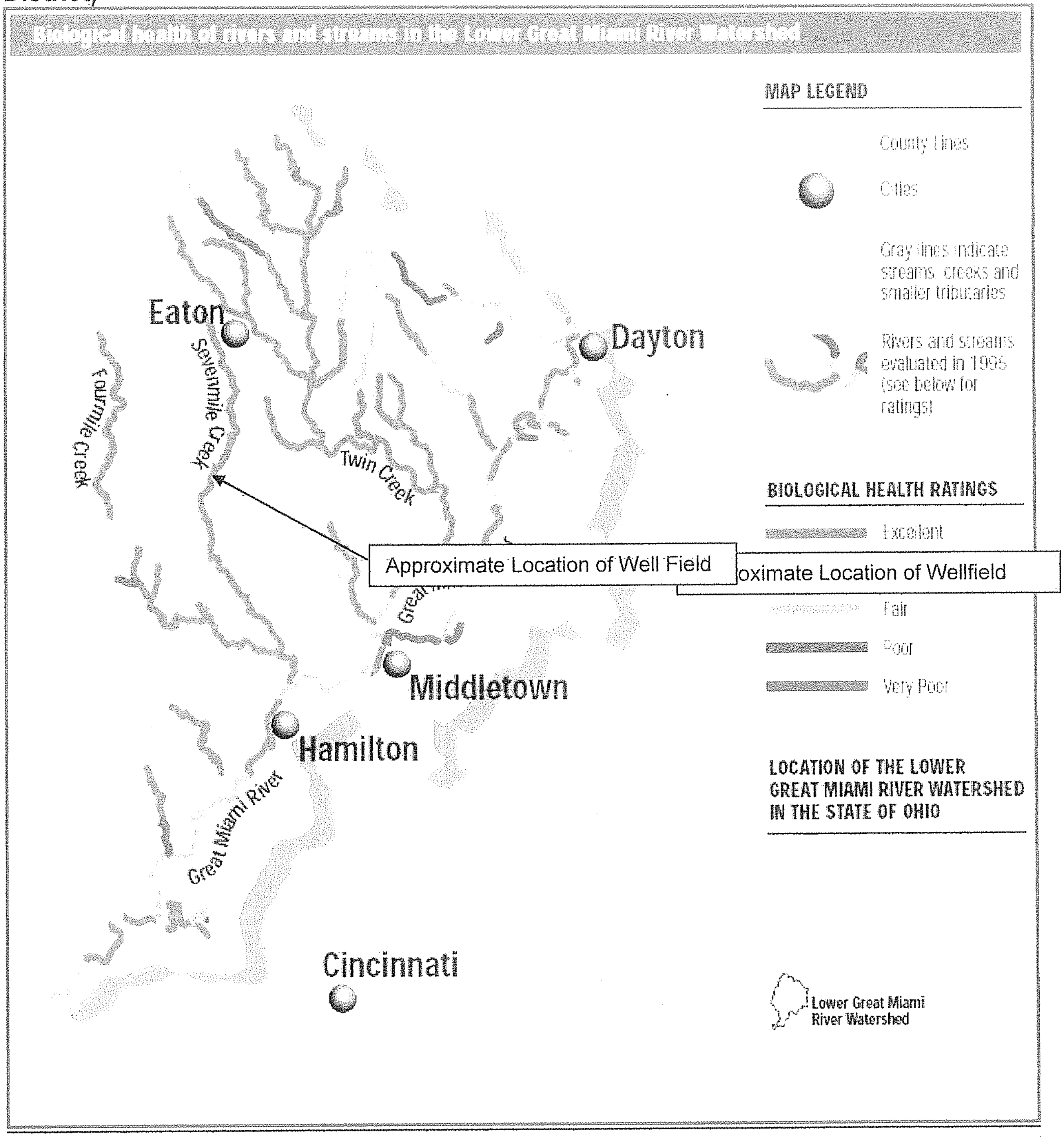
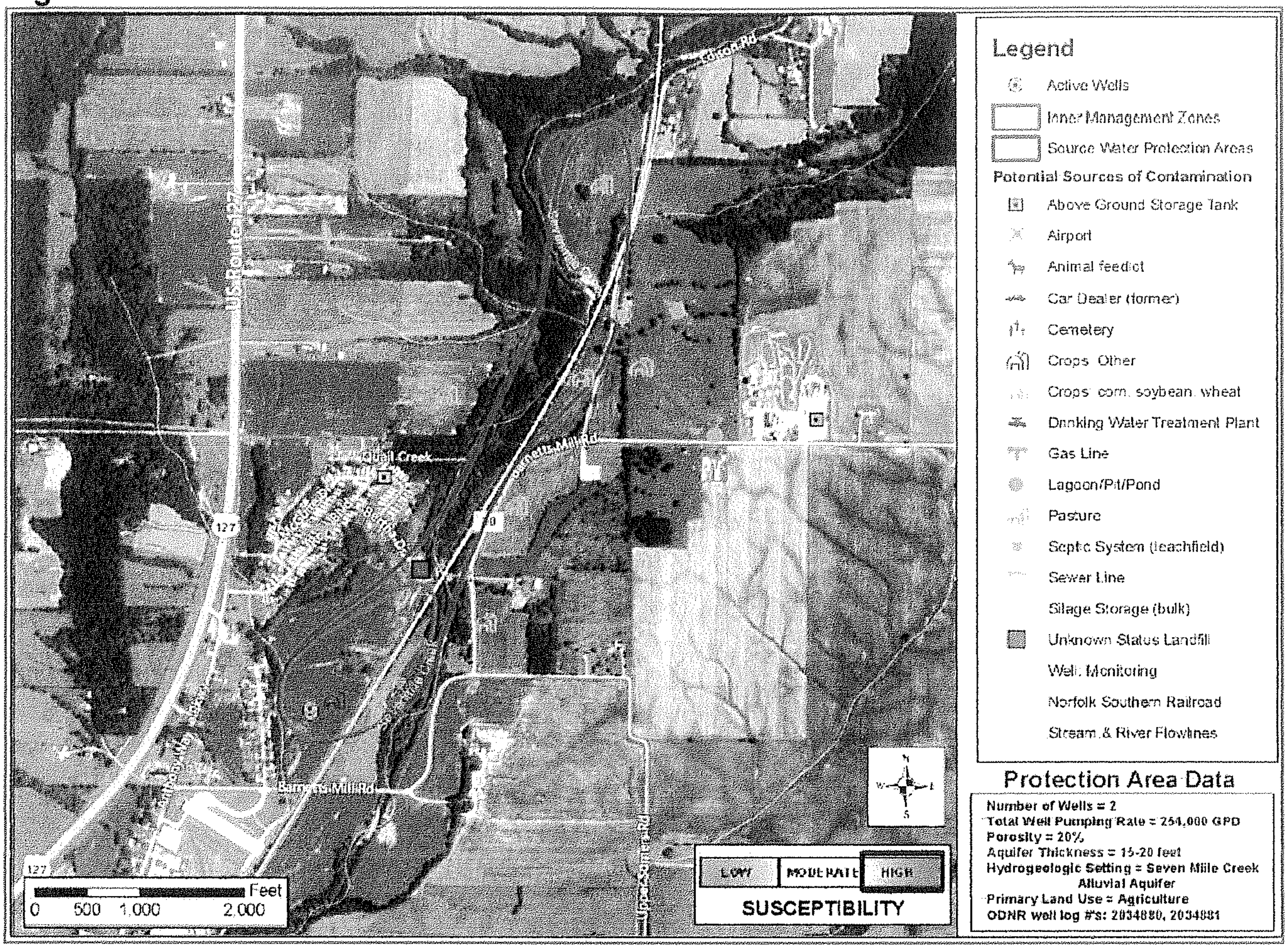


Figure 2: Well field Protection Area



This figure shows two areas, one inside the other. The "inner management zone" is the area that provides ground water to the Village of Camden's wells within one year of pumping (red area). A chemical spill in this zone poses a greater threat to the drinking water, so this area warrants more stringent protection. The "source water protection area" is the additional area that contributes water when the wells are pumped for five years (blue area). Together, they comprise the drinking water source protection area.

