Report of Joel W. Hennessy

U.S. EPA Region III
1650 Arch Street
Philadelphia, PA 19103

April 5, 2021

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I. Purpose and Background

This report presents my opinions regarding the relative sensitivity of the environment to potential petroleum leaks or releases from the Easton Point fuel station in Talbot County, located at 930 Port Street, Easton, Maryland (Figure 1). These opinions are based on hydrogeologic factors which control how petroleum hydrocarbons move through soil, contaminate groundwater resources, and move in the groundwater to human receptors. This report summarizes my evaluation of the various hydrologic factors and the use of groundwater around the Underground Storage Tank (UST) site.

a. Potential Effects of Releases from Underground Storage Tank Facilities

Petroleum hydrocarbons (including gasoline, diesel, and kerosene) may contaminate soil and groundwater if released to the subsurface via leakage from tanks or piping, or from spillage at the surface from overfills or other accidents. Petroleum can migrate downward by gravity through pore spaces between the soil particles until it reaches the groundwater table, the surface at which the pore spaces are saturated with water. Petroleum has low solubility and a density less than water, and may therefore form a separate phase which floats on the water table. This floating separate phase layer may be called a free product layer or Light Non-Aqueous Phase Liquid (LNAPL). LNAPL on the water table can migrate laterally away from the original source of the release and accumulate in wells or discharge to surface water forming a visible sheen. Some of the chemical constituents of petroleum can dissolve into groundwater, forming what is called a dissolved-phase plume of groundwater contamination. Some of the more common constituents of gasoline which can dissolve into the groundwater include benzene, toluene, ethylbenzene, and xylene (collectively referred to as BTEX), and methyl tertiary butyl ether (MTBE). These substances are in a class of chemical compounds known as volatile organic compounds (VOCs). Groundwater flows in aquifers from areas of higher groundwater elevation or pressure head to areas of lower groundwater elevation or pressure head. Contamination dissolved within groundwater will also migrate as the groundwater flows. In this way, petroleum-contaminated groundwater and LNAPL can flow to wells, springs, and surface water streams where human and/or ecological receptors can be exposed to the contamination.

In addition to direct exposure to contaminated groundwater, exposure to gasoline vapors can also occur. VOCs in gasoline released to the subsurface can vaporize and migrate in the vapor phase into overlying and nearby buildings, such as homes or businesses, and expose humans via inhalation or create a risk of explosion. Vapor transport in the subsurface can occur through permeable soils or along preferential pathways, such as permeable backfill placed around buried utility lines (gas, electric, water, phone, cable, storm or sanitary sewer), underground tanks, and piping from tanks to dispensers. Vapors can also be transported within a utility line itself. For example, if petroleum hydrocarbon liquid, contaminated groundwater, or vapors enter a sanitary sewer, the vapors could migrate quickly inside the sewer and into the buildings connected to it. In addition, native soils are often excavated and replaced or supplemented with backfill during construction of buildings and roads, or during the installation of utility lines and sewers. Soil which is excavated and replaced may have higher permeability and thus a greater ability to transport contamination than undisturbed soil. This occurs because the original layered soil structure is disrupted and the orientation of individual soil particles is disturbed, increasing both porosity (the void space between soil particles) and permeability (the ease with which liquid or vapor can migrate through the soil). Older urban areas with high building and population density may have had multiple episodes of construction and/or utility trenching and thus may have a greater likelihood of rapid subsurface vapor transport to inhabited living space than less developed areas.

Exposure to vapor is also a concern wherever dissolved-phase plumes of VOCs exist in groundwater, particularly where shallow contaminated groundwater lies beneath occupied buildings. VOCs will vaporize and contaminate the air (soil gas) in the unsaturated zone above the water table. Indoor air space in overlying buildings can then become contaminated as a result of the stack effect. The stack effect occurs because heated air in the home tends to rise, and creates a lower pressure in the home which can draw in soil gas through cracks or other openings in building foundations. In general, the shallower the contaminated groundwater and the more permeable the soil, the greater the potential for unacceptable exposure to vapor-phase contamination in indoor air.

