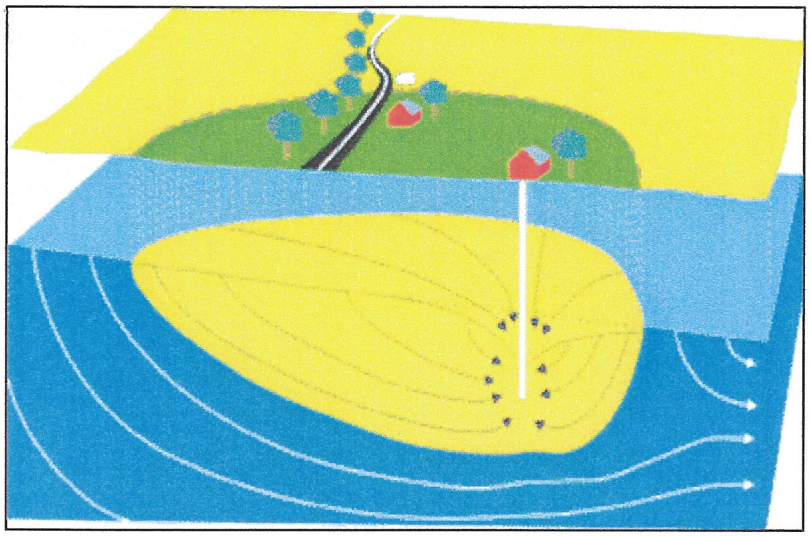
# SOURCE WATER ASSESSMENT

## FOR FORT RITCHIE / SMITHSBURG
## WASHINGTON COUNTY, MD



**Prepared By**
**Water Management Administration**
**Water Supply Program**
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MDE

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# EXECUTIVE SUMMARY

The Maryland Department of Environment's Water Supply Program (WSP) has performed a Source Water Assessment for the Fort Ritchie water system in Washington County, Maryland. This water system is identified as Public Water System Identification (PWSID) 0210007 by the Maryland Department of the Environment (MDE). The required components of this report as described in Maryland's Source Water Assessment Plan (SWAP) are:

- Delineation of the area that contributes water to the source
- Identification of potential sources of contamination
- Determination of the susceptibility of the water supply to contamination
- Recommendations for protecting the drinking water supply

The source of Fort Ritchie's ground water supply is the Catoctin Formation, which is an unconfined crystalline rock aquifer. The Source Water Protection Area (SWPA) for the three ground-water supply wells was delineated using the watershed delineation method for fractured bedrock wells. The area of the SWPA is based on land topography, and a calculation of the total ground-water contributing area during a drought. The WHPA is approximately 1713 acres in area.

Potential point and non-point sources of contamination within the assessment area were identified based on site visits, a review of MDE's databases, and a review of land use maps. Well information and water quality data for the system were also reviewed.

The susceptibility analysis for the Fort Ritchie water supply is based on a review of the water quality data, potential sources of contamination, aquifer characteristics, and well integrity. It was determined that the Fort Ritchie water supply may be susceptible to radionuclides and susceptible to total coliform bacteria, but not susceptible to synthetic organic compounds, volatile organic compounds, inorganic compounds, and microbiological contaminants including gardia & cryptosporidium.

# 1. INTRODUCTION

The Water Supply Program has conducted a Source Water Assessment for the Fort Ritchie water system in Washington County, Maryland.

The Fort Ritchie water system serves the U. S. Army Garrison at Fort Ritchie, about three miles northeast of Smithsburg, Washington County, Maryland. The Fort obtains it water supply from 6 wells and one spring. The annual average water use from all sources has averaged 67,000 gallons per day (gpd) for the past 3 years. The average use in the month of maximum use has been 85,000 gpd for the same period. The water system is owned by the federal government and operated by the base facilities engineering office. It serves a current population of 400 with 425 connections. These seven ground water sources together are permitted to appropriate 270,000 gpd. The base is scheduled to be closed but no definite date has been set for closure.

## 1.1 GROUND-WATER SUPPLY SYSTEM INFORMATION

Six of the seven existing wells were drilled in 1942 by the U.S. Geological Survey and may not be in compliance with the State's current well construction standards, which were implemented in 1973. Table 1 contains a summary of the wells and spring information.

Four of the six production wells (5,6,7,8) are situated along an easement north of the Ritchie facility. A fifth well (well 1) is located in the center of the facility parallel to the regional fracture trend. Well 9 and spring 2 are located on the southern boundary at the reservoir. See Figure 1 for wells and spring locations.

TABLE 1. WELL INFORMATION – FORT RITCHIE - PWSID # 0210007

| **Well #** | **Permit No.** | **Completi on Date** | **Total Dept h (ft)** | **Casing Depth (ft)** | **Water Appropriation Permit ID (Appropriation)** | **Aquifer Formation** | **Remarks** |
|---|---|---|---|---|---|---|---|
| 01 | WA-AK008 | 1942 | 340 | 82 | WA1982G200 (270,000 gpd) | Catoctin Metabasalt | Active well |
| 05 | WA-AI009 | 1942 | 200 | 43 | WA1982G200 (270,000 gpd) | Catoctin Metabasalt | Active well |
| 06 | WA-AI010 | 1942 | 191 | 41 | WA1982G200 (270,000 gpd) | Catoctin Metabasalt | Well has no pump. Kept for standby |
| 07 | WA-AI011 | 1942 | 25 | 25 | WA1982G200 (270,000 gpd) | Catoctin Metabasalt | Active well |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 08 | WA-AI012 | 1942 | 35 | 35 | WA1982G200 (270,000 gpd) | Catoctin Metabasalt | Active well |
| 09 | WA-88-1261 | 1991 | 82 | 82 | WA1982G200 (270,000 gpd) | Weaverton | Active well |
| Spring 2 | | | | | WA1982G200 (270,000 gpd) | Weaverton | Continuously flows into a reservoir |

## 1.2 HYDROGEOLOGY

Fort Ritchie is divided almost in the middle by two geologic formations (Figure 3). The eastern portion is underlain by Precambrian-aged metabasalt of the Catoctin Formation. This unconfined fractured-rock aquifer is characterized by massive metamorphosed basaltic rock which may contain quartz, epidote or marble lenses. This formation is generally overlain by a thin mantle of highly weathered rock material. The western portion of Fort Ritchie is mapped geologically as the Weaverton Formation. It is a thin-bedded quartzite with interbedded phylite overlain by a thick mantle of highly weathered rock.

The source of the ground water in Washington County is from precipitation in the form of rainfall or snowmelt. Most of the ground water available to the wells and spring exists in the weathered rock zone and in the overlying saprolite. Stream valleys tend to follow fracture traces and four of the wells (5,6,7,8) at Fort Ritchie are in a valley along a lineament, possibly a marble lens. The location of the wells in a relatively straight line suggest that they are withdrawing water from the same fracture zone.

Well # 9 and Spring 2 are located along the geologic contact for the Weaverton / Catoctin formations in a valley surrounded by mountains on three sides.

# 2. SOURCE WATER ASSESSMENT AREA DELINEATION

For ground-water systems, a Wellhead Protection Area (WHPA) is considered to be the source water assessment and protection area for the system. Consistent with the recommended delineation in the Maryland SWAP (MDE 1999), the watershed drainage area that contributes ground water to the supply wells methodology was used.

This original delineation shape was then modified by accounting for surface water bodies, topography, significant land features, and by using a conservative calculation of total ground-water recharge during a drought. For conservative purposes, a drought condition recharge value of 400 gpd per acre (or approximately 5.4 inches per year) was used to estimate the total ground-water contribution area required to supply the wells.

For Fort Ritchie, the current Water Appropriation Permit issued by the MDE Source Protection and Appropriation Division is for an average of 270,000 gpd for the six wells and spring 2. To determine the total ground-water contribution area during a drought, the following equation was used:

Recharge Area (acre) = Average Use (gpd)/Drought Condition Recharge (gpd/acre).

From the equation above, the required ground-water contributing area during a drought is approximately 675 acres. The delineated WHPA is approximately 1713 acres (Figure 1), which is significantly more area than needed to accommodate the permitted withdrawal rate. Additional site specific data would be needed to further refine the delineated area to more closely match the recharge area needed to support the appropriation permit.

## 3. INVENTORY OF POTENTIAL CONTAMINANTS WITHIN THE DELINEATED AREA

The MDE database was queried for potential contaminant sources within and near the WHPA. The contaminant databases include the Comprehensive Environmental Response, Compensation, and Liability Act Information System (CERCLIS), which includes National Priority List (Superfund) sites, Maryland Registered Underground Storage Tank (UST) sites, Maryland Leaking Underground Storage Tank (LUST) sites, landfills, pesticide dealers, ground-water discharge permits, Colonial Tanks & Pipelines, and Controlled Hazard Substances (CHS) generator sites.

### 3.1 POINT SOURCES

Potential point sources of contamination listed in the table below were identified and mapped from the MDE database. The database indicates that there are facilities that generate controlled hazardous substances, (CHS-Generators); ground water discharge (Dischargers), and underground storage tanks (UST) (Figure 2). This is a military installation that is in the processes of being closed. The population has dropped from 2000 in 1997 to 400 in 2005. No field verification was made to determine the current status of any of these contaminant sources.

Table 2 – POTENTIAL POINT SOURCES OF CONTAMINATION IN WHPA

| TYPE OF FACILITY | COMMENTS |
|---|---|
| CHS-Generator<br>U.S. Army Garrison- Fort Ritchie<br>MDE Code 8210020758<br>Record Code 162 | Site on the base that may contain hazardous substances<br>Electric Transformer Site |
| Highfield ?Cascade WWTP<br>Surface Water Discharger | Site Id – 90-DP-2749 |
| Fort Ritchies WWTP<br>Municipal Waste Water Discharger | Site Id – 94-DP-3107 |
| Fort Ritchie<br>Inactive groundwater Discharger | Site Id – 90-DP-2516 |
| UST<br>Cascade Elementary School<br>14519 Pennersville Rd<br>10,000 gal heating oil tank | Facility ID – 303<br>Owner ID - 139 |

A facility classified as a Controlled Hazard Substance Generator is one where hazardous substances are generated or stored. If these substances are handled inappropriately, they could contaminate ground water via a discrete point source. There is one CHS generator in he WHPA. The two active surface water dischargers are down gradient of the wells and therefore are low risk for producing contaminant sources to the wells and spring. The single UST at Cascade elementary is a 10,000 gallon heating oil tank that could be a potential contaminant source if it leaks.