DRINKING WATER SHORTAGE/EMERGENCY RESPONSE

A well-formulated contingency plan enables a utility to prepare for, respond to, and recover from crisis conditions without wasting time on futile or unnecessary efforts or spending funds unnecessarily. The plan defines the duties, responsibilities, and functions of all water system personnel with respect to each specific emergency condition. Camden has developed procedures to address specific situations that can be expected to arise, and these are documented in their contingency plan.

The following are issues that are specific to drinking water source protection. This information has been included in the water plant contingency plan.

DRINKING WATER SHORTAGE – SHORT TERM LOSS OF SOURCE

If the Village of Camden experiences a short-term loss of its drinking water source (such as through a short-lived emergency on the well field, collapse of a well, etc.), where there is not enough storage to compensate, it will:

A. If only one well is affected, isolate the affected well, and run the water system on the other well.

B. Start up the old wellfield which was contaminated with road salt. As noted in the 2013 OEPA-DDAGW sanitary survey letter, it may be possible for the Village to use the old wellfield in the future, depending on water quality (and extent of the chloride plume in the aquifer) and the well structure (casing quality, corrosion). In addition, the isolation radius must be maintained free from potential contaminant sources.

C. If the old wellfield is still contaminated, the village can either:

   1. Issue water conservation notices to customers to extend supply of elevated storage.
   2. Provide water hauling services and/or bottled water for drinking water. (Water hauling services are listed in section IV of the village contingency plan.)

Note: The Village of Camden has 2 distinct separate well fields. The new well field (2012) and the old well field located near the village park. The new well field has 2 wells and the old well field has 3 wells.

Camden can provide water from existing storage for up to 48 hours, provided it is not necessary to flush out the entire distribution system.

DRINKING WATER SHORTAGE – LONG-TERM LOSS OF SOURCE

In the event of complete loss of the current field, the village would:

A. If only one well is affected, isolate the affected well, and run the water system on the other well.

B. Start up the old wellfield which was contaminated with road salt. As noted in the 2013 OEPA-DDAGW sanitary survey letter, it may be possible for the Village to use the old wellfield in the future, depending on water quality (and extent of the chloride plume in the aquifer) and the well structure (casing quality, corrosion). In addition, the isolation radius must be maintained free from potential contaminant sources.

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FUNDING FOR WATER EMERGENCIES

The village currently does not have an emergency fund for work required to continue water service in the event of an emergency. All additional expenditures must be approved by the village council.

PLANNING FOR THE FUTURE

A. Current average daily pumpage = 0.200 million gallons per day
B. Current daily system design capacity = 0.375 million gallons per day
C. Well field capacity (the maximum amount the wells can pump, based on the capacity of the pumps) is 1.15 million gallons per day.

The Village of Camden is currently pumping about 53% of its design capacity and 17% of its well field capacity.

Census figures indicate that The Village of Camden has maintained a steady population over the past 10 years, with just a slight decline from 2000 to 2010. In 2000 there were about 2,302 residents in Camden and in 2010, about 2,046 residents live in the village. Currently, no significant growth or decline of population is anticipated. Also, at this time the village is not aggressively developing this area and does not anticipate a sudden spike in industrial use of the water.

DRINKING WATER SOURCE ASSESSMENT for the Village of Camden PWS ID #OH6800112

Protecting Ohio's Drinking Water Sources

May 2012
(revised from June 2002)

INTRODUCTION. The 1996 Amendments to the Safe Drinking Water Act establish a program for states to assess the drinking water source for all public water systems. Ohio's Source Water Assessment and Protection Program is designed to help public water systems protect their sources of drinking water from becoming contaminated. This assessment:

< identifies the drinking water source protection area, based on the area that supplies water to the well(s),

< inventories the potential contaminant sources in the area,

< evaluates the susceptibility of the drinking water source to contamination, and

< recommends protective strategies.

The purpose of the assessment is to provide information that the Village of Camden can use to help protect its source of drinking water from contamination.

SYSTEM DESCRIPTION & GEOLOGY. The Village of Camden operates a community public water system serving approximately 2,000 people in Preble County, Ohio. This system operates 2 wells in the new Barnett's Mill Road wellfield that pump approximately 254,000 gallons of water per day from a sand and gravel aquifer (water-rich zone) within the Seven Mile Creek Alluvial Aquifer System. The aquifer is covered by less than 10 feet of low-permeability material, which provides minimal protection from contamination. Depth to water in this aquifer is approximately 15 feet below the ground surface.

Soils in the area are silty loams which are moderately well-drained, meaning that much of the rainfall and snowmelt will infiltrate into the soil, instead of running off or ponding. The topography is generally flat. Ground water in this area is replenished by the gradual flow of water underground from higher to lower elevations and by approximately 7 inches per year of precipitation that infiltrates through the soil. At the Village of Camden's Barnett's Mill Road wellfield, ground water flows generally toward the southwest.

PROTECTION AREA. The Village of Camden's initial assessment was completed by Ohio EPA in June, 2002. The assessment was revised because ground water contamination from a former salt pile forced the Village to abandon their original wellfield and drill new wells (now referred to as the Barnett's Mill Road wellfield). The revised drinking water source protection area for the Village of Camden's wells is illustrated in Figure 1. This figure shows two areas, one inside the other. The "inner management zone" is the area that provides ground water to the Village of Camden's wells within one year of pumping. A chemical spill in this zone poses a greater threat to the drinking water, so this area warrants more stringent protection. The "source water protection area" is the additional area that contributes water when the wells are pumped for five years. Together, they comprise the drinking water source protection area.

Method Selection
An analytic element model computer program called GFLOW (Ground water FLOW) was used to determine the areal extent of the protection area. Protection areas based on computer modeling can be significantly more credible than those produced by simpler methods, especially in areas with complex geology. The time and effort required to develop a computer model are warranted when the wellfield is located in a complex hydrogeologic setting, and the hydrogeologic data needed to run the program are available for the area. Both criteria were met for the Village of Camden's source water assessment.

Model Set-up
The GFLOW model for the Village of Camden's Barnett's Mill Road wellfield was designed to simulate the characteristics of a sand and gravel alluvial aquifer that lies within bedrock. Figure 2 shows that the bedrock valley walls were modeled as "no-flow boundaries", meaning the bedrock does not contribute any water to the Village of Camden's wellfield. Since the bedrock in this area yields very little water, using no-flow boundaries is appropriate.

Model Values
Information needed to run the model includes, at a minimum, **pumping rate** of the wells, **hydraulic conductivity** of the aquifer (that is, the ease with which water moves through it), **aquifer thickness**, and **aquifer porosity**. For this model, the pumping rate of 254,000 gallons per day represents the average daily pumping rate as recorded in Ohio EPAs files, plus an additional 15 percent, to provide a more protective area. An aquifer thickness of 15-20 feet was used, based on well logs. Pump tests performed by Terran Corporation in 2011 at the Jered property (location of the new Barnett's Mill Road wellfield) calculated aquifer transmissivity values of 41,000 to 48,000 gallons per day per foot. From these transmissivity values, the hydraulic conductivity was calculated to range from 100 to 150 feet per day. Site specific information on the porosity of the alluvial aquifer was not available. Therefore, a porosity value of 20% was used based on values typically found in these kinds of sediments. Seven inches per year infiltration from precipitation was also assumed for the model.

The protection area was determined based on the best information available at the time of the assessment. If you would like to have more information about how this protection area was derived, or if you would like to collect additional information and revise your protection area, please call Ohio EPA staff listed at the end of this report. Also, a more detailed discussion of the technical aspects of modeling drinking water source protection areas can be found in the *Delineation Guidelines and Process Manual* (Ohio EPA, 2010) on Ohio EPAs Source Water Assessment and Protection Web page (www.epa.ohio.gov/ddagw/swap.aspx).

INVENTORY. On May 3, 2012, an inventory of potential contaminant sources located within the drinking water source protection area was conducted by Ohio EPA (Figure 1). Table 1 provides additional information about these types of potential contaminant sources.

A facility or activity is listed as a potential contaminant source if it has the **potential** to release a contaminant, based on the kinds and amounts of chemicals typically associated with that type of facility or activity. It is beyond the scope of this assessment to determine whether any specific potential source is **actually** releasing (or has released) a contaminant to ground water. Also, the inventory is limited to what Ohio EPA staff were able to observe on the day of the site visit. Therefore, the Village of Camden staff should be alert to the possible presence of potential sources of contamination that are not on this list.

