SOURCE WATER PROTECTION PROGRAM
BENEFITING THE SALISBURY WATER SYSTEM (PWSID 022-0004)
WICOMICO COUNTY, MARYLAND

ALWI Project No. MD7S075

August 8, 2013

Prepared for

CITY OF SALISBURY

IN PARTIAL FULFILLMENT OF MARYLAND DEPARTMENT OF THE ENVIRONMENT IFB SOLICITATION NO. U00R1400308

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SOURCE WATER PROTECTION PROGRAM

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1.0 INTRODUCTION

Advanced Land and Water, Inc. (ALWI) was engaged by the Maryland Department of the Environment (MDE) to assist 12 community groundwater systems, including the Salisbury Water System (the City), in developing and implementing Source Water Protection Programs (SWPPs). These programs will help protect public health by identifying implementable measures to address existing and potential contaminant threats to groundwater supplies of safe drinking water.

In 2003, MDE developed a Source Water Assessment Plan (SWAP) report for the City (Appendix A). ALWI updated this assessment following technical guidance and advice received from the Water Supply Program of MDE. Notwithstanding this, source water assessments and protection programs are intrinsically dynamic. This assessment continuously is affected by new data, changing regulations and the evolving experience and professional judgment of those involved in developing and implementing this assessment and the recommendations herein.

ALWI updated Source Water Protection Area (SWPA) delineations, point and non-point source threat inventories, and contaminant susceptibility analyses. We then worked with the City and its stakeholders to develop a customized set of recommendations and other measures to achieve ongoing source water protection.

1.1 PURPOSE

Maryland's Source Water Assessment Program was approved by the U.S. Environmental Protection Agency (EPA) in November 1999, and MDE completed the initial Source Water Assessment report and Source Water Protection Plan for the City in 2003. The 2003 report included recommendations for ongoing management and protection, as well as periodic updates to reflect changes to the water system, appropriation permit and/or land uses within SWPAs as they may periodically occur. Note that in the 2003 report, SWPAs were termed "wellhead protection areas."

While these past efforts included recommendations for certain source protection and management concepts, ALWI interprets that the previous assessment focused more on evaluating existing conditions than on implementing specific measures for ongoing protection. MDE determined that the City be included under ALWI's current contract, based on an agency perception of its ongoing vulnerability to potential groundwater contaminants. Another criterion was the size of the population served, and thus, the number of people to benefit from this effort.

Accordingly, the overall purpose of this contract is to assist the City in developing a more refined and ongoing SWPP, which includes specific guidance on implementing feasible source protection measures.

1.2 REGULATORY FRAMEWORK

ALWI followed MDE's source water assessment and wellhead protection guidelines, stemming from The Safe Drinking Water Act (SDWA) of 1974 and its later amendments, which established wellhead protection programs for each state under the oversight of the EPA. The 1996 Amendments to the SDWA mandated the State of Maryland to develop a Source Water Assessment Program.

MDE completed a Source Water Assessment in 2003 (Appendix A), upon which the present SWPP effort builds. In September of 2011, ALWI was awarded the SWPP contract. The City's participation in the SWPP was voluntary and not a regulatory requirement under the SDWA.

1.3 BACKGROUND INFORMATION

According to City representatives, the City water system (PWSID 022-0004) serves approximately 31,243 people and about 11,124 connections using the Park and Paleochannel (or "Paleo") Well Fields, each of which has its own treatment plant (Appendix A):

- **Park Well Field** - This well field consists of eight active wells (7B, 8A, 10B, 14A, 15A, 16A, 17 and 18), one out-of-service well (Well 2A) and one standby well (Well 6A) located along a dammed section of the South Prong of the Wicomico River, largely within a City-owned park. Well 2A was taken out of service when casing and screen deterioration was discovered during well rehabilitation. The City has plans to abandon Well 2A. Each of these wells is completed in the unconfined Quaternary System (also referred to as the Salisbury Aquifer). Over time, some Park wells have been replaced by new wells, drilled adjacent to the old wells, and labeled with the same well number, followed by a different letter. According to the City, given that replacement wells were typically drilled adjacent to the since-abandoned wells, it stands to reason that the old wells were abandoned due to integrity issues and not water quality issues. Treatment at the Park water treatment plant includes aeration (for Volatile Organic Compounds, carbon dioxide and dissolved iron concentration reduction), chlorination, pH adjustment (lime), use of a corrosion inhibitor, and fluoridation.

