Health Consultation

Groundwater Contamination in the area of Milford Hills Neighborhood and Industrial Facilities at Jake Alexander Boulevard

Salisbury, Rowan County, North Carolina 28144

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U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES
Agency for Toxic Substances and Disease Registry
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Health Consultation: A Note of Explanation

A health consultation is a verbal or written response from ATSDR or ATSDR's Cooperative Agreement Partners to a specific request for information about health risks related to a specific site, a chemical release, or the presence of hazardous material. In order to prevent or mitigate exposures, a consultation may lead to specific actions, such as restricting use of or replacing water supplies; intensifying environmental sampling; restricting site access; or removing the contaminated material.

In addition, consultations may recommend additional public health actions, such as conducting health surveillance activities to evaluate exposure or trends in adverse health outcomes; conducting biological indicators of exposure studies to assess exposure; and providing health education for health care providers and community members. This concludes the health consultation process for this site, unless additional information is obtained by ATSDR or ATSDR's Cooperative Agreement Partner which, in the Agency's opinion, indicates a need to revise or append the conclusions previously issued.

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Prepared By:

Division of Community Health Investigations
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Table of Contents

Abbreviations iii
Summary 1
Background and Statement of Issues 5
Site Description and History 5
North Carolina Department of Transportation Asphalt Testing Facility No. 45(NCDOT #45) 6
Chevron 6
Exxon-Mobil 7
Farmers Cooperative Exchange 7
Other Properties in the Area 7
Highlander Center Laundry 7
Morningstar Storage 8
The National Guard Armory 8
Discussion 8
Hydrogeology of the Area 9
Vapor Intrusion 9
Contamination History 10
Chlorinated Solvents in On-site Groundwater at NCDOT #45 10
Chlorinated Solvents in On-site Groundwater at Chevron 12
Petroleum Products in On-site Groundwater at Exxon-Mobile and FCX 13
Contaminants in Off-site, Residential and Commercial Drinking Water Wells 14
Data Limitations 15
Public Health Implications 15
Non-Cancer Health Effects 18
Estimated Theoretical Cancer Risk 20
Potential Exposure from Industrial Roadway Dust Suppression and Vehicle Washing Activities 21
Community Health Concerns 22
Quality Assurance 23
Conclusions 23
Recommendations 24
References 26

Appendices

Appendix A. Site Maps (Figures) A-1
Appendix B. Explanation of Comparison Values B-1
Appendix C. Data Tables C-1
Appendix D. Public Comments D-1

Abbreviations

1,1-DCE	1,1-dichloroethylene
1,1,1-TCA	1,1,1-trichloroethane
ATSDR	Agency for Toxic Substances and Disease Registry
BTEX	benzene, toluene, ethylbenzene, and xylenes
CCl_4	carbon tetrachloride
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CREG	Cancer Risk Evaluation Guides
DCE	dichloroethylene
DNAPL	dense nonaqueous phase liquid
EMEG	environmental media evaluation guide
EPA	Environmental Protection Agency
ERD	enhanced reductive dechlorination
FCX	Farmers' Cooperative Exchange
LNAPL	light nonaqueous phase liquid
MCL	maximum contaminant level
µg/L	micrograms per liter
MRL	minimal risk level
NC 2L	North Carolina 2L groundwater standard
NCDENR	North Carolina Department of Environment and Natural Resources
NCDHHS	North Carolina Department of Health and Human Services
NCDOT	North Carolina Department of Transportation
OEEB	Occupational and Environmental Epidemiology Branch
PAH	polycyclic aromatic hydrocarbons
PCE	tetrachloroethylene
ppm	parts per million
RfD	reference dose
TCE	trichloroethylene
UST	underground storage tank
VOC	volatile organic compounds

Summary

Introduction

On July 31, 2000, a member of the public petitioned the Agency for Toxic Substances and Disease Registry (ATSDR) to investigate the possibility that adverse health effects ("cancers, cardiovascular problems, renal and respiratory difficulties") observed in residents of Milford Hills neighborhood in Salisbury, North Carolina, might be caused by potential past exposures to contaminants emitted by two asphalt plants. These plants are located south-southwest of the neighborhood on the opposite side of Jake Alexander Boulevard (APAC-Carolina, Inc and Associated Asphalt) and a former petroleum terminal (Exxon-Mobile). On January 22, 2001, the director of the Division of Health Assessment and Consultation (DHAC) sent a letter to the petitioner committing ATSDR to evaluate the potential for adverse health effects from contaminants emitted from these two facilities.

In response to the petitioner's concerns, ATSDR released a Health Consultation on February 14, 2007, for APAC-Carolina, Inc., and Associated Asphalt which focused on contaminants in air. That consultation is available at http://www.atsdr.cdc.gov/HAC/pha/APACCarolinaIncandAssociatedAsphaltInc/APAC%20Carolina%20Inc.&%20Associated%20Asphalt%20Inc.%20HC%202-14-07.pdf. ATSDR concluded that 1) airborne concentrations of polycyclic aromatic hydrocarbons (PAHs) and volatile organic compounds (VOCs) pose no acute (i.e., short-term) or chronic (i.e., long-term) public health hazard, and 2) based on limited data, particulates in air may have caused asthmatics and other sensitive individuals to experience respiratory irritation.

The present consultation has been written to address the potential for groundwater contaminants from nearby asphalt and petroleum facilities to have migrated into the Milford Hills or Milford Terrace areas, contaminated private potable wells, and produced adverse health effects in residents who used that water for potable purposes. Possible worker exposure to contaminants, potential for contaminant vapor intrusion, and potential exposure to groundwater contaminants from other smaller facilities is also discussed.

Conclusion 1

Residents who drank water from wells containing the maximum detected levels of tetrachloroethylene (PCE) and 1,1-dichloroethylene (1,1-DCE), of 5.3 µg/L and 136 µg/L respectively, are not expected to have adverse health effects from chronic exposure. Workers who used the North Carolina Department of Transportation Testing Facility #45 (NCDOT #45) on-site well as a source of drinking water are not expected to experience adverse health effects from exposure to trichloroethylene (TCE). All other VOCs detected in residential and industrial drinking water wells were detected at levels below the Environmental Protection Agency's (EPA) maximum contaminant level (MCL) and ATSDR's health-based comparison values such as the Environmental Media Evaluation Guide (EMEG).

Conclusion basis

The MCL for PCE is 5 µg/L, and the lowest levels known to cause adverse health effects are higher. The cancer risk associated with drinking water at 5.3 µg/L is very low for all age groups.

The MCL for 1,1 DCE is 7 ug/L which is lower than the highest measured value in a private drinking water well (136 ug/L). However, the estimated daily doses for 1,1-DCE at 136 µg/L (see Table 2) do not exceed ATSDR's chronic minimum risk level (MRL) of 9 µg/kg/day, the EPA RfD of 50 ug/kg/day, or the EPA Health Advisory Level (HAL) of 1 mg/L for a 10 kg child consuming 1 liter of water per day up to a 7 year exposure. Although the duration of the contamination of this well is unknown, once contamination was detected in these wells the residents were connected to municipal drinking water. Based upon the ATSDR chronic MRL, EPA RfD, and EPA HAL, the levels of 1,1 DCE measured in private drinking water wells are not expected to have caused an adverse impact on human health. Even so, whenever possible 1,1 DCE levels in drinking water should not exceed the EPA MCL.

The use of the production well (#23 in Table 5 and Figure 1) on the former NCDOT #45 was discontinued in 1989 when TCE was detected at 24 µg/L. That level exceeded the maximum contaminant level (MCL) of 5 µg/L and the EMEG of 18 µg/L, but was too low to produce adverse effects after a lifetime of chronic exposure. The calculated doses for TCE are below the EPA's reference dose for chronic oral exposure which is meant to be protective of health for a lifetime daily exposure of 5×10^{-4} mg/kg/day. The cancer risk associated with drinking water at the 24 µg/L TCE concentration is 1×10^{-5} for 20 years of exposure. For example, an estimated theoretical cancer risk of 2×10^{-5} represents a possible two excess cancer cases in a population out of one hundred thousand people exposed. EPA considers this a low cancer risk.

Conclusion 2	Private wells in the Milford Hills and Milford Terrace neighborhoods are hydrogeologically upgradient from the asphalt/petroleum facilities. These wells were not impacted by the groundwater contaminants at the sites.
Conclusion basis	Based on groundwater investigation reports completed between 1994 and 2010, groundwater on the Jake Alexander Boulevard industrial facilities moves predominantly to the southeast, away from the Milford Hills/Milford Terrace areas. Groundwater contamination appears to have been contained within the general vicinity of the facilities' property boundaries. PCE was found in one residential well at 5.3 µg/L, exceeding the MCL of 5 µg/L. However, the level of 5.3 µg/L does not exceed ATSDR's Cancer Risk Evaluation Guide of 17 µg/L. The source of this PCE is unknown. Contaminants found in drinking wells closer to the facilities' boundaries are addressed in the discussion section of this health consultation.
Next steps	Groundwater monitoring at the industrial facilities has continued even after active remediation activities have stopped. NCDENR continues to monitor the industrial sites conditions.

Conclusion 3	No adverse health effects are expected from worker and nearby residents' inhalation exposure to TCE due to past use of the contaminated well water at the former NCDOT #45 site for operations such as dust suppression and vehicle washing.
Conclusion basis	ATSDR evaluated an exposure scenario that represented concentrations of TCE vapor that workers and nearby community members may have been exposed to if NCDOT #45 used their contaminated on-site well to suppress dust. When conducting the analysis, ATSDR used the highest concentration of TCE ever recorded in the well (54 µg/L). This level was detected in 1997 which is approximately eight years after the well was no longer used as a drinking source. The air dispersion model predicted a maximum TCE concentration of 0.012 $\mu g/m^3$ 495 meters from the center of the site. This value does not exceed ATSDR's inhalation cancer risk evaluation guide (CREG) for TCE of 0.5 $\mu g/m^3$ or EPA's chronic reference concentration of 2 $\mu g/m^3$ and is therefore unlikely to cause adverse health effects. The cancer risk associated with that concentration is 2.8×10^{-8} for 40 years of exposure for a resident and 1.4×10^{-8} for 20 years of exposure for a worker. For example, an estimated theoretical cancer risk of 2×10^{-8} represents a possible two excess cancer cases in a population out of one hundred million people exposed. This is a very low cancer risk.
Next Steps	The contaminated on-site well has been closed and is no longer in use. No future exposure from this source is expected.

Conclusion 4	Data are inadequate to conclude whether the potential contaminant vapor intrusion (VI) pathway could harm people's health. The information needed to make a decision is not available. ATSDR is working with NCDENR to gather the needed information.
Conclusion basis	Based on the concentrations in groundwater, contaminant vapor intrusion may have occurred or may be present in some of the sites' buildings; particularly, the former Farmer's Cooperative Exchange building, the former NCDOT #45 laboratory building, and the warehouse on the former Exxon-Mobil property. ATSDR is unaware of any soil gas or indoor air sample results.
Next steps	ATSDR will work closely with NCDENR to conduct a vapor intrusion evaluation. If samples are collected by the potentially responsible party and verified by NCDENR, ATSDR will analyze the data to determine if VI exists at levels that could prove harmful to someone's health.
Conclusion 5	No future health risks are expected to be associated with potable use of the groundwater near the industrial facilities of interest along Jake Alexander Boulevard.
Conclusion basis	With the exception of four private wells on Dan and Clancy Streets and Statesville Road (wells 2, 3, 7, and 12 in Table 4) that serve residences close to, but up-gradient of, the former NCDOT #45 site (currently APAC-Carolina), no one in the immediate Milford Hills/Milford Terrace vicinity is known to still be using their private wells as sources of drinking water. Nor are any workers currently drinking on-site groundwater, as all local businesses are now on city water.
Next steps	Continued monitoring of the sites on Jake Alexander Boulevard is recommended to ensure contamination does not affect off-site areas. Potable wells should not be installed immediately downgradient of the contaminated areas. Continued monitoring of the four private wells that are still used by residents on Dan and Clancy Streets and Statesville Road, up-gradient of the NCDOT #45 site is recommended. These public health-protective activities should be continued, as long as these wells are used for potable water, and the residents wish them to be monitored.

Background and Statement of Issues

In January 2001, ATSDR accepted a July 31, 2000 petition to investigate potential public health risks to residents of Milford Hills, a Salisbury, North Carolina neighborhood in close proximity to several industrial facilities on Jake Alexander Boulevard. The petitioner expressed concern that exposure to chemicals released from nearby asphalt and petroleum plants was responsible for perceived increases in local cancer incidence, and other community health problems such as diabetes, cardiovascular, renal, and respiratory problems. In a previous public health consultation (February 14, 2007), ATSDR evaluated the potential health effects from airborne exposure to the facilities' contaminant emissions to those living nearby (ATSDR 2007). This report is available at ATSDR's website: http://www.atsdr.cdc.gov/HAC/pha/APACCarolinaIncandAssociatedAsphaltInc/APAC%20Carolina%20Inc.&%20Associated%20Asphalt%20Inc.%20HC%202-14-07.pdf.

This health consultation focuses on groundwater contaminants from four facilities that may have migrated into the Milford Hills/Milford Terrace neighborhoods and their potential to have impacted residential wells. Two are currently active asphalt facilities: the former NCDOT Testing Facility #45 (currently APAC-Carolina) and a former Chevron facility (currently Associated Asphalt). The remaining two facilities are former petroleum facilities: the former Exxon-Mobile Bulk Petroleum Facility (currently Food Lion) and the former Farmers' Cooperative Exchange (FCX) property (currently Southern States). Smaller non-industrial facilities (e.g., the former Highlander Center Laundry, a National Guard armory and a storage business) are also discussed.

The petitioner was also concerned about possible worker and residential exposure from the use of contaminated well water for operations such as dust suppression and washing vehicles on the former NCDOT Testing Facility #45 site. ATSDR ran an air dispersion model to assess the potential impact from this exposure pathway to the surrounding community.

Site Description and History

Milford Hills and Milford Terrace are residential subdivisions located about three miles northwest of the city of Salisbury, North Carolina. Many homes in this area were built in the 1940s and 1950s. Jake Alexander Boulevard runs between Milford Hills and Milford Terrace (Figure 1, Appendix A). Milford Hills residents are included in census blocks 0513031 and 0513032 and had approximately 1,562 residents in 2000. Milford Terrace is included in census block 0515034 and had approximately 528 residents in 2000 (US Census Bureau 2000). 2000 census data were used because this was around the time the majority of the private well samples were taken and little exposure to contaminated groundwater occurred after this date. Demographic statistics for the area within a mile of the former NCDOT #45 site are displayed in Figure 2 (Appendix A).

The great majority of people in these neighborhoods are currently on municipal water drawn from the Yadkin River and distributed by Salisbury-Rowan Utilities. Only four residential wells close to the facilities of interest are still in use. All four are located north, i.e., up-gradient, of those facilities. ATSDR evaluated residential drinking water well information for the Milford Hills and Milford Terrace neighborhoods and compared it to groundwater data available for a cluster of industrial properties near the intersection of the Norfolk Southern Railroad with Jake Alexander Blvd, to determine if contaminant levels present in private wells could cause harmful

health effects for those who use them currently or in the past. In addition, ATSDR evaluated an exposure scenario intended to represent concentrations of TCE that workers and nearby residents may have been exposed to if NCDOT #45 used their contaminated on-site well for on-site dust suppression operations.

Jake Alexander Boulevard in Salisbury, North Carolina, has several current and former industrial properties, including two current asphalt-related businesses (APAC-Carolina, Inc., a hot mix asphalt plant, and Associated Asphalt, Inc., a liquid asphalt distribution terminal), and two former bulk petroleum storage facilities (Exxon-Mobil and FCX) located approximately 100 yards farther south-southeast on Jake Alexander Boulevard (Figure 1, Appendix A). Going forward, the term on-site will refer to four industries: NCDOT #45, the former Chevron, the former Exxon-Mobil, and FCX. These properties fall under the jurisdiction of the NCDENR which provides permits and cleanup oversight. These and other local industrial/commercial properties are described below.

North Carolina Department of Transportation Asphalt Testing Facility No. 45(NCDOT #45)

The former NCDOT #45 was located at 1831 Jake Alexander Blvd in Salisbury, North Carolina, west to southwest of Milford Hills (Figures 1 and 5, Appendix A). The facility is currently owned by APAC-Carolina, Inc., and produces hot mix asphalt used for highway and road construction. Formerly (i.e., in the 1980s when the site was owned/operated by REA Construction), NCDOT leased the property and operated an on-site laboratory where they tested the quality of asphalt mixtures using chlorinated solvents such as carbon tetrachloride (CCl_4), TCE, and trichloroethane (1,1,1, TCA) in the analysis. As displayed in Figure 1, NCDOT #45 is bordered by the Norfolk Southern Railroad to the south, a bulk asphalt terminal to the east (former Chevron facility), a concrete supply company to the west (Concrete Supply), and residential properties to the north (Milford Terrace) and northeast (Milford Hills). In 1989, the NCDOT safety engineer found 24 micrograms per liter (µg/L) of TCE in the on-site drinking water well. The facility immediately stopped using the well for drinking water. Anecdotal information gained from discussions with NCDENR states that the well continued operation for general uses, such as dust suppression, until the late nineties. On-site environmental investigations began in 1997, and found soil and groundwater contaminated with chlorinated solvents: TCE, TCA, CCl_4, as well as degradation compounds dichloroethylene (DCE), chloroform, and vinyl chloride. Groundwater cleanup began in 2002 with a pilot study of the effectiveness of enhanced reductive dechlorination (ERD). Throughout the remainder of this document, this site will be referred to as NCDOT #45.

Chevron

The former Chevron facility has been a liquid asphalt transfer and distribution terminal since 1951, and is located at 1825 Jake Alexander Boulevard, southwest of the Milford Hills area (NCDHHS 2002, Figures 1 and 5, Appendix A). Associated Asphalt is the current owner. Liquid asphalt handling operations include rail car unloading, tank storage, and truck offloading. The site has thirteen monitoring wells to characterize groundwater contamination. Tetrachloroethylene (PCE), benzene, 1,1-DCE, ethylbenzene, and bromoform have historically exceeded the North Carolina 2L (NC 2L) Standard for groundwater. See Appendix B for a definition of NC 2L Groundwater Quality Standards. Throughout the remainder of this document, this site will be referred to as the former Chevron facility.

Exxon-Mobil

The former Exxon-Mobile Marketing Terminal at 1715 Jake Alexander Boulevard is located south of both the NCDOT #45 and Former Chevron Facility sites, and southwest of Milford Hills (Figures 1 and 5, Appendix A). Food Lion, Inc., currently owns the property and uses the northwest portion as a parking lot for administrative offices. Food Lion also uses an old warehouse on the site for document storage. Currently, but for the occasional derelict building, the rest of the site is mostly open space. In 1986, when the former Exxon-Mobile property was decommissioned, an initial subsurface investigation found that soil and groundwater at the site were contaminated with petroleum products-primarily benzene, toluene, ethylbenzene, and xylenes (BTEX)—and isopropyl ether. Both the shallow and deep groundwater are contaminated. Site remediation (by soil vapor extraction and bioventing) began in 1998, and groundwater monitoring continues to this day (Groundwater and Environmental Services of North Carolina, 2009). Of note, aggressive fluid vapor recovery events have been performed periodically to remove light nonaqueous phase liquid (LNAPL), or free product, in the former fill rack area (Groundwater and Environmental Services of North Carolina, 2009). Throughout the remainder of this document, this site will be referred to as Exxon-Mobil.