GROUND WATER QUALITY. A review of the Village of Camden's water quality record for the Barnett's Mill Road wellfield currently available in Ohio EPAs drinking water compliance database did not reveal any evidence of chemical contamination at levels of concern in the aquifer.

Please note that this water quality evaluation has some limitations:

< the data evaluated are mostly for treated water samples only, as Ohio EPAs quality requirements are for the water being provided to the public, not the water before treatment.

< sampling results for coliform bacteria and naturally-occurring inorganics (other than arsenic) were not evaluated for this assessment, because they are not a reliable indicator of aquifer contamination.

Current information on the quality of the treated water supplied by the Village of Camden's Public Water System is available in the Consumer Confidence Report for the system, which is distributed annually. It reports on detected contaminants and any associated health risks from data collected during the past five years. Consumer Confidence Reports are available from the Village of Camden.

SUSCEPTIBILITY ANALYSIS. This assessment indicates that the Village of Camden's source of drinking water has a **high** susceptibility to contamination because of:

- the presence of a relatively thin protective layer of clay (less than 10 feet) overlying the aquifer,
- the shallow depth (less than 20 feet below ground surface) of the aquifer, and
- the presence of significant potential contaminant sources in the protection area.

This susceptibility means that under currently existing conditions, the likelihood of the aquifer becoming contaminated is relatively high. This likelihood can be minimized by implementing appropriate protective measures.

PROTECTIVE STRATEGIES. Protective strategies are activities that help protect a drinking water source from becoming contaminated. Implementing these activities benefits the community by helping to:

< protect the community's investment in its water supply.

< protect the health of the community residents by preventing contamination of its drinking water source.

< support the continued economic growth of a community by meeting its water supply needs.

< preserve the ground water resource for future generations.

< reduce regulatory monitoring costs.

Ohio EPA encourages the Village of Camden to develop and implement an effective Drinking Water Source Protection Plan. The plan can be developed from the information provided in this Drinking Water Source Assessment Report. The potential contaminant source inventory provides a list of facilities or activities to focus on. Table 2 lists protective strategies that are appropriate for the kinds of facilities/activities listed in the inventory. Finally, a document titled *Developing Local Drinking Water Source Protection Plans in Ohio* is available from Ohio EPA. This document offers comprehensive guidance for developing and implementing a municipal Drinking Water Source Protection Plan. Ongoing implementation of the plan will help protect the Village of Camden's valuable drinking water resources for current and future generations.

For further technical assistance on drinking water source protection, please contact John McGinnis at Ohio EPA's Southwest District Office (937-285-6449) or Linda Slattery at Ohio EPA's Central Office (614-644-2752). Additional information can be found at:
www.epa.ohio.gov/ddagw/swap.aspx.

This report was written by Linda Slattery, Ohio EPA, Division of Drinking and Ground Waters.

BIBLIOGRAPHY.

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Ohio EPA, 2009, *Drinking Water Source Protection Area Delineation Process Manual.*

Terran Corporation, 2011, *Hydrogeologic Evaluation of the Jered Property for use as the Village of Camden replacement municipal wellfield, Camden, Ohio.*

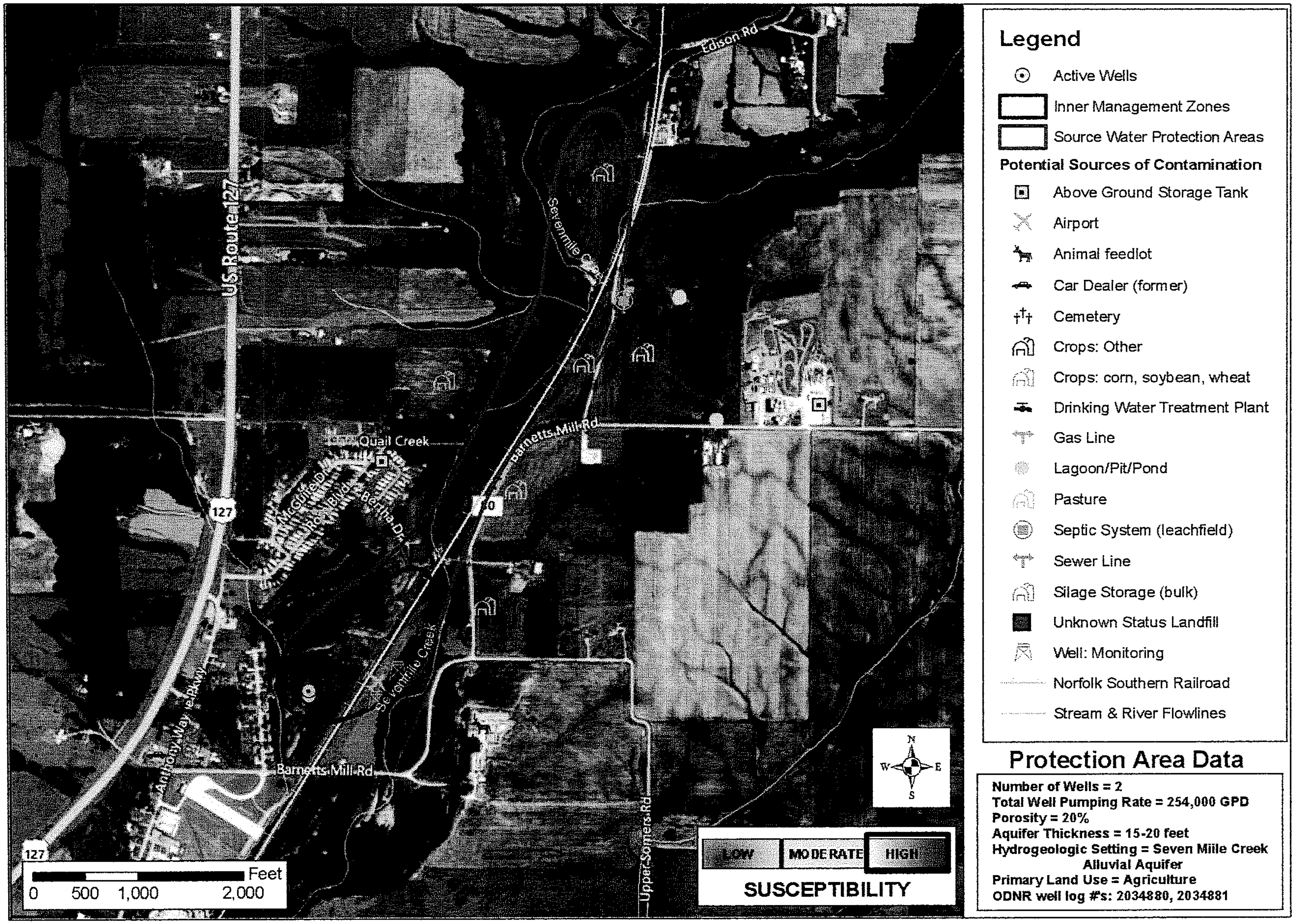
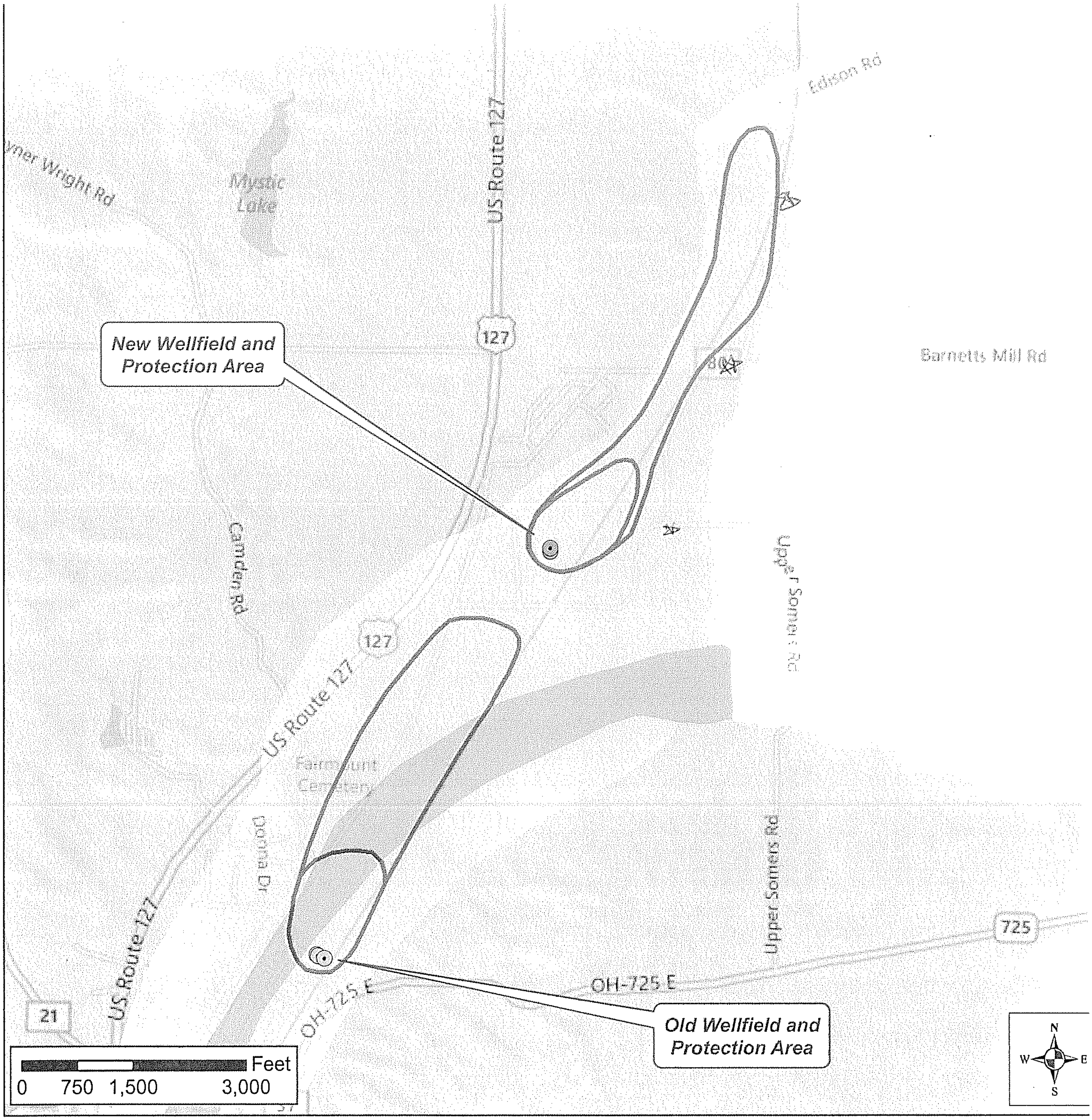