- **Paleo Well Field** - This well field consists of two active wells (Paleo Wells 1 and 2) and a third planned well. Each is or will be completed in highly productive fluvial sediments, known as the Paleochannel (Andreasen and Smith, 1997). The Paleo Well Field generally is located along Naylor Mill Road, on the northern edge of the City. As further discussed in Section 2.1, the Paleochannel is unusual for its prolific aquifer properties, limited areal extent and susceptibility to contamination. Treatment at the Paleo water treatment plant includes greensand filtration (for manganese), pH adjustment (caustic), chlorination, use of a corrosion inhibitor, and fluoridation.

In 2003, MDE recommended that Salisbury form a local planning committee to develop, refine and implement a source water protection plan for the two well fields, while continuing to

monitor regulated and unregulated contaminants as listed in the SDWA (Appendix A). Many of the 2003 MDE recommendations were not fully implemented. Herein we revisit these recommendations based on updated data (e.g., water quality, point source hazards inventories, land use overlays, etc.), steering committee discussions, applicable present guidelines and our professional experience. As such, this SWPP updates the earlier MDE recommendations.

2.0 SWPA DELINEATION UPDATE

As necessitated by applicable provisions of MDE Source Water Assessment guidance documentation, ALWI updated the delineations of the SWPAs for the Paleochannel Well Field and the Park Well Field (Figures 1 and 2, respectively). In working with the City's Steering Committee (see Chapter 5.0), for each area four zones were delineated and recommended to have incremental protection measures, with Zone 1 being the most restrictive.

2.1 HYDROGEOLOGIC FRAMEWORK

Andreasen and Smith (1997) describe the hydrogeologic framework of the aquifers supplying both the Paleo and Park well fields.

- **Paleo Well Field** - The Paleochannel is an exceptionally prolific but areally restricted curvi-linear sand-and-gravel deposit of fluvial (i.e., river) origin. Many geologists believe it was deposited during the Pleistocene Ice Ages, when fast-moving rivers were carrying coarse-grained sediments from glaciated terrain to the north and toward oceanic discharge considerably further south and east than found today. The coarseness of the sediments provides for an unusually prolific aquifer.

- **Park Well Field** - The sediments that comprise the Salisbury Aquifer, which supplies the Park Well Field, are believed to have been deposited in a sheet and thus cover a wider area than the more geographically narrow and laterally restricted Paleochannel. Both aquifer systems are partially overlain by discontinuous confining layers. As such, MDE judges them to be "semi-confined" for the purpose of source water protection area delineation.

2.2 PAST DELINEATIONS

In 2003, MDE delineated SWPA zones based on the numerical groundwater modeling work of Andreasen and Smith (1997). These authors used numerical groundwater modeling to backtrack parcels (or particles) of water to their most likely zones of origin under certain conditions. This technique allows the modeler to identify the most likely source and pathway of water entering each well. A standard hydrogeological practice is to use a limited number of particles, for simplicity and computational rapidity. However, limiting the number of particles can result in models falsely reflecting the spatial distribution between them, rather than the infinite continuum of intermediate particle positions that the model is endeavoring to portray.

In the 1993 Maryland Geological Survey (MGS) model, eight particles were used in the Park Well Field, one for each well (Andreasen and Smith, 1997). The authors published particle-discrete flow-paths, resulting in a mapped appearance of narrow channels of groundwater flow with parallel spaces between this. Their maps may not have been intended for strict SWAP

delineation use because of the possibility of confusion and misapprehension regarding intermediate locations between particle tracks.

Some may have misapprehended the discrete particle tracks as being the only zones of groundwater flow toward the wells; this literal interpretation would not have been the authors' intent. The Andreasen and Smith (1997) maps had delineations that took the form of elongated, narrow strips reaching away from the well fields (substantially more so for the Park well field), with spaces between that were an artifact of positioning of the particle tracks rather than being innate aquifer properties.

ALWI noted that Andreasen and Smith (1997) make no reference to source water protection (or its then-common synonym, wellhead protection). Cognizant of this, and with a goal to simplify source protection implementation and enforcement, ALWI proposed and MDE fully concurred with an infilling approach to the re-delineations. The re-delineations now are correlative with present appropriation permit quantities and represent a continuum of tracked particles (and contiguous areas of protection).