Releases of petroleum hydrocarbons to the subsurface can also present exposure to workers installing or maintaining subsurface utilities, or create a potential impact to the utility line itself. These potential exposures and impacts require appropriate evaluation and management.

b. Groundwater Resources in Maryland

The United States has been divided into 15 geographic groundwater regions defined by the U.S. Geological Survey (USGS Water Supply Paper 2242, 1984). These regions represent areas of roughly similar hydrogeologic characteristics and water use patterns. The UST site evaluated in this report lies within the Atlantic and Gulf Coastal Plain groundwater region. Within Maryland, this region is referred to as the Maryland Coastal Plain aquifer system (Maryland Department of Natural Resources Open-File Report No. 12-02-20).

In general, surficial aquifers in the Atlantic and Gulf Coastal Plain groundwater region have shallow depth to water and permeable soils. Based on these factors, shallow groundwater within the Coastal Plain groundwater region is very vulnerable to pollution (EPA Publication Number: 600/2-87/035, DRASTIC, June, 1987).

c. Use of Groundwater in Maryland and Talbot County

Based on water use data collected by USGS, in 2015 about 39% of the population of Maryland relied on groundwater for their source of water (2,330,643 out of a total population of 6,006,401). Within Talbot County, 100% of the population relies on groundwater, either from their own private water supply well or from a public supply which comes from a groundwater source. Slightly more than half of the population (19,803) relies on private wells for domestic water supply while the remainder (17,709) obtain their water from public supply wells (USGS Estimated Use of Water in the United States County-Level Data for 2015).

II. Rating a Site for Environmental Sensitivity

There are a number of factors which impact the overall environmental sensitivity of an individual site to releases of petroleum hydrocarbons. The remainder of this report describes and rates the Easton Point site based on (1) groundwater use, (2) likelihood that a release would contaminate groundwater and surface water.

a. Groundwater Use Rating

This factor evaluates whether and to what extent groundwater is used as a water supply. The greater the use of the groundwater, the greater the potential human health or economic impact if groundwater becomes contaminated. Human health impacts can occur when drinking water wells become contaminated. Economic impacts can occur when a contaminated groundwater resource must be treated prior to use or an alternative water supply must be obtained. Areas where groundwater is the only source of water and no public water supplies are available, or where the public water supply comes from groundwater, would be the most impacted.

i. Basis for the Groundwater Use Rating

For the purpose of this report, information from the 1990 U.S. Census, EPA's Safe Drinking Water Information System (SDWIS), and a subsurface investigation report for an adjacent site was used to evaluate groundwater use in areas around the Easton Point site. Figures 1 through 3 present United States Geologic Survey (USGS) topographic map, 1990 Census data for private well use, and an overlay of well locations identified in the subsurface investigation for the adjacent site.

ii. Private Drinking Water Wells

For private use of groundwater, information on source of water was available at the census block group level from the 1990 Census (information on private well use was not collected in either the 2000 Census or the 2010 Census). For this assessment, I first identified all of the census block groups which lie within or intersect a 1/4 mile radius around the site. Then, the number of census block groups which contain private wells was determined. For each block group with wells, the number of wells and the number of housing units were identified to determine the percentage of housing units with private wells within the block group (see discussion in paragraph II.a.v., below)

These results were used to determine a groundwater use rating on a five point scale, with a value of one having the least priority and the value of five having the greatest priority. The priority rating values were determined as follows: If no private wells existed within a 1/4 mile radius, the site was given a value of 1. If private wells existed in any of the census blocks which intersected the 1/4 mile radius, and those census blocks appeared to be down gradient (in the direction of groundwater flow) from the site, the resource priority rating was 2, 3, 4, or 5, based on the percentage of use as follows: 0 to 25 % = 2; 25 to 50 % = 3; 50 to 75 % = 4; 75 to 100 % = 5. The rationale for the sliding value scale, rather than stating that any groundwater use represents high priority, is that if public water is available (as would be for those sites where most houses are connected to public water), then the exposure to contaminated groundwater can be more easily mitigated by connecting to public water than in areas where most of the houses have private wells. However, if the public water supply is provided by groundwater wells within a ½ mile radius of the site, the use rating would be elevated to a value of 5 regardless of private well use (although that situation was not present for the Easton Point site).

iii. Public Water Supply Wells

For public water supply wells, I looked for the existence of any community water supply as reported in EPA's Safe Drinking Water Information System (SDWIS) database that listed groundwater as the primary source of water. Because no community water supply well existed within a ½ mile radius of the Easton Point site, the groundwater use rating is only based on private well use.