## 3.2 NON-POINT SOURCES

The Maryland Department of Planning's 2002 Land Use/Land Cover map for Washington County was used to determine potential non-point sources within the wellhead protection area (WHPA). The evaluation was based on land use designation (Figure 4). A summary of the percentage and acreage of each type of land use, using the 2002 map is presented in Table 3 below:

Table 3. - 2002 PERCENTAGE OF EACH LAND USE TYPE WITHIN WHPA

| Type of Land Use | Area (acres) | Percent of Total (%) |
|---|---|---|
| Low Density Residential | 318 | 19 |
| Medium Density Residential | 69 | 4 |
| Commercial | 328 | 19 |
| Open Urban Land | 31 | 2 |
| Cropland | 33 | 2 |
| Pasture | 32 | 2 |
| Forest | 879 | 51 |
| Water | 23 | 1 |
| Total Area | 1713 | 100 |

Residential areas account for 23 % of the total WHPA area. Figure 4 shows that the majority of the developed land use within the WHPA is currently served by or will be served by community sewer. The use of fertilizers and pesticides are also potential sources of pollution generally associated with residential land uses. Forested land area account for the majority of the land area within the WHPA.

## 4. REVIEW OF WATER QUALITY DATA

This chapter discusses the water quality data that has been reported to MDE for all the active Fort Ritchie wells and spring 2. The SWAP defines a threshold for reporting water quality data as 50% of the Maximum Contaminant Level (MCL). If a monitoring result is greater than 50% of an MCL, this assessment will describe the sources of such a contaminant and if possible locate the specific sources that are the cause of the elevated contaminant level. The Fort Ritchie water system has three plants that treat the water before it is pumped into the system. Table 4 is a list of the plants and the associated sources and type of treatment provided for the raw water.

TABLE 4. WELLS AND PLANT AT FORT RITCHIE

<table>
<tr><th>PWSID</th><th>WELL ID</th><th>PLANT ID</th><th>TREATMENT</th></tr>
<tr><td>210007</td><td>Fort Ritchie 1</td><td>2</td><td rowspan="7">Hexametaphosphate for corrosion control<br><br>PH Adjustment<br><br>Gaseous Chlorination<br><br>Fluoridation</td></tr>
<tr><td>210007</td><td>Fort Ritchie 5</td><td rowspan="4">5</td></tr>
<tr><td>210007</td><td>Fort Ritchie 6</td></tr>
<tr><td>210007</td><td>Fort Ritchie 7</td></tr>
<tr><td>210007</td><td>Fort Ritchie 8</td></tr>
<tr><td>210007</td><td>Fort Ritchie 9</td><td rowspan="2">6</td></tr>
<tr><td>210007</td><td>Spring 2</td></tr>
</table>

Water from well 1 is distributed to the system from plant 2. Wells 5,6,7, & 8 are treated and distributed from plant 5 and water from well 9 and spring 2 are distributed to the system from plant 6.

### 4.1 VOLATILE ORGANIC COMPOUNDS (VOC)

For the system, Table 5 lists all VOCs detected for the active sources. The presence of bromoform, chloroform, bromodichloromethane, and dibromochloromethane is due to the reaction of chlorine from the water treatment plant with naturally occurring organic compounds in the raw water. The concentrations observed were less than 10 parts per billion, which is below the maximum allowable level of 80 parts per billion for the sum of these four compounds. A review of the data also shows that well 2 (now inactive) had detectable levels of tetrachloroethylene in the early to mid 1990s.

TABLE 5. VOC DETECTS

| PWSID | PL | CONTAMINANT NAME | MCL (ppb) | SAMPLE DATE | RESULT (ppb) |
|---|---|---|---|---|---|
| 210007 | 1 | BROMODICHLOROMETHANE | | 25-Oct-90 | 1.6 |
| 210007 | 6 | BROMODICHLOROMETHANE | | 25-Oct-90 | 0.4 |
| 210007 | 6 | BROMODICHLOROMETHANE | | 18-Jan-96 | 1.4 |
| 210007 | 6 | BROMODICHLOROMETHANE | | 9-Apr-97 | 0.9 |
| 210007 | 6 | BROMODICHLOROMETHANE | | 1-Apr-98 | 0.9 |
| 210007 | 6 | BROMODICHLOROMETHANE | | 2-Mar-99 | 1.6 |
| 210007 | 6 | BROMODICHLOROMETHANE | | 9-Sep-02 | 1.7 |
| 210007 | 6 | BROMODICHLOROMETHANE | | 28-Oct-02 | 2.6 |
| 210007 | 6 | BROMODICHLOROMETHANE | | 25-Mar-05 | 3.2 |
| 210007 | 1 | CHLOROFORM | | 25-Oct-90 | 2.3 |
| 210007 | 6 | CHLOROFORM | | 18-Jan-96 | 1.1 |
| 210007 | 6 | CHLOROFORM | | 9-Apr-97 | 1 |
| 210007 | 6 | CHLOROFORM | | 1-Apr-98 | 1.7 |
| 210007 | 6 | CHLOROFORM | | 2-Mar-99 | 3 |
| 210007 | 6 | CHLOROFORM | | 9-Sep-02 | 4.8 |
| 210007 | 6 | CHLOROFORM | | 28-Oct-02 | 5 |
| 210007 | 6 | CHLOROFORM | | 25-Mar-05 | 7.8 |
| 210007 | 3 | CHLOROMETHANE | | 27-Aug-97 | 3 |
| 210007 | 2 | CHLOROMETHANE | | 2-Mar-99 | 1.6 |
| 210007 | 3 | CHLOROMETHANE | | 2-Mar-99 | 1.4 |
| 210007 | 6 | CHLOROMETHANE | | 2-Mar-99 | 1.7 |
| 210007 | 4 | CHLOROMETHANE | | 2-Mar-99 | 1.4 |
| 210007 | 5 | CHLOROMETHANE | | 2-Mar-99 | 1.2 |
| 210007 | 6 | CHLOROMETHANE | | 9-Sep-02 | 2.5 |
| 210007 | 1 | DIBROMOCHLOROMETHANE | | 25-Oct-90 | 0.6 |
| 210007 | 6 | DIBROMOCHLOROMETHANE | | 25-Oct-90 | 0.2 |
| 210007 | 6 | DIBROMOCHLOROMETHANE | | 28-Oct-02 | 0.7 |
| 210007 | 6 | DIBROMOCHLOROMETHANE | | 25-Mar-05 | 0.7 |
| 210007 | 3 | STYRENE | 100 | 27-Aug-97 | 1 |
| 210007 | 2 | TETRACHLOROETHYLENE | 5 | 7-Jun-90 | 0.8 |
| 210007 | 2 | TETRACHLOROETHYLENE | 5 | 17-Aug-90 | 3.5 |
| 210007 | 4 | TETRACHLOROETHYLENE | 5 | 17-Aug-90 | 0.2 |
| 210007 | 3 | TETRACHLOROETHYLENE | 5 | 18-Jan-96 | 1.2 |
| 210007 | 3 | TETRACHLOROETHYLENE | 5 | 31-Oct-97 | 1 |

## 4.2 SYNTHETIC ORGANIC COMPOUNDS

Two synthetic organic compounds were detected in the finished water sample for plants 5 and 6. Di (2-Ethylhexyl) Phthalate exceeded the MCL on two out of 8 samples taken between 1995 and 2002. This contaminant is used in the manufacture of plastics and can cause reproductive difficulties, liver problems and cancer in humans. A review of the data indicates that both these SOCs were detected in the laboratory blanks andtherefore we don not believe represent the water quality of the supply.

TABLE 6. SOC DETECTS

| PWSID | PLANT | CONTAMINANT NAME | MCL (ppb) | SAMPLE DATE | RESULT (ppb) |
|---|---|---|---|---|---|
| 210007 | 6 | DALAPON | 200 | 28-Oct-02 | 0.1 |
| 210007 | 2 | DI(2-ETHYLHEXYL) ADIPATE | 400 | 28-Jun-95 | 1.89 |
| 210007 | 3 | DI(2-ETHYLHEXYL) ADIPATE | 400 | 28-Jun-95 | 1.09 |
| 210007 | 4 | DI(2-ETHYLHEXYL) ADIPATE | 400 | 28-Jun-95 | 3.25 |
| 210007 | 2 | DI(2-ETHYLHEXYL) PHTHALATE | 6 | 28-Jun-95 | 0.59 |
| 210007 | 3 | DI(2-ETHYLHEXYL) PHTHALATE | 6 | 28-Jun-95 | 2.29 |
| 210007 | 4 | DI(2-ETHYLHEXYL) PHTHALATE | 6 | 28-Jun-95 | 2.78 |
| 210007 | 5 | DI(2-ETHYLHEXYL) PHTHALATE | 6 | 28-Jun-95 | 1.4 |
| 210007 | 6 | DI(2-ETHYLHEXYL) PHTHALATE | 6 | 28-Jun-95 | 0.57 |
| **210007** | **5** | **DI(2-ETHYLHEXYL) PHTHALATE** | **6** | **26-Sep-01** | **9.9** |
| **210007** | **6** | **DI(2-ETHYLHEXYL) PHTHALATE** | **6** | **28-Oct-02** | **12.9** |
| 210007 | 5 | DI(2-ETHYLHEXYL) PHTHALATE | 6 | 1-Sep-04 | 1.1 |

## 4.3 INORGANIC COMPOUNDS

No inorganic compound has been detected above 50% of the MCL for any finished water sample taken since 1993. A summary of all detected IOC concentrations in the ground-water samples collected is shown in Table 7.