Farmers Cooperative Exchange

The Farmers Cooperative Exchange (FCX) site is currently owned by Southern States Cooperative, Inc., and is located at 1710 Jake Alexander Boulevard, south of Milford Hills, east of Exxon-Mobile, and southeast of the NCDOT #45 and Chevron sites (Figures 1 and 5, Appendix A). Southern States acquired the property in 1986. Historic releases of petroleum products from an above ground storage tank (AST) system and retail fuel dispenser island operated by FCX contaminated both soil and groundwater. Southern States removed the AST and the dispenser island in late 1986. In 1993, a comprehensive site assessment performed at the neighboring Exxon-Mobile bulk petroleum terminal by Ecological Services, Inc., reported the presence of dissolved petroleum hydrocarbons at the FCX site. In an effort to clean up the soil and groundwater contamination, soil vapor extraction, air sparging, and bioventing began in 1999. Groundwater monitoring continues to this day (Duncklee & Dunham, 2010). Southern States currently uses the property as a retail store for farmers. Throughout the remainder of this document, this site will be referred to by the name of its former owner, FCX.

Other Properties in the Area

Highlander Center Laundry

North-northwest of the aforementioned sites is the former location of the former Highlander Center Laundry at the intersection of Jake Alexander Boulevard and Statesville Boulevard. The facility is no longer in operation and the building has been demolished. Its timeframe of operation is uncertain. The stand-alone facility was located in the current northwest right-of-way of Jake Alexander Boulevard where the street intersects Statesville Boulevard. Their services included dry cleaning which is a process known to be associated with PCE contamination. NCDENR has completed a preliminary investigation to characterize the extent of the groundwater PCE plume. The site is located hydraulically upgradient of the Milford Terrace and Milford Hills neighborhoods and this plume was considered to be a potential source of PCE contamination in area residential wells. However, based on the results of NCDENR's investigation, it appears unlikely that the release associated with the former drycleaner is the

source of residential water supply well contamination found in the Milford Terrace and Milford Hills Neighborhoods. NCDENR delineated, both horizontally and vertically, the PCE contaminant plume at the former cleaner (NCDENR 2012).

Morningstar Storage

Just north of FCX on the opposite side of the railroad tracks is another facility called Morningstar Storage (Figures 1 and 5, Appendix A). NCDENR has advised ATSDR that the Inactive Hazardous Sites Branch has no incident folder for Morningstar Storage, as far as it is known (personal communication; M. Alvalle of NCDENR). The on-site well (#19) was sampled on August 26, 1994, and November 6, 1996 (Pitner and Alvalle 2010). This well was a former on-site drinking water well and is shown in Figure 1, Appendix A. Results are summarized in Table 5, Appendix C. No volatile organic compounds (VOCs) were found except for low detections in 1996 of an estimated 2.6 µg/L PCE (MCL is 5 µg/L) and 1.3 µg/L 1,1-DCE (MCL is 7 µg/L).

The National Guard Armory

At 1835 Jake Alexander Blvd., just south of the intersection with Dan Street, a National Guard Armory exists directly across the street from Milford Hills and just opposite the western terminus of Spring Dr (Figure 1, Appendix A). NCDENR once considered the possibility that this facility was the source of the low level of PCE (5.3 µg/L) detected in 1993 at a private well on Spring Street (Well #10 in Figure 1, Appendix A, and Table 4, Appendix C) (NCDENR 2005). However, no plausible link with the National Guard Armory was ever demonstrated.

Vehicle maintenance procedures such as oil and antifreeze changes, axle lubrication, and battery replacements were reportedly performed at this site in years prior to its 1960 renovation. No major spills have been reported for this center. Analyses of samples from the only on-site monitoring well have not detected any volatile or semi-volatile organic compounds. Contaminated soil and a 550-gallon underground storage tank (UST) were removed in 1989. The site was given a “no further action” status by the NC UST program in 1992. All wastes from vehicle maintenance are transported off site for disposal. No other sources of contamination exist on the site. The facility uses city water and sewers.

Based on these results, the NC Superfund Section concluded in 2006 that this site did not qualify for further remedial site assessment under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA).

Discussion

Chlorinated solvent contamination (primarily TCE, 1,1-DCE, & 1,1,1-trichloroethane) predominates at the two asphalt operation sites (NCDOT #45 and, to a lesser extent, Chevron). It is unlikely that contaminants from the other two petroleum-related sites have migrated to affect residential wells in the Milford Hills and Milford Terrace neighborhoods. The analytical results from private residential/commercial well sampling in the Milford Hills area are presented in Tables 4 and 5 of Appendix C of this health consultation. The well numbers correspond to those in Figure 1 in Appendix A. The target VOCs listed in Tables 4 and 5 reflect NCDENR’s decision to analyze for on-site-related VOCs that could have migrated from the NCDOT #45 and Chevron sites into the Milford Hills area. However, a comparison of the VOC concentrations in groundwater samples from perimeter on-site monitor wells suggests that off-site migration of

target VOCs from either site has not occurred in the direction of the Milford Hills or Milford Terrace neighborhoods (Tables 6 and 7, Appendix C). Figure 3 shows an overhead view of the former NCDOT #45 facility, and Figure 4 shows a site map of the former Chevron facility. The monitor well numbers in Tables 6 and 7 (Appendix C) correspond with those listed in Figures 2 and 4 (Appendix A), respectively. Finally, Figure 5 is a site map of the Milford Hills/Milford Terrace area, showing the general direction of groundwater flow.

Hydrogeology of the Area

Most of the information about groundwater contaminants, movement, and characteristics comes from investigations conducted at the individual industrial facilities. Area groundwater occurs between 8 and 20 feet below ground surface. There is a surficial and secondary aquifer. The unconfined surficial aquifer is made up of layers of fine silty saprolitic materials that limit the movement of groundwater and the secondary aquifer consists of the various bedrock units underlying the first unit (Figure 6, Arcadis 2000). A downward-vertical hydraulic gradient exists between the upper and lower portions of the surficial aquifer, as evidenced by the differences in water-level elevations between shallow and deep wells (Arcadis 2000). The regional groundwater flow direction in the surficial aquifer is to the southeast but is variable on the local scales, so that flow directions at the site may be anywhere from south-southwest to east (Figure 5). The secondary aquifer generally flows toward the southeast. Average groundwater velocity has been calculated to be between 10 and 15 feet per year (Arcadis 2006; Aquaterra 1994; Duncklee & Dunham, 2002). Of note, the past use of the on-site well at the NCDOT #45 site could have created a negative pressure gradient that would discourage off-site migration. Using the groundwater velocity above, approximately 100 years[1] would have been required for groundwater contaminants to migrate from the ExxonMobil site to the nearest down-gradient non-industrial off-site well approximately 1,200 feet away (well #21 in Figure 1, Appendix A, and Table 5, Appendix C).

Milford Hills is located north of the FCX and Exxon-Mobile sites, and lies northeast of the NCDOT #45 and Chevron sites. Milford Terrace is north to northwest of these same facilities. This is opposite the direction of groundwater flow (i.e., hydraulically up-gradient). Therefore, one would not expect contaminated groundwater from any of these sites to migrate into either residential neighborhood provided the groundwater continued along in the direction of its natural flow.

Vapor Intrusion

Vapor intrusion (VI) warrants consideration because of the volatile nature of the site-related contaminants (i.e. PCE, TCE, 1,1-DCE, and BTEX) and because the plumes are within 100 feet of buildings (EPA 2002, NCDENR 2011). VI is the upward migration of volatile compounds from the subsurface-contaminated groundwater and soil through the pore spaces of soil and up into buildings. The concentrations of contaminants entering the indoor air from subsurface depend upon site and building-specific factors such as building construction, number and spacing of cracks and holes in the foundation, and the impact of the heating and air conditioning system on increasing or decreasing flow from the subsurface. Low confidence is generally attributed to

[1] The 100 year travel time is an estimate that was calculated using the groundwater migration rates provided in the 2006 Arcadis report. Inconsistencies in geology could influence flow rates and either increase or decrease migration time.

decisions based on one sampling event, unless there is clear evidence that this will result in a health protective decision. Indoor air monitoring that reflects seasonal variations for the site should provide a better basis for an exposure estimate. The California Environmental Protection Agency (CalEPA) guidance recommends at least a late summer/early fall sample in addition to a late winter/early spring sample.

CalEPA also establishes two basic criteria for determining if it is necessary to evaluate VI. First, volatile contaminants must be present in the subsurface, and second, the existing or future buildings at a site must be close to subsurface contamination so that vapor migration into indoor air is possible (CalEPA 2005). EPA recommends that any building within 100 feet laterally or vertically of the contamination plume should be considered a candidate for VI (EPA 2002). The 100-foot distance assumes that no preferential pathways are present and other factors such as fluctuations in groundwater levels are minimal (ATSDR 2005). The contaminant plumes in Salisbury have buildings located directly over the plumes and within 100 lateral feet of the plumes. For future VI investigations, ATSDR recommends that the CalEPA, ITRC, ATSDR, EPA, and NCDENR guidance be followed.

Contamination History

Chlorinated Solvents in On-site Groundwater at NCDOT #45

In 1989, the NCDOT #45 facility's site safety engineer found 24 µg/L of TCE in the on-site drinking water well (well #23 in Figure 1 and Table 5). This concentration exceeded both EPA's MCL of 5 µg/L for drinking water, and NC 2L groundwater standard of 3 µg/L for TCE in groundwater (ARCADIS 2000; NCAC, 2005). See Appendix B for a definition of NC 2L Groundwater Quality Standards. Immediately after the discovery, workers were supplied with bottled water and the facility was connected to municipal drinking water supplies.

Initial investigations conducted from 1997 through 2000 confirmed that soil and groundwater at the site were contaminated with asphalt testing solvents, the most significant of which was TCE (ARCADIS 2000). During the initial investigation, the maximum reported groundwater concentration of TCE was 4,800 µg/L (4.8 mg/L) in 1997 (ARCADIS 2000). On-site groundwater monitoring following the initial investigation indicated that the dissolved-phase plume was likely contained within the property boundary (NCDENR 2005; ARCADIS 2000, 2004, 2005a, 2005b, 2006, and 2007; Table 6, Appendix C). However, TCE has migrated downward and has been found in deep well 45DW-4, which is 162 feet below ground surface. There are no downgradient wells at similar depths to determine if the plume is migrating off-site. A downgradient well that is closest to the depth of 45DW-4 is 45DW-9, which is 116 ft below ground surface. TCE was detected only once in 45DW-9 at 1 µg/L in 2007. The highest concentrations of TCE have been found in wells of intermediate depth, several of which have detections above 1,000 µg/L (Table 6). Discussions with NCDENR representatives during an ATSDR site visit addressed the possibility that the use of the on-site production well could have encouraged the plume to migrate to the depths of the intermediate wells. Wells 45DW-3, 5, 6, 7, and 8 are drilled to approximately the equivalent depth of the intermediate wells (Arcadis 2006). The highest concentration of TCE (16,000 µg/L in 2002) at the site was in an intermediate depth well, 45IW-6. This concentration is significant enough for ATSDR to consider the possibility that the TCE could exist as a dense nonaqueous phase liquid (DNAPL) outside of the dissolved phase plume.

DNAPL

As a general "rule of thumb," experience has shown that a DNAPL source may be present upgradient of a monitoring well if sample concentrations exceed 1 percent of the effective solubility of the compound of interest (Kueper and Davies 2009). The solubility of TCE at 20º C is 1,100 milligrams per liter (mg/L; Pankow and Cherry 1996). Only one sample exceeded the 1% general "rule-of-thumb" which was the maximum TCE concentration recorded at the site of 16,000 µg/L. It was taken from an intermediate depth monitoring well and this concentration would translate to 1.5% of the effective solubility of TCE. It is important to note that this general rule-of-thumb should not be the only qualifier used to determine the presence of a DNAPL at a site. It is guidance used as a screening tool and, if exceeded, should be used in conjunction with other investigation methods. Other investigation methods that make the presence of DNAPL at the site unlikely are (Kueper and Davies 2009):

- Visual observation –
  Throughout the site's history, there has never been a DNAPL obtained from the bottom of a monitoring well or as an emulsion from a pumped water sample. No interface probe has indicated the presence of a DNAPL.

- Presence of contamination in unusual locations –
  The data at NCDOT # 45 was consistent with an area of contamination and locations downgradient from this area. No unusual areas of contamination were found.

- Groundwater contaminant concentration trends with depth –
  Abrupt reversals of concentration gradients with depth or increasing concentrations with depth can be associated with DNAPL presence. These conditions do not occur at the site. TCE concentrations at depth indicate levels one would expect with a dissolved phase plume, and the data in Table 6 show that the concentrations of TCE on the NCDOT #45 site do not exhibit abrupt reversals of concentration.

As additional confirmation of the absence of free-phase conditions at the site, ATSDR contacted the NCDOT who confirmed the absence of free-phase TCE (DNAPL) at asphalt sites on Jake Alexander Boulevard in Salisbury (ATSDR 2011).

Environmental agencies such as NCDENR have the responsibility for overseeing site characterization studies and analyses. To date, state agencies have not found evidence of DNAPL in the groundwater.

Environmental Remediation at NCDOT #45

In a pilot study conducted between June 2002 and June 2003, an enhanced reductive dechlorination (ERD) process was used to treat contaminated groundwater on the NCDOT #45 site. The ERD process entailed injecting large amounts of sucrose, in the form of a solution of food-grade molasses, into the contaminated groundwater. This sugar served as a stimulating energy source for microorganisms present in the aquifer (ARCADIS 2005b). The stimulated microorganisms then removed chlorine molecules from the chlorinated solvents (e.g., TCE), making the breakdown compounds more readily degradable by other microorganisms in the underground environment.

The ERD process was implemented to create an in-situ reactive zone which reduced chlorinated solvents (e.g., TCE) at the source, while simultaneously increasing levels of degradation products (e.g., 1, 2-DCE, and vinyl chloride), and the by-products of molasses fermentation (e.g., acetone and 2-butanone). However, the effectiveness of the treatment was generally limited to the immediate vicinity of each individual injection well, probably due to the slow movement of groundwater in the area. (See section entitled "Hydrogeology of the Area.")

Following the ERD pilot, the former contractor for NCDOT at this site, ARCADIS, recommended that the residual groundwater contaminants at the site be allowed to attenuate naturally (ARCADIS 2005b, NCAC 2005). This remedial option was proposed by NCDOT to NCDENR. The recommendation was based on evidence that (1) the dissolved phase plume was contained within the property boundary; (2) the trend was for decreasing concentrations over time; and (3) the potential for exposure was largely eliminated when almost all nearby homes were connected to the municipal water supply. Three residents living just north, i.e., up-gradient, of the NCDOT #45 site continue to use their private wells. Periodic analyses indicate that those wells remain free of site-related contamination (wells 2, 3, and 7 in Table 4, Appendix C).

Groundwater Monitoring

The ERD pilot study was followed up with semi-annual groundwater monitoring to assess the effectiveness of the remediation of target chlorinated solvents (NCDENR 2005; ARCADIS 2004). Following ERD, levels of TCE fell, as levels of dechlorination products (e.g., isomers of DCE) rose (ARCADIS 2006). This pattern is exemplified best by monitoring data from 45DW-2, a deep well approx 120' SSE (i.e., downgradient) of the source well (45DW-1) and approx 160' N of the southern fence line (Figure 3, Appendix A).

Sampling of on-site monitoring wells began in 1996. Figure 3 (Appendix A) shows some details of the NCDOT #45 site, including the locations of these wells. Since the late 1990s, both the deep and shallow monitoring wells (45MW6, 45MW7, 45DW3, 45DW5, 45DW9) in the southeast corner of the site (i.e., towards the predominant direction of groundwater flow) have registered less than or equal to 1 µg/L TCE (ARCADIS 2007) with the exception of one sample in 45MW6 taken on August 22, 2001. That sample contained 6.9 µg/L of TCE. Other than this one sample, TCE and its degradation products have not been detected in the monitoring wells at the southeast corner of the site (ARCADIS 2004, 2005a, 2006, 2007). In addition, groundwater transport modeling calculations show a very low potential that the groundwater concentrations measured at the site would have any significant impact on groundwater quality beyond the site boundaries (ARCADIS 2005).

Chlorinated Solvents in On-site Groundwater at Chevron

Environmental investigations have taken place at the Chevron site since the early 1980's. The on-site Phase II Environmental Assessment was conducted in 1998 to screen the site for potential contaminant sources (BBL 2002). On May 4, 2001, 8.9 µg/L PCE was detected in monitoring well M-10; lower levels (<0.5 to 2.0 µg/L) were detected at this location from the Fall of 2001 to Spring of 2004 (Fig 5). Except for these detections of PCE, the perimeter wells to the south and southeast (i.e., the direction of groundwater flow) have not shown detectable levels of the target chlorinated VOCs listed in Table 7, Appendix C. In well M-8 on the western fence line adjacent to NCDOT #45, the concentrations of benzene detected on August 12, 1992, and September 1993 (20 and 160 µg/L, respectively) exceeded the 1 µg/L NC2L groundwater standard. With

these two exceptions, benzene was not detected in M-8, or any other monitoring well (Table 7), above NC2L groundwater standards (BBL 2002, BBL 2006).

The nearest private well to the former Chevron site (well #1 in Table 4; Ted's Chicken Fig 4) was situated near the southeastern fence-line, on the same side of Jake Alexander Blvd. On Nov 20, 1992, 136 µg/L 1,1-DCE was detected in this well (C&ET 1992; Table 4, Appendix C). In 1996, 1.3 µg/L of 1,1-DCE was detected in well #19, located on the Morningstar Storage property (Fig 1). In 2000, VOCs were detected in well #20, located on the Patterson Paving property (Fig 1). The wells are mentioned here, as well as below, with the other off-site wells of Milford Hills and Milford Terrace because they are close to, and potentially down-gradient of, the former Chevron site.

Based on the data made available to ATSDR, the highest level of 1,1-DCE on the Chevron site was 63 µg/L in monitoring well M-8 in 1992 (BBL 2006). In 1993, 1,1-DCE was not detected in this well. 1,1_DCE was not detected in perimeter monitoring wells on the former Chevron site nearest to well #1 (i.e., monitoring wells M-10, M-12 and M-12D in Table 7, Appendix C) in any year they were sampled. However, these wells and M-8 are not directly upgradient of well #1 and well #20. Also, M-12 and M-12D were not sampled until 2002. M-10 was sampled in the same time period, but this well is located some distance from well #1 and well #20. Moreover, the wells may not be comparable in depth. In 2001, well #1 had DCA at low levels. In 1996 well #19 had 1.3 µg/L of 1,1-DCE. The NCDOT #45 or former Chevron cannot be ruled out as potential sources of the 1,1-DCE contamination in well#1, #19 and #20. Due to lack of both spatial and temporal monitoring and drinking well data, the actual source of the contamination cannot be determined.