iv. Groundwater Flow Direction

If the 1/4 mile radius around the UST site intersected multiple census block groups, I reviewed a topographic map of the area around the site for indications of likely groundwater flow direction. I then based the groundwater use rating from the use percentage of the down gradient census block groups, and ignored those census block groups that are up gradient or otherwise unable to be impacted by releases via groundwater from the site.

v. Summary of Groundwater Use Rating for Easton Point Site

For the Easton Point site, the quarter mile radius intersects four census block groups (Figure 2). The block group where the site is located has no housing units with wells (0% well use for the 1990 Census). However, information available from a groundwater investigation adjacent to the site (Figure 3) indicates that a water supply well does exist within the census block group, so I assigned that block group a rating of 2 rather than 1. The block group north of the site indicates 2% of housing units have wells. The block groups west and south of the site have higher well use (97.5% and 96.6%), but, as shown in Figures 1 and 2, these are across the river, so could not be impacted by groundwater from under the site (groundwater would discharge to surface water, preventing it from impacting the groundwater in either of those two block groups). I therefore only based the overall groundwater use rating on the two block groups on the east side of the river. Both of those block groups had a rating of 2, so the overall groundwater use rating for the site was 2. Table 1 provides a summary of the well use data and groundwater use rating for the site.

b. Likelihood that a Release Would Contaminate Groundwater or Surface Water Rating

This factor evaluates the ease with which groundwater can become contaminated if a release occurs above the water table. It does not consider whether anyone is using the groundwater. In some areas of the country, groundwater is very shallow and can become contaminated easily. In other areas, groundwater is very deep, or beneath relatively impermeable soil, and contamination is less likely to reach groundwater. For this assessment, depth to groundwater and soil type were combined to establish a single rating for the site. The assessment presented in this report is similar to established relative rating systems for evaluating the potential for groundwater to become contaminated based on hydrogeologic factors (EPA Publication Number: 600/2-87/035, DRASTIC, June, 1987).

i. Basis for the Likelihood that a Release Would Contaminate Groundwater or Surface Water Rating

Depth to groundwater and soil type are the two controlling factors considered in this evaluation. However, if there was information indicating that releases from the site had already caused soil, groundwater, or surface water contamination, the site would be given the highest rating (i.e., highest likelihood that a release would contaminate groundwater or surface water). In general, the shallower the depth to groundwater, the more likely that releases would migrate to and contaminate the groundwater. Furthermore, when the soil type is made up of permeable coarse-grained material, such as sand, the easier it is for a release to migrate downward and reach the groundwater. Finer grained soil, such as a clay, is less permeable and serves to restrict downward migration of the release. In addition, if a site is located close to a surface water body, a release could cause surface water contamination when the groundwater or petroleum hydrocarbons discharge to surface water.

ii. Depth to Groundwater

Depth to groundwater data was obtained or estimated for the site based on depth to groundwater measurements for monitoring wells installed for the adjacent McMahan Bulk Fuel Terminal investigation (Miller Environmental, 2007). Figure 3 shows the proximity of McMahan Bulk Fuel Terminal to Easton Point fuel station.

Values were assigned based on depth ranges as follows:

0 - 15 ft	5
15 - 30 ft	4
30-50 ft	3
50-75 ft	2
> 75 ft	1

iii. Soil Type

Soil type was based on boring logs for monitoring wells installed for the adjacent McMahan Bulk Fuel Terminal investigation.

Values were assigned for soil type as follows:

Sand or Loamy Sand (or coarser grained material)	5
Sandy Loam or Loam	4
Sandy Clay Loam, Silt Loam, or Silt	3
Sandy Clay or Clay Loam or Silty Clay Loam	2
Clay or Silty Clay	1

iv. Evidence of a Release Causing Groundwater or Surface Water Contamination

The Subsurface Investigation Report (October 19, 2007) for the McMahan Bulk Fuel Terminal adjacent to the Easton Point fuel station, found soil and groundwater contamination as a result of leakage from an underground fuel transfer line. Six monitoring wells were installed, from 6 to 10 foot depth as part of the investigation. All groundwater samples from those wells detected petroleum hydrocarbons, as did the water supply well for that site (sampled from a tap within the building). In addition, the release also migrated to surface water causing a visible sheen on the adjacent river.

v. Summary of Likelihood that a Release Would Contaminate Groundwater or Surface Water Rating for Easton Point Site

Depth to groundwater at the adjacent site was generally less than 3 feet. Soil types at the adjacent site in the upper 10 feet ranged from clay to sand, with sand being most represented at the water table. A petroleum release at the adjacent site caused contamination of the groundwater and adjacent surface water. The overall likelihood rating, considering depth to groundwater, soil type, and evidence of release causing groundwater and surface water contamination was 5. Table 2 provides a summary of the depth to groundwater, soil type data, and Likelihood Rating for the site.