2.3 DELINEATION UPDATE

The 1993 MGS model (Andreasen and Smith, 1997) served as the base from which ALWI began revising City delineations. The revised delineations also reflect changes in groundwater withdrawal rates since 1993, as follows:

1. **Review of 1993 MGS Model** - As aforementioned, the 1993 model (Andreasen and Smith, 1997) served as the base from which we began revising City delineations. This model incorporated a multi-zone approach based on various modeled transport times. We preserved this multi-zone approach in our revisions based on 10-, 20- and 50-year times of travel. These travel zones became revised SWPA Zones 1, 2 and 4, respectively. Note that present Zone 4 was termed Zone 3 by Andreasen and Smith (1997).

2. **Filling in Spatial Gaps** - As directed by MDE and approved by the City, spatial gaps on the 1993 MGS delineation maps were filled in to achieve more uniform and implementable SWPAs (Figures 1 and 2). We believe these gaps were artifacts of a finite number of discrete particle tracks used in the initial modeling. Filling these gaps also increased the overall protective area around each well. The City agreed with this approach during Steering Committee meetings held on December 21, 2011, March 12, 2012 and May 7, 2012.

3. **Incorporation of Additional Paleochannel Areas** - The Steering Committee requested that we continue to delineate (to afford protection for) the entire Paleochannel as mapped by the Wicomico County Planning Office and reflected on the County Zoning Map dated January 22, 2009 (Appendix B). ALWI notes that the entire Paleochannel, reflected in Appendix B, would not otherwise warrant protection as mandated by applicable MDE guidance, but we acceded to the Steering Committee request. These areas are shown as SWPA Zone 3 (Figures 1 and 2). Where the Paleochannel overlaps more restrictive SWPAs (i.e., Zones 1 and 2), the protections associated with the most restrictive applicable zone would apply.

4. **Scaling of MGS Delineations to Account for Permit Increase** - The prior Source Water Assessment for the City relied on the 1993 MGS delineations (Figures 34, 35 and 39 of Andreasen and Smith, 1997). Because those models reflect the City groundwater appropriation in 1993 (5,200,000 gallons per day [gpd]), those delineations became obsolete once the overall appropriation was increased to 7,600,000 gpd. In order to estimate the additional area required (accounting for the City appropriation increase), we applied scaling factors by well field (Table 1) calculated from 2010 forecasts (Figures 34, 35 and 39 of Andreasen and Smith, 1997). These scaling factors were applied to the Zone 1 and 2 delineation updates only, because we recommend that Zone 4 protective measures be limited to public education and community outreach. Zone 3 is predicated on the zoning map and is not dependent on the MGS model, and thus required no adjustment.

The City agreed with this overall approach during the aforementioned Steering Committee meetings. The re-delineated SWPAs generally are larger in total area than those depicted by Andreasen and Smith (1997). Figures C1 and C2 within Appendix C depict jurisdictional enforcement by Zone. Re-delineated SWPAs are described as follows:

ZONE	BASIS / DESCRIPTION	CONTAMINANT HAZARDS (CHAPTER 3)	PROTECTION STRATEGY (CHAPTERS 4 AND 5)
1	10-Year Time of Travel; Scaled to Accommodate Permit & Population Changes Since Original 1993 Models	Inventoried & Mapped	Functionally Identical City and County Ordinances
2	20-Year Time of Travel; Scaled to Accommodate Permit & Population Changes Since Original 1993 Models	Inventoried & Mapped	Functionally Identical City and County Ordinances
3	Remainder of Paleochannel	Inventoried or Mapped if also in a Travel Time Zone	Functionally Identical City and County Ordinances
4	50-Year Time-of-Travel	Inventoried & Mapped	Public Awareness & Community Outreach

In response to a request from the City, MDE verified agency acceptance of these re-delineations in correspondence to the City dated October 24, 2012 (Appendix D).

3.0 CONTAMINANT THREATS ASSESSMENT

ALWI performed a regulatory database review, field reconnaissance and limited interviews in order to expand the 2003 inventory of potential sources of contamination to encompass the updated SWPAs. We considered both point and non-point sources of contamination in SWPP Zones 1, 2 and 4, as well as in the portion of Zone 3 that also was within an original modeled travel zone (see green outlines on Figures 3 and 4).