Petroleum Products in On-site Groundwater at Exxon-Mobile and FCX

According to a North Carolina Department of Health and Human Services (NCDHHS) memo dated November 6, 2002, reports compiled in January and February of 2002 showed significant groundwater contamination under all four sites to the west and south of Milford Hills (NCDHHS 2002). At that time, two of the sites (Exxon-Mobile and FCX), both roughly 1,000 feet southeast (i.e., downgradient) of the NCDOT#45 and Chevron sites, had already undergone groundwater remediation. In 1986, the former Exxon-Mobil Distribution Terminal was decommissioned, the property was sold to Food Lion, Inc., and an initial subsurface investigation began (GES, 2009). That same year, Southern States, a retail center for farm, home and garden supplies acquired the property of the former FCX. The company removed the fuel distribution pump island and several aboveground petroleum product storage tanks, and began an initial subsurface investigation (Duncklee & Dunham, 2002).

Petroleum-related compounds were the predominate contaminants in the groundwater at these sites. They are located just south of the western edge of the Milford Hills area (Figures 1 and 5, Appendix A). However, they are down gradient (south) of residential communities and would not be expected to impact upgradient wells.

Both properties have been under active remediation since the late 1990's (Duncklee & Dunham, 2002; Hart & Hickman, 2002). LNAPL or free product has been detected at the FCX site and periodically found at the Exxon-Mobile site in the former fill rack area. Both sites have removed the LNAPL by aggressive fluid vapor recovery events (Dunklee & Dunham 2010). NCDENR has determined the extent of petroleum contamination has been defined and is limited to the

former Exxon-Mobile terminal and FCX properties (NCDENR 2005). Milford Hills is to the north and upgradient of both (Figure 5, Appendix C; NCDHHS 2002). With the exception of low levels of chloroform, no detectable concentrations of VOCs analyzed were found during 1992 and 1997 in the private well serving the Mid-Carolina Broadcasting Station (well #21 in Figure 1 and Table 5). This well is approximately 600 feet south of the former ExxonMobil property (Turner, Hart & Hickman, 1999). Exposure to these contaminants via drinking water is unlikely because all businesses in the area have utilized municipal water for drinking and other purposes for most of the last two decades (NCDENR 2005, personal communication, M. Alvalle, NCDENR, May 2010.)

Contaminants in Off-site, Residential and Commercial Drinking Water Wells

In 1992 and1993 NCDOT tested private residential and commercial wells in the Milford Hills area. Only two of the 10 sampled wells during that sampling event (wells #1 and 10 in Figure 1 and Table 4) contained chlorinated solvents at levels exceeding federal drinking water standards. Both of those properties were connected to municipal water supplies soon thereafter (Arcadis 2205b; Pitner and Alvalle 2010). Figure 1 in Appendix A depicts the approximate locations of these 10 wells (numbered 1-10) and13 others, relative to the local industrial facilities. Tables 4 and 5 in Appendix C summarize the historical sampling results for all 23 of the domestic and commercial wells depicted on Figure 1. ATSDR does not have any information on well depths. Figure 5 shows the general direction of groundwater flow in the area.

Wells #2 through #13 and #16 through #18 are upgradient from the four industrial sites and should not be impacted by the industrial contamination. In 1993, well #10 contained PCE at 5.3 µg/L which exceeds its MCL of 5 µg/L. NCDENR once considered the possibility that the National Guard Armory facility on the opposite side of Jake Alexander Blvd. was the source of the PCE detected in this well (Table 4, Appendix C) (NCDENR 2005). However, no plausible link with the National Guard Armory was ever demonstrated.

Wells #14 and #15 are located in the Westwood neighborhood approximately one mile west of the industrial facilities. Well water tests found no site-related contaminants. Arsenic and barium were detected below levels of concern. Both residences are now on the municipal water supply.

Wells #19, #21, and #22 are private commercial wells located downgradient from the sites. On November 6, 1996, PCE and 1,1-DCE were detected in well #19. The concentration of PCE was an estimated value and below the MCL, and the 1,1-DCE was below the MCL. No other site-related contaminants were detected in the other two wells.

Former drinking water wells #1 and 20 both contained a variety of chlorinated solvents. Only the levels of 1,1-DCE exceeded the MCL of 7 µg/L. Well #1 contained 1,1-DCE at 98 µg/L in May 1992 and 136 µg/L in November of the same year. Several other chlorinated solvents were detected but were below their respective MCLs. Well #20 contained 37.8 µg/L of 1,1-DCE. Very little is known about the past uses of well #20. Given the limited availability of historical data for these two wells, it is difficult to ascertain the source of the 1,1-DCE contamination or if the concentrations are representative of past exposure. The past concentrations could have been higher, lower, or nonexistent.

Data Limitations

The well water and groundwater monitoring well data for this area has both spatial and temporal limitations. The majority of the private wells sampled are upgradient of the site. The few wells that may be downgradient were sampled infrequently. Much of the off-site sampling and on-site monitoring data were collected a decade after the initial discovery of the contamination in the drinking water wells.

No sampling data exist for private drinking water wells in the Milford Hills area prior to late 1992. The Occupational and Environmental Epidemiology Branch (OEEB) of the NC Division of Public Health is not aware of any private well data from Milford Hills from the1960's through the 1980's (NCDHHS 2002). In addition, private well data that are available come from only eighteen widely scattered wells, almost all of which are up-gradient of the industrial sites of interest. A few of these upgradient wells had detections of PCE. NCDENR is currently investigating an upgradient site that may be a source of PCE.

No downgradient wells exist at a similar depth to 45DW-4.Without downgradient wells at a similar depth, the TCE plume cannot be considered delineated.

A few off-site wells (well #1, #19 and #20) near the sites had detections of 1,1-DCE. The groundwater data is insufficient to determine the source of the contamination or how long the wells were contaminated.

No soil gas or indoor air samples have been taken. These samples would be helpful to evaluate the existence of contaminant vapor intrusion.

Public Health Implications

Understanding how site conditions may influence the extent to which people come in contact with site contaminants is central to the public health assessment process. Thus, once the simple environmental screening has been completed, site-specific exposure doses are calculated. Exposure doses are estimated and then compared to health guideline values. Estimating an exposure dose requires identifying how much, how often, and how long a person may come in contact with some concentration of the contaminant in a specific medium (air, water, soil). The equation and assumptions used to estimate exposure doses from drinking contaminated water are provided in Exhibit 1 below.

ATSDR recognizes the unique vulnerabilities of infants and children. This must be taken into account when considering potential exposures and health effects. Children are not just 'little adults' - they are often undergoing rapid development of various body systems, and their behavioral patterns often result in increased contact with environmental media.

The highest recorded concentration of 1,1-DCE in a residential private well (#1) was 136 µg/L - EPA's MCL is 7 µg/L and ATSDR's chronic Environmental Media Evaluation Guide (EMEG) is 90 µg/L for children and 300 µg/L for adults. Several other chlorinated solvents were detected in this well but were below their respective MCLs and EMEGs. ATSDR's EMEGs are estimated contaminant concentrations that are not expected to result in adverse noncarcinogenic health effects based on ATSDR evaluation, and EPA's MCLs are protective for children, as well as adults, over a lifetime of exposure to the specified drinking water contaminant. Commercial Well #20 contained 37.8 µg/L of 1,1-DCE. The higher concentration in well #1 was used in the dose

calculations and since that value did not produce dose levels that are of concern, dose calculations were not generated for well #20. Well #1 served a single residence outside of the Milford Hills neighborhood. Residents who used well #1 as a domestic water supply would also have been exposed dermally and via inhalation, whenever they took baths or showers using this water. Depending on the frequency of bathing and showering, and the amount of water consumed at home, the in-home dermal and inhalation exposures combined may have been comparable to the oral exposures, (McKone and Daniels, 1989).

In 1993, residential well #10 contained PCE at 5.3 µg/L which exceeds its MCL of 5 µg/L but does not exceed ATSDR's CREG of 17 µg/L. ATSDR's CREGs are estimated contaminant concentrations that would be expected to cause no more than one excess cancer in a million (10^{-6}) persons exposed during their lifetime. PCE was detected below the MCL in residential wells #1, 11, 17, 18. Given the lack of historical data, it is not possible to determine if these wells ever reached PCE levels that would be of concern.

In 1989, well #23, (located on the NCDOT #45 site) contained TCE at 24 µg/L which exceeds its MCL of 5 µg/L and the chronic EMEG for adults of 18 µg/L. This was the concentration used in the dose calculations because it is the one sample collected during the time the well was used for potable purposes. Immediately following this detection, the well was no longer used as a source of drinking water.

Exhibit 1: Exposure Dose Equation for Ingestion

$$\mathbf{D = \frac{C \times IR \times EF \times AF}{BW}}$$

where,

D	=	exposure dose in milligrams per kilogram per day (mg/kg/day)
C	=	chemical concentration in milligrams per kilogram or liter (mg/kg) or (mg/L)
IR	=	intake rate in milligrams or milliliters per day (mg/day) or (ml/day)
EF	=	exposure factor (unitless)
AF	=	bioavailablity factor (unitless)
BW	=	body weight in kilograms (kg)

In the absence of complete information, ATSDR applied several health protective assumptions to estimate exposure doses as conservatively as possible. ATSDR was protective of health in its selection of the concentrations to be used, by using an exposure factor of one, and by assuming the contaminants were 100% bioavailable. The exposure factor is an expression of how often and how long a person may be contacting a substance in the environment and using an exposure factor of one is the most conservative. 100% bioavailability assumes complete absorption of the ingested contaminant. ATSDR evaluated exposure of individuals that were drinking water from the contaminated wells. Specifically, ATSDR estimated exposure doses using the following assumptions and default intake rates for exposure through ingestion:

- The maximum concentrations detected of 1,1-DCE and PCE in residential drinking water wells were used when calculating exposure doses and are 136 µg/L and 5.3 µg/L, respectively. The maximum concentration detected of TCE in a commercial drinking water well was 24 µg/L.
- The average daily water intake rates provided in the EPA Exposure Factors Handbook were used and are provided in Table 1 below (EPA 2011). An exposure factor of 1 is a health protective measure to represent a resident being exposed daily. For the worker exposure to TCE, an exposure factor of 5/7 was used to represent the worker being exposed for 5 days of the week.
- The body weights of children and adults were taken from the Exposure Factors Handbook and are provided in Table 1 (EPA 2011).
- The bioavailability of all contaminants was assumed to be 100%—that is, all of the contaminant in media that a person ingested was assumed to enter the bloodstream.

Table 1. Estimates for Body Weight and Daily Drinking Water Ingestion Rate

Group	Body Weight in Kilograms	Mean Ingestion of Drinking Water in Milliliters per Day†
Birth to <1 year	7.8	504
1 to <2 years	11.4	308
2 to <6 years	17.4	402
6 to <11 years	31.8	480
11 to <21 years	64.2	753
21 to <65 years	80	1,183
65+ years	76	1,242

Weight for children and adults obtained from Table 8-1 of (EPA, 2011), recommended values for body weight (males and females combined).
† Obtained from Tables 3-1 and 3-3 of (EPA, 2011)

The calculated doses are presented in the following tables and an explanation of the doses is provided in the *Non-cancer Health Effects* section.

Table 2. ***Calculated Exposure Doses and Inhalation Concentrations used for the Assessment of Non-Cancer Health Effects from Exposure to TCE, PCE, and 1,1-DCE in Drinking Water at the Salisbury Site***

	PCE		1,1-DCE		TCE	
Age Ranges	**Dose (µg/kg/day)**	**Comparison Value (RfD in µg/kg/day)**	**Dose (µg/kg/day)**	**Comparison Value (chronic MRL in µg/kg/day)**	**Dose (µg/kg/day)**	**Comparison Value (RfD in µg/kg/day)**
Birth to <1 year	0.34	6	8.8	9	NA	0.5
1 to <2 years	0.14	6	3.7	9	NA	0.5
2 to <6 years	0.12	6	3.1	9	NA	0.5
6 to <11 years	0.080	6	2.1	9	NA	0.5
11 to <21 years	0.062	6	1.6	9	0.20	0.5
21 to <65 years	0.078	6	2.0	9	0.25	0.5
65+ years	0.087	6	2.2	9	NA	0.5

NA = Not Assessed
µg/kg/day = micrograms of contaminant per kilogram of body weight per day
RfD = EPA's Reference Dose; MRL = ATSDR's Minimal Risk Level
TCE = trichloroethylene; 1,1-DCE = 1,1 dichloroethylene; PCE = tetrachloroethylene
Since the only drinking well that showed TCE at levels of concern was solely used by NCDOT #45 workers, TCE doses were only calculated for ages that would reflect the worker population.
Source: EPA RfDs and MRLs were referenced at EPA's Integrated Risk Information System (IRIS) website www.EPA.gov/iris

Non-Cancer Health Effects

Often, ingestion exposure is the most significant source of exposure to hazardous substances from a site. In the case of VOC contamination, however, inhalation and dermal exposures can make a contribution to the total exposure dose (that is, the total amount of contaminant that enters and can affect a person's body). A precise estimate of these non-ingestion exposures is seldom achievable. A common estimation is that non-ingestion exposures yield a contaminant dose comparable to the ingestion dose (ATSDR, 2005). This estimation may underestimate exposures to people who may be exposed to TCE from shower water for periods of 30 minutes or more per day. However, for the purposes of this evaluation, we doubled ingestion exposure doses to account for additional exposure from inhalation and dermal exposures.

Chemicals exceeded regulatory MCLs but to determine if a health effect is likely/unlikely, ATSDR uses health based guidelines to determine if an adverse health effect could occur. The estimated daily doses for 1,1-DCE (136 µg/L), presented in Table 2 did not exceed ATSDR's chronic minimum risk level (MRL) of 9 µg/kg/day. Doubling these doses to account for inhalation and dermal exposure causes the dose in children less than one year old to exceed the MRL. Therefore, if there were children in the residence less than one year old, they may have an increased risk of experiencing adverse non-cancer health effects. However, the calculated dose for children less than one year old is 1,000 times lower than the lowest observed adverse effect

level (LOAEL). Of note, EPA's reference dose (RfD) is 50 µg/kg/day for 1,1-DCE and none of the doses, even when doubled, exceed the RfD. Also, the 0.136 mg/L 1,1-DCE concentration does not exceed EPA's Health Advisory Level (HAL) of 1 mg/L for a 10 kg child consuming 1 liter of water per day up to a 7 year exposure. MRLs, RfDs, HALs, and other comparison values mentioned in this consultation, are defined in Appendix B. ATSDR's chronic MRLs are estimates of a long-term (greater than 1 year), exposure level at which no non-cancerous effects would be expected. ATSDR's chronic MRL for 1,1-DCE was derived by dividing the LOAEL for 1,1-DCE (9,000 µg/kg/day for hepatocellular swelling and fatty changes in rats) by an uncertainty factor of 1,000 (ATSDR 1994). An uncertainty factor is one of several, generally 10-fold, default factors used in deriving comparison values from experimental data. Uncertainty factors are mathematical adjustments for reasons of safety when knowledge is incomplete. For example, factors used in the calculation of doses that are not harmful (adverse) to people. These factors are applied to the LOAEL or the no-observed-adverse-effect level (NOAEL) to derive a MRL. Uncertainty factors are used to account for variations in people's sensitivity, for differences between animals and humans, and for differences between a LOAEL and a NOAEL. Scientists use uncertainty factors when they have some, but not all, the information from animal or human studies to decide whether an exposure will cause harm to people (ATSDR 2005).).

The estimated daily doses from the maximum PCE drinking water concentration (5.3 µg/L) are presented in Table 2. None of these doses exceed EPA's oral RfD of 6 µg of PCE/kg/day; or doubling the dose to account for inhalation and dermal exposure. EPA's RfD is an estimate (with uncertainty spanning perhaps an order of magnitude) of a daily exposure to the human population (including sensitive subgroups) that is likely to be without an appreciable risk of deleterious effects during a lifetime (EPA 1988).

The estimated daily doses for workers exposed to TCE (24 µg/L) from drinking water are presented in Table 2. The doses do not exceed EPA's RfD of 0.5 µg/kg/day. EPA's RfD is meant to be protective for a lifetime of exposure and the workers were exposed to the TCE for less than a lifetime. Therefore, workers are not expected to experience adverse health effects from TCE exposure.

Regarding mixtures, the sample with 1,1-DCE from residential Well #1 was the only sample of the three tested that had multiple contaminants. One way to evaluate mixtures is to take the hazard index approach. The hazard index approach uses the assumption of additive dose to assess the non-cancer health effects of a mixture from the data on the components. Exposures or doses for the various components of the mixture are scaled by a defined level of exposure generally regarded as "acceptable" by the agency performing the assessment. The defined levels used in this evaluation were ATSDR's MRL for 1,1-DCE and TCE. The general equation for the hazard index (*HI*) is:

$$HI = (E_1 / DL_1) + (E_2 / DL_2)\ldots(E_n / DL_n)$$

E_1 is calculated dose of the first chemical in the mixture and DL_1 is some defined level of exposure to the first chemical, E_2 and DL_2 are the corresponding levels for chemical 2, and the summation can extend to any number of chemicals, signified by the *n*. When the hazard quotient for a single chemical exceeds unity, concern for the potential hazard of the chemical increases. Similarly, when the hazard index for a mixture exceeds unity, concern for the potential hazard of

the mixture increases (ATSDR 2004). The hazard index of the sample was 1.2 which exceeds one, so there may be an additive effect associated with exposure from Well #1.

Estimated Theoretical Cancer Risk

The excess theoretical cancer risk is the number of increased cases of cancer in a population above background that may result from exposure to a particular contaminant under the assumed exposure conditions from site-related contamination. For example, an estimated theoretical cancer risk of 2×10^{-6} represents a possible two excess cancer cases in a population out of one million people exposed. Because of the uncertainties and conservatism inherent in deriving the cancer slope factors, this is only an estimate of risk; the true risk is unknown (ATSDR 2005b).

ATSDR calculated the theoretical cancer risk and considered exposure from ingestion of the TCE contaminated water and the results are presented in Table 3 below. The cancer risks for PCE have been doubled to account for inhalation and dermal exposure. ATSDR did not assess the theoretical cancer risk for 1,1-DCE because there is no statistically or biologically significant increase in tumor incidence at any site in the relevant oral bioassays (EPA 2002).

Table 3. Estimated Theoretical Increased Risk of Cancer for Past Exposure to TCE in Drinking Water at the Millsboro TCE Site

Increased Risk of Cancer			
Age Range	**TCE**	**PCE**	**Above the E-05 risk?**
Birth to <1 year	NA	0.004 in 100,000 per year	No
1 to <2 years	NA	0.002 in 100,000 per year	No
2 to <6 years	NA	0.006 in 100,000 per year	No
6 to <11 years	NA	0.006 in 100,000 per year	No
11 to <21 years	0.2 in 100,000 per year	0.008 in 100,000 per year	No
21 to <65 years	1 in 100,000 per year	0.004 in 100,000 per year	No
65+ years	NA	0.004 in 100,000 per year	No

NA = Not Assessed
TCE = trichloroethylene; PCE = tetrachloroethylene
EPA's target risk range for Superfund Sites is 1 in 1,000,000 to 1 in 10,000.
Since the only drinking well that showed TCE at levels of concern was solely used by NCDOT #45 workers, TCE doses were only calculated for ages that would reflect the worker population.