III. TABLES

Table 1. Groundwater Use Rating
Table 2. Likelihood that a Release Would Contaminate Groundwater or Surface Water

IV. FIGURES

Figure 1. Topographic Map, Easton Point Site
Figure 2. 1990 Census Private Well Use, Easton Point Site
Figure 3. Adjacent Site Subsurface Investigation Area

V. Reference Materials

Information from Databases accessed through EPA Region III ArcGIS

1990 Census block group data

Safe Drinking Water Information System (SDWIS)

Other References

DRASTIC: A Standardized System for Evaluating Ground Water Pollution Potential Using Hydrogeologic Settings, EPA Number: 600/2-87/035, June, 1987
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Maryland Coastal Plain Aquifer Information System: Hydrogeologic Framework, Maryland Department of Natural Resources Open File Report No. 12-02-20, 2013, available at:
http://www.mgs.md.gov/reports/OFR_12-02-20.pdf

Subsurface Investigation Report, McMahan Bulk Fuel Terminal, 930 Port Street, Easton MD, prepared by Miller Environmental Inc., October 19, 2007

U.S. EPA Penalty Guidance for Violations of UST Regulations, OSWER Directive 9610.12, November 1990, available at: https://www.epa.gov/sites/production/files/2014-02/documents/d9610.12.pdf

TABLES

Table 1. Groundwater Use Rating

Site Address	Number of census block groups which intersect 1/4 mile radius from site	Number of census block groups with private wells	ID Number of census block group	Private well information by block group			Comments (other factors, such as likely groundwater flow direction, community water supply wells within ½ mile, etc.)	Overall ground water use rating[1] (lowest use rating = 1, highest use rating = 5)
				number of wells in block group	number of housing units in block group	percentage of housing units with wells (and use rating)		
Easton Point 930 Port Street Easton, MD	4	3	17867	0	324	0% (2*)	No public wells within ½ mile. Block groups 17869 and 18000 are located across river, unable to be impacted via groundwater release from the UST site. *Block group 17867 does have a water supply well at the former McMahan Bulk Oil Terminal located adjacent to the Easton Point site, as indicated in the Subsurface Investigation Report dated October 19, 2007, so that block group was assigned a rating of 2 rather than 1.	2
			17793	22	1080	2% (2)		
			17869	311	319	97.5% (5)		
			18000	599	620	96.6% (5)		

[1] The groundwater use rating is on a five-point scale, with a value of 1 having the least priority and the value of 5 having the greatest priority. The priority rating values are determined as follows: If no private wells exist within a census block group, the block group is given a value of 1. If private wells exist within a census block group, the block group is given a value of 2, 3, 4, or 5, based on the percentage of use as follows: 0 to 25 % = 2; 25 to 50 % = 3; 50 to 75 % = 4; 75 to 100 % = 5. If there are multiple block groups within a ¼ mile radius of the site, block groups that cannot be impacted by a release to groundwater will not be included in the overall use rating.

Table 2. Likelihood that Release would Contaminate Groundwater and Surface Water

Site Name and Address	Depth to groundwater[1]	Depth to ground water rating[2]	Soil type	Soil type rating[3]	Comments	Likelihood that release would contaminate groundwater and surface water (lowest = 1, highest = 5)
Easton Point 930 Port Street Easton, MD	3 feet	5	Mostly sand, but ranges from clay to sand, with occasional gravel and cobbles.	5	Depth to groundwater and soil type based on adjacent site data reported in Subsurface Investigation Report, McMahan Bulk Fuel Terminal, 930 Port Street, Easton, MD (October 19, 2007). That report also indicated groundwater had been contaminated by petroleum hydrocarbons released from an underground transfer line. In addition, the release also migrated to surface water causing a visible sheen on the adjacent river.	5

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[1] Depth to groundwater data was based on depth to groundwater measurements from monitoring wells at adjacent site

