WELLHEAD PROTECTION PLAN
GREEN RIDGE STATE PARK – HEADQUARTERS COMPLEX
ACHD SITE NO. 66
Belle Grove, Allegany County, Maryland

ALWI Project No. AL7N001

1.0 INTRODUCTION

Advanced Land and Water, Inc. (ALWI) was retained by the Allegany County Health Department (ACHD), to prepare a wellhead protection plan for the headquarters complex of Green Ridge State Forest (the Complex), located 0.2 mile southwest of the intersection of National Freeway (Interstate Route 68) and M.V. Smith Road, near the summit of Green Ridge where it is crossed by Fifteen Mile Creek, in northeastern Allegany County, Maryland. The headquarters complex consists of visitors' services, a rangers office and maintenance shed. This site, designated No. 66 by ACHD, is served by two closely spaced production wells completed in the perched bedrock aquifer.

The draft MDE "Transient Water Systems Operations Guidance" manual (herein termed the "Guidance Manual") defines a Non-Transient Non-Community (NTNC) Water System as one that "...serves at least 25 regular consumers over 6 months per year." Given an unlikelihood of significant visitors center traffic in the winter, ALWI classified the complex as a Transient Non-Community (TNC) system.

1.1 PURPOSE

The Safe Drinking Water Act (SDWA) of 1974 required the U.S. Environmental Protection Agency (EPA) to develop enforceable drinking water quality standards to protect the public health. In 1986, amendments made to the SDWA strengthened provisions for the protection of underground sources of drinking water. These amendments included provisions for establishing Wellhead Protection Programs by individual states under "umbrella" EPA oversight. The EPA approved a statewide Wellhead Protection Program developed by MDE in June 1991.

The MDE program originally applied to community water supplies, only. A newly proposed broadening of the federal Clean Water Act will have the result of expanding the MDE Wellhead Protection Program to encompass non-community supplies both transient and non-transient in nature. ACHD, in cooperation with MDE, established this program to bring existing non-community supplies into compliance with the coming regulations.

1.2 SCOPE

ALWI prepared this wellhead protection plan following ACHD requirements, which followed MDE guidelines for transient system operation and wellhead protection.

1. **Site Reconnaissance and Interview** – ALWI observed the on-site wellhead, storage, treatment, and distribution infrastructure to the degree exposed without excavation or exposure to personal hazards. The owner of the Hotel described its history, water use and other issues potentially germane to wellhead protection.

2. **Baseline Water Quality Assessment** - ALWI purged the water system and collected samples for analysis in the ACHD laboratory that is affiliated with the Maryland Department of Health and Mental Hygiene (DHMH). ALWI performed this fieldwork in accordance with MDE potable water sampling criteria including in-field measurements of turbidity, chlorine, and pH. ACHD selected the analyte list based on countywide experience with potability concerns and the capabilities of the aforementioned laboratory. The analytes included total and fecal coliform bacteria, nitrates, nitrites, iron, sulfur and manganese (Appendix A).

3. **Contamination Hazard Assessment** – ALWI identified existing and potential contaminant hazards within the delineated WHPA based on visual observations and the techniques enumerated above. ALWI ranked these hazards in term of relative risk and provided concrete suggestions for their appropriate address. More generally, herein ALWI provides specific recommendations for source reduction measures, contingency plans, and other methods that may help better protect against occurrences of groundwater contamination.

2.0 HYDROGEOLOGIC FRAMEWORK

ALWI used published information from the United States Geological Survey and the Maryland Geological Survey to identify and describe the characteristics of the local hydrogeologic setting.

2.1 BEDROCK GEOLOGY

The Complex is situated within the Appalachian Valley and Ridge physiographic province and is underlain by sandstones of the Pocono Group, of Mississippian age. At Town Hill, these rocks have been intensely folded resulting in a large syncline (concave-upward fold). Alternating synclines and anticlines typify the structural geology of eastern Allegany County.

In three dimensions, the rock formations of such folds dip at right angles to the direction of plunge of the entire fold system. In general, dip directions may help govern groundwater (and contaminant) movement directions in the bedrock but plunge directions have no relation. As aforementioned, at this location the bedding planes are nearly flat-lying but curve upward sharply on the flanks of the hill. Topography is so marked that deep groundwater flow directions are also more likely influenced by topography than by structure. Reported local well yields are sparse but doubtfully exceed 5 gpm.