Figure 1. Drinking Water Source Protection Area and Potential Contaminant Source Inventory for the Village of Camden, Identification #OH6800112.

May 7, 2012



Legend

- Active Wells
- Inner Management Zones
- Source Water Protection Areas

Hydrogeologic Setting

- Alluvial
- Buried Valley
- Ground Moraine
- End Moraine Complex

Protection Area Data

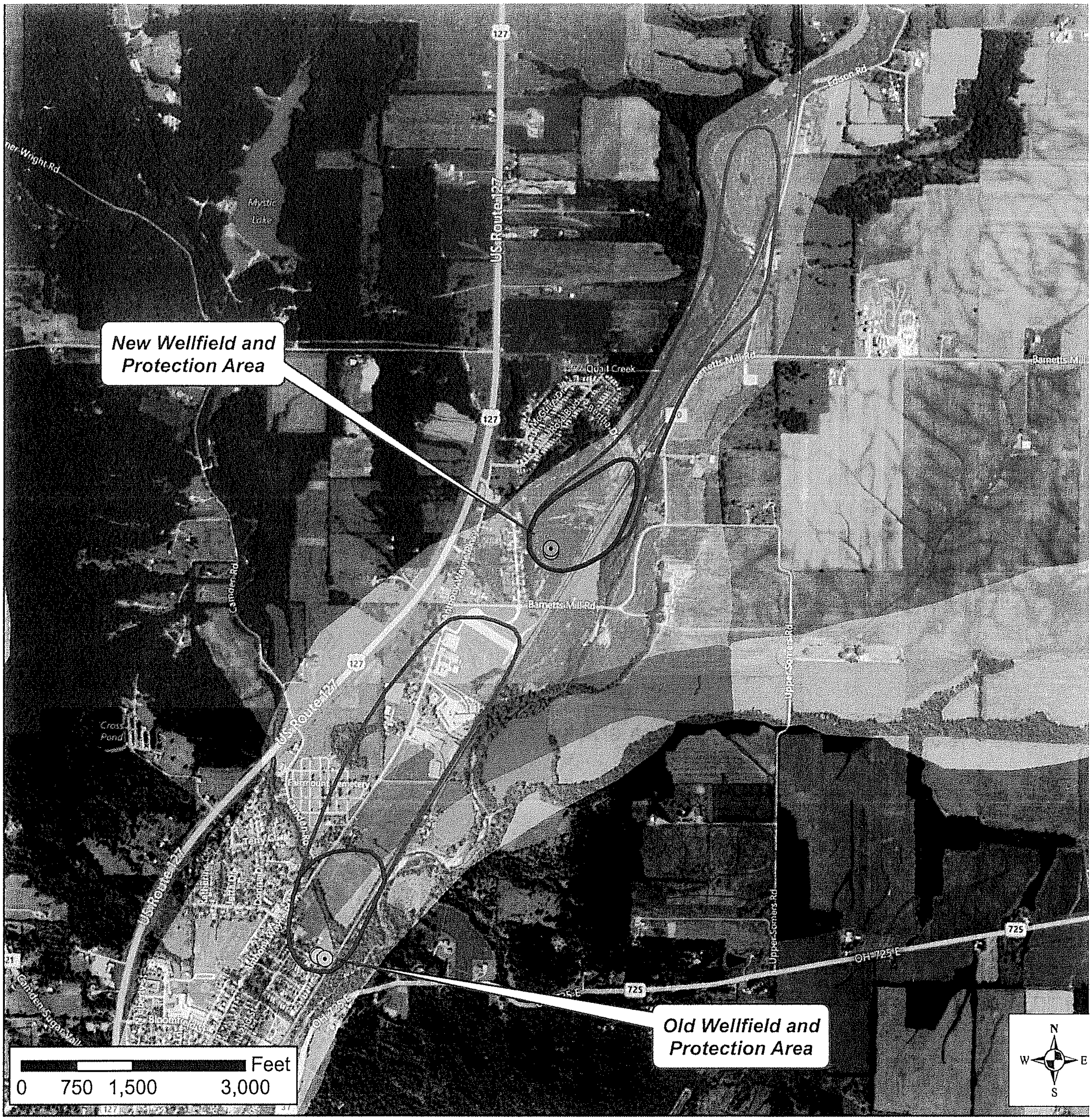
Number of Wells = 2
Total Well Pumping Rate = 254,000 GPD
Porosity = 20%
Aquifer Thickness = 15-20 feet
Hydrogeologic Setting = Seven Mile Creel Alluvial Aquifer
ODNR Well Log #'s = 2034880, 2034881