Table 7. SUMMARY OF IOC DETECTS

| PWSID | PLANT | CONTAMINANT NAME | MCL (PPM) | SAMPLE DATE | RESULT (ppm) |
|---|---|---|---|---|---|
| 210007 | 2 | BARIUM | 2 | 15-May-01 | 0.08 |
| 210007 | 6 | BARIUM | 2 | 15-May-01 | 0.06 |
| 210007 | 5 | BARIUM | 2 | 19-Nov-01 | 0.006 |
| 210007 | 2 | BARIUM | 2 | 26-Jul-04 | 0.029 |
| 210007 | 6 | BARIUM | 2 | 26-Jul-04 | 0.07 |
| 210007 | 3 | CALCIUM | | 17-Oct-94 | 36.4 |
| 210007 | 5 | CALCIUM | | 17-Oct-94 | 11.6 |
| 210007 | 3 | CALCIUM | | 28-Jun-95 | 36.4 |
| 210007 | 2 | FLUORIDE | 4 | 28-Jun-95 | 0.77 |

| | | | | | |
|---|---|---|---|---|---|
| 210007 | 3 | FLUORIDE | 4 | 28-Jun-95 | 0.81 |
| 210007 | 4 | FLUORIDE | 4 | 28-Jun-95 | 0.96 |
| 210007 | 5 | FLUORIDE | 4 | 28-Jun-95 | 1.02 |
| 210007 | 6 | FLUORIDE | 4 | 28-Jun-95 | 1.05 |
| 210007 | 3 | FLUORIDE | 4 | 10-Feb-98 | 1 |
| 210007 | 2 | FLUORIDE | 4 | 1-Apr-98 | 0.8 |
| 210007 | 6 | FLUORIDE | 4 | 1-Apr-98 | 1.1 |
| 210007 | 5 | FLUORIDE | 4 | 5-Nov-98 | 0.95 |
| 210007 | 4 | FLUORIDE | 4 | 3-Feb-99 | 0.1 |
| 210007 | 2 | FLUORIDE | 4 | 28-Mar-01 | 0.86 |
| 210007 | 5 | FLUORIDE | 4 | 28-Mar-01 | 0.66 |
| 210007 | 2 | FLUORIDE | 4 | 15-May-01 | 0.4 |
| 210007 | 6 | FLUORIDE | 4 | 15-May-01 | 0.35 |
| 210007 | 2 | FLUORIDE | 4 | 26-Jul-04 | 0.36 |
| 210007 | 5 | FLUORIDE | 4 | 26-Jul-04 | 0.27 |
| 210007 | 6 | FLUORIDE | 4 | 26-Jul-04 | 0.3 |
| 210007 | 2 | FLUORIDE | 4 | 1-Sep-04 | 0.68 |
| 210007 | 5 | FLUORIDE | 4 | 1-Sep-04 | 0.68 |
| 210007 | 3 | IRON | .3 | 17-Oct-94 | 0.18 |
| 210007 | 3 | IRON | .3 | 28-Jun-95 | 0.18 |
| 210007 | 2 | NICKEL | | 15-May-01 | 0.019 |
| 210007 | 6 | NICKEL | | 15-May-01 | 0.007 |
| 210007 | 5 | NICKEL | | 19-Nov-01 | 0.006 |
| 210007 | 1 | NITRATE | 10 | 10-Mar-93 | 1.1 |
| 210007 | 2 | NITRATE | 10 | 10-Mar-93 | 1.2 |
| 210007 | 3 | NITRATE | 10 | 10-Mar-93 | 1.2 |
| 210007 | 4 | NITRATE | 10 | 10-Mar-93 | 1.4 |
| 210007 | 5 | NITRATE | 10 | 10-Mar-93 | 2.6 |
| 210007 | 6 | NITRATE | 10 | 10-Mar-93 | 1.8 |
| 210007 | 3 | NITRATE | 10 | 19-Oct-94 | 1.26 |
| 210007 | 5 | NITRATE | 10 | 19-Oct-94 | 1.91 |
| 210007 | 2 | NITRATE | 10 | 28-Jun-95 | 1.1 |
| 210007 | 3 | NITRATE | 10 | 28-Jun-95 | 1.1 |
| 210007 | 4 | NITRATE | 10 | 28-Jun-95 | 0.8 |
| 210007 | 5 | NITRATE | 10 | 28-Jun-95 | 0.7 |
| 210007 | 6 | NITRATE | 10 | 28-Jun-95 | 0.5 |
| 210007 | 5 | NITRATE | 10 | 25-Aug-95 | 2.06 |
| 210007 | 3 | NITRATE | 10 | 11-Dec-96 | 1.24 |
| 210007 | 4 | NITRATE | 10 | 11-Dec-96 | 0.923 |
| 210007 | 5 | NITRATE | 10 | 11-Dec-96 | 1.4 |
| 210007 | 2 | NITRATE | 10 | 8-Dec-97 | 0.965 |
| 210007 | 3 | NITRATE | 10 | 8-Dec-97 | 1.56 |
| 210007 | 4 | NITRATE | 10 | 8-Dec-97 | 1.51 |
| 210007 | 5 | NITRATE | 10 | 8-Dec-97 | 1.93 |
| 210007 | 6 | NITRATE | 10 | 8-Dec-97 | 0.789 |
| 210007 | 3 | NITRATE | 10 | 10-Feb-98 | 1 |
| 210007 | 2 | NITRATE | 10 | 1-Apr-98 | 0.3 |
| 210007 | 6 | NITRATE | 10 | 1-Apr-98 | 0.5 |
| 210007 | 5 | NITRATE | 10 | 5-Nov-98 | 1.6 |

| | | | | | |
|---|---|---|---|---|---|
| 210007 | 3 | NITRATE | 10 | 1-Dec-98 | 0.873 |
| 210007 | 4 | NITRATE | 10 | 1-Dec-98 | 0.5 |
| 210007 | 4 | NITRATE | 10 | 3-Feb-99 | 1.6 |
| 210007 | 2 | NITRATE | 10 | 7-Dec-99 | 0.7 |
| 210007 | 4 | NITRATE | 10 | 7-Dec-99 | 1.3 |
| 210007 | 5 | NITRATE | 10 | 7-Dec-99 | 1.7 |
| 210007 | 6 | NITRATE | 10 | 7-Dec-99 | 0.8 |
| 210007 | 2 | NITRATE | 10 | 12-Dec-00 | 0.3 |
| 210007 | 4 | NITRATE | 10 | 12-Dec-00 | 1.3 |
| 210007 | 5 | NITRATE | 10 | 12-Dec-00 | 2.2 |
| 210007 | 6 | NITRATE | 10 | 12-Dec-00 | 0.8 |
| 210007 | 2 | NITRATE | 10 | 28-Mar-01 | 0.2 |
| 210007 | 5 | NITRATE | 10 | 28-Mar-01 | 1.6 |
| 210007 | 5 | NITRATE | 10 | 19-Nov-01 | 1 |
| 210007 | 1 | NITRATE | 10 | 31-Jan-02 | 0.6 |
| 210007 | 2 | NITRATE | 10 | 31-Jan-02 | 0.5 |
| 210007 | 6 | NITRATE | 10 | 31-Jan-02 | 0.6 |
| 210007 | 2 | NITRATE | 10 | 25-Nov-02 | 0.6 |
| 210007 | 5 | NITRATE | 10 | 25-Nov-02 | 1.8 |
| 210007 | 6 | NITRATE | 10 | 25-Nov-02 | 0.7 |
| 210007 | 2 | NITRATE | 10 | 23-Oct-03 | 0.4 |
| 210007 | 5 | NITRATE | 10 | 23-Oct-03 | 1.7 |
| 210007 | 6 | NITRATE | 10 | 23-Oct-03 | 0.7 |
| 210007 | 2 | NITRATE | 10 | 1-Sep-04 | 0.5 |
| 210007 | 5 | NITRATE | 10 | 1-Sep-04 | 1.9 |
| 210007 | 2 | NITRATE | 10 | 22-Nov-04 | 0.1 |
| 210007 | 5 | NITRATE | 10 | 22-Nov-04 | 1.6 |
| 210007 | 6 | NITRATE | 10 | 22-Nov-04 | 1.2 |
| 210007 | 2 | NITRITE | 1 | 19-Oct-94 | 0.02 |
| 210007 | 3 | NITRITE | 1 | 28-Jun-95 | 0.002 |
| 210007 | 1 | pH | | 17-Oct-94 | 8.6 |
| 210007 | 2 | pH | | 17-Oct-94 | 6.7 |
| 210007 | 3 | pH | | 17-Oct-94 | 8.6 |
| 210007 | 3 | pH | | 17-Oct-94 | 8.6 |
| 210007 | 4 | pH | | 17-Oct-94 | 6.4 |
| 210007 | 5 | pH | | 17-Oct-94 | 6.4 |
| 210007 | 5 | pH | | 17-Oct-94 | 6.4 |
| 210007 | 5 | pH | | 17-Oct-94 | 9.7 |
| 210007 | 5 | pH | | 17-Oct-94 | 6.4 |
| 210007 | 2 | pH | | 28-Jun-95 | 8.2 |
| 210007 | 3 | pH | | 28-Jun-95 | 9.6 |
| 210007 | 4 | pH | | 28-Jun-95 | 7 |
| 210007 | 5 | pH | | 28-Jun-95 | 7.9 |
| 210007 | 6 | pH | | 28-Jun-95 | 6.7 |
| 210007 | 2 | pH | | 23-Jun-97 | 7.3 |
| 210007 | 3 | pH | | 23-Jun-97 | 7.1 |
| 210007 | 5 | pH | | 23-Jun-97 | 6.9 |
| 210007 | 3 | SODIUM | | 17-Oct-94 | 97.5 |
| 210007 | 5 | SODIUM | | 17-Oct-94 | 165 |