2.2 SAPROLITE AND SOIL MANTLE

Natural chemical weathering of the shallow portion of the bedrock, due to percolating water, has chemically altered many of the original rock-forming minerals to clays and other secondary minerals. This has resulted in the development of shallow saprolite (weathered bedrock) and the overlying soil mantle. The thickness of the soil and saprolite is generally 2 to 10 feet, but it varies considerably over short distances. In highly fractured zones, enhanced groundwater storage and movement has accelerated the breakdown of the rock-forming minerals and has caused formation of a thicker saprolitic deposit.

2.3 AQUIFER RECHARGE

Precipitation infiltrating through the soil on site and/or in up-gradient areas is the primary source of aquifer recharge to the on-site supply well. Generally, overlying soil horizons act to absorb and then slowly release infiltrating precipitation. However, in areas where fracture zones have formed, percolating groundwater can reach the water table quickly. A portion of the precipitation percolates downward through the soil mantle and then migrates through narrow, interconnected joints, fractures, faults, and cleavage planes in the bedrock.

2.4 GEOLOGY-CONTROLLED GROUNDWATER FLOW

Generally, bedding plane partings and cross-bedding fracture zones (where present) function as both downward and lateral water conduits. Consequently, such zones receive and transmit water at a rate higher than would otherwise be achievable and, accordingly, are preferential conduits for groundwater flow and contaminant transport.

Despite the bedrock's overall hardness and resistance to erosion, hydraulic permeabilities in bedding planes and fracture zones within the Hampshire Formation may be several times greater than in surrounding less-fractured rock. This intrinsic characteristic portends the possibility for the existence of specific zones with higher-than-normal well yields, higher-than-normal groundwater flow velocities and higher-than-normal susceptibility to groundwater contamination.

Because of the compressional tectonic forces that formed the Town Hill syncline, the underlying bedrock is resistant to erosion (hence forming a hill) and typified as a poor aquifer because fractures are few, narrow and of limited length.

3.0 WATER QUALITY ASSESSMENT

Slaughter and Darling (1962) reported the regional water quality as extremely irony (20 micrograms per liter [mg/l]) slightly acidic (pH of 6.6). ALWI interpreted that the reddish colors of the local rock exposures as likely attributable to the presence of iron.

At this location, ALWI collected baseline groundwater samples on December 14, 1998, in accordance with the MDE sampling procedures specified in COMAR 26.08.05. ALWI collected the samples from a sink in the bathroom as specified in COMAR 26.04.01.14. ACHD's laboratory analyzed the samples for those constituents of countywide concern. These included total coliform bacteria as specified in COMAR 26.04.01.11A-C, alkalinity, color, conductance, hardness, iron, manganese, nitrate-nitrite nitrogen (COMAR 26.04.01.14(4)(a)), nitrite nitrogen (COMAR 26.04.01.14(4)(b)), pH, and total dissolved solids.

The results are included as Appendix A, and suggest potability with respect to the analyses performed. Based on its location at the top of Town Hill, the supply appears not to be at risk for surface water influence as defined in the MDE guidance document.

4.0 WHPA DELINEATION

ALWI delineated a WHPA surrounding this site's well using generalized criteria developed by MDE for non-community supplies, as modified by ALWI (with ACHD consent) based on the specific topographic setting of the site. ALWI began by using a fixed radius of 1,000 feet around the well but noted that the site is located at the summit of a hill whose flanks exceed 2,000 feet in width. Further considering the rural setting and the depth of the wells ALWI herein considered the WHPA to extend 1,000 feet parallel to the trend of Town Hill but laterally only 500 feet.

The resultant delineation is shown on the "Water Plant Information" survey form (Appendix B) and encompasses approximately 15% of the circle (originally 72 acres in size) or 12 acres. Within an assumed 600 gallons per day per acre (gpd/ac) of annualized groundwater recharge (Slaughter and Darling, 1962, Table 37) and taking a further 50% reduction for steep slopes, over 3,600 gallons per day exists within the aquifer beneath this WHPA. In actuality, the modest demand on this well (doubtlessly less than 500 gpd) is nearly one full order of magnitude smaller than the WHPA, lending a high degree of conservatism to this analysis.

Negligible nitrate-nitrogen concentrations were detected in the sample ALWI collected. This obviated the need for a nitrate balance assessment.

5.0 CONTAMINANT THREATS ASSESSMENT

ALWI performed a site reconnaissance on December 14, 1998. During the reconnaissance, local land use conditions were observed with emphasis on the potential use, storage and disposal practices of hazardous materials and petroleum products. Such conditions may have included visual evidence for present or former spills, stained or discolored ground surfaces, stressed vegetation, unusual odors, or visible underground storage tank (UST) facilities. Adjacent and nearby properties were also visually scanned for such evidence from the property and nearby public right-of-ways. Off-site properties were not entered. No interview information was available to corroborate these limited observations.