LOW | MODERATE | **HIGH**

SUSCEPTIBILITY

Environmental Protection Agen
Division of Drinking and Groun

May 2, 2012



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- Complex

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May 2, 2012

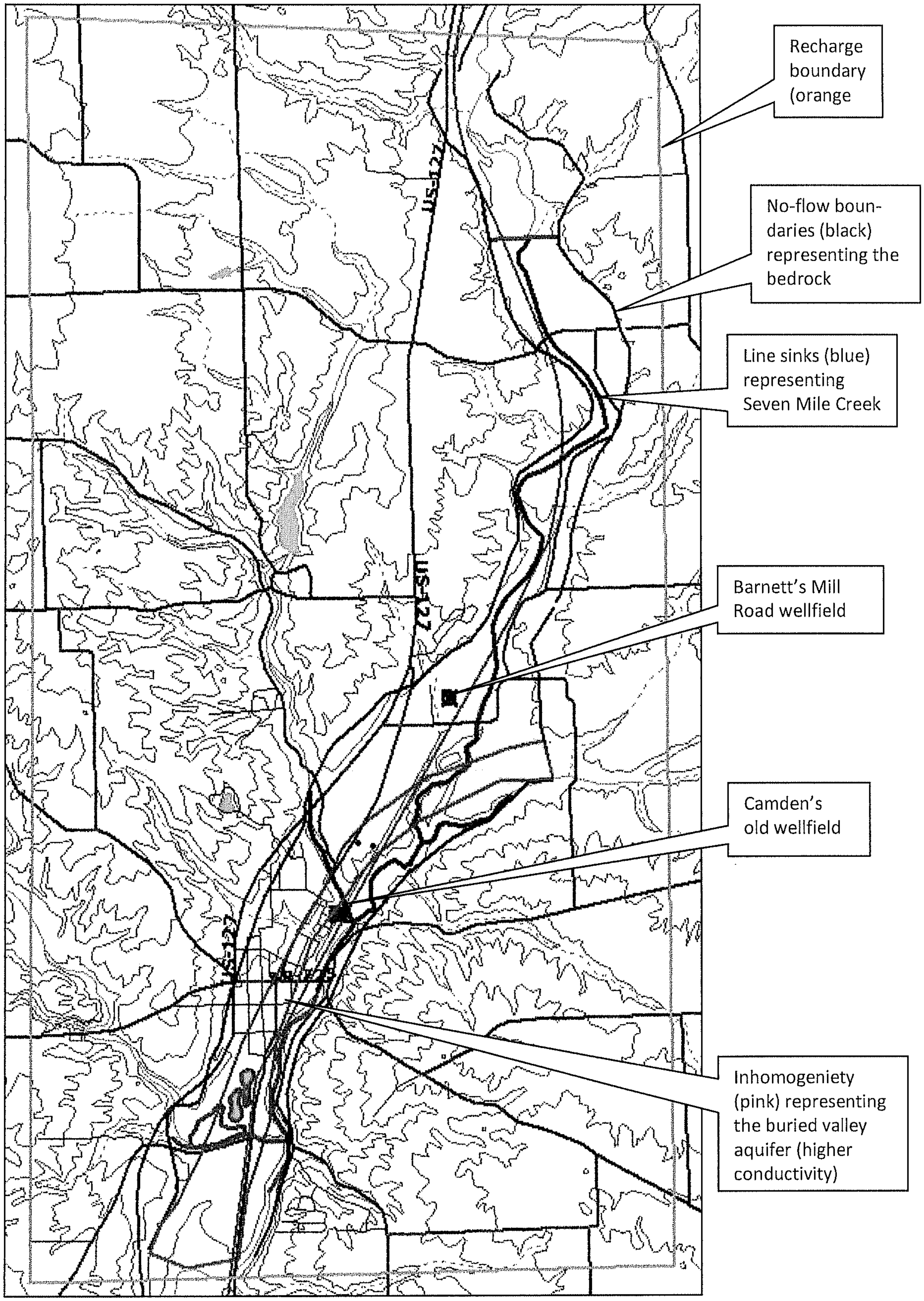
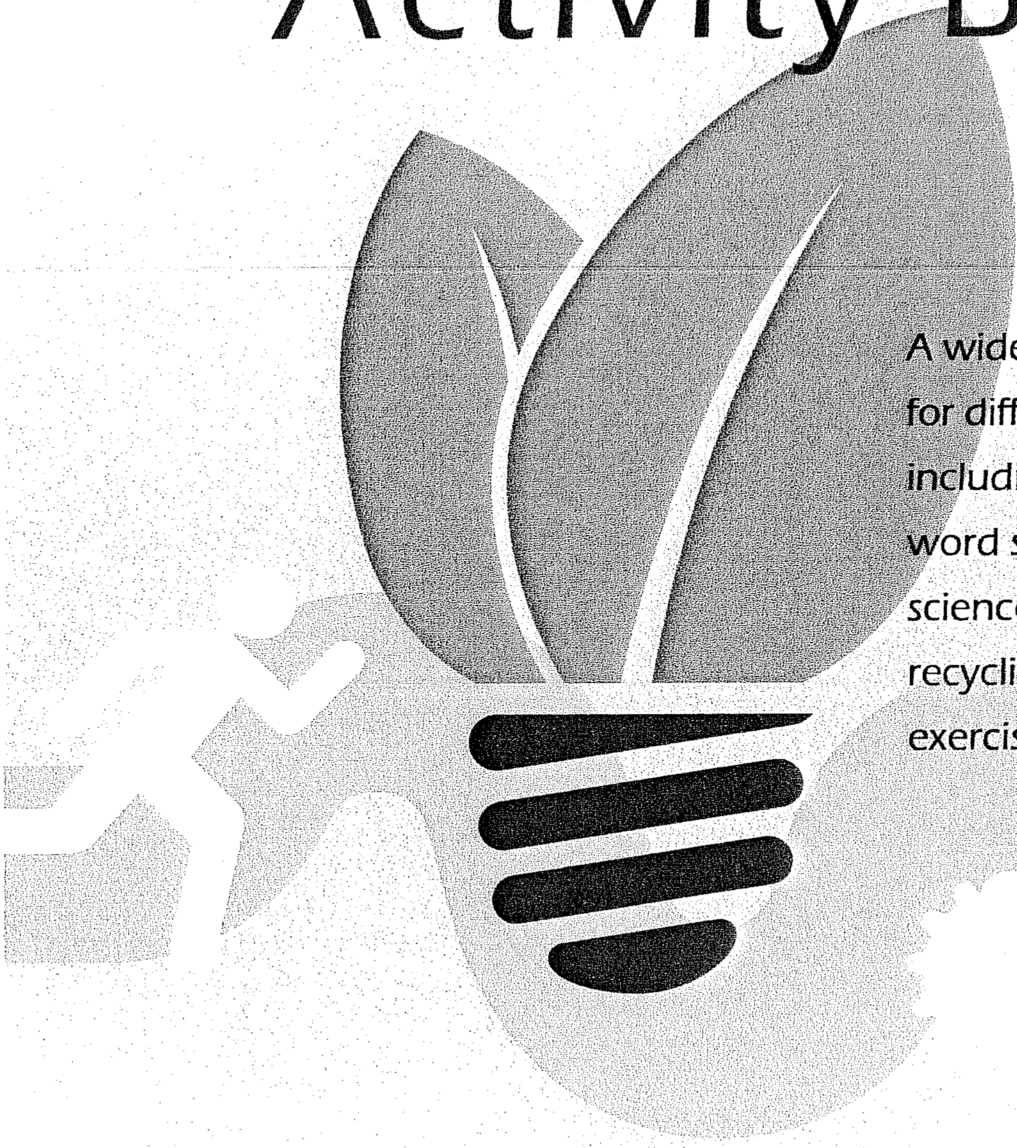


Figure 2. GFLOW model setup figure for the Village of Camden

Environmental Activity Book



A wide range of activities for different age groups, including a word search, word scramble, suggested science experiments, recycling symbol decoding exercise and water use quiz.

Ohio EPA

Answers on page 12

Environment and Energy Word Search

D	S	R	R	E	W	0	P	0	R	D	Y	H	H	M
L	S	C	L	S	L	H	0	Y	C	H	S	C	A	E
Z	0	A	R	I	W	L	0	H	T	N	F	I	C	T
L	K	0	0	U	Y	A	E	X	0	D	I	D	I	S
E	A	S	P	G	B	M	L	I	L	Q	S	I	D	Y
T	G	M	R	R	I	B	S	K	D	L	H	C	I	S
0	R	E	R	C	A	S	E	E	B	E	K	A	F	0
I	N	E	A	E	I	C	P	R	J	A	N	T	I	C
E	D	L	E	M	H	0	U	D	S	C	C	I	C	E
G	E	A	E	S	S	T	W	L	R	H	Q	Q	A	Z
A	A	0	G	I	M	W	0	N	S	I	S	F	T	R
I	A	C	T	0	S	T	C	E	S	N	I	R	I	U
W	V	I	B	U	F	F	E	R	G	G	W	0	0	P
P	0	L	L	U	T	I	0	N	R	Y	Y	G	N	I
N	C	A	R	S	D	N	I	W	D	V	T	S	U	F

Acidic
Carpool
Coal
Emissions
Fog
Hydropower
Leaching
Scrubbers
Trees
Acidification
Cars
Deposition
Energy
Frogs
Insects
Pollution
Snow
Walk
Buffer
Chemical
Ecosystem
Fish
Geothermal
Lake
Rain
Soil
Wind