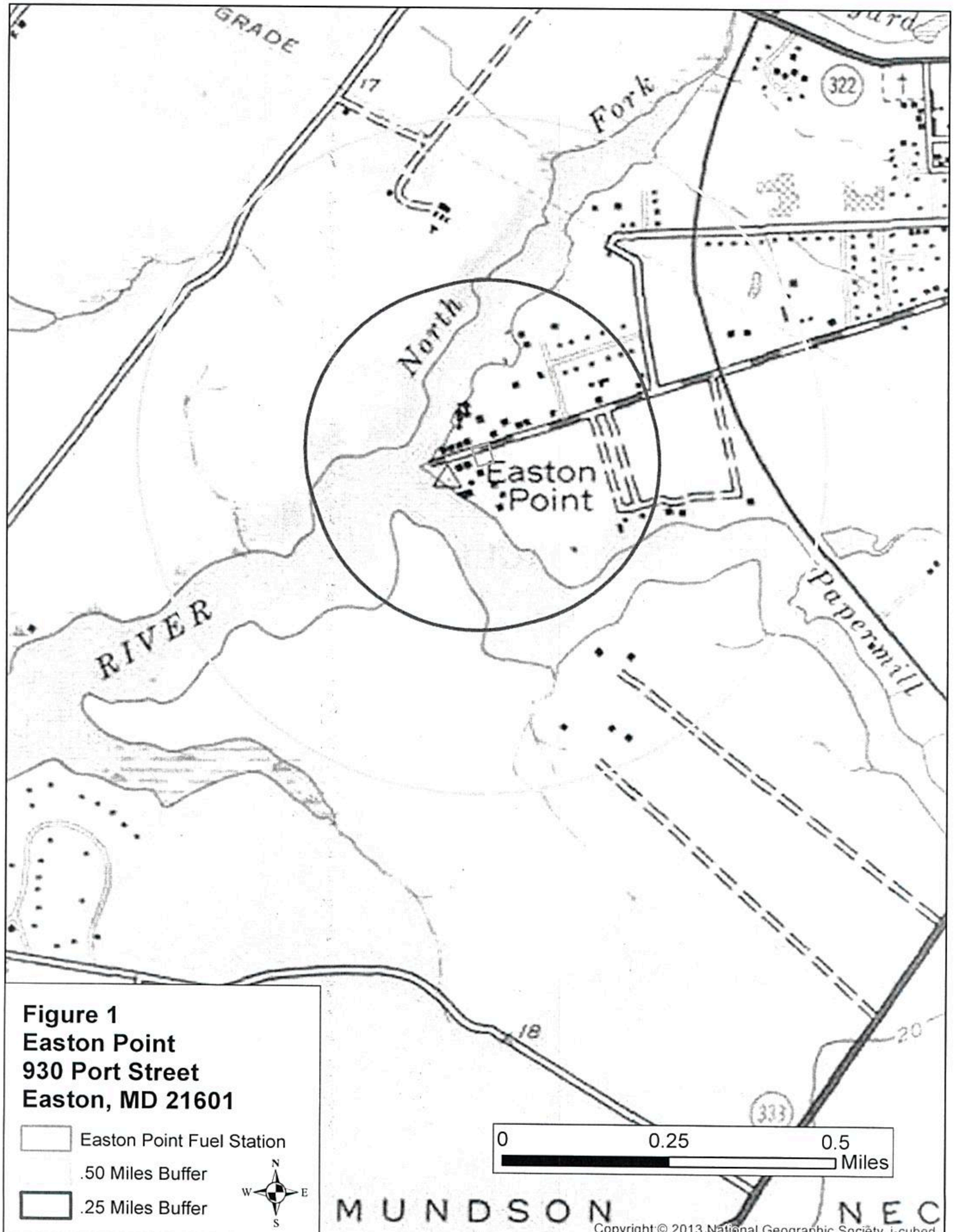
[2] Depth to groundwater rating values were assigned based on depth ranges as follows:

0 - 15 ft	5
15 - 30 ft	4
30-50 ft	3
50-75 ft	2
> 75 ft	1

[3] Values were assigned for soil type rating as follows:

Sand or Loamy Sand (or coarser grained material)	5
Sandy Loam or Loam	4
Sandy Clay Loam, Silt Loam, or Silt	3
Sandy Clay or Clay Loam or Silty Clay Loam	2
Clay or Silty Clay	1