5.1 Potential Hazards At the Wellhead

Design, construction and present condition are important factors in determining a well's susceptibility to contamination. Existing well completion reports for the wells (Appendix C) suggest the following:

1. **Casing and Cap** - Steel casing (approximately 6 in. in diameter) was set within a 10-inch diameter hole to approximately 20 feet below ground surface (BGS) in Well 1 and to 42 feet BGS in Well 2. ALWI observed that the portion of the casing exposed at ground surface appeared intact for the well. The well was equipped with a conventional pitless-style cap of the type that can sometimes allow insects to enter the well. An upgrade to a more modern cap would provide greater protection against microbial contamination.

2. **Grout** - Neat Portland cement originally sealed the annular space from 20 feet to ground surface for Well 1 and from 42 feet to ground surface for Well 2. ALWI could not observe the condition of this grout. If the subsurface grout is missing, bridged, or otherwise degraded, surficial contaminants could find a "short-circuit" pathway to groundwater by flowing down the outside of the casing.

3. **Water Bearing Zones** –Water-bearing fractures were encountered at approximately 210 and 315 feet below grade in Well 1. No accurate indication of fracture depths in Well 3 was provided. According to interview information provided by Ranger Lillard, Well 1 encounters reduced yields during drought periods.

5.2 Other Local Contamination Risks

Based solely on visual observation and interview information, ALWI identified the following potential sources of contamination within the WHPA: various on-site USTs, a vehicle maintenance building that contained hydraulic lifts and unmarked floor drains, and salt from parking lot deicing. These hazards are further discussed in the following section.

6.0 CONCLUSION AND RECOMMENDATIONS

ALWI found that the supply is potable relative to the analyses performed. No discharge to groundwater has been confirmed by any of the facilities or practices ALWI observed. Nevertheless, ALWI provides recommendations to assess and mitigate the risk from the following hazards:

1. **Underground Storage Tanks (USTs)** – USTs are present on-site and store heating oil, gasoline and diesel fuel. According to an informal interview, the fiberglass tanks are ten years old. The precise number, design, and condition of these USTs could not be

verified. Based on past experience, ALWI has observed that UST sites may achieve compliance and pass leakage detection tests even with low to moderate degrees of subsurface petroleum contamination. Given the proximity of the UST field to the wells, analytical testing to confirm the absence of gasoline and diesel oil constituents (e.g., benzene, toluene, ethylbenzene, xylene, methyl-tertiary-butyl ether [MTBE], naphthalene, and totals for both gasoline- and diesel-range petroleum hydrocarbon compounds seems appropriate[1]. Such testing should occur during late winter and again in late summer to assess variances due to seasonal differences in groundwater elevation. Periodic monitoring and other corrective actions as necessary should then continue based on the findings.

2. **Maintenance Buildings** – ALWI observed the presence of on-site storage buildings for equipment and supplies used in the maintenance and repair of forest property and facilities. ALWI recommends that potential liquid and solid contaminants be stored in sealed containers in precise accordance with manufacturers' and distributors' recommendations. Leaks and spills should be cleaned up at once using non-reactive absorbent materials whenever possible. The use of water for cleanup and fire fighting should be limited so that potential contaminants are not entrained. In this way, the potential for an uncontrolled, down-gradient release would be lessened.

3. **Floor Drains** - ALWI observed open floor drains in one of the buildings (the other building was inaccessible). The drains discharge to an unknown location. Should this drain discharge to the subsurface, it represents a potential pathway for liquid contaminants to enter the water supply. ALWI observed an oil stain on the floor of the maintenance building. For these reasons, ALWI recommends that all floor drains in vehicle maintenance and storage areas be sealed.

4. **Vehicle Lifts** – ALWI observed hydraulic vehicle lifts in the maintenance shed. No visible leakage or spillage of hydraulic oil associated with the lifts was observed at floor level. According to COMAR 26.10.02.02.B (3), hydraulic lift tanks are exempt from UST regulatory registration and reporting requirements. However, releases from hydraulic lift systems may be regulated, and releases from lifts of this type could occur long before being visually detectable. Therefore, ALWI recommends that the subfloor lifts be removed, properly closed and replaced with above-ground systems of modern design.

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[1] Any finding of petroleum-contaminated groundwater must be reported to the MDE Oil Control Program. Such a report would open (or reopen) an Oil Control Program case file. MDE Oil Control Program representatives may order additional sampling, UST tightness testing, UST removal(s), monitoring well drilling, and/or other investigative and remedial measures. ALWI suggests that site ownership and ACHD interests consult legal counsel before taking any action that could have adverse financial or environmental liability consequences.