Note that neither the delineation of Zone 3 nor its protection (beyond the aforementioned travel zones) is required or suggested under applicable MDE guidance. Its inclusion as a delineated area and a protection zone merely was at the request of the City and County. Consequently and because of contractual limitations and in accordance with applicable MDE guidance, ALWI did not identify point or non-point contamination sources in those areas of Zone 3 beyond the originally modeled travel zones.

3.1 STATE ENVIRONMENTAL DATABASE REVIEW

MDE provided ALWI the following state-maintained environmental databases to incorporate into point-source hazard inventories, with the date of database publication provided parenthetically as follows:

- Municipal and Industrial Groundwater Discharge Permits (12/21/2011);
- Pesticide Dealers (1/12/2012);
- Land Restoration Program Sites (Voluntary Cleanup Program and Comprehensive Environmental Response, Comprehensive, and Liability Act) (1/16/2012);
- Oil Control Program Underground Storage Tank and Leaking Underground Storage Tank Database (10/14/2011);
- Supplemental database listings of solid waste facilities, wood waste disposal sites and other hazardous waste generators (2/2012); and
- Resource Conservation and Recovery Act (RCRA) sites (6/18/2012).

The databases helped with interpretations of groundwater susceptibility, in that the listed facilities may be generators of hazardous materials, petroleum products and/or other drinking water contaminants. Results of this review are integrated with the susceptibility discussion in Chapter 3 of this report.

Note that the hazard classifications within the furnished MDE databases transcend the guidelines for groundwater source protection, as established by MDE (for example, sites which merely generate hazardous wastes as an incidence of business operations and that are not locations of controlled hazardous substances releases need not be mapped). If such locations were included in the MDE databases they were included herein, even though it was not necessary to include them.

3.2 FIELD RECONNAISSANCE

ALWI supplemented the database review with a visual reconnaissance within the SWPAs on December 21, 2011 and January 13, 2012 (Table 2; Figures 3 and 4). During this reconnaissance, local land use conditions within Zones 1, 2 and 4 (and within the sub-portion of Zone 3 initially delineated by Andreasen and Smith [1997]) were observed with an emphasis on the potential use, storage and disposal practices of hazardous materials and petroleum products in such a location where City wells potentially could entrain related contaminants.

Such conditions may have included visual evidence of present or former spills, stained or discolored ground surfaces, stressed vegetation, unusual odors or visible underground storage tank facilities. Adjacent and nearby properties were visually scanned from public rights-of-way to the degree practicable.

Table 2 generally reflects the results of the field reconnaissance for point source contamination hazards. Though ALWI did not observe specific contamination threats warranting further investigation or corrective action, (1) contamination hazards may exist that remain undetected because of limitations in the methods employed (concealed visual evidence, etc.) and/or (2) new contamination hazards may develop in the future. For these reasons, the measures employed herein for identifying contamination hazards should be repeated periodically.

ALWI also performed a field reconnaissance of the wellheads, themselves, guided by City representatives. The municipal production wells appeared to possess good physical integrity, though no subsurface or invasive work of a confirmatory nature was performed. The production wells terminate inside structures, and the Paleo wells also are surrounded by fencing. No confirmed sources of existing, direct contamination to the wells or aquifer within SWPAs were observed.

The water supply exploratory borings in the Paleo well field are used by the City as raw water quality monitoring locations. The wells are properly secured with locks. Typically water supply exploratory borings which are not intended for future use would be abandoned since they are possible point source hazards of contaminations. However, the City currently is utilizing these borings and has acknowledged that they will be properly abandoned once they no longer are used for raw water quality monitoring.

3.3 NON-POINT SOURCE CONTAMINATION HAZARDS AS SUGGESTED BY LAND USE

MDE guidance suggests consideration and mapping of the public sewer service area and the following classifications of land use within the SWPAs (exclusive of Zone 3 areas outside of mapped travel time zones): agriculture, forest, residential, industrial, commercial, public lands and mined lands (Figures 3 and 4). Each of these has potential implications in terms of non-point contamination sources (e.g., septic systems outside of public sewer service areas and the possibility of leaking mains inside said areas).

Potential sources of non-point-source contamination may include but are not restricted to:

- **Septic System Discharges** - These include nitrate- and bacteria-laden discharges concordant with the intended design of septic systems. They also can include the inappropriate discharge of hazardous and other regulated liquids through such systems, arising from ignorance or intent. For this reason, MDE guidance suggests consideration and mapping of the public sewer service area(s), with the inference that those areas not sewered are on septic systems. Sewer system maps available from the Maryland Department of Planning (Figures 3 and 4) suggest that 83% of the Paleo and 61% of the Park SWPAs lie outside of the sewered area.