| | | | | | |
|---|---|---|---|---|---|
| 210007 | 3 | SODIUM | | 28-Jun-95 | 97.5 |
| 210007 | 3 | SODIUM | | 10-Feb-98 | 99.1 |
| 210007 | 2 | SODIUM | | 1-Apr-98 | 106 |
| 210007 | 6 | SODIUM | | 1-Apr-98 | 25.4 |
| 210007 | 5 | SODIUM | | 5-Nov-98 | 70.1 |
| 210007 | 4 | SODIUM | | 3-Feb-99 | 39.8 |
| 210007 | 2 | SODIUM | | 28-Mar-01 | 387 |
| 210007 | 5 | SODIUM | | 28-Mar-01 | 37 |
| 210007 | 2 | SODIUM | | 1-Sep-04 | 38.7 |
| 210007 | 5 | SODIUM | | 1-Sep-04 | 37.3 |
| 210007 | 2 | SULFATE | | 28-Jun-95 | 12 |
| 210007 | 3 | SULFATE | | 28-Jun-95 | 9.4 |
| 210007 | 4 | SULFATE | | 28-Jun-95 | 8.2 |
| 210007 | 5 | SULFATE | | 28-Jun-95 | 6.5 |
| 210007 | 6 | SULFATE | | 28-Jun-95 | 4.8 |
| 210007 | 3 | SULFATE | | 10-Feb-98 | 29 |
| 210007 | 2 | SULFATE | | 1-Apr-98 | 2.8 |
| 210007 | 6 | SULFATE | | 1-Apr-98 | 2.8 |
| 210007 | 5 | SULFATE | | 5-Nov-98 | 2.8 |
| 210007 | 4 | SULFATE | | 3-Feb-99 | 17.3 |

## 4.4 MICROBIOLOGICAL CONTAMINANTS

To assess the potential of Ground Water Under the Direct Influence (GWUDI) of surface water, ground-water sampling records were reviewed. Ground water supplies are tested for surface water influence to determine their susceptibility to surface water microorganisms such as giardia and cryptosporidium. These microorganisms are resistant to simple disinfection treatment.

If surface water directly recharges an aquifer through major fractures in rock and do not pass through the soil overburden then an aquifer is likely to have elevated levels of coliform bacteria that would have otherwise been filtered out. These values would be particularly high following a significant rainfall event. Sampling carried out following such events is used to determine the potential for a water supply well to be under the direct influence of surface water.

In 1998 and 1999, GWUDI tests were carried out on the wells and spring at Fort Ritchie. The results are given in Table 8. Well 1 tested positive for total coliform in March 1999 but tested negative in a subsequent test in June. Well 6 tested positive for total coliform in four samples taken in March 1999. In June only two of the four samples tested positive for total coliform from the same well. Well 7 tested positive for total coliform in 6 of 8 samples taken in March and June of 1999. Well 8 tested positive in 5 of 8 samples tested in March and June of 1999. Spring 2 had some fecal coliform in early samples, but none when re-sampled.

From an assessment of the ground-water sampling results from the wells and spring, the ground water at Forth Ritchie is not under the direct influence of surface water.