FIGURES


GRADE
17
Fork
322
North
Easton
Point
RIVER
Papermill
18
20
333
MUNDSON
NEC
Figure 1
Easton Point
930 Port Street
Easton, MD 21601
Easton Point Fuel Station
.50 Miles Buffer
.25 Miles Buffer
N
W
E
S
0
0.25
0.5
Miles
Copyright:© 2013 National Geographic Society, i-cubed

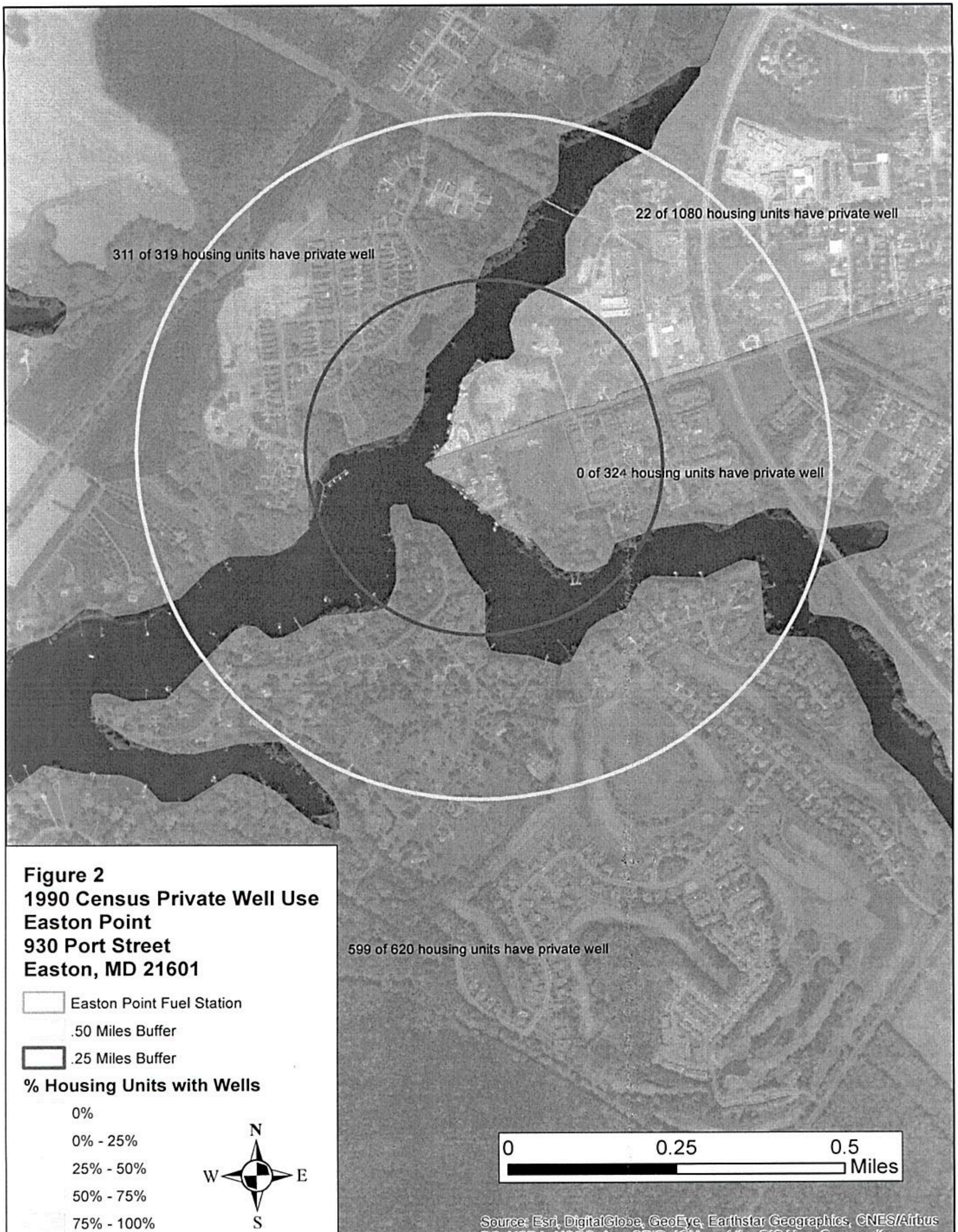
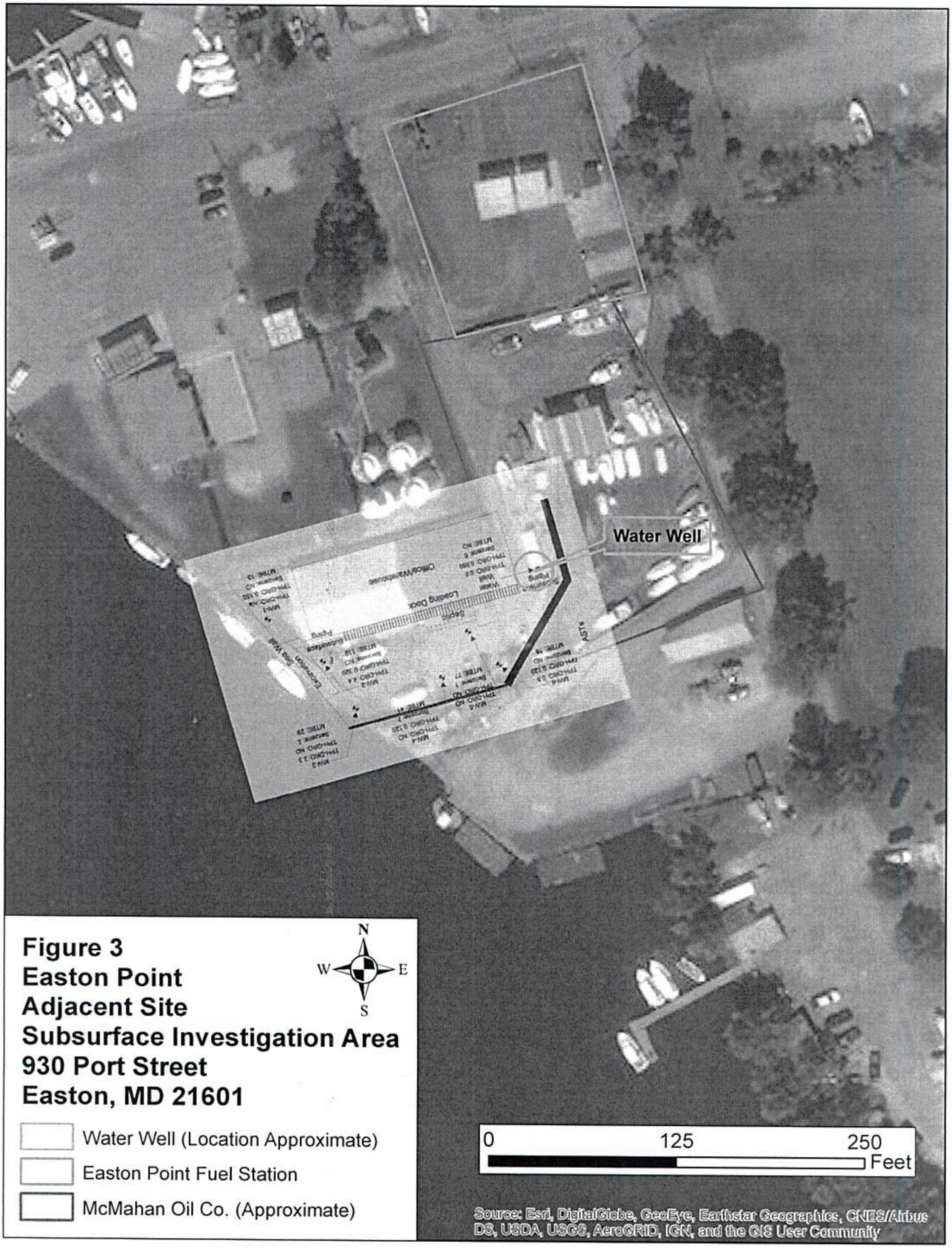


Figure 2
1990 Census Private Well Use
Easton Point
930 Port Street
Easton, MD 21601

Easton Point Fuel Station
.50 Miles Buffer
.25 Miles Buffer

% Housing Units with Wells
0%
0% - 25%
25% - 50%
50% - 75%
75% - 100%


Water Well
Figure 3
Easton Point
Adjacent Site
Subsurface Investigation Area
930 Port Street
Easton, MD 21601
N
W
E
S
Water Well (Location Approximate)
Easton Point Fuel Station
McMahan Oil Co. (Approximate)
0
125
250
Feet
Source: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community