- **Agriculture** - Fertilization of cultivated fields, livestock wastes, and agri-chemical releases constitute the primary sources of groundwater contamination from agricultural sources. Agricultural lands within the SWPAs may be sources of nutrients (including nitrates), herbicides, insecticides and/or animal wastes. Agricultural land use statistics by SWPA are included in Table 3. As displayed on Figures 3 and 4, agricultural land uses appear not to exist closer than 600 feet from the Paleo wells and 3,000 feet from the Park wells.

- **Sediment and Stormwater** - Commercial and industrial land uses, particularly those with substantial impervious areas, may contribute to contaminant- and sediment-laden stormwater within the SWPAs. Some measure of additional, future development also is possible. Related land use statistics by SWPA are included in Table 3.

- **Fuel Use and Storage** - Liquid petroleum products commonly are used as a heating fuel. The extent of reliance on heating fuels within the SWPAs is unknown, and determining the degree to which heating oil is used was outside of the scope of this SWPP. However, it is reasonable to assume that some use of liquid petroleum products exist within the SWPAs. Leaks and spills associated with the use and storage of heating fuels may expose City sources to hydrocarbon contamination.

Sources of the information summarized in this subsection included available 2010 GIS data for land use and public sewer service areas. Data sources included the Maryland Department of Planning and Wicomico County. Figures 3 and 4 reflect areas within applicable SWPAs and travel zones, outside present municipal sewer service areas. Table 3 reflects dominant land uses by type, within each delineated SWPA.

4.0 CONTAMINANT SUSCEPTIBILITY

ALWI completed a review of available groundwater quality records, integrated with other findings herein, to support an assessment of groundwater susceptibility. MDE guidance defines a threshold for regarding a water source being “susceptible” to a given contaminant as being either:

- When the concentrations exceed 50% of the Maximum Contaminant Level (MCL); and/or

- When a persistent but lower concentration is either increasing or appears to be associated with an unknown or unexpected source.

In addition to these water quality data considerations, ALWI also considered the following factors in evaluating overall susceptibility:

1. The spatial position of sources of potential contamination relative to sources and SWAPs;

2. Observed conditions of wellhead integrity and housekeeping; and

3. The natural chemical properties of the source water within contributing aquifers.

Water within the City distribution system is treated and meets regulatory requirements. This susceptibility analysis is not an evaluation of System compliance. The finding of susceptibility does not indicate or suggest an out-of-compliance condition or a need for immediate, corrective action. Matters of compliance are addressed through MDE-mandated sampling programs.

4.1 PROCEDURES

ALWI completed the susceptibility assessment in accordance with the following step-wise procedure:

1. **Obtain and Filter Water Quality Databases** - ALWI reviewed available electronic databases of water quality analyses provided by MDE for the period 2002 to 2011 and further supplemented by data provided by the City for the period of 2005 to 2011. These data document myriad contaminants, though many of these are not subject to this groundwater assessment due to having only a Secondary MCL[1] (e.g., iron, manganese, etc.). For this reason, the databases were filtered to isolate only groundwater contaminants affecting City supplies.

2. **Consider Chemical Classes and Sampling Conditions** - The furnished databases were developed by MDE as an incidence of operational compliance record-keeping. These databases contained analytical records for inorganic compounds (IOCs) including radiological species, volatile and synthetic organic compounds (VOCs and SOCs). In most cases, the available water quality records only reflect post-treatment, composite water samples (of largely surface water) but do not reflect raw groundwater sources. As such, mixing, blending and treatment efficacy is reflected in the water quality results as furnished to us. Generally the absence of comprehensive analytical results for raw groundwater samples hampered our efforts to correlate specific water quality findings with specific wells.

3. **Review Paper Records in MDE Files** - ALWI supplemented the MDE databases with laboratory reports that were available in MDE paper files.

4. **Identify "Exceedance" Instances** - In order to identify water quality sample exceedances, ALWI compared each specific analytical result to published MCLs (in COMAR 26.04.01 as of September 2011). Guided by MDE, we judged that a concentration greater than 50 % of a given MCL should be considered an "exceedance." Procedurally, this was accomplished by sorting the database by analyte and concentration.