## Table 8. GWUDI TEST RESULTS – PWSID 0210007

| SOURCE NAME | RAIN DATE | RAIN AMOUNT (INCHES) | REMARK | SAMPLE DATE | TEMP ($^0$C) | PH | TURBIDITY NTU) | TOTAL COLIFORM | FECAL COLIFORM |
|---|---|---|---|---|---|---|---|---|---|
| FT RITCHIE1 | 21-Mar-99 | 1.06 | WET | 22-Mar-99 | 13.8 | 6.3 | 0.34 | -1.1 | -1.1 |
| FT RITCHIE1 | 21-Mar-99 | 1.06 | WET | 23-Mar-99 | 13.9 | 6.4 | 0.3 | -1.1 | -1.1 |
| FT RITCHIE1 | 21-Mar-99 | 1.06 | WET | 24-Mar-99 | 13.3 | 6.5 | 0.11 | -1.1 | -1.1 |
| FT RITCHIE1 | 21-Mar-99 | 1.06 | WET | 25-Mar-99 | 13.3 | 6.2 | 0.7 | 8.1 | -1.1 |
| FT RITCHIE1 | 15-Jun-99 | 0.5 | WET | 15-Jun-99 | 14.4 | 6.2 | 2.5 | -1.1 | -1.1 |
| FT RITCHIE1 | 15-Jun-99 | 0.5 | WET | 16-Jun-99 | 14.4 | 6.4 | 0.38 | -1.1 | -1.1 |
| FT RITCHIE1 | 15-Jun-99 | 0.5 | WET | 17-Jun-99 | 13.3 | 6.4 | 1.5 | -1.1 | -1.1 |
| FT RITCHIE1 | 15-Jun-99 | 0.5 | WET | 18-Jun-99 | 13.3 | 6.4 | 0.3 | -1.1 | -1.1 |
| FT RITCHIE1 | 26-Jan-00 | 0 | DRY | 26-Jan-00 | 13.3 | 6 | 1.5 | -1.1 | -1.1 |
| FT RITCHIE1 | 26-Feb-01 | 0 | DRY | 26-Feb-01 | 11.1 | 6.6 | 0.4 | -1.1 | -1.1 |
| FT RITCHIE 5 | 1-Dec-98 | 0 | DRY | 1-Dec-98 | | 7.2 | 0.1 | -1 | -1 |
| FT RITCHIE 5 | 19-Jan-99 | 0 | DRY | 19-Jan-99 | | 6.8 | 0.45 | -1 | -1 |
| FT RITCHIE 5 | 21-Mar-99 | 1.06 | WET | 22-Mar-99 | 12.8 | 6.6 | 0.52 | -1.1 | -1.1 |
| FT RITCHIE 5 | 21-Mar-99 | 1.06 | WET | 23-Mar-99 | 12.2 | 6.4 | 0.23 | -1.1 | -1.1 |
| FT RITCHIE 5 | 21-Mar-99 | 1.06 | WET | 24-Mar-99 | 12.2 | 6.4 | 0.2 | -1.1 | -1.1 |
| FT RITCHIE 5 | 21-Mar-99 | 1.06 | WET | 25-Mar-99 | 12.2 | 6.4 | 0.21 | -1.1 | -1.1 |
| FT RITCHIE 5 | 15-Jun-99 | 0.5 | WET | 15-Jun-99 | 13.3 | 6.4 | 0.4 | -1.1 | -1.1 |
| FT RITCHIE 5 | 15-Jun-99 | 0.5 | WET | 16-Jun-99 | 12.2 | 6.4 | 0.1 | -1.1 | -1.1 |
| FT RITCHIE 5 | 15-Jun-99 | 0.5 | WET | 17-Jun-99 | 13.3 | 6.5 | 0.1 | -1.1 | -1.1 |
| FT RITCHIE 5 | 15-Jun-99 | 0.5 | WET | 18-Jun-99 | 12.2 | 6.5 | 0.11 | -1.1 | -1.1 |
| FT RITCHIE 6 | 1-Dec-98 | 0 | DRY | 1-Dec-98 | | 9.3 | 0.15 | -1 | -1 |
| FT RITCHIE 6 | 19-Jan-99 | 0 | DRY | 19-Jan-99 | | 6.8 | 0.09 | -1 | -1 |
| FT RITCHIE 6 | 21-Mar-99 | 1.06 | WET | 22-Mar-99 | 12.2 | 6.5 | 1 | 8.1 | -1.1 |
| FT RITCHIE 6 | 21-Mar-99 | 1.06 | WET | 23-Mar-99 | 12.2 | 6.4 | 0.08 | 8.1 | -1.1 |
| FT RITCHIE 6 | 21-Mar-99 | 1.06 | WET | 24-Mar-99 | 12.2 | 6.3 | 0.09 | 8 | -1.1 |
| FT RITCHIE 6 | 21-Mar-99 | 1.06 | WET | 25-Mar-99 | 12.2 | 6.4 | 0.09 | 8 | -1.1 |
| FT RITCHIE 6 | 15-Jun-99 | 0.5 | WET | 15-Jun-99 | 14.4 | 6.3 | 0.25 | 2.6 | -1.1 |
| FT RITCHIE 6 | 15-Jun-99 | 0.5 | WET | 16-Jun-99 | 12.2 | 6.4 | 0.08 | 8.1 | -1.1 |
| FT RITCHIE 6 | 15-Jun-99 | 0.5 | WET | 17-Jun-99 | 12.2 | 6.5 | 0.07 | -1.1 | -1.1 |
| FT RITCHIE 6 | 15-Jun-99 | 0.5 | WET | 18-Jun-99 | 11.1 | 6.5 | 0.09 | -1.1 | -1.1 |
| FT RITCHIE 7 | 1-Dec-98 | 0 | DRY | 1-Dec-98 | | 7.5 | 0.12 | -1 | -1 |
| FT RITCHIE 7 | 19-Jan-99 | 0 | DRY | 19-Jan-99 | | 6.8 | 0.2 | -1 | -1 |
| FT RITCHIE 7 | 21-Mar-99 | 1.06 | WET | 22-Mar-99 | 12.2 | 6.4 | 0.69 | 1.1 | -1.1 |
| FT RITCHIE 7 | 21-Mar-99 | 1.06 | WET | 23-Mar-99 | 12.2 | 6.4 | 0.19 | 1.1 | -1.1 |
| FT RITCHIE 7 | 21-Mar-99 | 1.06 | WET | 24-Mar-99 | 12.2 | 6.4 | 0.21 | 1.1 | -1.1 |
| FT RITCHIE 7 | 21-Mar-99 | 1.06 | WET | 25-Mar-99 | 13.3 | 6.3 | 0.09 | -1.1 | -1.1 |
| FT RITCHIE 7 | 15-Jun-99 | 0.5 | WET | 15-Jun-99 | 12.2 | 6.5 | 0.17 | 8 | -1.1 |
| FT RITCHIE 7 | 15-Jun-99 | 0.5 | WET | 16-Jun-99 | 12.2 | 6.4 | 0.09 | 4.6 | -1.1 |
| FT RITCHIE 7 | 15-Jun-99 | 0.5 | WET | 17-Jun-99 | 12.2 | 6.5 | 0.08 | 8.1 | -1.1 |
| FT RITCHIE 7 | 15-Jun-99 | 0.5 | WET | 18-Jun-99 | 11.1 | 6.4 | 0.08 | -1.1 | -1.1 |
| FT RITCHIE 8 | 1-Dec-98 | 0 | DRY | 1-Dec-98 | | 6.8 | 0.11 | -1 | -1 |
| FT RITCHIE 8 | 19-Jan-99 | 0 | DRY | 19-Jan-99 | | 6.7 | 0.11 | 1 | -1 |
| FT RITCHIE 8 | 21-Mar-99 | 1.06 | WET | 22-Mar-99 | 12.2 | 6.4 | 0.28 | 2.6 | -1.1 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| FT RITCHIE 8 | 21-Mar-99 | 1.06 | WET | 23-Mar-99 | 12.2 | 6.4 | 0.16 | 2.6 | -1.1 |
| FT RITCHIE 8 | 21-Mar-99 | 1.06 | WET | 24-Mar-99 | 11.7 | 6.5 | 0.11 | 1.1 | -1.1 |
| FT RITCHIE 8 | 21-Mar-99 | 1.06 | WET | 25-Mar-99 | 12.2 | 6.4 | 0.06 | -1.1 | -1.1 |
| FT RITCHIE 8 | 15-Jun-99 | 0.5 | WET | 15-Jun-99 | 12.2 | 6.5 | 0.25 | 4.6 | -1.1 |
| FT RITCHIE 8 | 15-Jun-99 | 0.5 | WET | 16-Jun-99 | 12.2 | 6.5 | 0.09 | 2.6 | -1.1 |
| FT RITCHIE 8 | 15-Jun-99 | 0.5 | WET | 17-Jun-99 | 12.2 | 6.5 | 0.1 | -1.1 | -1.1 |
| FT RITCHIE 8 | 15-Jun-99 | 0.5 | WET | 18-Jun-99 | 11.1 | 6.5 | 0.09 | -1.1 | -1.1 |
| FT RITCHIE 9 | 21-Mar-99 | 1.06 | WET | 22-Mar-99 | 11.1 | 5.6 | 0.68 | -1.1 | -1.1 |
| FT RITCHIE 9 | 21-Mar-99 | 1.06 | WET | 23-Mar-99 | 11.1 | 5.6 | 0.31 | -1.1 | -1.1 |
| FT RITCHIE 9 | 21-Mar-99 | 1.06 | WET | 24-Mar-99 | 11.1 | 5.7 | 0.45 | -1.1 | -1.1 |
| FT RITCHIE 9 | 21-Mar-99 | 1.06 | WET | 25-Mar-99 | 11.1 | 5.6 | 0.44 | -1.1 | -1.1 |
| FT RITCHIE 9 | 15-Jun-99 | 0.5 | WET | 15-Jun-99 | 12.2 | 5.7 | 0.13 | 4.6 | 4.6 |
| FT RITCHIE 9 | 15-Jun-99 | 0.5 | WET | 16-Jun-99 | 11.1 | 5.7 | 0.09 | -1.1 | -1.1 |
| FT RITCHIE 9 | 15-Jun-99 | 0.5 | WET | 17-Jun-99 | 11.1 | 5.7 | 0.16 | -1.1 | -1.1 |
| FT RITCHIE 9 | 15-Jun-99 | 0.5 | WET | 18-Jun-99 | 10 | 5.7 | 0.2 | -1.1 | -1.1 |
| FT RITCHIE 9 | 26-Jan-00 | 0 | DRY | 26-Jan-00 | 12.2 | 5.5 | 2.2 | -1.1 | -1.1 |
| FT RITCHIE 9 | 27-Feb-00 | 1.05 | WET | 28-Feb-00 | 8.9 | -6 | 1.5 | -1.1 | -1.1 |
| FT RITCHIE 9 | 27-Feb-00 | 1.05 | WET | 29-Feb-00 | 10 | -6 | 1.1 | -1.1 | -1.1 |
| FT RITCHIE 9 | 27-Feb-00 | 1.05 | WET | 1-Mar-00 | 10 | -6 | 1.2 | -1.1 | -1.1 |
| FT RITCHIE 9 | 27-Feb-00 | 1.05 | WET | 2-Mar-00 | 10 | -6 | 1.3 | -1.1 | -1.1 |
| FT RITCHIE 9 | 5-Mar-01 | 1.26 | WET | 5-Mar-01 | 11.1 | 6 | 1.6 | -1.1 | -1.1 |
| FT RITCHIE 9 | 5-Mar-01 | 1.26 | WET | 6-Mar-01 | 11.1 | 6 | 1.1 | -1.1 | -1.1 |
| FT RITCHIE 9 | 5-Mar-01 | 1.26 | WET | 7-Mar-01 | 11.1 | 6 | 1.5 | -1.1 | -1.1 |
| FT RITCHIE 9 | 5-Mar-01 | 1.26 | WET | 8-Mar-01 | 11.1 | 6 | 3.6 | -1.1 | -1.1 |
| SPRING 2 | 1-Dec-98 | 0 | DRY | 1-Dec-98 | | 5.6 | 0.1 | -1 | -1 |
| SPRING 2 | 19-Jan-99 | 0 | DRY | 19-Jan-99 | | 5.7 | 0.17 | 3.1 | -1 |
| SPRING 2 | 21-Mar-99 | 1.06 | WET | 22-Mar-99 | 8.9 | 4.8 | 0.09 | -1.1 | -1.1 |
| SPRING 2 | 21-Mar-99 | 1.06 | WET | 23-Mar-99 | 8.9 | 5 | 0.06 | -1.1 | -1.1 |
| SPRING 2 | 21-Mar-99 | 1.06 | WET | 24-Mar-99 | 8.9 | 4.9 | 0.06 | -1.1 | -1.1 |
| SPRING 2 | 21-Mar-99 | 1.06 | WET | 25-Mar-99 | 8.9 | 4.8 | 0.06 | -1.1 | -1.1 |
| SPRING 2 | 15-Jun-99 | 0.5 | WET | 15-Jun-99 | 10.6 | 4.9 | 0.09 | -1.1 | -1.1 |
| SPRING 2 | 15-Jun-99 | 0.5 | WET | 16-Jun-99 | 10.6 | 4.9 | 0.07 | 8 | 2.6 |
| SPRING 2 | 15-Jun-99 | 0.5 | WET | 17-Jun-99 | 11.1 | 4.8 | 0.07 | -1.1 | -1.1 |
| SPRING 2 | 15-Jun-99 | 0.5 | WET | 18-Jun-99 | 10 | 4.9 | 0.12 | 8 | 4.6 |
| SPRING 2 | 26-Jan-00 | 0 | DRY | 26-Jan-00 | 11.1 | -5.5 | 1.2 | -1.1 | -1.1 |
| SPRING 2 | 27-Feb-00 | 1.05 | WET | 28-Feb-00 | 8.9 | -6 | 2.3 | 2.6 | -1.1 |
| SPRING 2 | 27-Feb-00 | 1.05 | WET | 29-Feb-00 | 10 | -6 | 1.7 | 8.1 | -1.1 |
| SPRING 2 | 27-Feb-00 | 1.05 | WET | 1-Mar-00 | 10 | -6 | 1 | 1.1 | -1.1 |
| SPRING 2 | 27-Feb-00 | 1.05 | WET | 2-Mar-00 | 10 | -6 | 1.2 | -1.1 | -1.1 |
| SPRING 2 | 5-Mar-01 | 1.26 | WET | 5-Mar-01 | 11.1 | 6 | 0.3 | -1.1 | -1.1 |
| SPRING 2 | 5-Mar-01 | 1.26 | WET | 6-Mar-01 | 11.1 | 6 | 0.3 | -1.1 | -1.1 |
| SPRING 2 | 5-Mar-01 | 1.26 | WET | 7-Mar-01 | 11.1 | 6 | 0.3 | -1.1 | -1.1 |
| SPRING 2 | 5-Mar-01 | 1.26 | WET | 8-Mar-01 | 11.1 | 6 | 0.3 | -1.1 | -1.1 |

## 4.5 RADIONUCLIDES

A summary of all radionuclides concentrations in the ground-water samples collected from the finished water at the plants serving the system are shown in Table 9 below. Radionuclides have primary drinking water standard parameters, except for Radon-222. EPA has proposed an MCL of 300 pCi/L and an alternate MCL of 4000 pCi/L for community water systems if the State has a program to address the more significant risk from radon in indoor air. The occurrence of these radionuclides is due to the decay of uranium and thorium in the aquifer.