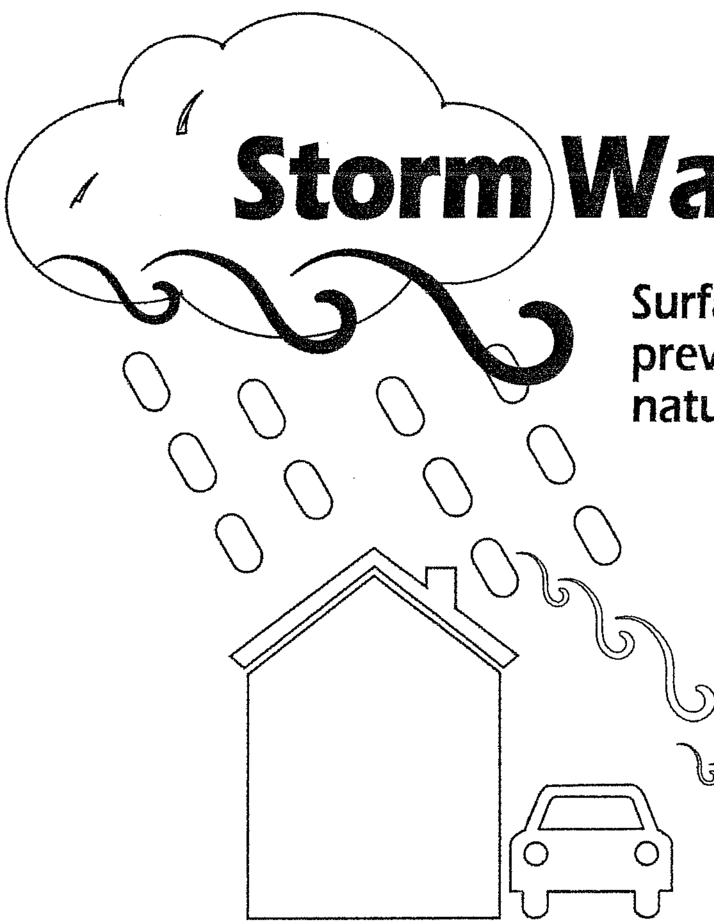
What About Our Water?

Most people in North America get their water from a public water utility. Public utilities are companies or government agencies that supply needs such as electricity, gas or water to the public. Water utilities get their water from rivers, lakes, reservoirs or underground aquifers. The water is treated to make it safe to drink.

Because we reuse the same water over and over, it can become polluted by people and industry. Even deep underground aquifers can be polluted from the surface. For example, many household items, such as car wax, spot remover or floor polish and other chemicals should not be poured down the drain or thrown out in the trash.

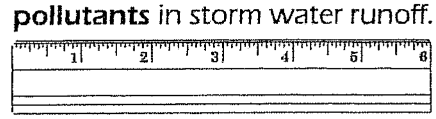
Even lawn chemicals and other garden products used outdoors may be toxic, and can contaminate water sources by running off the land into storm drains. That water can end up in lakes and rivers. Let's take care of our water resources. Use your "Blue Thumb" to conserve water, protect it and get involved.

Storm Water Runoff



Surfaces like driveways, sidewalks and streets **prevent storm water runoff from naturally soaking into the ground.**

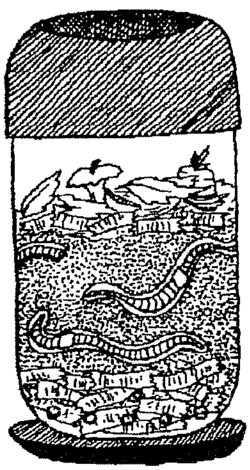
The first inch of rainfall is responsible for the **bulk of the pollutants** in storm water runoff.



Storm water can pick up **debris, chemicals and dirt.**

Never Underestimate the Power of a Worm!

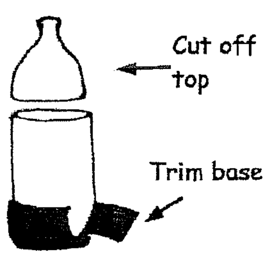
Worms play a major role in breaking down plant matter and creating fertile soil. Earthworms eat fallen leaves and other plant parts. Their droppings, or "castings," fertilize the soil. As they tunnel into the earth, they move leaves and other organic material downward, and bring deeper soil to the surface. This tunneling and mixing aerates the soil so that plant roots and water penetrate it more easily. Observe wonderful worm activity yourself by building a worm column!

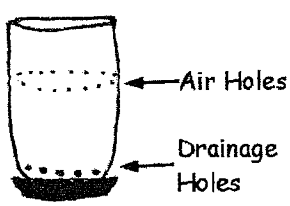


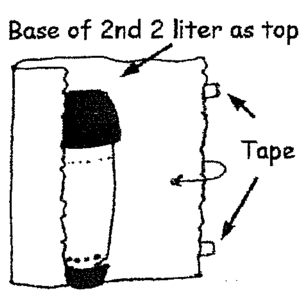
Materials:

- **Two 2 liter bottles**
- **One large paper bag or sheet of brown paper** for a screen
- **15-30 red composting worms.** These can be ordered from a variety of sites online.
- **Shredded newspaper** (cut 8 –10 pages into thin strips, cut strips in half)
- **Worm food**: organic leftovers from your kitchen, garden or yard (plant material, egg shells, coffee grounds).
- **Water**

Procedure:



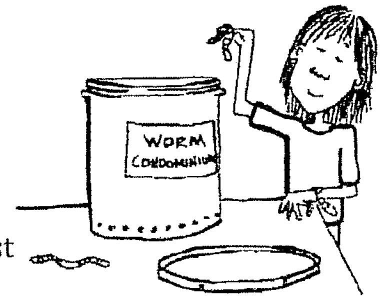




1. Remove the label from your two-liter bottle and cut the top off about 10 cm below the top. If your bottle has a base, cut the sides off for better viewing.
2. Ask your parents to help you poke at least four holes with a large hot nail. Poke low around the base of the bottle. Poke a row of air holes toward the top of the container using a smaller nail.
3. Cut the brown paper bag so it encircles the bottle and extends about 4 centimeters higher. Tape the paper around the column but leave it loose so you can easily pull it up. Worms prefer the dark, so leave the screen on the bottle unless you plan to observe the worms. Cut the bottom off the second two-liter bottle and use as a top to your worm column.
4. Fill the worm column (two-liter bottle) two-thirds full with shredded newspaper bedding. Add about a cup of water to the newspaper then fluff it until the paper strips are well separated. Make sure bedding is moist, but not saturated with water! Place worms on top of bedding. Add organic food, such as kitchen waste and leaves, to the column every 3 to 4 days. Worms feed by sucking or pumping material into their bodies, so the food should be moist and cut into small pieces.

After several months, you'll have a rich compost product that you can use in yor garden.

Ask your family to consider making a "worm condo" out of a five-gallon bucket, which can support a larger worm colony and can compost all of your family's organic kitchen wastes!



SOURCE: OSU Extension

Aquifer in a Cup (Aquifer on the Go)

Background

Many communities obtain their drinking water from underground sources called aquifers. Water suppliers or utility officials drill wells through soil and rock into aquifers for the ground water contained therein to supply the public with drinking water. Homeowners who cannot obtain their drinking water from a public water supply will have their own private wells drilled on their property to tap this supply. Unfortunately, ground water can become contaminated by harmful chemicals such as lawn care products and household cleaners that were used or disposed of improperly after use or any number of other pollutants. These chemicals can enter the soil and rock, polluting the aquifer and eventually the well. Such contamination can pose a significant threat to human health. The measures that must be taken by well owners and water plant operators to either protect or clean up contaminated aquifers are quite costly.

NOTE: This demonstration should follow a class discussion on potential sources of pollution to drinking water supplies.

Objective

To illustrate how water is stored in an aquifer, how ground water can become contaminated, and how this contamination ends up in a drinking water source. Ultimately, students should get a clear understanding of how careless use and disposal of harmful contaminants above the ground can potentially end up in the drinking water below the ground. This particular experiment can be done by each student at their work station.