5. **Assess Frequency and Relative Percentage of Exceedance Instances** - The number of times that a given analyte was detected in a concentration greater than 50% of its respective MCL was discerned in terms of overall frequency, percentage of total number of samples and date range of exceedance. Contaminants with results equaling or exceeding 50% of the MCL more than 10% of the time were considered *prima facie* susceptible. ALWI also identified changes in contaminant trends over time, even for those that did not equal or exceed 50% of the MCL more than 10% of the time.

[1] In accordance with the 1999 MDE SWAP guidance document, ALWI did not include secondary MCLs in the quantitative susceptibility analysis herein.

6. **Integration** - ALWI then considered these identified exceedances in the context of the results of the contamination hazard reconnaissance to correlate water quality results to specific field observations suggestive of a condition of susceptibility. Results are listed in Table 4 and are discussed in Sections 4.2 through 4.3 herein.

ALWI noted that the 2003 MDE-prepared Source Water Assessment reports susceptibility to certain water quality parameters and chemical classes detailed in the following paragraphs/sections. We also observed that hydrogeological conditions (unconfined to semi-confined aquifers) and land uses (generally anthropogenic development for the Park well field and generally agricultural for the Paleo well field) suggest a level of future risk of contaminant entrainment (including but not restricted to VOCs for both well fields and nitrates for the Paleo well field) irrespective of the content of the water quality records reviewed for this SWPP and discussed herein.

For conservatism and appropriate source water protection, provisions of ALWI-recommended ordinances (see Sections 5.1 and 5.2, Table 5) have been developed to help limit the likelihood of future contamination from point and non-point sources, whether or not presently contributing to conditions of quantitative susceptibility.

4.2 NITRATE SUSCEPTIBILITY

The City completed a nitrate sampling program for the Park well field from January 2009 to December 2011. Nitrate concentrations exceeded 50% of the MCL more than 10% of the time in Wells 7, 8, 10, 14, 15, 16, 17 and 18. Susceptibility statistics for these wells are presented in Table 4. From this information we concluded that the Park well field collectively is susceptible to nitrate contamination (Figure 5) and that data to exclude specific wells from this determination is insufficient.

Several point and non-point nitrate sources exist within and adjacent to the Park well field, including but not limited to Elks Golf Course, the Salisbury Pony League (baseball field), the Salisbury Zoo, residential lawns and agricultural lands. Additionally, landowners who are not connected to the public sewer system may use septic systems that could contribute nitrate to groundwater.

While the 2003 Source Water Assessment stated that the Paleo well-field is not susceptible to nitrates (confirmed in this report), the City believes that nitrates could become a problem in the well field. A test well near the Jersey Road/Naylor Mill Road intersection has recorded levels above the 50% MCL. While the susceptibility may not be as high as in the Park Water Treatment Plant, the nitrate concentrations observed in this test well may forebode a future condition of nitrate susceptibility.

Despite its residential and agricultural land use patterns (Table 3 and Figures 3 and 4), the Paleo well field is not presently susceptible to nitrate contamination (Figure 6). This finding is supported by available water quality data (Table 4 and Figure 6). Notwithstanding this finding, ALWI cautions that the City should continue to closely monitor nitrate concentrations in the Paleo wells, as a large proportion of lands within the Paleo SWPA are (1) in agricultural use

and/or (2) outside of City sewer service. Given those conditions, a future finding of susceptibility is of heightened possibility.

4.3 LEAD SUSCEPTIBILITY

The City completed a limited, source-specific lead sampling program for both well fields on February 25, 2008. Paleo Well No. 1, and Park Well Nos. 7, 14, 15 and 17 were tested. Park Well 17 had a lead concentration of 0.0161 mg/L, exceeding the drinking water MCL of 0.015 mg/L. Lead also was detected at a very low concentration (0.0024 mg/L), far below 50% of the MCL, in Well 1. Two days later, Well 10 also was tested for lead, and had a very low concentration (0.0025 mg/L), far below 50% of the MCL. Lead was not detected in the other wells tested during these sampling events. From this data, we concluded that Park Well 17 is susceptible to lead contamination. Additionally, lead was detected at 0.006 mg/L (below 50% of the MCL) in Paleo Well 1 in March 2005.