TABLE 9. SUMMARY OF RADIONUCLIDES DETECTS

| PWSID | PL | CONTAMINANT | MCL (pCi/L) | SAMPLE DATE | RESULT (pCi/L) |
|---|---|---|---|---|---|
| 210007 | 6 | COMBINED RADIUM (226 & 228) | 5 | 19-Nov-03 | 2.2 |
| 210007 | 6 | GROSS ALPHA | 15 | 20-Dec-99 | 2 |
| 210007 | 6 | GROSS ALPHA | 15 | 19-Nov-03 | 4 |
| 210007 | 3 | GROSS BETA | 50 | 20-Dec-99 | 2 |
| 210007 | 6 | GROSS BETA | 50 | 20-Dec-99 | 2 |
| 210007 | 6 | GROSS BETA | 50 | 19-Nov-03 | 9 |
| 210007 | 6 | RADIUM-228 | 5 | 19-Nov-03 | 2.2 |
| 210007 | 1 | RADON-222 | 300* | 17-Oct-94 | 490 |
| 210007 | 2 | RADON-222 | 300* | 17-Oct-94 | 85 |
| 210007 | 3 | RADON-222 | 300* | 17-Oct-94 | 490 |
| 210007 | 4 | RADON-222 | 300* | 17-Oct-94 | 480 |
| 210007 | 5 | RADON-222 | 300* | 17-Oct-94 | 1845 |
| 210007 | 5 | RADON-222 | 300* | 17-Oct-94 | 2020 |
| 210007 | 5 | RADON-222 | 300* | 17-Oct-94 | 605 |
| 210007 | 5 | RADON-222 | 300* | 17-Oct-94 | 2005 |
| 210007 | 2 | RADON-222 | 300* | 23-Jun-97 | 90 |
| 210007 | 3 | RADON-222 | 300* | 23-Jun-97 | 240 |
| 210007 | 5 | RADON-222 | 300* | 23-Jun-97 | 1735 |
| 210007 | 6 | RADON-222 | 300* | 20-Dec-99 | 160 |

* proposed MCL – not adopted

## 5. SUSCEPTIBILITY ANALYSIS

To evaluate the susceptibility of the ground-water source to contamination, the following criteria were used:

1. The available water quality data
2. The presence of potential contaminant sources in the WHPA
3. The aquifer characteristics
4. The well integrity
5. The likelihood of change to the natural conditions

Fort Ritchie wells withdraw water from the unconfined fractured-rock aquifer. Wells using unconfined aquifers are in general more susceptible to contamination from surface activities. Table 9 summarizes the susceptibility of Fort Ritchie's ground water supply to the various contaminants.

## 5.1 VOLATILE ORGANIC COMPOUNDS (VOCs)

There is one point source of a Controlled Hazardous Substance (CHS) and one UST site within the WHPA. Based on the water quality data reviewed, it is determined that the active water supply sources at Fort Ritchie are not susceptible to VOCs.

## 5.2 SYNTHETIC ORGANIC COMPOUNDS (SOCs)

Our investigation did not yield any significant source of ground water contamination by synthetic organic compounds.

In addition, from the drillers log for well 9, there is approximately 45 ft of soil overburden above the bedrock aquifer. Most synthetic organic compounds have a high affinity to adhere to soil particles and with the significant soil overburden thickness reported, application of pesticides and herbicides on croplands and residential areas are not likely to infiltrate into the ground-water aquifer.

Based on the water quality data reviewed and lack of identified sources of ground water contamination by synthetic organic compounds, the water supply was determine to not be susceptible to SOCs.

## 5.3 INORGANIC COMPOUNDS (IOCs)

Based on the water quality data reviewed, the water supply is not susceptible to regulated inorganic compounds (IOCs).

## 5.4 RADIONUCLIDES

Water samples from all the plants serving FR had multiple occurrences where results exceeded the lower proposed MCL for Radon-222. Radon 222 is naturally occurring and is present due to the decay of uranium bearing minerals in the rock aquifer.

Depending on the standard adopted by the EPA and based on the water quality data, the water supply at Fort Ritchie may be susceptible to radon-222 but not to other radionuclides.

## 5.5 MICROBIOLOGICAL CONTAMINANTS

From an assessment of GWUDI ground-water results by MDE, the six wells, and spring 2 are not under the direct influence of surface water. Based on the water quality review and the condition and construction of the wells and spring, the ground water supply at Fort Ritchie is not susceptible to bacterial or protozoan contaminants present on the surface including Giardia & cryptosporidium, but are susceptible to total coliform bacteria.

TABLE 10: SUSCEPTIBILITY LOGIC CHART – PWSID # 070248

| Contaminant Name | Are Contaminant Sources Present in WHPA? | Are Contaminants Detected in WQ Samples at Levels of Concern? | Is Well Integrity a Factor? | Is the Aquifer Vulnerable? | Is the System Susceptible? |
|---|---|---|---|---|---|
| VOC | NO | NO | NO | NO | NO |
| SOC | NO | NO | NO | NO | NO |
| IOC | NO | NO | NO | NO | NO |
| RADIONUCLIDES | YES[1] | MAYBE | NO | YES | MAYBE |
| MICROBIOLOGICAL PATHOGENS | NO | NO` YES (total coliform) | NO | NO | NO (Gardia & Cryptosporidium) YES (total coliform) |

[1] Naturally occurring in the aquifer

## 6. RECOMMENDATIONS FOR PROTECTING THE WATER SUPPLY

With the information contained in this report, Fort Ritchie is provided an overview of the risks to its drinking water supply. Being aware of the WHPA, knowing potential contaminant sources, evaluating current and future development, staying informed of MDE's progress on investigating ground water contamination, and effective outreach and education are examples of management practices that will help protect the water supply.

## 6.1 MONITORING

The system should continue to monitor the ground water for all SWDA contaminants as required by MDE.

Annual raw water sampling for microbiological contaminants is a good way to check the integrity of each well.

## 6.2 CONTIGENCY PLAN

As required by the Code of Maryland Regulations (COMAR) 26.04.01.22, all water system owners are required to prepare and submit for approval a plan to provide safe drinking water under emergency conditions.

## 6.3 CHANGES IN USE

The army has decided to close the base and sell the property. The new owner will need to make changes to the water appropriation permit and the changes could affect the WHPA. Methods for minimizing the risk of contamination to ground water from new land use should be part of all planning and development review.

## 6.4 CONTAMINANT SOURCE INVENTORY UPDATES/INSPECTIONS

The management of the water system is encouraged to conduct its own survey of the WHPA to ensure that there are no additional potential sources of contamination.

## 6.5 EDUCATION

Providing training on proper handling of hazardous materials to protect ground water resources should be implemented for all personnel involved in facility maintenance.

## 7. REFERENCES

The following sources of information were consulted as a part of this investigation:


1. Maryland Department of the Environment, Water Supply Program, 1999, Maryland's Source Water Assessment Plan, 36. p.
2. Maryland Geologic Survey 1968. *Washingtonl County Geologic Map adapted from Maryland Geological Survey's Geologic Map of Maryland.*
3. United States Environmental Protection Agency (USEPA). 1999. *Proposed Radon in Drinking Water Rule.* Office of Water. EPA 815-F-99-006. October.
4. United States Environmental Protection Agency (USEPA). 2001. *A Small Systems Guide to the Total Coliform Rule.* Office of Water. EPA 816-R-01-017A. June.


### Sources of Data

Water Appropriation and Use Database
Public Water Supply Inspection Reports
Monitoring Reports
MDE Water Supply Program Oracle Database
MDE Waste Management Sites Database
Maryland Office of Planning 2002 Washington County Land Use Map
USGS Topographic 7.5 minute Quadrangle Map – 1953 (1985), Smithsburg Maryland Quad

# FIGURES

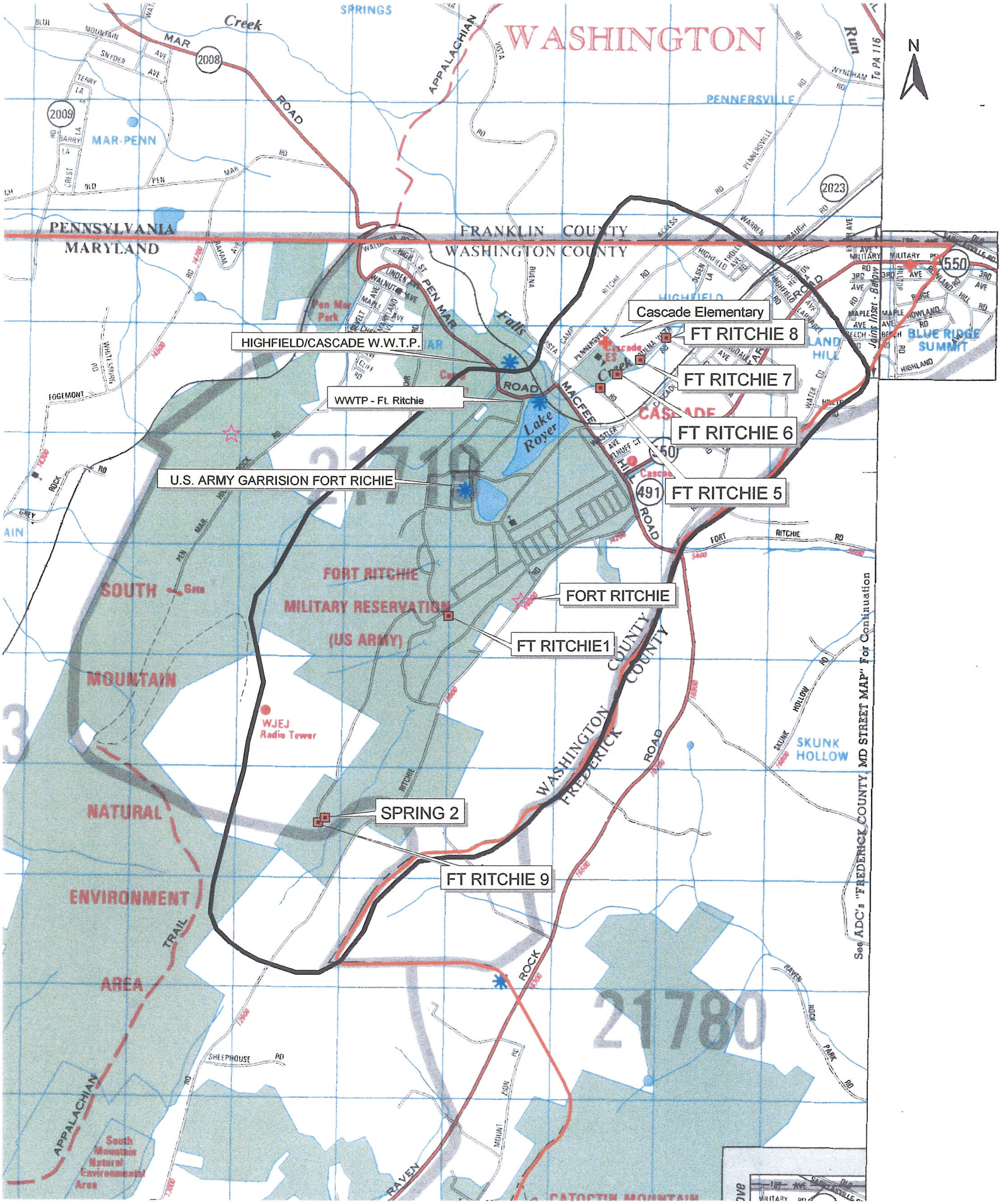
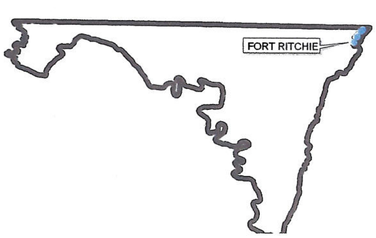