ATSDR calculated the theoretical cancer risk for TCE and PCE using EPA's oral cancer slope factors. For TCE, the oral cancer slope factor (4.6×10^{-2} $(mg/kg/day)^{-1}$) is multiplied by the daily exposure dose to obtain the increased risk of cancer. Using the EPA oral cancer slope factor with the doses for workers and assuming the worker consumed the volume of well water presented in Table 2 every work day for 20 years, there would be an estimated increased risk between 0.2 and 1×10^{-5}. For example, an estimated theoretical cancer risk of 2×10^{-5} represents a possible two

excess cancer cases in a population out of one hundred thousand people exposed. The workers' theoretical risk is a low level of increased risk and health effects are unlikely as a result of these exposures. EPA's general target risk range for risk management at Superfund sites is between 1 in 1,000,000 (1×10^{-6}) and 1 in 10,000 (1×10^{-4}).

For PCE, the oral cancer slope factor (2.1×10^{-3} $(mg/kg/day)^{-1}$) is multiplied by the daily exposure dose to obtain the theoretical increased risk of cancer. Using the EPA oral cancer slope factor with the doses for the age ranges presented in Table 3, there would be a very low risk that does not exceed EPA's general target risk range. 30 years was chosen for the exposure duration in this theoretical cancer risk calculation because that is the national upper-bound time (90th percentile) that people spend at one residence. The amount of time that the individuals lived at the residence in question is not known (ATSDR 2005).

Potential Exposure from Industrial Roadway Dust Suppression and Vehicle Washing Activities

In addition to the drinking water route of exposure, ATSDR evaluated an exposure scenario that represented concentrations of TCE that one may have been exposed to if NCDOT #45 used their contaminated on-site well for industrial operations such as, suppressing dust and washing vehicles. ATSDR assessed this route of exposure in response to a community member request. ATSDR used the highest concentration of TCE recorded in the well of 54 µg/L and assumed that 10,000 liters of well water were applied to an area equivalent to half of the property (4550 m^2) for 15 minutes each day. A discussion with a sales representative from Company Wrench confirmed that 10,000 liters was more than enough water to cover the area in question (Company Wrench 2011). Company Wrench is a rental and sales company of dust suppression equipment. These assumptions generated a TCE air emission rate of 1.3×10^{-7} grams/second which was incorporated into a fugitive dust model—the appropriate model for estimating the dispersion of VOCs at low concentrations.

The model assessed air dispersion emissions coming from the on-site application of TCE-contaminated water for dust suppression. TCE is a volatile chemical and the majority of TCE present in water and on soil surfaces will volatilize to the atmosphere (ATSDR 1997). The dispersion model provides algorithms to estimate the air quality impact of gas-phase emissions on environments with simple terrain. The model calculates average annual concentrations at receptors of interest and computes downwind concentrations using specific meteorological conditions. The dispersion model was mainly selected for this study because of its ability to simulate rectangular area sources of varying length and width dimensions (EPA 1993).

Below is a list of the assumptions used in the modeling:

- 1 area source
- Roughness height 80 centimeters
- Atmospheric stability class B
- Anemometer height 10 meters
- Ambient Temperature 300 Kelvin
- Mixing Height 300 meters
- Wind Speed 1 meters/second

The model generated a maximum TCE concentration of 0.012 µg/m^3 495 meters from the center of the site. This is the approximate distance from the site to the closest point of the Milford Hills neighborhood. The modeled maximum value does not exceed ATSDR's TCE inhalation cancer risk evaluation guide (CREG) of 0.2 µg/m^3 and, is therefore unlikely to cause adverse health effects. The theoretical cancer risk associated with the modeled TCE exposure is 2.8×10^{-8}. ATSDR CREGs are estimated contaminant concentrations expected to cause no more than one excess cancer in a million persons exposed over a lifetime. CREGs are calculated from EPA's cancer slope factors, or cancer potency factors, using conservative default values for exposure rates. Because both CREGs and cancer slope factors reflect estimates of hypothetical risk, neither can be used to make actual predictions of cancer risk. The true risk is unknown and may be close to zero. As for our site-specific scenario, exposure would not have occurred for a lifetime and would have likely taken place during the day when most people in the Milford Hills/Terrace area would be at work and away from their homes. Thus, no adverse health effects are expected from exposure to TCE vapors emitted while using the water for activities like dust suppression.

Information made available to ATSDR by state officials indicates that all residences in communities near the NCDOT #45 (e.g., Milford Hills) currently have access to municipal drinking water, even though four residents (all up-gradient of the asphalt plants) chose to continue using their wells (well #2, 3, 7, and 12 in Figure 1) and not connect to city water. The sampling of these four residential wells has not shown levels of any contaminants that exceed health based comparison values. Therefore, it appears that no one in this area is being exposed to VOC-contaminated groundwater from the neighboring asphalt plants. According to an NCDENR memo dated July 26, 2005, all businesses in the area utilize municipal water for drinking and other purposes. No responses were received to letters that NCDENR sent in Nov/Dec 2000, and again on July 22, 2002, offering to sample wells at residences and businesses throughout the Milford Hills area (NCDENR 2005). Continued sampling of wells just north (i.e., up-gradient) of the NCDOT #45 site on Dan and Clancy Streets has shown that the only contaminants detected (carbon tetrachloride and chloroform) were more than 10 and 100 times lower, respectively, than their corresponding MCLs (Pitner and Alvalle, 2010). These contaminants were also below chronic EMEGs for both children and adults. Therefore, based on all the data available to ATSDR, the groundwater beneath the four industrial sites addressed in this health consultation currently poses, or is likely to have posed in the past, no public health hazard to Milford Hills/Milford Terrace area residents. However, with so little historical data, it is difficult to ascertain the source of the contaminants detected in residential Well #1 and commercial Well #20, and one cannot completely disregard the possibility that the contaminants in Well#1 and #20 might be attributed to the NCDOT #45 or former Chevron sites.

Community Health Concerns

Community members have expressed concern that a number of health problems (including gastrointestinal illness, respiratory problems, cancer, higher suicide rates, and death) in the community might be related to long-term exposure to air and groundwater pollutants originating from nearby asphalt and petroleum facilities in Salisbury. The present consultation addresses the possibility that adverse health effects may have resulted from past consumption of drinking water from private wells. Based on the direction of groundwater flow from the local industrial sites, residents in Milford hills/Milford Terrace are not likely to have been exposed to on-site

groundwater contaminants via their private drinking water wells. The levels of contaminants that were detected in their wells were too low to produce any adverse health effects.

Quality Assurance

In preparing this report, ATSDR relied on the information provided in the referenced documents and on contacts with North Carolina state government officials. ATSDR assumes that adequate quality assurance and control measures were followed during sampling, chain-of-custody, laboratory procedures, and data reporting. The validity of the analyses and conclusions drawn in this document are dependent on the availability and reliability of that information.

Conclusions

The available data, though limited, supports the conclusion that no one living in the Milford Hills community and vicinity was likely to have been exposed to levels of asphalt- or petroleum-facility-related chemicals in groundwater that would result in adverse health effects. This determination is based on the following:

1.) Groundwater movement at the industrial properties of interest is generally toward the southeast, and not towards either Milford Hills or Milford Terrace. Therefore, the groundwater contaminants detected in private residential wells (#2-18) in Milford Hills/Milford Terrace appear to be unrelated to groundwater contaminants detected at the individual industrial facilities evaluated in this consultation and any contaminants that were detected in those wells were not at levels that would constitute a public health hazard.

2.) Because of generally low contaminant levels in private, non-industrial, off-site drinking water wells, groundwater contaminants are not expected to have caused any past or present cancerous or noncancerous adverse health effects in Milford Hills/Milford Terrace residents. With the exception of 1,1-DCE and PCE detected in two private wells (1992), levels of contaminants in non-industrial, off-site, private wells in Milford Hills and vicinity did not exceed the applicable MCLs or chronic EMEGs. Based on the limited sampling data, chronic exposure to the maximum levels of 1,1-DCE and PCE detected in private residential wells are not expected to cause adverse health effects.

3.) No adverse health effects are expected from nearby residents inhaling airborne contaminants from past use of the contaminated well on the former NCDOT site #45 for operations such as dust suppression and vehicle washing.

4.) Data are inadequate to conclude whether the potential vapor intrusion (VI) pathway could harm people's health. The information needed to make a decision is not available. ATSDR is working with NCDENR to gather the needed information.

5.) No future health risks are expected to be associated with the groundwater at the industrial facilities of interest along Jake Alexander Boulevard. Currently, only three known up-gradient residences drink water from private wells in the Milford Hills vicinity of Salisbury, NC.

6.) Current NCDOT #45 workers are not at risk of adverse health effects from ingestion of contaminated groundwater because the on-site drinking water well is no longer in use.

Recommendations

1.) Continue periodic sampling of the four private wells being used in the Milford Terrace community. These wells are close to (albeit up-gradient of) sites with known groundwater contamination.

2.) Permanently seal contaminated private wells (commercial or residential) that are no longer in use. If any continue to be used, ensure they are only used for non-potable purposes (irrigation, washing, etc.).

3.) NCDENR should evaluate the potential for vapor intrusion. ATSDR will provide assistance as needed.

4.) NCDENR should evaluate whether contamination is migrating off-site at depth.

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Appendix A. Figures

Figure 1. Approximate locations of domestic and commercial off-site wells in the Milford Hills/Milford Terrace area Salisbury, NC. (Well numbers same as in Tables 4 and 5)

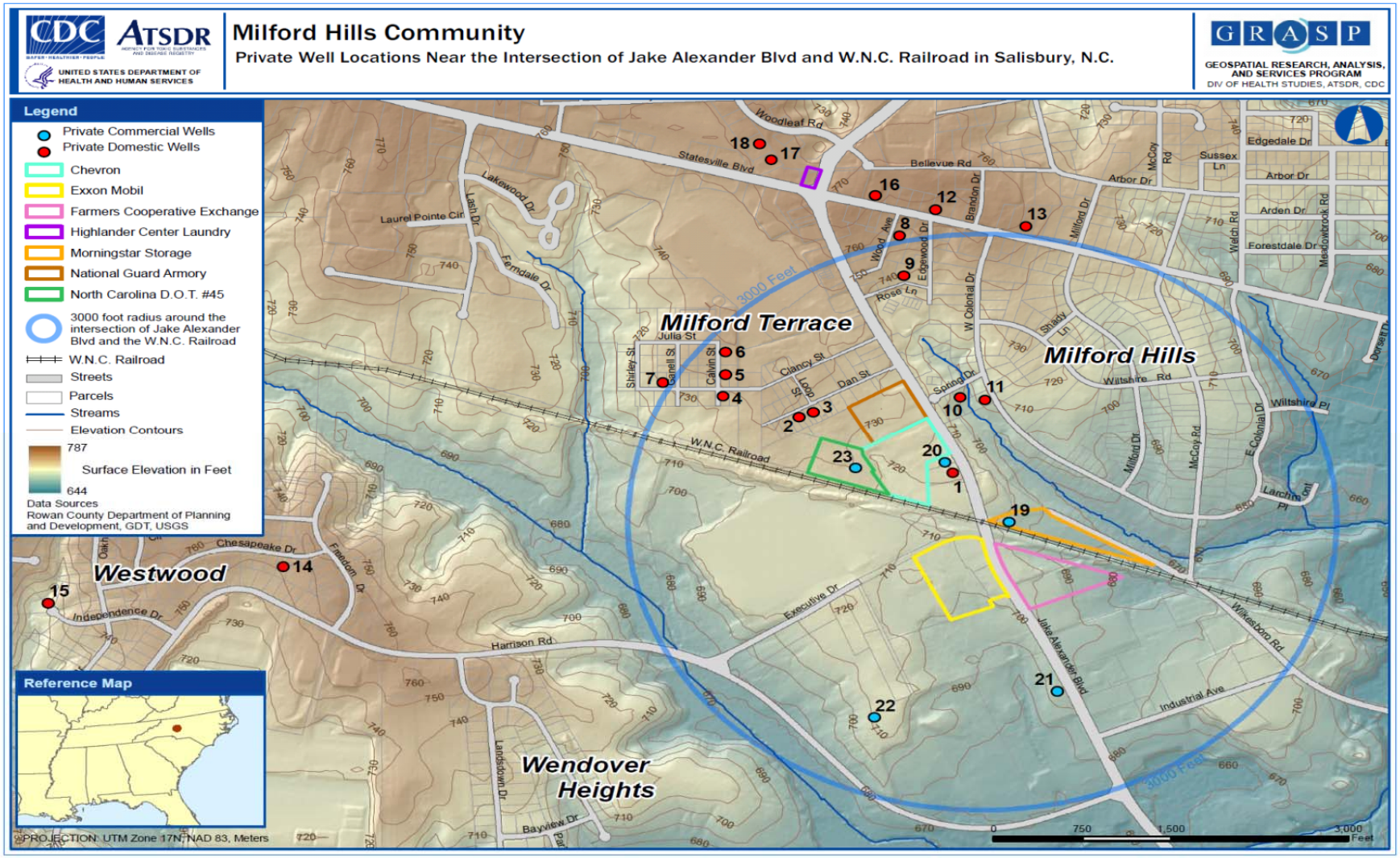
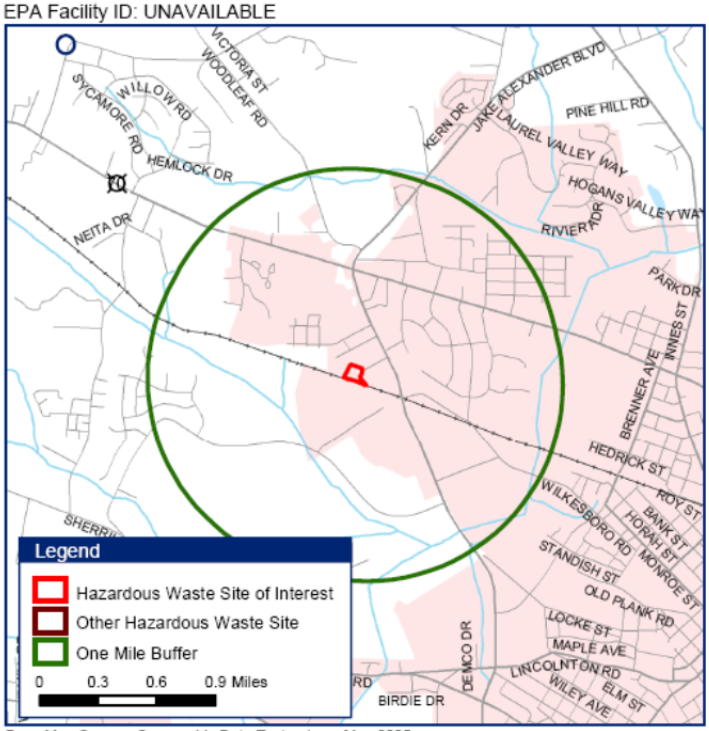


Figure 2. Demographic statistics in the Milford Hills/Milford Terrace area Salisbury, NC.

NCDOT NO. 45
Salisbury, NC

EPA Facility ID: UNAVAILABLE



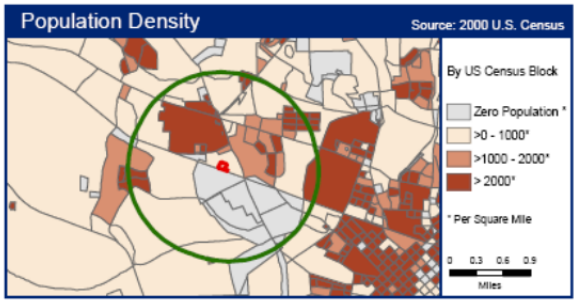
Base Map Source: Geographic Data Technology, May 2005.
Site Boundary Data Source: ATSDR Geospatial Research, Analysis, and Services Program, Current as of Generate Date (bottom left-hand corner).
Coordinate System (All Panels): NAD 1983 StatePlane North Carolina FIPS 3200 Feet

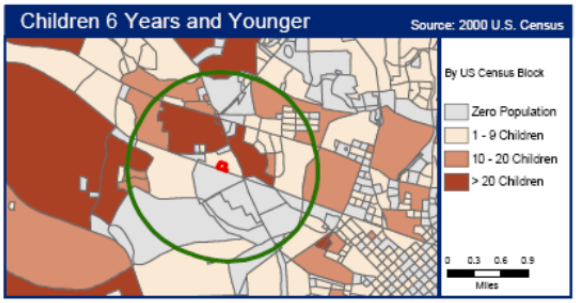
Site Location: Rowan County, NC

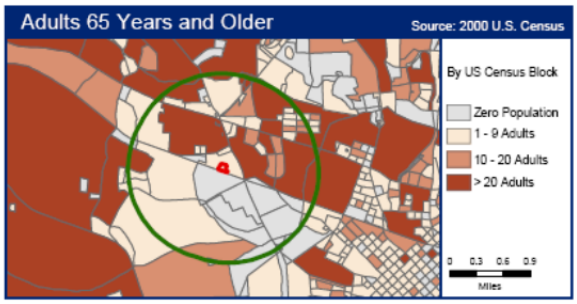
Demographic Statistics
Within One Mile of Site*

Total Population	3,375
White Alone	2,209
Black Alone	968
Am. Indian & Alaska Native Alone	6
Asian Alone	73
Native Hawaiian & Other Pacific Islander Alone	1
Some Other Race Alone	50
Two or More Races	69
Hispanic or Latino**	105
Children Aged 6 and Younger	319
Adults Aged 65 and Older	654
Females Aged 15 to 44	726
Total Housing Units	1,594

Demographics Statistics Source: 2000 U.S. Census
* Calculated using an area-proportion spatial analysis technique
** People who identify their origin as Hispanic or Latino may be of any race.