The distribution of lead contamination throughout the two well fields is not indicative of aquifer-wide contamination. It is more likely that lead is leaching from pumping or pipe equipment in Well No. 17 as an indirect consequence of groundwater acidity. Prior to 1995, lead widely was used in the manufacture of pump equipment and in the composition of plumbing components. Wells installed prior to 1995 may continue to use lead-based equipment.

Exposure to acidic groundwater can cause lead to leach from the equipment and become dissolved in the groundwater that is in direct contact with the well. Though blending likely keeps distribution system concentrations below applicable public health standards, ALWI recommends that the City consider replacing the Well 17 pump and supporting appurtenances with equipment of assured lead-free design. More detailed recommendations are provided in Section 5.2.

4.4 OTHER GROUNDWATER CONTAMINANTS

Other positive detections for certain water quality parameters existed within the datasets provided by MDE and the City. The relative frequency and concentrations of these detections varied greatly. Relevant observations include the following:

- Certain contaminants that MDE made special note of in the 2003 SWAP remained well below 50% of the MCL, but had additional detections since MDE's previous analysis (e.g., Methyl Tertiary Butyl Ether, or MTBE, and 1,2-Dichloropropane). Because these two parameters have shown continuous but sporadic detections over time, we recommend monitoring with greater frequency than otherwise required by MDE.

- For other parameters mentioned by MDE in the 2003 report, concentrations have not since been detected (e.g., tetrachloroethylene and benzene).

- Our review of water quality data indicated that City sources are not susceptible to radionuclides or microbial contaminants.

5.0 STEERING COMMITTEE INTERACTIONS AND RECOMMENDATIONS

Salisbury convened a Source Water Protection Steering Committee comprised of officials representing the City and Wicomico County Departments of Planning and Public Works. ALWI met with the Committee twice during the first half of 2012.

5.1 ORDINANCES

The Steering Committee accepted an ALWI recommendation to achieve source water protection via ordinance, inasmuch as each jurisdiction already had protective ordinances on the record. Appendix E contains source protection ordinances as they existed at the start of this effort: City Ordinance No. 1912 and County Code Chapter 255 (2004) land use protection ordinances.

ALWI led Steering Committee discussions to contrast the City and County ordinances. The MDE Model Wellhead Protection Ordinance may have formed a rough framework for the initial development of both ordinances prior to our involvement. At the outset of this SWPP, both ordinances were found to cover part of the same land area, but differed in technical detail. Elements in both ordinances were vague and in certain places, seemingly contradictory.

We recommended, and the Steering Committee readily agreed to have functionally identical ordinances for both jurisdictions (e.g., land use restrictions would be the same for the Paleochannel in City and County ordinances). Achieving this required myriad adjustments in the detailed narrative of both ordinances, as summarized on Table 5. The revised ordinances now reflect a single set of protection measures operative both within and outside of City limits.

5.2 DELIBERATIONS AND AGREEMENTS

The Steering Committee enthusiastically supported the SWPP effort and came to an agreement on the following:

1. **Delineations** - The Steering Committee accepted the re-delineations but sought that they be reviewed and approved by the MGS, who had performed the initial 1993 delineations. The Steering Committee came to accept an ALWI recommendation that MDE serve as the reviewing and approving agency, inasmuch as source water protection is guided, regulated and approved by MDE. Said approvals were sought and achieved in writing (Appendix D).

2. **Ordinance Revisions** - As detailed in Section 5.1, the Steering Committee invested substantial time and effort discussing, deliberating and ultimately agreeing on functionally identical protection strategies for each zone as summarized in Table 5.

3. **Community Involvement and Public Workshop** - The Steering Committee initially accepted the concept of public involvement in source water protection, as ordinance revisions require the review and voting approval by both City and County Councils. Applicable MDE guidance also recommends public involvement in the consideration and adoption of protective measures (such as the Ordinances). The Steering Committee originally planned to merge a joint City-County public workshop on source water protection with the public input solicitation processes otherwise inherent to Ordinance(s) revision and adoption procedures of

each jurisdiction. However, the City later decided that a senior staff briefing was preferred, in lieu of a public workshop. The City ultimately came to direct us to produce a final version of the report, stating that, "the report is well-written and quite self-explanatory, so we do not necessarily need to meet to go over it." Prior to expressing this desire, a presentation for a public workshop already had been drafted and is included as Appendix F. We recommend that a workshop, incorporating the presentation provided in Appendix F, be conducted at such time that the City and County determine to implement our ordinance recommendations.