5. **Roadway and Parking Area Deicing** – Highway and parking area deicing practices may increase a seasonal risk of sodium and chloride contamination. The Maryland State Highway Administration is unlikely to curtail or otherwise change deicing practices on Interstate 68. However, consideration should be given to using non-chemical abrasives on the parking lot for deicing to the degree possible. Baseline and bi-annual sampling for sodium and chlorides should be considered.

6. **Subsurface Disposal Facilities** – Older septic tanks of the type likely present may have seams. Though the low nitrate concentrations in groundwater indicate no present release, property ownership interest should embark on a regularly scheduled program of pump-outs. When the septic system needs replacement, the tank should be replaced with a seamless model and no facilities should be relocated uphill or within 100 feet of the well.

7.0 SELECTED REFERENCES

MDE Public Drinking Water Program, 1998, Transient Water System Operations Guidance; Guidance For Counties With Delegated Responsibilities (Draft), 45p.

Slaughter, Turbit H. and John M. Darling, 1963, The Water Resources of Allegany and Washington Counties: Maryland Department of Geology, Mines, and Water Resources, Bulletin 24, p. 408.

NONCOMMUNITY WATER SUPPLY SANITARY SURVEY

1. System Name: Green Ridge State Forest Headquarters

2. WAS: 66

3. System Information:

Address: Star Route, Box 50
Flintstone, Maryland

Phone No.: (301) 777-2345

4. ADC Map/Grid: N/A

5. Tax Map/Plat N/A

6. Population:

Transient >25
Regular
Total 25+

7. Property Information:

Owner's Name DNR Forest Parks & Wildlife Service

Address: Star Route, Box 50
Flintstone, Maryland

Phone No. (301) 777-2345

8. No. Service Connections:

9. Type of Facility:

Food Service
Church
Campground
Daycare
Other (specify) Forest

10. Contact Person:
Name: Francis Zumbrun

Phone No. (301) 777-2345

11. Operator:
Name:

Cert. No.

12. Sample History (Has the system had any violations?):

Bacteria: None apparent or reported

Nitrate: None apparent or reported

SURVEY RESULTS

13. Comments on System, Recommendations:

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2. **Maintenance Buildings** – ALWI observed the presence of on-site storage buildings for equipment and supplies used in the maintenance and repair of forest property and facilities. Leaks and spills should be cleaned up at once using non-reactive absorbent materials whenever possible. The use of water for cleanup and fire fighting should be limited so that potential contaminants are not entrained. In this way, the potential for an uncontrolled, down-gradient release would be lessened.
3. **Floor Drains** - ALWI observed open floor drains that discharge to an unknown location. ALWI recommends that all floor drains in vehicle maintenance and storage areas be sealed.
4. **Vehicle Lifts** – ALWI observed hydraulic vehicle lifts in the maintenance shed. No visible leakage or spillage of hydraulic oil associated with the lifts was observed at floor level. Releases from lifts of this type could occur long before being visually detectable. Therefore, ALWI recommends that the subfloor lifts be removed, properly closed and replaced with above-ground systems of modern design.
5. **Roadway and Parking Area Deicing** – Highway and parking area deicing practices may increase a seasonal risk of sodium and chloride contamination. The Maryland State Highway Administration is unlikely to curtail or otherwise change deicing practices on Interstate 68. However, consideration should be given to using non-chemical abrasives on the parking lot for deicing to the degree possible. Baseline and bi-annual sampling for sodium and chlorides should be considered.
6. **Subsurface Disposal Facilities** – Older septic tanks of the type likely present may have seams. Though the low nitrate concentrations in groundwater indicate no present release, property ownership interest should embark on a regularly scheduled program of pump-outs. When the septic system needs replacement, the tank should be replaced with a seamless model and no facilities should be relocated uphill or within 100 feet of the well.

14. Inspected by:	15. Date inspected:	16. System Vulnerability
Mark W. Eisner	12/02/98	Protected _____ Vulnerable yes (see report)

WATER PLANT INFORMATION

17. Type of Treatment:
(Check all that apply)

Disinfection	
Gas Chlorine:	____
Sodium Hypochlorite	x
Ultraviolet Radiation	____
Iron Removal	____
Nitrate Removal	____
PH Neutralizer	____
Other	____
Unknown	____

18. System Schematic (Process Flow):

NOTE: This diagram is a simplified schematic of operational process flow observed or described on the date of the reconnaissance. Many water systems possess malfunctioning, disconnected and/or occasionally/regularly-bypassed equipment. Actual treatment processes may differ, therefore, from those shown herein.