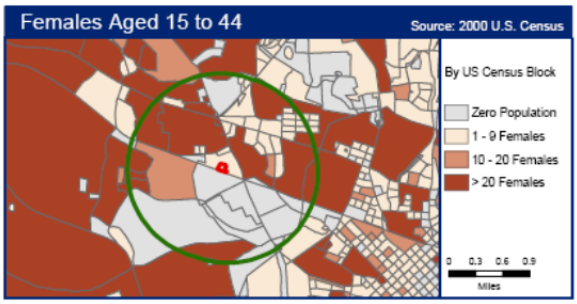


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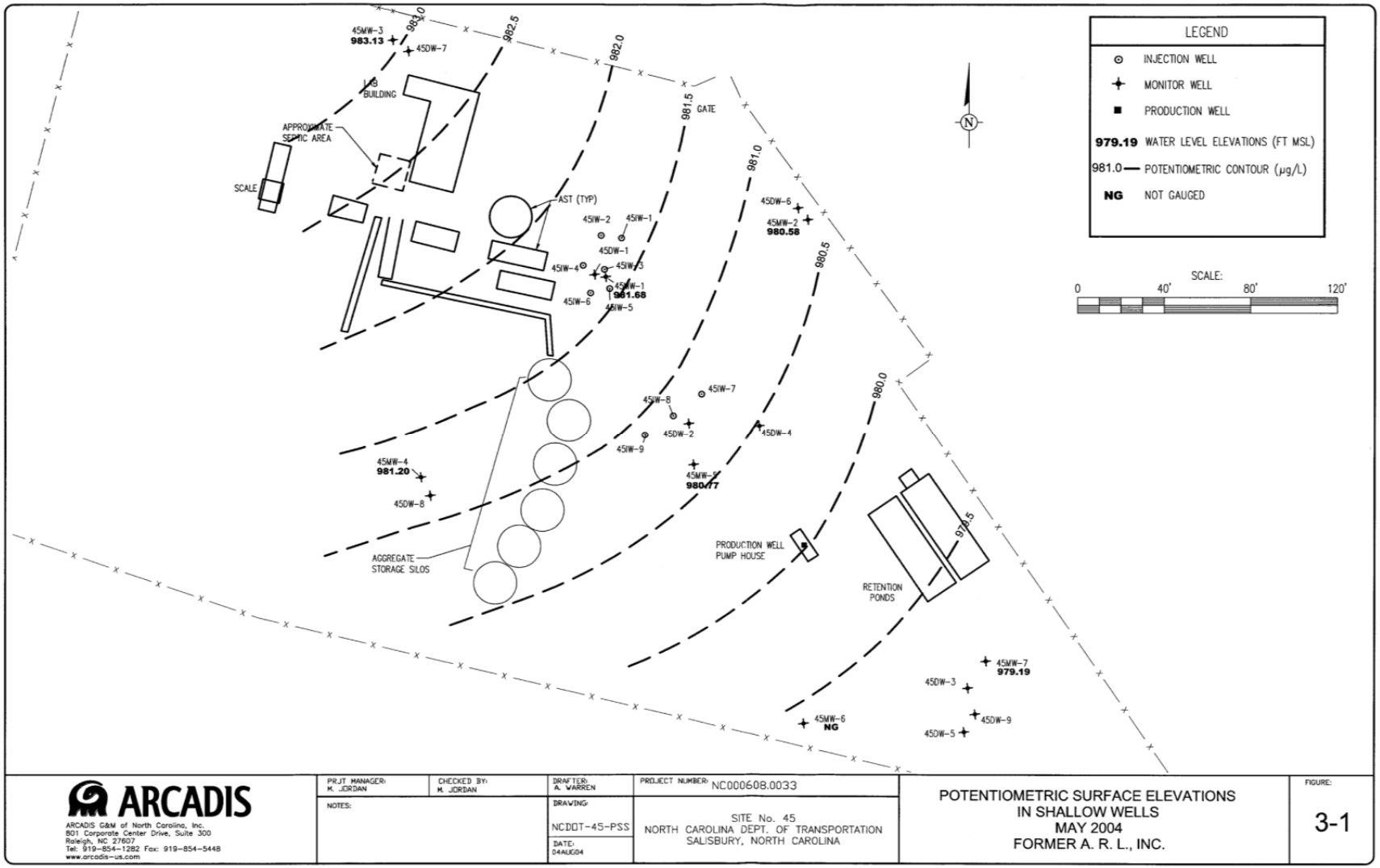
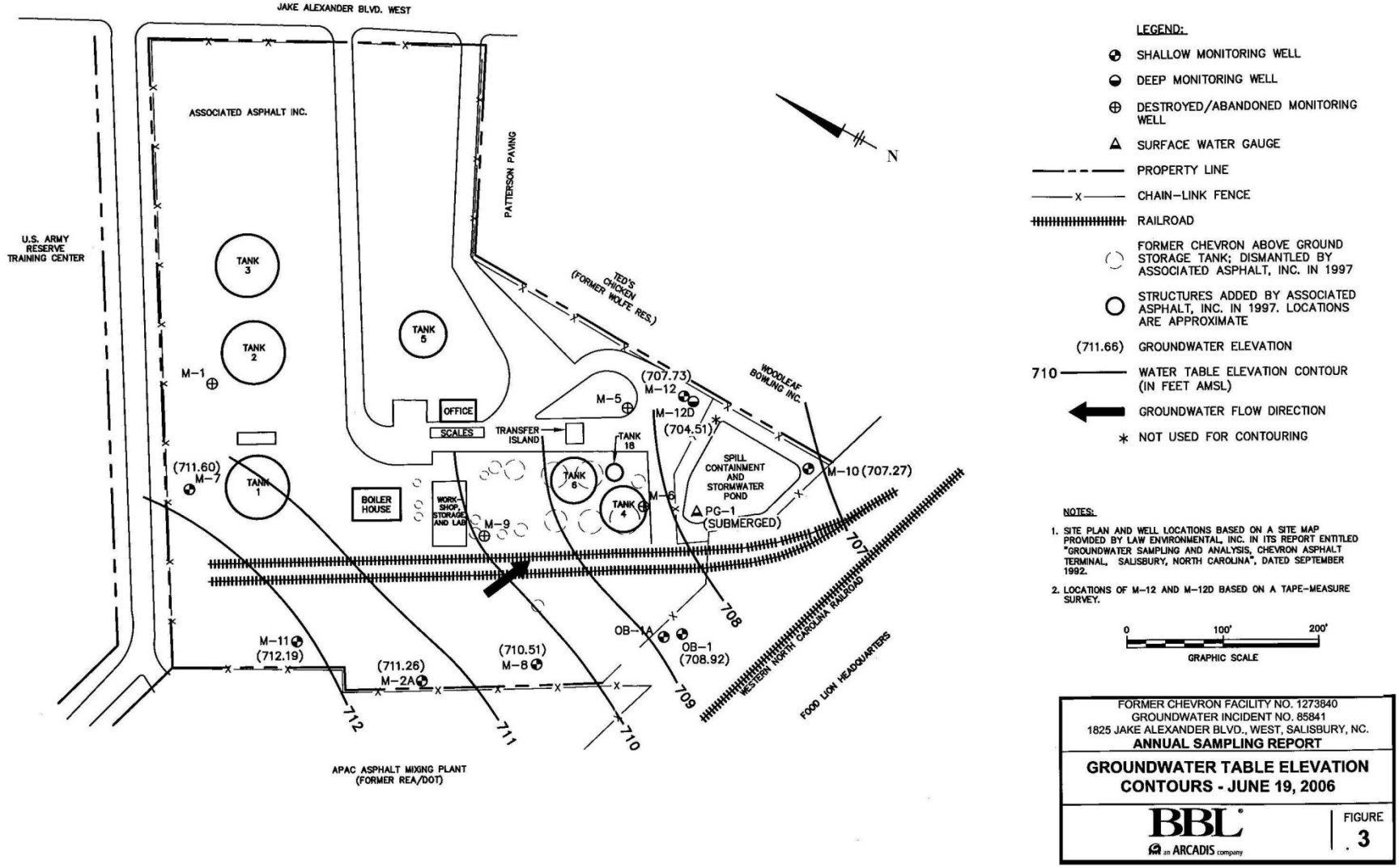
Figure 3. On-site map of former NCDOT Asphalt Facility No. 45 showing groundwater contours and monitor well locations. Well numbers in Table 6, Appendix C correspond with those on this map.



Source: ARCADIS (2004a). June 2004 Groundwater Monitoring Event, Former NCDOT Asphalt Testing Facility No. 45, 1831

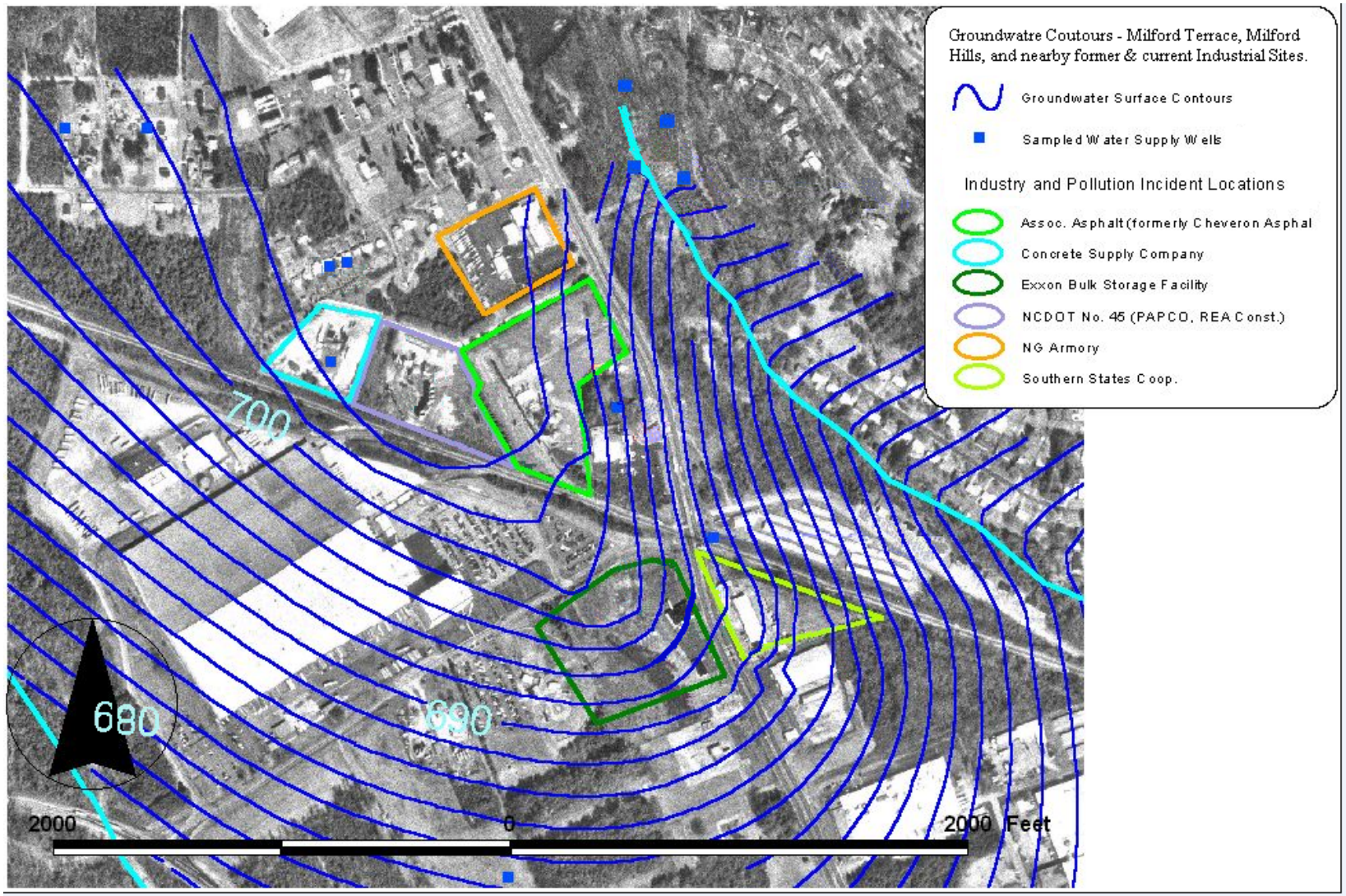
Elevations referenced to an arbitrary datum of 1000 feet. The Figure shows that the general flow of groundwater is to the southeast.

Figure 4. Site map of Chevron (currently Associated Asphalt) showing locations of monitor wells. (Well numbers correspond with those on Table 7.)



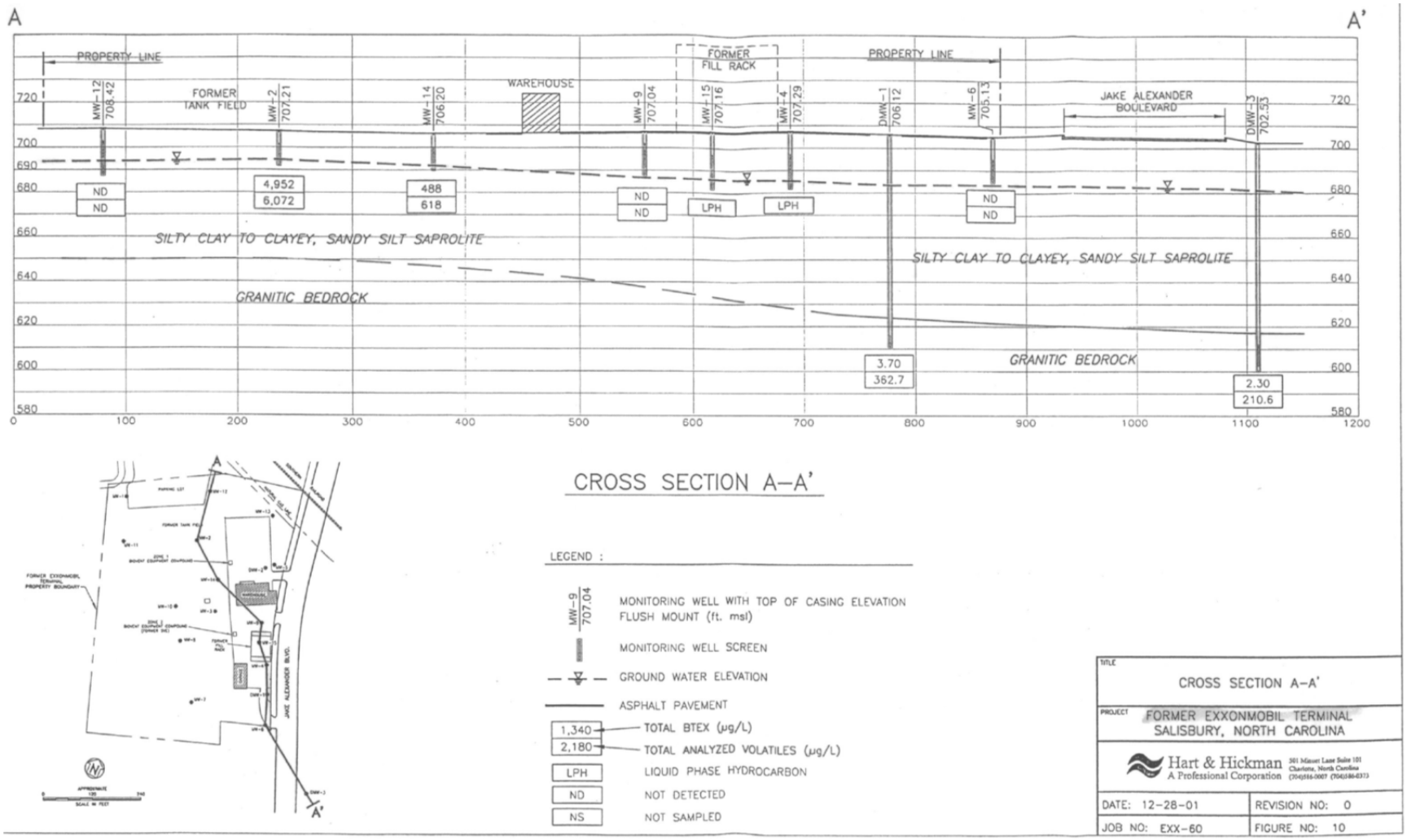
Source: BBL (2006). Report of Groundwater Monitoring Data – June 2006, Former Chevron Asphalt Terminal, Facility ID #1273840, 1825 Jake Alexander Boulevard West, Salisbury, NC.

Figure 5. Map showing locations of sampled water supply wells and the general direction of area groundwater flow including Milford Hills, Milford Terrace, and nearby industrial/commercial sites.



Source: Modified after NCDENR (2005). Internal memo re: Milford Hills and NCDOT. North Carolina Department of Environment and Natural Resources, Groundwater Section, Mooresville Regional Office, July 26, 2005. Groundwater flows from the higher to lower numbered groundwater contour lines.

Figure 6. North-South cross-section of the former ExxonMobil site showing the slight hydraulic gradient and the fine silty clay soils that contribute to the slow movement of area groundwater.



Source: Hart & Hickman (2002). Semiannual Monitoring and Activities Status Report – Former ExxonMobil Terminal, Salisbury, North Carolina.

Appendix B. Explanation of Comparison Values

Comparison Values – Definitions

ATSDR comparison values are media-specific concentrations considered to be safe under default conditions of exposure. They are used as screening values in the preliminary identification of site-specific "contaminants of concern." This term should not be interpreted to mean "hazard." As ATSDR uses the phrase, a "contaminant of concern" is a chemical substance detected at the site in question and selected by the health assessor for further evaluation of potential health effects. Generally, a chemical is selected as a "contaminant of concern" because its maximum concentration in air, water, or soil at the site exceeds one of ATSDR's comparison values.

That said, however, it must be emphasized that comparison values are not thresholds of toxicity. Although concentrations at, or below, the relevant comparison value may reasonably be considered safe, it does not automatically follow that any environmental concentration that exceeds a comparison value would be expected to produce adverse health effects. The principal purpose behind highly conservative, health-based standards and guidelines is to enable health professionals to recognize and resolve potential public health hazards before they become actual public health consequences. Thus, comparison values are designed to be preventive, rather than predictive, of adverse health effects. The probability that such effects will actually occur does not depend on environmental concentrations alone, but on a unique combination of site-specific conditions and individual lifestyle and genetic factors that affect the route, magnitude, and duration of actual exposure.

Listed and described below are the comparison values ATSDR used in this consultation.

CONCENTRATION-BASED COMPARISON VALUES:

Environmental Media Evaluation Guides (EMEGs) are concentrations of substances in water, soil, or air that are calculated from ATSDR minimal risk levels for those substances by factoring in default body weights and ingestion rates. Assuming default conditions of exposure, any given EMEG (a concentration) is equivalent to the corresponding MRL (a daily dose). If sufficient data are available, ATSDR develops EMEGs, and the MRLs from which they are derived, for exposures of acute (14 days or less), intermediate (15-365 days), and chronic (daily exposure for a year or more) durations.

Reference Dose Media Evaluation Guide (RMEG) is the concentration of a contaminant in air, water, or soil that corresponds to EPA's Reference Dose (RfD) for that contaminant, when default values for body weight and intake rates are taken into account.

Maximum Contaminant Levels (MCLs) represent contaminant concentrations in drinking water that EPA deems protective of public health (considering the availability and economics of water treatment technology) over a lifetime (70 years) at an exposure rate of 2 liters of water per day. Unlike other comparison values, MCLs are legally enforceable drinking water standards.

Cancer Risk Evaluation Guides (CREGs) are estimated contaminant concentrations expected to cause no more than one excess cancer in a million persons exposed over a lifetime. CREGs are calculated from EPA's cancer slope factors, or cancer potency factors, using default values for exposure rates. Because both CREGs and cancer slope factors reflect estimates of hypothetical risk, neither can be used to make realistic predictions of cancer risk. The true risk is unknown and may be as low as zero.

Health Advisory Levels (HALs) are health-based reference levels of substance concentrations in drinking water at which adverse noncarcinogenic health effects would not be anticipated. Such levels are established for one day, 10 days, long-term and life-time exposure periods. A margin of safety is included in its calculation.