In the following subsections, we summarize measures that we offered to the Steering Committee for implementation. We recommend execution of these to help verify certain findings that presently are tenuous due to limited data, the budget supporting this effort and/or the non-invasive nature of SWPP development efforts.

5.3 RECOMMENDATIONS FOR SUPPLEMENTAL INVESTIGATION

1. **Resample for Lead** - The City should continue sampling Well No. 17 for lead concentrations, to observe changes in time. To determine whether or not lead is leaching from pump equipment, the City should consider sampling both before and after the well is purged during a pumping event. Lower lead concentrations following the flushing of the well would indicate the acidic water causes lead to leach during the quiescent periods between pumping events. Constant lead concentrations after flushing would indicate that the aquifer in the vicinity of the affected well is contaminated with lead. If the former condition is factual, the remedy would be to replace the equipment with components of certified lead-free design.

2. **Continued Monitoring For Nitrate, MTBE and 1,2-Dichloropropane** - The City should continue sampling for these constituents to verify that they are not increasing with time. Nitrate results might be used to further differentiate between point sources and land uses of non-point contaminant origin.

5.4 PROTECTIVE RECOMMENDATIONS

The citizens benefit the most from the City and County both adopting the Ordinance revisions outlined in Table 5. Protective measures within portions of Zone 3 outside of the MGS-delineated travel time zones do not strictly bear on protection of present City sources, but are included at the specific request of the Steering Committee.

In addition to the Ordinance recommendations, below is a list of other protective recommendations, again presented in decreasing order of our present sense of their relative importance, implementation feasibility (including cost) and benefit. The need and order of these easily could change based on investigative findings, available funding and the input of MDE and other parties.

1. **Agricultural Outreach** - We see potential benefit in financial incentives (including but not necessarily restricted to property tax reductions) offered to property owners of CAFOs and other farms, for their proactive and voluntary cooperation in planting trees, rotating crops, and otherwise changing land management practices in a way that results in improved City

water quality. The implementation of such a program would require careful planning and ongoing public relations to be successful in the long-term. Also, the concurrence and active assistance of the County would be needed for effective implementation because much of the City's source water originates in County jurisdiction.

2. **Community Outreach and Public Education** - The City and County should consider a concerted, SWPA-wide community outreach and awareness program, concentrating on residential (particularly those with septic systems) and commercial landowners. The City should consider a mass mailing with pertinent information on best management practices for the handling of chemicals as a measure to educate landowners on contamination issues.

3. **Acquire or Ease Specific Properties** - Absent other beneficial results and assuming the availability of financial resources, the City could consider acquiring and/or granting easements with respect to specific properties to lessen the likelihood of existing or potentially incompatible land uses.

4. **Extend Service Areas to Annexed Properties -** The City should extend water and sewer service throughout Zones 1 and 2, possibly as well as other annexed/purchased areas. Once this is achieved, private wells and septic systems should be abandoned. This would help prevent future short-circuiting of contaminants into the source aquifer(s) by way of obsolete domestic wells, as well as limit non-point nitrate (and other) contamination associated with relict septic systems.

5. **Post "No Dumping" Signs Within SWPA** - The City and County should consider posting "No Dumping" signs at various locations within the SWPAs to discourage the informal disposal of hazardous wastes and petroleum products. Similarly, the City and County periodically should examine the SWPAs for evidence of dumping, while removing unwanted debris and waste items at the same time.

6. **Create a Spill Notification System** - The potential exists for surficial spills to infiltrate the unconfined aquifer. A spill notification system along MD Routes 12, 13, 50, 346 and 350, as well as the railroad that runs through the Paleo SWPA, would give water plant managers notice of potential contaminants that could impact drinking water quality. This would allow them ample time to design and incorporate preventative measures to reduce the impact of these spills. This effort should include members of the County's emergency management division, the Salisbury Fire Department and other appropriate entities.

7. **Abandon Unused Wells** - ALWI recommends that the City go forward with the plan to abandon the Paleo well field test borings once they no longer are needed for raw water quality monitoring purposes. Any other unused wells should be abandoned, including private wells and unused USGS monitoring wells within the Park. Such wells may function as a conduit through which contamination at the surface may enter groundwater aquifers at depth.

6.0 REFERENCES

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