Figure 2: Potential Sources of Contamination in WHPA




1000 0 1000 2000 Feet

**Legend**

Water Sources | WHPA | Dischargers | Chs-Generators | UST

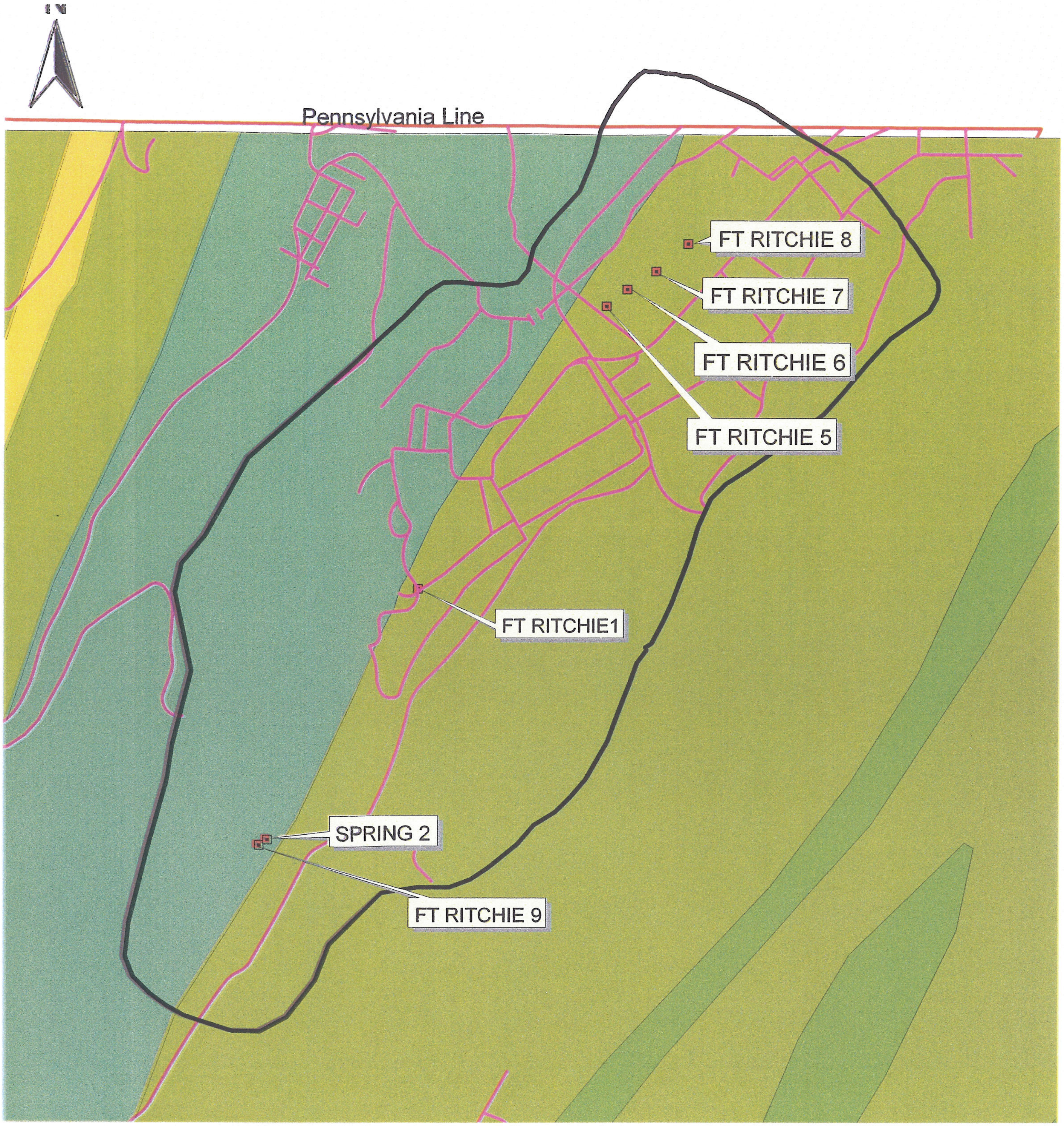
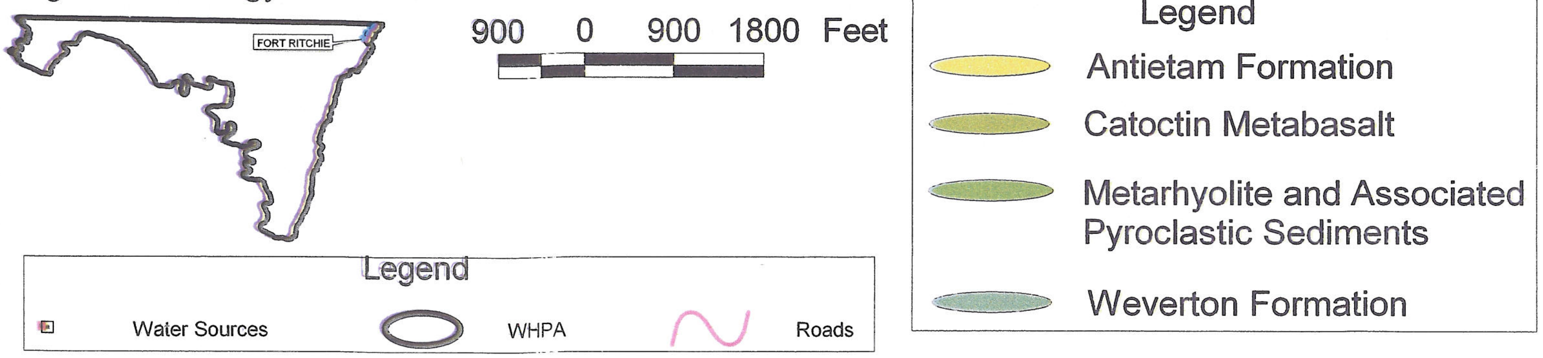