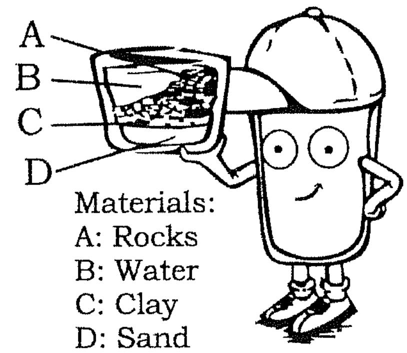
Materials Needed Per Student

- **One clear, plastic cup** that is 2 3/4" deep by 3 1/4" wide for each student.
- **One piece of modeling clay or floral clay** that will allow a 2" flat pancake to be made by each student for their cup.
- **White play sand** that will measure 1/4" in the bottom of each student's cup.
- **Aquarium gravel** (natural color if possible) or small pebbles (approximately ½ cup per student.) (Hint: As many small rocks may have a powdery residue on them, you may wish to rinse them and dry on a clean towel prior to use. It is best if they do not add cloudiness to water.)
- **Red food coloring**
- **1 bucket of clean** water and **small cup** to dip water from bucket

continued on next page

Aquifer in a Cup (continued)

Procedure



1. Pour 1/4" of white sand in the bottom of each cup completely covering the bottom of the container. Pour water into the sand, wetting it completely (there should be no standing water on top of sand). Let students see how the water is absorbed in the sand, but remains around the sand particles as it is stored in the ground and ultimately forming part of the aquifer.

2. Have each student flatten the modeling clay (like a pancake) and cover 1/2 of the sand with the clay (have each student press the clay to one side of the container to seal off that side).

   The clay represents a "confining layer" that keeps water from passing through it. Pour a small amount of water onto the clay. Let the students see how the water remains on top of the clay, only flowing into the sand below in areas not covered by the clay.

3. Use the aquarium rocks to form the next layer of earth. Place the rocks over the sand and clay, covering the entire container. To one side of your cup, have students slope the rocks, forming a high hill and a valley (see illustration). Explain to students that these layers represent some of the many layers contained in the earth's surface. Now pour water into your aquifer until the water in the valley is even with your hill. Students will see the water stored around the rocks. Explain that these rocks are porous, allowing storage of water within the pores and openings between them. They will also notice a "surface" supply of water (a small lake) has formed. This will give them a view of both the ground and surface water supplies which can be used for drinking water purposes.

4. Use the food coloring and put a few drops on top of the rock hill as close to the inside wall of the cup as possible. Explain to students that often old wells are used to dispose of farm chemicals, trash and used motor oils and other activities above their aquifer can end up in their drinking water. They will see that the color spreads not only through the rocks, but also to the surface water and into the white sand at the bottom of their cup. This is one way pollution can spread throughout the aquifer over time.

Follow-up:

Discuss with students other activities that could pollute their aquifer. Assign students the task of locating activities around the school or their own homes that could pollute their drinking water sources if not properly maintained. Allow students to drain off the water in their cups and carry home their container to refill with water and show their parents surface and ground water and how the food coloring illustrates pollution activity above their aquifer can affect all water. Students should discuss with parents what steps they can take as a household to prevent water pollution.

SOURCE: U.S. EPA, Office of Water, www.epa.gov/safewater

Answers on page 12

Water Word Scramble

Unscramble the words to learn some interesting facts about water.

1. Every ngivli thing needs water to live. ________________
2. The average American uses about 50 oslgaln of water each day for personal use. ________________
3. Only one percent of the water on rteha is fresh water that is available for drinking or other uses. ________________
4. If water is too polluted, it might not be safe to eat the hsif you catch or to wsmi in the water. ____________
5. An eqrifau is an underground area of water that collects between spaces in rocks. ________________
6. A lewl is a deep hole dug or drilled below the ground surface into an aquifer to get water. ________________
7. tolatunPls can seep through the soil and make ground water unsafe to drink. ________________
8. Water treatment plants can remove pollutants from water so it is asfe to drink. ________________
9. Drinking water can come from grduon or usrfaec water. ____________ ____________
10. fnuoRf is water that naturally flows off the land, sometimes forming streams. ________________
11. Soil and other pollutants are often draeopsrtnt to streams as storm water runs off the ground. ________________
12. It is everyone's pesrobsiniltiy to help prevent water pollution. ________________
13. Many communities get their drinking water from underground sources called an qfiuaer. ________________
14. Cleaning pollution from aquifers is ycsolt. ________________

Write down three things you or your family can do to help prevent water pollution.

1. ____
2. ____
3. ____

Answers on page 12

Is it Safe to Play Outdoors Today?

Sometimes, especially during the summer, the air is harder to breathe because of pollution. Scientists measure the quality of the air with the Air Quality Index (AQI). On days that the air quality is bad, people with asthma or other breathing problems should try to stay inside. Once you know what the colors mean, you can use the AQI to help decide if you should play indoors or out. Look for the AQI in the newspaper, on the weather forecast or ask a grown-up to sign up for daily e-mail alerts at www.enviroflash.info.

Color the rectangles and then draw a line from the AQI word(s) on the left side to the correct color on the right.

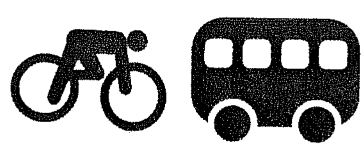
1. Unhealthy
2. Moderate
3. Very Unhealthy
4. Hazardous
5. Unhealthy for Sensitive Groups
6. Good

Green
Yellow
Orange
Red
Purple
Maroon

Motor vehicles are the **primary source of smog** and account for almost **50% our air pollution.**

Avoid unnecessary driving: The most effective way to **save fuel and reduce emissions** from your vehicle is to use it less.

Alternatives include



consolidating trips, telecommuting, carpooling, using public transit and biking or walking.

Answers on page 12

Decoding the Recycling Symbol

You have probably seen the recycling symbol on plastic containers around your house. But, do you know what the different numbers mean? They help people to know what type of plastic the container is made of and whether it can be recycled with other household items or if it needs to be taken to a special facility. See if you can match up the symbols below with the correct item. You may want to look around your house for help.

1 This is polyethylene terephtalate, also known as PETE or PET. It is generally clear. This plastic is picked up by most curbside recycling programs.

2 This is high density polyethylene, or HDPE. It is usually opaque (cloudy). It is also picked up by most curbside recycling programs.

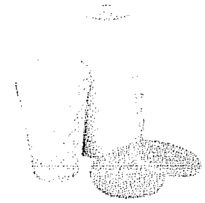
3 This is polyvinyl chloride, also known as PVC. PVC is a tough plastic. It is rarely accepted by recycling programs.

4 This is low-density polyethylene (LDPE). This plastic is considered safe, but is unfortunately not often accepted by curbside recycling programs. It is typically clear, thin and flexible.

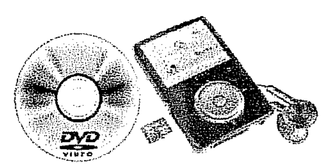
5 This is polypropylene. This plastic is also considered safe, and is increasingly being accepted by curbside recycling programs. It is hard plastic used in food containers and textiles.

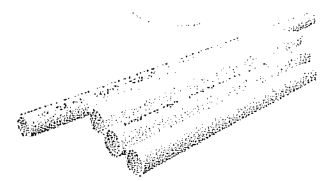
6 This is polystyrene, or Stryofoam. It is difficult to recycle and most recycling programs won't accept it.

7 This number basically means "everything else." It includes polycarbonate and BPA, which are not safe for use as food or drink containers. It is difficult to recycle and most curbside recycling programs won't accept it.