NC 2L Groundwater quality standards for Class GA and Class GSA ground waters are defined in 15A NCAC 02L .0202 (d) as *the least of* the following: (1) the equivalent of an ATSDR drinking water RMEG adjusted for relative source contribution; (2**)** a VSD-equivalent concentration, i.e., one which corresponds to a "virtually Safe Dose" (VSD) which poses a hypothetical incremental lifetime cancer risk of $1x10^{-6}$; (3) a Taste threshold limit value; (4) an Odor threshold limit value; (5) a Maximum contaminant level; or (6) a National secondary drinking water standard. Since VSD-based doses and concentrations are typically much lower than all other comparison values for the same chemical, the NC 2L GW Standard will tend to be that VSD-related value, whenever such a value exists for said chemical.

DOSE-BASED COMPARISON VALUES:

Minimal Risk Levels (MRL) are estimates of daily human exposure to a chemical (doses expressed in mg/kg/day) that are unlikely to be associated with any appreciable risk of deleterious non-cancer effects over a specified duration of exposure. MRLs are calculated using data from human and animal studies and are reported for acute (14 day), intermediate (15–364 day), and chronic (365 day or more) exposures. Chemical-specific MRLs are published in the ATSDR toxicological profiles written for those specific chemicals.

Reference Dose (RfD) is an estimate of the daily dose of a contaminant that is unlikely to cause non-carcinogenic adverse health effects over a lifetime of chronic exposure. Like ATSDR's MRL, EPA's RfD is a dose usually expressed in mg/kg/day.

Comparison Values - Application

ATSDR assesses a site by evaluating the level of exposure in potential or completed exposure pathways. An exposure pathway describes the way in which chemicals may enter a person's body. It includes all the steps between the release of a chemical and the population exposed; that is, 1) a chemical release source, 2) a chemical movement, 3) a place where people can come into contact with the chemical, 4) a route of human exposure, and 5) a population that could be exposed. (In this assessment for Salisbury, N.C., ATSDR evaluates chemicals in the groundwater that people living in nearby residences might have regularly consumed in the past.)

Comparison values (CVs) are screening tools used to evaluate environmental data relevant to the exposure pathways. Although different agencies like ATSDR and EPA develop their own comparison values for their own purposes, the procedures they follow are essentially the same and, more often than not, the values they arrive at are very similar, as well. Comparison values are concentrations of contaminants that represent safe levels of exposure. They are derived from available health guidelines, such as ATSDR's minimal risk levels (for non-cancer effects) and EPA's cancer slope factors (for cancer effects).

Conservative exposure assumptions are used in the derivation of comparison values to ensure that the latter are much lower than all known levels of effect and, as a result, will be protective of

public health in essentially all exposure situations. Thus, if the concentrations in the exposure medium are less than the CV, the exposures are not of potential health concern and no further analysis of the pathway is required. Nevertheless, even if a site-specific concentration exceeds the relevant comparison value that does not mean that exposure at that level will necessarily lead to adverse effects. Comparison values are based on default, rather than site-specific, conditions of exposure, and generally contain generous margins of safety. Site-specific environmental factors and patterns of activity have a major impact on the magnitude and duration of exposure, and they (more than the concentrations alone) will determine whether contaminants that exceed their comparison values might lead to adverse health effects. ATSDR's comparison values are screening tools only**;** they cannot be used to predict the occurrence of adverse health effects. Further analyses utilizing the best medical and toxicological information available are required to determine the public health implications of exposures that exceed state or federal guidelines.

Contaminants of Concern and Public Health Implications

Contaminants of concern (COCs) are the site-specific chemical substances that exceed comparison values and have been subsequently selected by the health assessor for further evaluation. In the first step of the COC selection process, the maximum contaminant concentrations are compared directly to health-based comparison values. ATSDR considers site-specific exposure factors to ensure selection of appropriate health comparison values. (For example, if only adult workers are exposed to soil at a fenced site, an adult soil EMEG would be more appropriate for screening purposes than would a pica child EMEG.) If the maximum concentration reported for a chemical is less than the health comparison value, that chemical is not of public health concern and no further data review is required. If the maximum concentration is greater than the health comparison value, the chemical is selected for additional data review. In addition, any detected chemicals for which no relevant health comparison values exist are automatically selected for additional data review.

The next step of the process requires a more in-depth review of data for each of the contaminants selected to determine the public health implications, if any, of the selected COCs. Having served their purpose in the initial screening process, comparison values are not directly relevant to the toxicological evaluation of public health implications. Conclusions drawn during the latter stage of the analysis are based on the best medical and toxicological information available (ATSDR 1992).

References

[ATSDR] Agency for Toxic Substances and Disease Registry. 1992. Public Health Assessment Guidance Manual. Atlanta: US Department of Health and Human Services.

[ATSDR] Agency for Toxic Substances and Disease Registry. 2005. Public Health Assessment Guidance Manual (Update). Atlanta: US Department of Health and Human Services.

[EPA] Environmental Protection Agency. 1986. Guidelines for carcinogen risk assessment. FR 51(185):33992–34006.

[EPA] Environmental Protection Agency. 2005. Guidelines for carcinogen risk assessment. Washington DC: EPA/630/P-03/001B, Risk Assessment Forum; March 2005. p. 2–53.

[NC] North Carolina Administrative Code, Title 15a. Subchapter 2l - Groundwater Classifications and Standards (last amended December 1, 2005), Department of Environment and Natural Resources, Environmental Management Commission, Raleigh, North Carolina.

Appendix C. Data Tables

Table 4. VOC Concentrations (ppb?) in Private Domestic Wells Sampled From 1987 – 2006

WELL #	Date Sampled	Compd.:	PCE	TCE	1,1,1-TCA	1,1,2-TCA	CCl4	CHCl3	1,1-DCA	1,2-DCA	1,1-DCE	1,2-DCE	BDCM	DBCM
		MCL:	5	5	200	5	5	80	-----	5	7	70	80	80
		cEMEG:	-----	-----	-----	-----	-----	400	-----	-----	300	-----	700	3000
		NC2L:	0.7	2.8	200	-----	0.269	70	70	0.38	7	-----	0.56	-----
1	1/23/2001		ND	ND			ND			0.65				
	11/20/1992		0.7	0.9	ND	ND	ND	ND	0.47		ND	ND	ND	ND
	5/4/1992		<0.25	0.38	29.9	ND	<0.75	1.2	ND	ND	136	1.7		ND
						<0.25		0.31	<0.25	0.5	98		ND	ND
2	9/7/2006		ND	ND	36		0.13	0.38				ND	ND	ND
	8/10/2005		ND	ND	ND	ND	ND	<0.25	ND	ND	ND	ND	ND	ND
	2/10/2004		ND	ND	ND	ND	<0.25	<0.25	ND	ND	ND	ND	ND	ND
	11/25/2002		ND	ND	ND	ND	ND	<0.25	ND	ND	ND	ND	ND	ND
	11/8/2001		ND	ND	ND	ND	0.32	0.29	ND	ND	ND	ND	ND	ND
	12/18/2000		ND	ND	ND	ND	<0.5	<0.25	ND	ND	ND	ND	ND	ND
	8/1/2000		ND	ND	ND	ND	<0.5	<0.5	ND	ND	ND	ND	ND	ND
	9/30/1997		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	11/20/92		ND	ND	ND	ND	ND	1.1	ND	ND	ND	ND	ND	ND
	10/12/1992		ND	ND	ND	ND	<0.75	0.27	ND	ND	ND	ND	ND	ND

Continued

Table 4(cont'd). VOC Concentrations (µg/L or ppb) in Private Domestic Wells Sampled From 1987 – 2006

WELL #	Date Sampled	Compd.:	PCE	TCE	1,1,1-TCA	1,1,2-TCA	CCl4	CHCl3	1,1-DCA	1,2-DCA	1,1-DCE	1,2-DCE	BDCM	DBCM
		MCL:	5	5	200	5	5	80	-----	5	7	70	80	80
		cEMEG:	-----	-----	-----	-----	-----	400	-----	-----	300	-----	700	3000
		NC2L:	0.7	2.8	200	-----	0.3	70	700	0.38	7	-----	0.6	-----
3	9/7/2006		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	8/10/2005		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	2/10/2004		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	11/25/2002		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	11/8/2001		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	12/18/2000		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	8/1/2000		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	11/20/1992		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
4	1/21/1993		ND	ND	ND	ND	ND	ND	ND	ND	ND	NA	ND	ND
5	1/21/1993		ND	ND	ND	ND	ND	ND	ND	ND	ND	NA	ND	ND
6	1/21/1993		ND	ND	ND	ND	ND	ND	ND	ND	ND	NA	ND	ND
7	8/1/2000		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	1/21/1993		ND	ND	ND	ND	ND	ND	ND	ND	ND	NA	ND	ND

Continued

Table 4(cont'd). VOC Concentrations (µg/L or ppb)in Private Domestic Wells Sampled From 1987 – 2006

WELL #	Date Sampled	Compd.:	PCE	TCE	1,1,1-TCA	1,1,2-TCA	CCl4	CHCl3	1,1-DCA	1,2-DCA	1,1-DCE	1,2-DCE	BDCM	DBCM
		MCL:	5	5	200	5	5	80	-----	5	7	70	80	80
		cEMEG:	-----	-----	-----	-----	-----	400	-----	-----	300	-----	700	3000
		NC2L:	0.7	2.8	200	-----	0.3	70	700	0.38	7	-----	0.6	-----
8	8/1/2000		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	1/21/1993		ND	ND	ND	ND	ND	ND	ND	ND	ND	NA	ND	ND
9	1/21/1993		ND	ND	ND	ND	ND	ND	ND	ND	ND	NA	ND	ND
10	1/21/1993		5.3	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
11	8/1/2000		3.1	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
12	12/18/2000		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	8/1/2000		ND	ND	ND	ND	ND	<0.05	ND	ND	ND	ND	ND	ND
13	8/1/2000		ND	ND	ND	ND	ND	0.5	ND	ND	ND	ND	ND	ND
14	8/1/2000		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
15	8/1/2000		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
16	7/9/1987		0.07	ND	ND	ND	ND	ND	0.18	ND	ND	ND	ND	ND

Continued

Table 4(cont'd). VOC Concentrations (µg/L or ppb) in Private Domestic Wells Sampled From 1987 – 2006

WELL #	Date Sampled	Compd.:	PCE	TCE	1,1,1-TCA	1,1,2-TCA	CCl4	CHCl3	1,1-DCA	1,2-DCA	1,1-DCE	1,2-DCE	BDCM	DBCM
		MCL:	5	5	200	5	5	80	-----	5	7	70	80	80
		cEMEG:	-----	-----	-----	-----	-----	400	-----	-----	300	-----	700	3000
		NC2L:	0.7	2.8	200	-----	0.3	70	700	0.38	7	-----	0.6	-----
17	7/9/1987		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
18	12/18/2000		ND	ND	ND	ND	ND	33	ND	ND	ND	ND	3.2	1.4
	5/31/2000		ND	ND	ND	ND	ND	62.2	ND	ND	ND	ND	17	3.3
	11/4/1999		0.6	ND	ND	ND	ND	ND	ND	ND	0.5	ND	NA	ND
	9/9/1999		0.7	ND	ND	ND	ND	ND	ND	ND	5	ND	NA	ND
	5/12/1999		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	NA	ND
	2/3/1999		0.9	ND	ND	ND	ND	ND	ND	ND	ND	ND	NA	ND

Well numbers on this table correspond to the well numbers on Figure 1.
MCL = U.S. EPA's Maximum Contaminant Level; **µg/L** = micrograms per liter; **ppb** = parts per billion; **cEMEG** = ATSDR's chronic adult Environmental Media Evaluation Guide for Drinking Water; **NC2L** = 2005 North Carolina's 2L Groundwater Standards; **PCE** = perchloroethylene = tetrachloroethylene; **TCE** = trichloroethylene; **1,1,1-TCA** = 1,1,1-trichloroethane; **1,1,2-TCA** = 1,1,2-trichloroethane; **CCl4** = carbon tetrachloride; **CHCl3** = chloroform; **1,1-DCA** = 1,1-dichloroethane; **1,2-DCA** = 1,2-dichloroethane; **1,1-DCE** = 1,1-dichloroethylene; **1,2-DCE** = 1,2-dichloroethylene; **BDCM** = bromodichloromethane; **DBCM** = dibromochloromethane; **ND** = non-detect (detection limits not specified); **NA** = not analyzed. These wells were not analyzed for **benzene**.
Source: Andrew Pitner of the N.C. Department of Environment and Natural Resources (NC DENR) and Thomas Chris Niver of the N.C. Department of Transportation (NCDOT).
Blue values exceed NC2L groundwater quality standards; **Red** values exceed U.S. EPA Maximum Contaminant Levels (MCLs). NC2L groundwater standards are usually much lower than EPA's MCLs because the former are often based on departure points (e.g., hypothetical cancer risk levels, odor/taste thresholds, & secondary MCLs) not considered appropriate by U.S. EPA for use in developing primary MCLs.)

Table 5. VOC Concentrations (µg/L or ppb) in Private Commercial Wells Sampled From 1989 – 2000

WELL #	Date Sampled	Compd.:	PCE	TCE	1,1,1-TCA	1,1,2-TCA	CCl4	CHCl3	1,1-DCA	1,2-DCA	1,1-DCE	1,2-DCE	BDCM	DBCM
		MCL:	5	5	200	5	5	80	-----	5	7	70	80	80
		cEMEG:	-----	-----	-----	-----	-----	400	-----	-----	300	-----	700	3000
		NC2L:	0.7	2.8	200	-----	0.3	70	700	0.38	7	-----	0.6	0.41
19	11/6/1996		2.6E	ND	ND	ND	ND	ND	ND	ND	1.3	ND	ND	ND
	8/26/1994		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
20	10/11/2000		ND	<0.5	4.5	ND	1.6	ND	<0.5	<0.5	37.8	ND	<0.5	ND
21	12/8/1997		ND	ND	ND	ND	ND	0.3T	ND	ND	ND	ND	ND	ND
	5/4/1992		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
22	8/1/2000		ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
23	8/28/1997		ND	54	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	7/2/1996		ND	50	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND
	5/16/1989		ND	24	ND	ND	ND	ND	ND	ND	ND	ND	ND	ND

Well numbers on this table correspond to the well numbers on Figure 1.
MCL = U.S. EPA's Maximum Contaminant Level; **µg/L** = micrograms per liter; **ppb** = parts per billion; **cEMEG** = ATSDR's chronic adult Environmental Media Evaluation Guide for Drinking Water; **NC2L** = North Carolina's 2L Groundwater Standards; **E** = estimated value. **T** = tentative value. **PCE** = perchloroethylene = tetrachloroethylene; **TCE** = trichloroethylene; **1,1,1-TCA** = 1,1,1-trichloroethane; **1,1,2-TCA** = 1,1,2-trichloroethane; **CCl4** = carbon tetrachloride; **CHCl3** = chloroform; **1,1-DCA** = 1,1-dichloroethane; **1,2-DCA** = 1,2-dichloroethane; **1,1-DCE** = 1,1-dichloroethylene; **1,2-DCE** = 1,2-dichloroethylene; **BDCM** = bromodichloromethane; **DBCM** = dibromochloromethane; **ND** = non-detect (detection limits not specified); these wells were not analyzed for **benzene**. **Source:** Andrew Pitner of the N.C. Department of Environment and Natural Resources (NCDENR) and Thomas Chris Niver of the N.C. Department of Transportation (NCDOT). **Blue** values exceed NC2L groundwater quality standards; **Red** values exceed U.S. EPA Maximum Contaminant Levels (MCLs). NC2L groundwater standards are usually much lower than EPA's MCLs because the former are often based on departure points (e.g., hypothetical cancer risk levels, odor/taste thresholds & secondary MCLs) not considered appropriate by U.S. EPA for use in primary MCL development.

Table 6 Historical Concentrations in Groundwater, NCDOT Asphalt Testing Facility #45, Salisbury, North Carolina

	Constituent	Acetone	MEK	Chloroform	1,1-DCE	cis-1,2-DCE	Naphthalene	TCE	Vinyl chloride
NCAC 2L	GW std	700	4200	0.19	7	70	21	2.8	0.015
MCL	Drinking water std			80	7	70		5	2
Monitoring Well ID	Date Sampled	Concentration (µg/L or ppb)							
45MW-1	15-Nov-96	NA	NA	**5.0**	**33J**	53 J	NA	**1,400**	NA
	2-Nov-99	NA	NA	**5.0**	**8.2**	56	NA	**550**	NA
	21-Aug-01	NA	NA	**<100**	**<100**	**110**	<100	**1,500**	NA
	6-Jun-02	NA	NA	**3.4**	5.3	**72 D**	<1	**1,100 D**	NA
	1-Oct-02	NA	NA	<10	**<10**	**89**	<10	**1,300**	NA
	18-Dec-02	NA	NA	<50	**<50**	**620**	<50	**95**	**<50**
	18-Mar-03	NA	NA	**1.7 J**	<1	52 J	<1	**35 J**	<1
	10-Jun-03	NA	NA	**4.5**	<1	9.8	<1	**24**	<1
	9-Dec-03	NA	NA	<25	**<25**	26	<25	**49**	**<25**
	3-Jun-04	NA	NA	<1	<1	23	<1	**33**	<1
	13-Dec-04	NA	NA	<1	<1	26	<1	**23**	<1
	20-Jun-05	NA	NA	<1	<1	50	<1	**30**	<1
	20-Dec-05	<625	1,440	<25	**<25**	**85.5**	<25	**30.5**	**<25**
	17-Jan-06	**1,530**	**8,000**	<16	**<16**	**106**	<16	**23**	**<16**
	15-Jun-06	133	1,730	<1	<1	**120**	<1	<1	<1
	8-Jan-07	210	740	<1	<1	**310**	<1	<1	**1.2**
	14-Jun-07	<25	<5	<1	<1	38	<1	<1	**9.2**
	27-Nov-07	<25	5.5	<1	<1	<1	<1	<1	<1.0
45MW-2	2-Nov-99	NA	NA	<1	<1	<1	NA	**3.3**	NA
	22-Aug-01	NA	NA	<5	<5	<5	NA	<5	NA
	5-Jun-02	NA	NA	<1	<1	<1	<1	<1	NA
	1-Oct-02	NA	NA	<1	<1	<1	<1	<1	NA
	10-Dec-03	NA	NA	<1	<1	<1	<1	<1	<1
	3-Jun-04	NA	NA	<1	<1	<1	<1	<1	<1

Table 6 Historical Concentrations in Groundwater, NCDOT Asphalt Testing Facility #45, Salisbury, North Carolina