Figure 3: Geology of WHPA



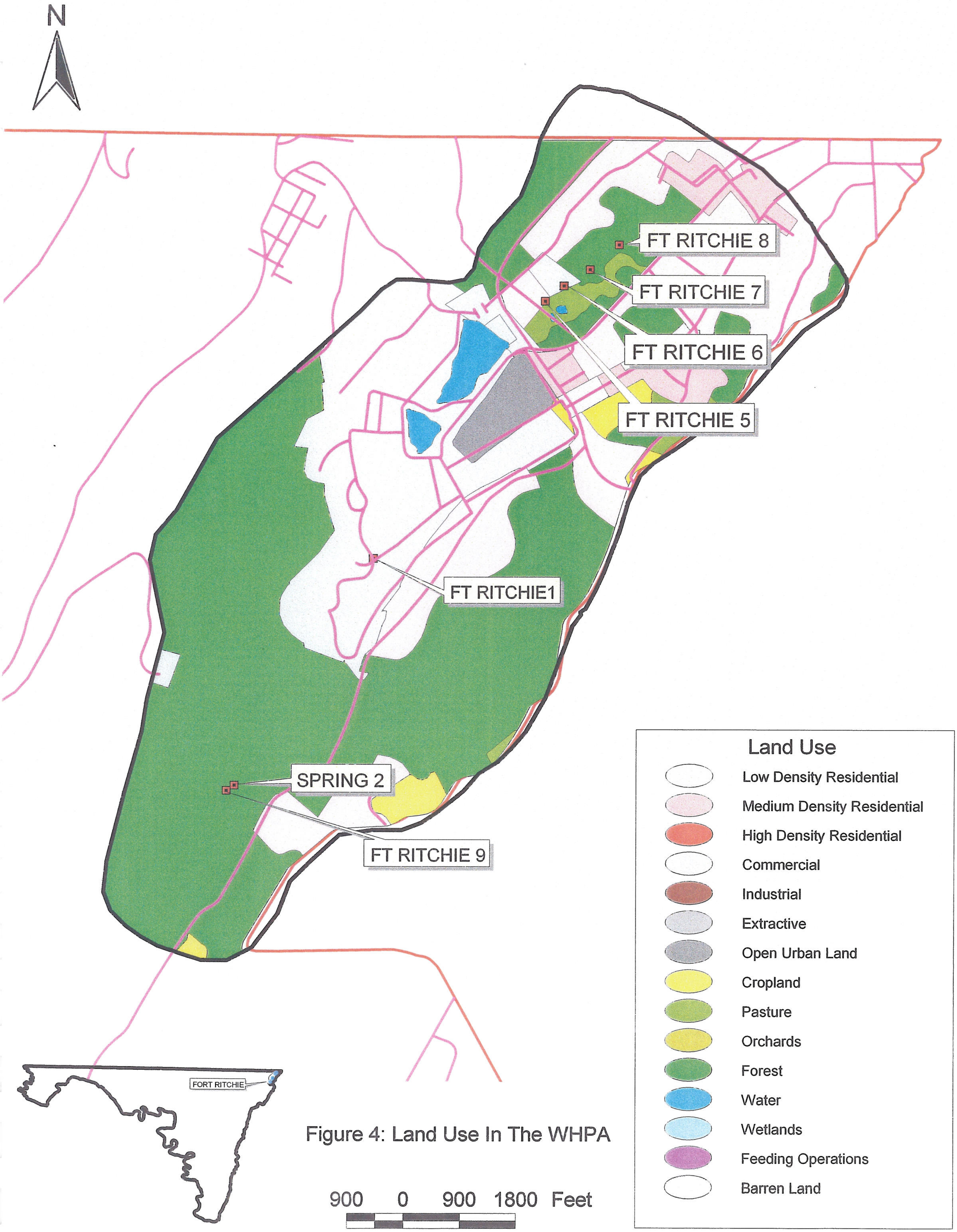



Figure 4: Land Use In The WHPA

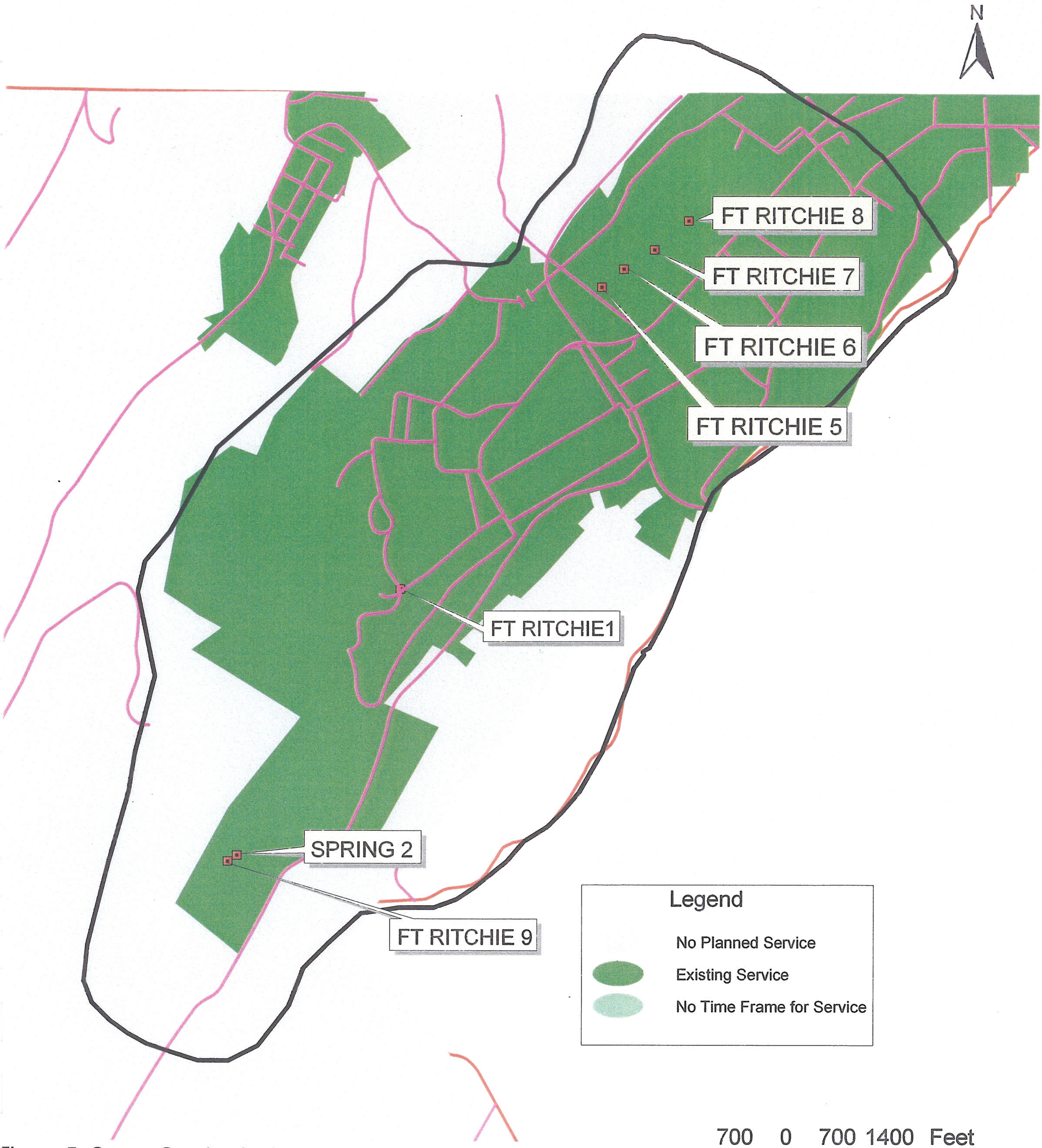
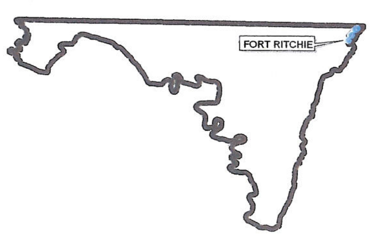
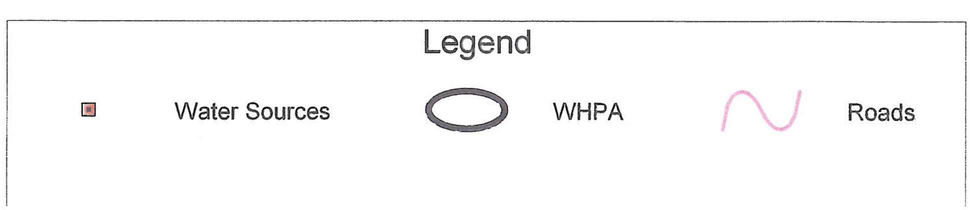



Figure 5: Sewer Service in the WHPA



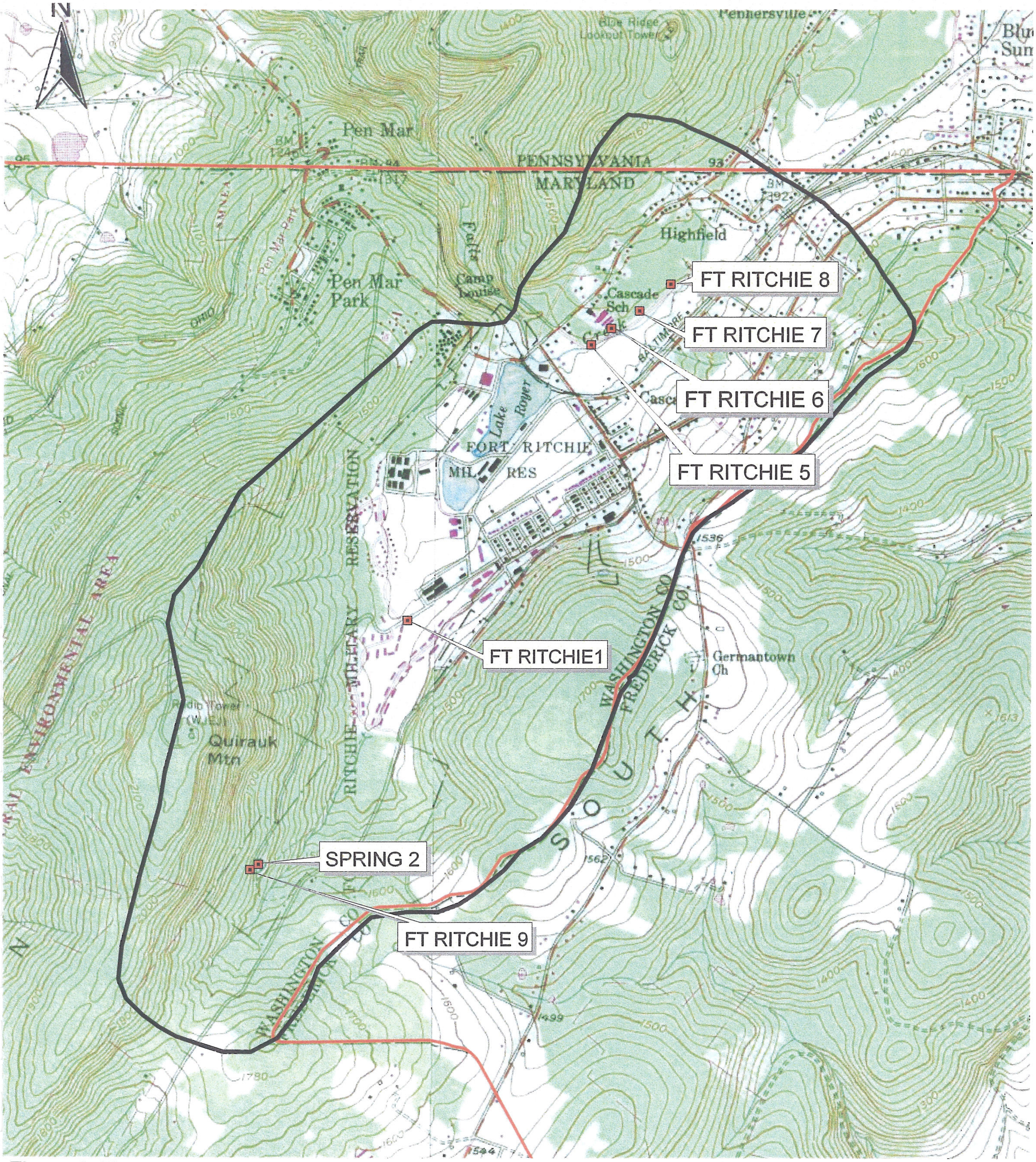



Figure 6: Topographic Map of WHPA