19. System Storage:

Ground Storage	____
Elevated Storage	____
Hydropneumatic Tank	x
Other	____

20. Storage Capacity:

Typical Domestic

21. Untreated water sampling tap?

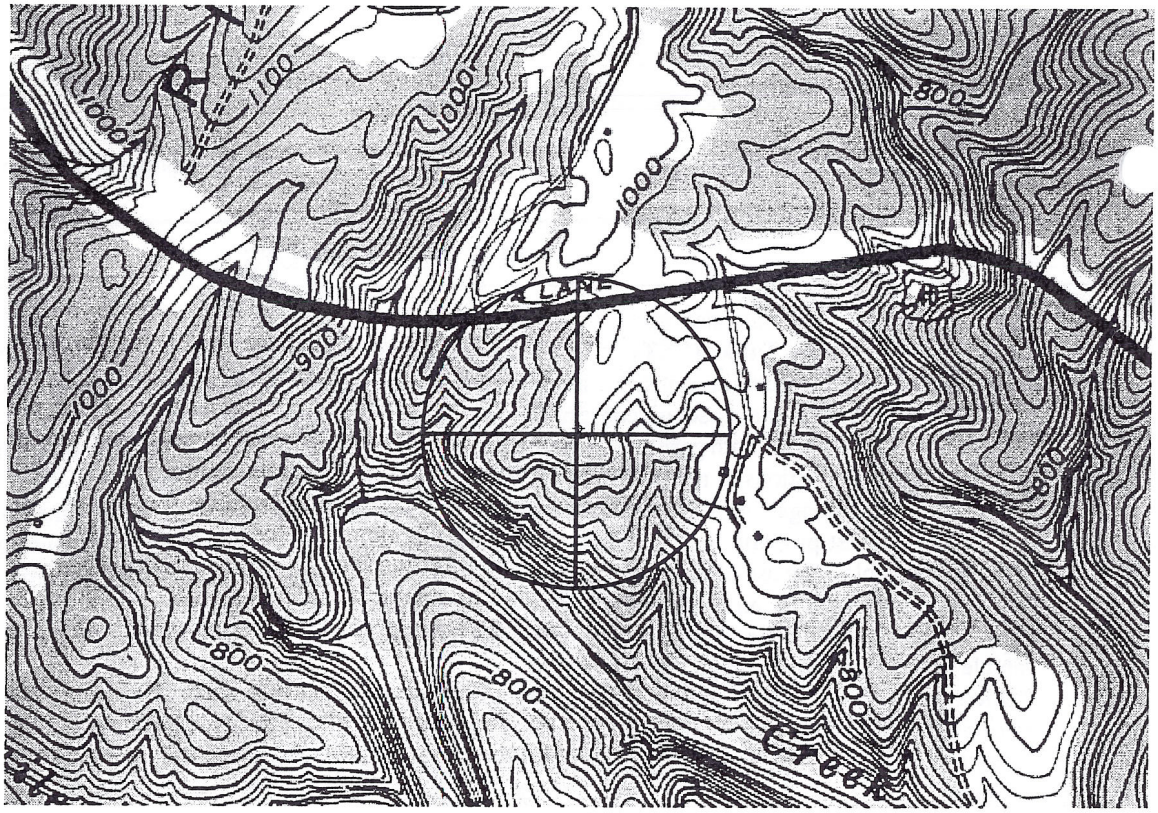
Yes ____ No x

WELL INFORMATION

22. Well Information:

Tag Number:	AL-81-0685 AL-88-0820
Year Drilled:	1988/1992
Casing Depth:	20/42
Well Depth:	396/423
Well Yield:	10/25
Casing Height:	1/1
Grout Depth:	20/42
Pitless Adapter?	____
Wiring OK?	unknown
Pump OK?	unknown

24. Well Location Diagram (1 in. = 1250 ft.) with Approximate Distances from Potential Contaminant Sources (i.e. septic, sewer lines, structures, petroleum storage, surface water bodies, etc.):



23. Well Type:

Drilled	x
Driven	____
Dug	____

25. Aquifer:

Name:	Mississippian
GAP #:	____
Confined	____
Unconfined	x
Semi-confined	____

26. Quantity Used:

Daily Avg (gpd)	<1,000
Pumping Rate (gpm)	____
Hours run per day	____

27. Well Cap:

Type?	____
Seal Tight?	O.K.
Vented?	O.K.
Screened?	No
Conduit OK?	O.K.

28. Casing Diameter:

2"	____
4"	____
6"	x
Other	____

29. Casing Type:

PVC	____
Metal	x
Concrete	____