	Constituent	Acetone	MEK	Chloroform	1,1-DCE	cis-1,2-DCE	Naphthalene	TCE	Vinyl chloride
NCAC 2L	GW std	700	4200	0.19	7	70	21	2.8	0.015
MCL	Drinking water std			80	7	70		5	2
Monitoring Well ID	Date Sampled	Concentration (µg/L or ppb)							
	14-Dec-04	NA	NA	<1	<1	<1	<1	<1	<1
	20-Jun-05	NA	NA	<1	<1	<1	<1	<1	<1
	19-Dec-05	<25	<25	<1	<1	<1	<1	<1	<1
	15-Jun-06	<25	<25	<1	<1	<1	<1	<1	<1
	4-Jan-07	<25	<5	<1	<1	<1	<1	<1	<1
	15-Jun-07	<25	9.8	<1	<1	<1	<1	<1	<1
	27-Nov-07	<25	5.7	<1	<1	<1	<1	<1	<1
45MW-3	2-Nov-99	NA	NA	<1	<1	<1	NA	<1	NA
	22-Aug-01	NA	NA	<5	<5	<5	NA	<5	NA
	5-Jun-02	NA	NA	<1	<1	<1	<1	<1	NA
	1-Oct-02	NA	NA	<1	<1	<1	<1	<1	NA
	9-Dec-03	NA	NA	<1	<1	<1	<1	<1	<1
	3-Jun-04	NA	NA	<1	<1	<1	<1	<1	<1
	14-Dec-04	NA	NA	<1	<1	<1	<1	<1	<1
	20-Jun-05	NA	NA	<1	<1	<1	<1	<1	<1
	19-Dec-05	<25	<25	<1	<1	<1	<1	<1	<1
	15-Jun-06	<25	<25	<1	<1	<1	<1	<1	<1
	4-Jan-07	<25	<5	<1	<1	<1	<1	<1	<1
	15-Jun-07	<25	10	<1	<1	<1	<1	<1	<1
	27-Nov-07	<25	<5	<1	<1	<1	<1	<1	<1
45MW-4	14-Nov-96	NA	NA	<1	<1	<1	NA	<1	NA
	2-Nov-99	NA	NA	<1	<1	<1	NA	**5**	NA
	22-Aug-01	NA	NA	<5	<5	<5	NA	**6.9**	NA
	4-Jun-02	NA	NA	<1	<1	<1	<1	**5**	NA

Table 6 Historical Concentrations in Groundwater, NCDOT Asphalt Testing Facility #45, Salisbury, North Carolina

	Constituent	Acetone	MEK	Chloroform	1,1-DCE	cis-1,2-DCE	Naphthalene	TCE	Vinyl chloride
NCAC 2L	GW std	700	4200	0.19	7	70	21	2.8	0.015
MCL	Drinking water std			80	7	70		5	2
Monitoring Well ID	Date Sampled	Concentration (µg/L or ppb)							
	1-Oct-02	NA	NA	<1	<1	<1	<1	<1	NA
	9-Dec-03	NA	NA	<1	<1	<1	<1	**4.7**	<1
	30-Dec-03	NA	NA	<1	<1	<1	<1	2.3	<1
	3-Jun-04	NA	NA	<1	<1	<1	<1	**4.1**	<1
	14-Dec-04	NA	NA	<1	<1	<1	<1	1.9	<1
	20-Jun-05	NA	NA	<1	<1	<1	<1	**3**	<1
	19-Dec-05	<25	<25	<1	<1	<1	<1	1.95	<1
	15-Jun-06	<25	<25	<1	<1	<1	<1	**4.7**	<1
	4-Jan-07	<25	<5	<1	<1	<1	<1	2.5	<1
	15-Jun-07	<25	<5	<1	1.3	1.6	<1	**5.8**	<1
	28-Nov-07	<25	<5	<1	1.7	3	<1	**4.9**	<1
45MW-5	15-Nov-96	NA	NA	<1	<1	<1	NA	3	NA
	2-Nov-99	NA	NA	<1	<1	<1	NA	3.7	NA
	5-Jun-02	NA	NA	<1	<1	<1	**37**	1	NA
	3-Sep-02	NA	NA	<5	<5	<5	**39 J**	<5	NA
	2-Oct-02	NA	NA	<1	<1	<1	**49**	1.4	<1
	17-Dec-02	NA	NA	<1	<1	<1	**41**	2.5	<1
	10-Jun-03	NA	NA	<1	<1	<1	**28**	5.2	<1
	18-Mar-03	NA	NA	<1	<1	<1	**48**	4	<1
	8-Dec-03	NA	NA	<1	<1	<1	<1	2.1	<1
	30-Dec-03	NA	NA	<1	<1	<1	<1	2.5	<1
	3-Jun-04	NA	NA	<1	<1	<1	20	1.4	<1
	14-Dec-04	NA	NA	<1	<1	<1	6.7	<1	<1
	20-Jun-05	NA	NA	<1	<1	<1	5.5	1.8	<1

Table 6 Historical Concentrations in Groundwater, NCDOT Asphalt Testing Facility #45, Salisbury, North Carolina

	Constituent	Acetone	MEK	Chloroform	1,1-DCE	cis-1,2-DCE	Naphthalene	TCE	Vinyl chloride
NCAC 2L	GW std	700	4200	0.19	7	70	21	2.8	0.015
MCL	Drinking water std			80	7	70		5	2
Monitoring Well ID	Date Sampled	Concentration (µg/L or ppb)							
	19-Dec-05	<25	<25	<1	<1	<1	12.9	2.2	<1
	15-Jun-06	<25	<25	<1	<1	<1	13.2	2.3	<1
	8-Jan-07	<25	<5	<1	<1	<1	15	2.2	<1
	15-Jun-07	NS	NS	NS	NS	NS	NS	NS	NS
	27-Nov-07	NS	NS	NS	NS	NS	NS	NS	NS
45MW-6	15-Nov-96	NA	NA	<1	<1	<1	NA	<1	NA
	2-Nov-99	NA	NA	<1	<1	<1	NA	<1	NA
	22-Aug-01	NA	NA	<5	<5	<5	<5	**6.9**	<5
	7-Jun-02	NA	NA	<1	<1	<1	<1	<1	NA
	2-Oct-02	NA	NA	<1	<1	<1	<1	<1	NA
	3-Jun-04	NA	NA	NA	NA	NA	NA	NA	NA
	14-Dec-04	NA	NA	NA	NA	NA	NA	NA	NA
	20-Jun-05	NA	NA	<1	<1	<1	<1	<1	<1
	19-Dec-05	<25	<25	<1	<1	<1	<1	<1	<1
	15-Jun-06	<25	<25	<1	<1	<1	<1	<1	<1
	8-Jan-07	<25	<5	<1	<1	<1	<1	<1	<1
	15-Jun-07	<25	<5	<1	1.3	<1	<1	<1	<1
	27-Nov-07	<25	5.4	<1	<1	<1	<1	<1	<1
45MW-7	4-Jun-02	NA	NA	<1	<1	<1	<1	<1	<1
	4-Oct-02	NA	NA	<1	<1	<1	<1	<1	NA
	8-Dec-03	NA	NA	<1	<1	<1	<1	<1	<1
	30-Dec-03	NA	NA	<1	<1	<1	<1	<1	<1
	3-Jun-04	NA	NA	<1	<1	<1	<1	<1	<1
	8-Jan-07	<25	<5	<1	<1	<1	<1	<1	<1

Table 6 Historical Concentrations in Groundwater, NCDOT Asphalt Testing Facility #45, Salisbury, North Carolina

	Constituent	Acetone	MEK	Chloroform	1,1-DCE	cis-1,2-DCE	Naphthalene	TCE	Vinyl chloride
NCAC 2L	GW std	700	4200	0.19	7	70	21	2.8	0.015
MCL	Drinking water std			80	7	70		5	2
Monitoring Well ID	Date Sampled	Concentration (µg/L or ppb)							
	15-Jun-07	<25	<5	<1	<1	<1	<1	<1	<1
	28-Nov-07	<25	<5	<1	<1	<1	<1	<1	<1
45DW-1	15-Nov-96	NA	NA	<1	<1	4.0	<1	**3,400**	NA
	21-Jan-97	NA	NA	<1	<1	3.0	<1	**2,200**	NA
	18-Mar-97	NA	NA	<1	<1	3.0	<1	**4,800**	NA
	2-Nov-99	NA	NA	<1	**8.6**	5.8	NA	**1,500**	NA
	21-Aug-01	NA	NA	<100	<100	<100	NA	**1,100**	NA
	6-Jun-02	NA	NA	<1	<1	1.4	<1	**800 D**	NA
	3-Sep-02	NA	NA	<10	<10	<10	<10	**1,200**	NA
	2-Oct-02	NA	NA	<10	<10	<10	<10	**1,000**	NA
	18-Dec-02	NA	NA	<50	<50	<50	<50	**580**	NA
	19-Mar-03	NA	NA	<1	<1	2.1	<1	**730 J**	<1
	10-Jun-03	NA	NA	<1	<1	1.5	<1	**1,000**	<1
	9-Dec-03	NA	NA	<1	<1	2.6	<1	**1,300**	<1
	30-Dec-03	NA	NA	<25	<25	<25	<25	**790**	<25
	3-Jun-04	NA	NA	<1	<1	3.5	<1	**400**	<1
	13-Dec-04	NA	NA	<2	<2	**330**	<2	**220**	<2
	20-Jun-05	NA	NA	<5	<5	**220**	<5	**520**	<5
	19-Dec-05	<25	<25	<1	<1	**501 J**	<1	<1	<1
	15-Jun-06	<25	<25	<1	1.04	**486**	<1	<1	<1
	8-Jan-07	310 J	1,600	<5	<5	**180**	<5	**42**	<5
	14-Jun-07	<25	<5	<1	1.4	1.7	<1	**5.4**	<1
	28-Nov-07	696	1,060	<1	<1	12.7	<1	**4.0**	**3.0**

Table 6 Historical Concentrations in Groundwater, NCDOT Asphalt Testing Facility #45, Salisbury, North Carolina

	Constituent	Acetone	MEK	Chloroform	1,1-DCE	cis-1,2-DCE	Naphthalene	TCE	Vinyl chloride
NCAC 2L	GW std	700	4200	0.19	7	70	21	2.8	0.015
MCL	Drinking water std			80	7	70		5	2
Monitoring Well ID	Date Sampled	Concentration (µg/L or ppb)							
45DW-2	10-Apr-97	NA	NA	<1	<1	<1	NA	**550**	NA
	24-Apr-97	NA	NA	<20	<20	<20	NA	**430**	NA
	2-Nov-99	NA	NA	<1	**8.9**	8.6	NA	**1,200**	NA
	21-Aug-01	NA	NA	<100	<100	<100	NA	**1,100**	NA
	6-Jun-02	NA	NA	**1.8**	<1	9.7	<1	**1,400 D**	NA
	3-Sep-02	NA	NA	<10	<10	<10	<10	**1,700 D**	NA
	3-Oct-02	NA	NA	<20	<20	<20	<20	**1,300**	NA
	17-Dec-02	NA	NA	<25	<25	**160 J**	<25	**360 J**	<25
	18-Mar-03	NA	NA	<1	1.1	**470**	<1	**720**	**2.2**
	10-Jun-03	NA	NA	<1	<1	**290**	<1	**690**	<1
	9-Dec-03	NA	NA	**0.33 J**	<20	**470**	<20	**440**	<20
	30-Dec-03	NA	NA	<25	<25	**900**	<25	<25	<25
	3-Jun-04	NA	NA	<10	<10	**1,400**	<10	**11**	**22**
	13-Dec-04	NA	NA	<10	<10	**1,600**	<10	<10	**19**
	20-Jun-05	NA	NA	<10	<10	**1,500**	<10	<10	**11**
	19-Dec-05	<50	**4220**	<50	<50	**805**	<50	<50	<50
	17-Jan-06	489	**17,200**	<50	<50	**912**	<50	<50	<50
	15-Jun-06	**1,020**	**22,700**	<1	<1	**727**	<1	1.76	**3.38**
	8-Jan-07	**1,500**	**19,000**	<10	<10	**700**	<10	<10	<10
	15-Jun-07	**820**	**5,400**	<20	<20	**570**	<20	<20	<20
	28-Nov-07	480	242	<1	<1	**384**	<1	<1	**1.3**
45DW-3	10-Apr-97	NA	NA	<1	<1	<1	NA	<1	NA
	6-Jun-02	NA	NA	<1	<1	<1	<1	<1	NA
	4-Oct-03	NA	NA	<1	<1	<1	<1	<1	NA

Table 6 Historical Concentrations in Groundwater, NCDOT Asphalt Testing Facility #45, Salisbury, North Carolina

	Constituent	Acetone	MEK	Chloroform	1,1-DCE	cis-1,2-DCE	Naphthalene	TCE	Vinyl chloride
NCAC 2L	GW std	700	4200	0.19	7	70	21	2.8	0.015
MCL	Drinking water std			80	7	70		5	2
Monitoring Well ID	Date Sampled	Concentration (µg/L or ppb)							
	8-Dec-03	NA	NA	<1	<1	<1	<1	<1	<1
	30-Dec-03	NA	NA	<1	<1	<1	<1	<1	<1
	3-Jun-04	NA	NA	<1	<1	<1	<1	<1	<1
	14-Dec-04	NA	NA	<1	<1	<1	<1	<1	<1
	20-Jun-05	NA	NA	<1	<1	<1	<1	<1	<1
	19-Dec-05	<25	<25	<1	<1	<1	<1	<1	<1
	15-Jun-06	<25	<25	<1	<1	<1	<1	<1	<1
	8-Jan-07	<25	<5	<1	<1	<1	<1	<1	<1
	15-Jun-07	<25	<5	<1	<1	<1	<1	<1	<1
	27-Nov-07	<25	5.3	<1	<1	<1	<1	<1	<1
45DW-4	16-Feb-00	NA	NA	<1	<1	<1	NA	**48**	NA
	21-Aug-01	NA	NA	<5	<5	<5	NA	<5	NA
	6-Jun-02	NA	NA	<1	<1	<1	<1	**39**	NA
	4-Oct-02	NA	NA	<1	<1	<1	<1	**47**	NA
	17-Dec-02	NA	NA	<2	<2	<2	<2	**43**	<2
	18-Mar-03	NA	NA	<1	<1	<1	<1	**66**	<1
	10-Jun-03	NA	NA	<1	<1	<1	<1	**57**	<1
	9-Dec-03	NA	NA	<1	<1	3.5	<1	**22 J**	<1
	30-Dec-03	NA	NA	<1	<1	2.9	<1	**17**	<1
	3-Jun-04	NA	NA	<1	<1	1.3	<1	**8.6**	<1
	13-Dec-04	NA	NA	<1	<1	1.5	<1	**8.2**	<1
	20-Jun-05	NA	NA	<1	<1	4.2	<1	**3.5**	<1
	19-Dec-05	NA	NA	NA	NA	NA	NA	NA	NA
	15-Jun-06	<25	<25	<1	<1	<1	<1	**7.2**	<1

Table 6 Historical Concentrations in Groundwater, NCDOT Asphalt Testing Facility #45, Salisbury, North Carolina

	Constituent	Acetone	MEK	Chloroform	1,1-DCE	cis-1,2-DCE	Naphthalene	TCE	Vinyl chloride
NCAC 2L	GW std	700	4200	0.19	7	70	21	2.8	0.015
MCL	Drinking water std			80	7	70		5	2
Monitoring Well ID	Date Sampled	Concentration (µg/L or ppb)							
	8-Jan-07	<25	<5	<1	<1	1.1	<1	**7.6**	<1
	14-Jun-07	<25	<5	<1	<1	1	<1	**9.5**	<1
	28-Nov-07	<25	<5	<1	<1	1.2	<1	**13.1**	<1
45DW-5	4-Jun-02	NA	NA	<1	<1	<1	<1	<1	NA
	4-Oct-02	NA	NA	<1	<1	<1	<1	<1	NA
	8-Dec-03	NA	NA	<1	<1	<1	<1	<1	<1
	30-Dec-03	NA	NA	<1	<1	<1	<1	<1	<1
	3-Jun-04	NA	NA	<1	<1	<1	<1	<1	<1
	14-Dec-04	NA	NA	<1	<1	<1	<1	<1	<1
	20-Jun-05	NA	NA	<1	<1	<1	<1	<1	<1
	19-Dec-05	<25	<25	<1	<1	<1	<1	<1	<1
	15-Jun-06	<25	<25	<1	<1	<1	<1	<1	<1
	4-Jan-07	NS	NS	NS	NS	NS	NS	NS	NS
	14-Jun-07	NS	NS	NS	NS	NS	NS	NS	NS
	27-Nov-07	NS	NS	NS	NS	NS	NS	NS	NS
45DW-6	30-Aug-01	NA	NA	<5	<5	<5	NA	<5	NA
	5-Jun-02	NA	NA	<1	<1	<1	<1	<1	NA
	1-Oct-02	NA	NA	<1	<1	<1	<1	<1	NA
	8-Dec-03	NA	NA	<1	<1	<1	<1	<1	<1
	30-Dec-03	NA	NA	<1	<1	<1	<1	<1	<1
	3-Jun-04	NA	NA	<1	<1	<1	<1	<1	<1
	14-Dec-04	NA	NA	<1	<1	<1	<1	<1	<1
	20-Jun-05	NA	NA	<1	<1	<1	<1	<1	<1
	19-Dec-05	<25	<25	<1	<1	<1	<1	<1	<1

Table 6 Historical Concentrations in Groundwater, NCDOT Asphalt Testing Facility #45, Salisbury, North Carolina

	Constituent	Acetone	MEK	Chloroform	1,1-DCE	cis-1,2-DCE	Naphthalene	TCE	Vinyl chloride
NCAC 2L	GW std	700	4200	0.19	7	70	21	2.8	0.015
MCL	Drinking water std			80	7	70		5	2
Monitoring Well ID	Date Sampled	Concentration (µg/L or ppb)							
	15-Jun-06	<25	<25	<1	<1	<1	<1	<1	<1
	4-Jan-07	<25	<5	<1	<1	<1	<1	<1	<1
	15-Jun-07	<25	9.2	<1	<1	<1	<1	<1	<1
	27-Nov-07	<25	5.6	<1	<1	<1	<1	<1	<1
45DW-7	29-Aug-01	NA	NA	<5	<5	<5	NA	<5	NA
	5-Jun-02	NA	NA	<1	<1	<1	<1	<1	NA
	1-Oct-02	NA	NA	<1	<1	<1	<1	<1	NA
	9-Dec-03	NA	NA	<1	<1	<1	<1	<1	<1
	30-Dec-03	NA	NA	<1	<1	<1	<1	<1	<1
	3-Jun-04	NA	NA	<1	<1	<1	<1	<1	<1
	14-Dec-04	NA	NA	<1	<1	<1	<1	<1	<1
	20-Jun-05	NA	NA	<1	<1	<1	<1	<1	<1
	19-Dec-05	<25	<25	<1	<1	<1	<1	<1	<1
	15-Jun-06	<25	<25	<1	<1	<1	<1	<1	<1
	4-Jan-07	<25	<5	<1	<1	<1	<1	<1	<1
	15-Jun-07	<25	<5	<1	<1	<1	<1	<1	<1
	27-Nov-07	<25	6.0	<1	<1	<1	<1	<1	<1
45DW-8	4-Jun-02	NA	NA	<1	<1	1.4 J	<1	<1	NA
	1-Oct-02	NA	NA	<1	<1	1.3	<1	<1	NA
	9-Dec-03	NA	NA	<1	<1	2.0	<1	<1	<1
	30-Dec-03	NA	NA	<1	<1	<1	<1	<1	<1
	3-Jun-04	NA	NA	**1.6**	<1	<1	<1	<1	<1
	14-Dec-04	NA	NA	<1	<1	<1	<1	<1	<1
	20-Jun-05	NA	NA	**1.3**	<1	<1	<1	<1	<1