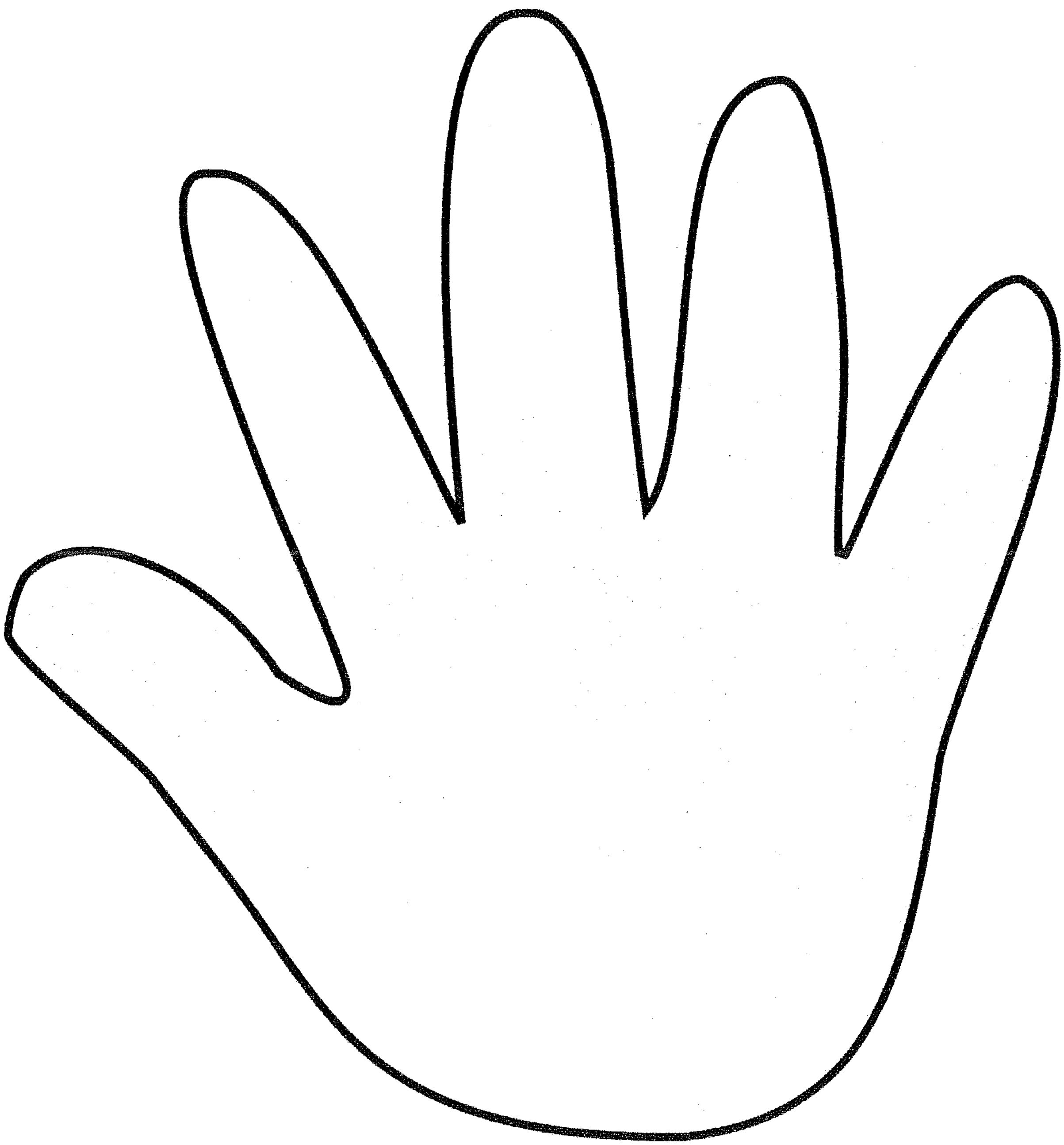



Give a Hand to Mother Earth

Everyone likes a compliment. Mother Earth likes to be appreciated also. One way we pay a compliment to Mother Earth is by taking care of her.

On each finger, write one thing you can do to take care of Mother Earth.



Answers on page 12

Down the Drain: How Much Water Do You Use?

Most of us don't think about how much water we use on a daily basis. Using the numbers on the right, fill in the blank to guess how many gallons of water you think you would use for the following. It may be helpful to picture a gallon of milk in your mind to help you see how much water is in a gallon.

A Wash your hands? ________

B Brush your teeth ________ (with the water running)?

C Brush your teeth ________ (with the water turned off)?

D Take a shower? ________

E Take a bath? ________

F Flush the toilet? ________

G Get a drink? ________

H Wash the dishes by hand? ________

I Water the lawn? ________

J Wash the car? ________

1 15-30 gallons

2 0.5 gallons

3 40 gallons

4 1 gallon

5 10 gallons

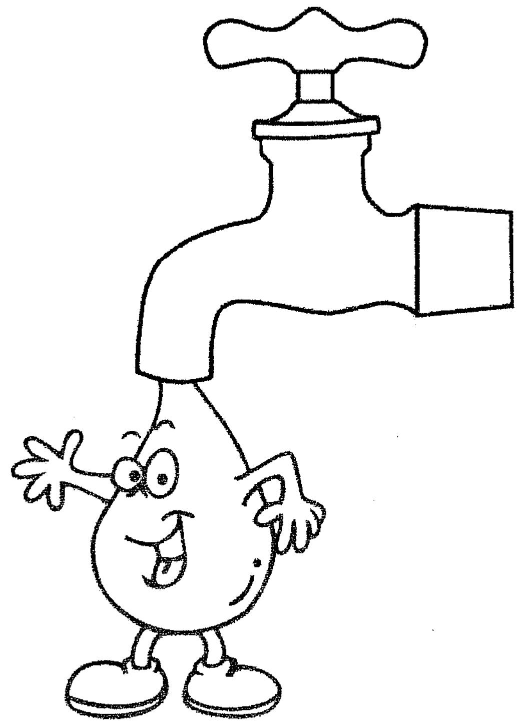
6 50 gallons

7 1 gallon

8 180 gallons

9 0.25 gallons

10 4-7 gallons



Here are some other interesting water usage facts.

To process one can of fruit or vegetables – 9.3 gallons

To manufacture a new car and its four tires – 39,090 gallons

To produce one ton of steel – 62,600 gallons

Answer Key

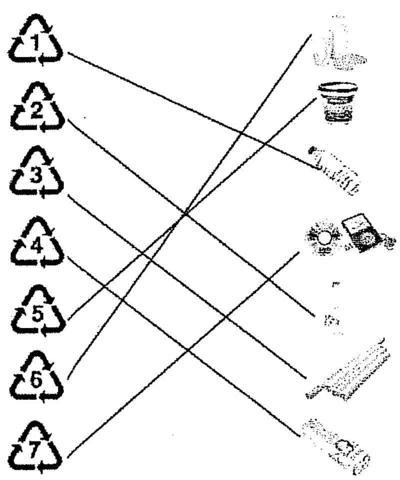
Environment and Energy Word Search
page 2

D	S	R	R	E	W	O	P	O	R	D	Y	H	H	M
L	S	C	L	S	L	H	O	Y	C	H	S	C	A	E
Z	O	A	R	I	W	L	O	H	T	N	F	I	C	T
L	K	O	O	U	Y	A	E	X	O	D	I	D	I	S
E	A	S	P	G	B	M	L	I	L	Q	S	I	D	Y
T	G	M	R	R	I	B	S	K	D	L	H	C	I	S
O	R	E	R	C	A	S	E	E	B	E	K	A	F	O
I	N	E	A	E	I	C	P	R	J	A	N	T	I	C
E	D	L	E	M	H	O	U	D	S	C	C	I	C	E
G	E	A	E	S	S	T	W	L	R	H	Q	Q	A	Z
A	A	O	G	I	M	W	O	N	S	I	S	F	T	R
I	A	C	T	O	S	T	C	E	S	N	I	R	I	U
W	V	I	B	U	F	F	E	R	G	G	W	O	O	P
P	O	L	L	U	T	I	O	N	R	Y	Y	G	N	I
N	C	A	R	S	D	N	I	W	D	V	T	S	U	F

Water Word Scramble
page 7

1. living
2. gallons
3. earth
4. swim
5. aquifer
6. well
7. pollutants
8. safe
9. ground, surface
10. runoff
11. transported
12. responsibility
13. aquifer
14. costly

Decoding the Recycling Symbol
page 9



Is it Safe to Play Outdoors Today?
page 8

1. Unhealthy - red
2. Moderate - yellow
3. Very unhealthy - purple
4. Good - green
5. Unhealthy for sensitive groups - orange
6. Hazardous - maroon

Down the Drain: How Much Water Do You Use?
page 11

A. 1 gallon
B. 1 gallon
C. 0.25 gallons
D. 15-30 gallons
E. 40 gallons
F. 4-7 gallons
G. 0.5 gallons
H. 10 gallons
I. 180 gallons
J. 50 gallons