Table 6 Historical Concentrations in Groundwater, NCDOT Asphalt Testing Facility #45, Salisbury, North Carolina

	Constituent	Acetone	MEK	Chloroform	1,1-DCE	cis-1,2-DCE	Naphthalene	TCE	Vinyl chloride
NCAC 2L	GW std	700	4200	0.19	7	70	21	2.8	0.015
MCL	Drinking water std			80	7	70		5	2
Monitoring Well ID	Date Sampled	Concentration (µg/L or ppb)							
	19-Dec-05	<25	<25	<1	<1	<1	<1	<1	<1
	15-Jun-06	<25	<25	<1	<1	<1	<1	<1	<1
	4-Jan-07	<25	<25	**1.4**	<1	<1	<1	<1	<1
	15-Jun-07	<25	9.7	**1.2**	<1	<1	<1	<1	<1
	28-Nov-07	<25	6.0	<1	<1	1.2	<1	<1	<1
45DW-9	4-Jun-02	NA	NA	**1.1**	<1	<1	<1	<1	NA
	1-Oct-02	NA	NA	<1	<1	<1	<1	<1	NA
	8-Dec-03	NA	NA	<1	<1	<1	<1	<1	<1
	30-Dec-03	NA	NA	<1	<1	<1	<1	<1	<1
	14-Dec-04	NA	NA	<1	<1	<1	<1	<1	<1
	20-Jun-05	NA	NA	<1	<1	<1	<1	<1	<1
	19-Dec-05	<25	<25	<1	<1	<1	<1	<1	<1
	15-Jun-06	<25	<25	<1	<1	<1	<1	<1	<1
	4-Jan-07	<25	<5	<1	<1	<1	<1	<1	<1
	15-Jun-07	<25	9.6	<1	<1	<1	<1	<1	<1
	28-Nov-07	<25	6.1	<1	<1	<1	<1	1.0	<1
45IW-1	29-Aug-01	NA	NA	**19**	<1	7.1	<1	**170**	NA
	7-Jun-02	NA	NA	<1	<1	4.1	<1	**83**	NA
	3-Oct-02	NS	NS	NS	NS	NS	NS	NS	NS
	30-Dec-03	NA	NA	<1	<1	8.8	<1	**150**	<1
	2004-2007	NS	NS	NS	NS	NS	NS	NS	NS
45IW-2	29-Aug-01	NA	NA	**23**	5.5	**120**	<1	**1,100**	NA
	7-Jun-02	NA	NA	<200	<200	<200	<200	**1,400**	NA
	3-Oct-02	NS	NS	NS	NS	NS	NS	NS	NS

Table 6 Historical Concentrations in Groundwater, NCDOT Asphalt Testing Facility #45, Salisbury, North Carolina

	Constituent	Acetone	MEK	Chloroform	1,1-DCE	cis-1,2-DCE	Naphthalene	TCE	Vinyl chloride
NCAC 2L	GW std	700	4200	0.19	7	70	21	2.8	0.015
MCL	Drinking water std			80	7	70		5	2
Monitoring Well ID	Date Sampled	Concentration (µg/L or ppb)							
	9-Dec-03	NA	NA	**5.1**	3.6	63	<1	**1,100**	<1
	3-Jun-04	NA	NA	<1	1.4	7.8	<1	**120**	**1.3**
	13-Dec-04	NA	NA	**2**	3.7	63	<1	**5,000**	<1
	20-Jun-05	NA	NA	**2.5**	4.2	**93**	<1	**2,000**	<1
	19-Dec-05	<500	<500	<20	<20	<20	<20	**298**	<20
	15-Jun-06	<25	<25	<1	3.64	**85.6**	<1	**1,650**	<1
	4-Jan-07	<25	<5	<1	<1	**92**	<1	**1,600**	<1
	15-Jun-07	<250	<50	<10	<10	**100**	<10	**1,800**	<10
	27-Nov-07	<25	5.2	**3.1**	5.2	**113**	<1	**1,920**	<1
45IW-3	29-Aug-01	NA	NA	**25**	**8.3**	**91**	<1	**1,000**	NA
	7-Jun-02	NA	NA	**4.5 J**	6.2 J	53 DJ	<1	**1,200**	NA
	2002-2007	NS	NS	NS	NS	NS	NS	NS	NS
45IW-4	29-Aug-01	NA	NA	**22**	**9.1**	**150**	<1	**3,300**	NA
	7-Jun-02	NA	NA	**10 J**	<1	200 J	<1	**6,100 J**	NA
	4-Oct-02	NA	NA	<10	<10	<10	<10	**190 J**	NA
	2003-2007	NS	NS	NS	NS	NS	NS	NS	NS
45IW-5	29-Aug-01	NA	NA	**20**	**21**	**99**	<1	**2,900**	NA
	7-Jun-02	NA	NA	**7.8 J**	**17 J**	**94 J**	<1	**2,500 J**	NA
	2-Oct-02	NA	NA	<10	<10	**87**	<10	**3,500**	NA
	18-Dec-02	NA	NA	<100	<100	<100	<100	**2,200**	<100
	19-Mar-03	NA	NA	**4.1 J**	6 J	64 J	<1	**2,000 J**	<1
	11-Jun-03	NA	NA	**4.7**	**7.4**	<1	<1	**1,800**	<1
	8-Dec-03	NA	NA	<25	2.4 J	**110**	<25	**2,900**	<25
	30-Dec-03	NA	NA	**1.3 J**	6.4 J	38	<25	**880**	<25

Table 6 Historical Concentrations in Groundwater, NCDOT Asphalt Testing Facility #45, Salisbury, North Carolina

	Constituent	Acetone	MEK	Chloroform	1,1-DCE	cis-1,2-DCE	Naphthalene	TCE	Vinyl chloride
NCAC 2L	GW std	700	4200	0.19	7	70	21	2.8	0.015
MCL	Drinking water std			80	7	70		5	2
Monitoring Well ID	Date Sampled	Concentration (µg/L or ppb)							
	3-Jun-04	NA	NA	5.1	7	56	<1	1,500	<1
	14-Dec-04	NA	NA	3.8	8	67	<1	2,200	<1
	20-Jun-05	NA	NA	<10	<10	71	<10	1,400	<10
	19-Dec-05	<5,000	<5,000	<200	<200	2,590	<200	<200	<200
	15-Jun-06	<25	<25	1.2	<1	49.7	<1	73.9	<1
	4-Jan-07	<250	<50	<10	<10	840	<10	37	<10
	15-Jun-07	<120	79	<5	16	3,100	<5	54	<5
	27-Nov-07	<25	7.5	1.6	13.2	2,200	<1	1,230	2.5
45IW-6	29-Aug-01	NA	NA	22	20	130	<1	7,600	NA
	7-Jun-02	NA	NA	7.7 J	20 J	130 J	<1	9,600 J	NA
	2-Oct-02	NA	NA	<1,000	<1,000	<1,000	<1,000	16,000	NA
	18-Dec-02	NA	NA	<500	<500	<500	<500	9,100	<500
	19-Mar-03	NA	NA	4 J	7.3 J	110 J	<1	8,100 J	<1
	11-Jun-03	NA	NA	4.5	8.2	77	<1	7,600	<1
	8-Dec-03	NA	NA	<200	<200	170 J	<200	9,100	<200
	30-Dec-03	NA	NA	<1	<1	130	<1	4,700	<1
	3-Jun-04	NA	NA	3	4.6	45	<1	2,300	<1
	14-Dec-04	NA	NA	3.8	6.9	80	<1	6,000	<1
	20-Jun-05	NA	NA	<20	<20	71	<20	7,200	<20
	19-Dec-05	<10,000	<10,000	<400	<400	<400	<400	4,980	<400
	15-Jun-06	<25	<25	<1	<1	80	<1	4,790	<1
	4-Jan-07	<1,200	<250	<50	<50	130	<50	6,600	<50
	15-Jun-07	<1,200	<250	<50	<50	110	<50	5,100	<50
	27-Nov-07	<25	<5	6.8	7.8	162	<1	5,920	<1

Table 6 Historical Concentrations in Groundwater, NCDOT Asphalt Testing Facility #45, Salisbury, North Carolina

	Constituent	Acetone	MEK	Chloroform	1,1-DCE	cis-1,2-DCE	Naphthalene	TCE	Vinyl chloride
NCAC 2L	GW std	700	4200	0.19	7	70	21	2.8	0.015
MCL	Drinking water std			80	7	70		5	2
Monitoring Well ID	Date Sampled	Concentration (µg/L or ppb)							
45IW-7	29-Aug-01	NA	NA	**20**	<1	36	<1	**480**	NA
	7-Jun-02	NA	NA	**4 J**	<1	25 J	<1	**570 J**	NA
	2002-2007	NS	NS	NS	NS	NS	NS	NS	NS
45IW-8	29-Aug-01	NA	NA	**42**	<1	6	<1	**640**	NA
	7-Jun-02	NA	NA	**2.5 J**	<1	8.4 J	<1	**1,400 J**	NA
	2002-2007	NA	NA	NA	NA	NS	NS	NS	NS
45IW-9	29-Aug-01	NA	NA	**23**	<1	<1	<1	**970**	NA
	7-Jun-02	NA	NA	**1.5**	<1	2.0	<1	**1,800**	NA
	2002-2007	NS	NS	NS	NS	NS	NS	NS	NS

Data derived from Arcadis 2008 Semi-Annual Report Groundwater Monitoring Event. Former NCDOT Asphalt Testing Facility No. 45, 1831 West Jake Alexander Blvd. Salisbury, North Carolina. NC105023.0002. ARCADIS G & M of North Carolina, Inc. 2007. Prepared for North Carolina Department of Transportation.

Well numbers in this table correspond to the monitoring wells in Figure 3.

Concentrations with a J are quantified as estimated.

GW = groundwater, MEK = Methyl ethyl ketone, DCE = Dichloroethene, TCE = Trichloroethylene, NA = Not analyzed, NS = Not sampled, MCL = Maximum Contaminant Level

Note: NC2L groundwater standards are usually lower than EPA's **MCLs** because the former are often based on departure points not considered appropriate by U.S. EPA for use in the development of drinking water standards. For example, **the NC2L groundwater standard for vinyl chloride ($1.5x10^{-5}$ mg/L or ppm = $1.5x10^{-2}$ µg/L or ppb)** is based on a modeled estimate of a hypothetical 1-in-a-million cancer risk level. U.S. EPA does not consider that hypothetical cancer risk levels provide a practical basis for quantitative safe drinking water standards (i.e., MCLs). As a matter of policy, legally *unenforceable* Maximum Contaminant Level *Goals* (**MCLGs**) are generally set equal to zero for known carcinogens, while legally *enforceable* MCLs are based on non-cancer effect levels and the safety factor approach.

TABLE 7: Concentrations (µg/L or ppb) of Selected VOCs in Monitor Wells on former Chevron Site

WELL #	Date Sampled	Compd.:	PCE	TCE	1,1,1-TCA	CHCl3	1,1-DCA	1,1-DCE	Benzene	DBCM
		MCL:	5	5	200	80	-----	7	5	80
		cEMEG:	-----	18	-----	400	-----	300	20	3000
		NC2L:	0.7	2.8	200	70	70	7	1	-----
Perimeter Wells Near West Fence that abuts the former NCDOT #45 Property.										
M-2A	6/26/2002		<0.25	<0.25	<0.25	<0.25	<0.25	<0.25		
	5/4/2001		<1	<1	<1	<1	<1	<1	<1	NR
	9/1993		ND	ND	ND	ND	ND	ND	<1	<1
	8/12/1992		<5	<5	<5	<5	<5	<5	ND <5	NR <5
M-8	6/26/2002		<0.25	<0.25	<0.25	<0.25	<0.25	<0.25		
	1/8/2002		<0.4	<0.4	<0.4	<0.4	<0.4	<0.4	<1	NR
	5/4/2001		<1	<1	<1	<1	<1	<1	<0.4	NR
	9/1993		ND	ND	ND	ND	ND	ND	<1 160	<1
	8/12/1992		<5	<5	44	<5	15	63	20	NR <5
Perimeter Well in South-Most Corner of Former Chevron Property										
M-10	6/19/2006		0.93	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25
	5/31/2005		1.60	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50

Continued

TABLE 7 (cont'd): Selected VOCs (µg/L or ppb) in Monitor Wells on former Chevron Sit

WELL #	Date Sampled	Compd.:	PCE	TCE	1,1,1-TCA	CHCl3	1,1-DCA	1,1-DCE	Benzene	DBCM
		MCL:	5	5	200	80	-----	7	5	80
		cEMEG:	-----	18	-----	400	-----	300	20	3000
		NC2L:	0.7	2.8	200	70	700	7	1	-----
Perimeter Well in South-Most Corner of Former Chevron Property (continued)										
M-10	4/29/2004		1.70	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	11/25/2003		<0.50	0.80	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	4/17/2003		1.0	<0.5	<0.50	<0.50	<0.50	<0.50	<0.5	<0.50
	9/11/2002		1.3	0.5	<0.40	<0.40	<0.40	<0.40	<0.4	<0.40
	6/26/2002		2	0.5	<0.40	<0.40	<0.40	<0.40	<0.4	<0.40
	10/17/2001		0.7	2.8	<0.40	<0.40	<0.40	<0.40	<0.4	<0.40
	5/4/2001		8.9	<1	<1	<1	<1	<1	<1	<1
	9/?/1993		ND	ND	ND	ND	ND	ND	ND	NR
	8/12/1992		<5	<5	<5	<5	<5	<5	<0.5	<5
Perimeter Wells on South East Property Line Nearest Ted's Chicken.										
M-12	6/19/2006		<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25
	5/31/2005		<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50

Continued

TABLE 7 (cont'd): Selected VOCs (µg/L or ppb) in Monitor Wells on former Chevron Site (continued)

WELL #	Date Sampled	Compd.:	PCE	TCE	1,1,1-TCA	CHCl3	1,1-DCA	1,1-DCE	Benzene	DBCM
		MCL:	5	5	200	80	-----	7	5	80
		cEMEG:	-----	18	-----	400	-----	300	20	3000
		NC2L:	0.7	2.8	200	70	700	7	1	-----
Perimeter Wells on South East Property Line Nearest Ted's Chicken (continued).										
M-12	4/29/2004		<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	11/25/2003		<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	4/17/2003		<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.5	<0.50
	9/11/2002		<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<0.4	<0.40
	6/26/2002		<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<0.4	<0.40
	1/8/2002		<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<0.4	<0.40
M-12D	6/19/2006		<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	<0.25	0.32
	5/31/2005		<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	4/29/2004		<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	11/25/2003		<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
	4/17/2003		<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.5	<0.50
	9/11/2002		<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	0.50	<0.40

Continued

TABLE 7 (cont'd): Selected VOCs (µg/L or ppb) in Monitor Wells on former Chevron Site (continued)

WELL #	Date Sampled	Compd.:	PCE	TCE	1,1,1-TCA	CHCl3	1,1-DCA	1,1-DCE	Benzene	DBCM
		MCL:	5	5	200	80	-----	7	5	80
		cEMEG:	-----	18	-----	400	-----	300	20	3000
		NC2L:	0.7	2.8	200	70	700	7	1	-----
	6/26/2002		<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	<0.4	<0.40
	1/8/2002		<0.40	<0.40	<0.40	<0.40	<0.40	<0.40	1.0	<0.40

Well numbers on this table correspond to the well numbers on Figure 6.

MCL = U.S. EPA's Maximum Contaminant Level; **cEMEG** = ATSDR's chronic adult Environmental Media Evaluation Guide for Drinking Water; **NC2L** = 2005 North Carolina's 2L Groundwater Standards; **PCE** = perchloroethylene = tetrachloroethylene; **TCE** = trichloroethylene; **1,1,1-TCA** = 1,1,1-trichloroethane; **CHCl3** = chloroform; **1,1-DCA** = 1,1-dichloroethane; **1,1-DCE** = 1,1-dichloroethylene; **DBCM** = dibromochloromethane or chlorodibromomethane; **ND** = non-detect (detection limits not specified); **NR** = not reported. **Blue** values exceed **NC2L** groundwater quality standards; **Red** values exceed U.S. EPA Maximum Contaminant Levels (**MCL**s). **Source:** BBL Environmental Services, Inc.; after: "Historical Summary of Analytes Detected in Groundwater, Associated Asphalt, Inc./ Former Chevron Asphalt Terminal."

Note: NC2L groundwater standards are usually much lower than EPA's **MCL**s because the former are often based on departure points (e.g., hypothetical cancer risk levels, odor/taste thresholds, & secondary MCLs) which are not considered appropriate by U.S. EPA for use in developing primary MCLs.

Appendix D. Public Comments

From December 22, 2011 through March 21, 2012, ATSDR released this Salisbury, North Carolina Health Consultation (HC) for public review and comment. This appendix contains both the comments received during the comment period and ATSDR's response to those comments. In addition, text in the HC was modified where required.

Comment 1 - Page 4, Conclusion 5 Next Steps - The next to last sentence that starts *"Continued monitoring of four private wells ...."* seems to be incomplete.

ATSDR Response – The phase "is recommended" was included to complete the sentence.

***Comment 2* –** Discussion on page 14, 2nd paragraph in *Contaminants in Off-site, Residential and Commercial Drinking Water Wells* - Recommend indicating location of Highland Laundry Center on Figure 1.

ATSDR Response – The approximate location of the former Highland Laundry Center was included on Figure 1 in Appendix A.

***Comment 3* –** Page 17, next to last paragraph - Recommend an explanation of "uncertainty factors" be provided for the "public" reader.

ATSDR Response – A definition of an uncertainty factor was included in the *Noncancer Health Effects* section.

***Comment 4* –** Page 18 - The last sentence in the next to last paragraph is a repeat of the last sentence in 2 paragraphs above.

ATSDR Response – The first appearance of that sentence was removed.

***Comment 5* –** Page 19, 1st full paragraph - Change concern to "concerned".

ATSDR Response – The recommended change was made.

***Comment 6* –** Page 20, 1st full paragraph - List the well numbers referencing back to Figure 1 in the text.

ATSDR Response – ATSDR listed the well numbers of the four residences as they are referred to in Figure 1.

***Comment 7* –** Figure 3 - The "general public" reader will not be able to interpret the direction of groundwater flow from the information on this map. In addition, the groundwater flow elevations are difficult to read. We recommend adding an arrow to indicate the direction of groundwater flow.

ATSDR Response – Text has been added to explain the direction of groundwater flow in the Appendix A Figures.

Comment 8 – Figure 5 - See comment #7; recommend adding an arrow indicating the direction of groundwater flow.

ATSDR Response – Text has been added to explain the direction of groundwater flow.

Comment 9 – Tables - Add the following definitions to the footnotes: *µglL, ppb.* Add definition for *MCL* to Table 3.

ATSDR Response – The definitions were included in the footnotes.

Comment 10 – Page 9, discussion of groundwater flow rate from Exxon site to nearest down gradient well. Suggest caution in expressing the estimated 100 year travel time. This assumes a consistent geology and no disturbances that may influence flow rates.

ATSDR Response – A footnote was included to explain that the 100 year migration time was an estimate and that inconsistencies in geology could either increase or decrease that migration time.

Comment 11 – Page 18, discussion of TCE-associated risk to workers - There is limited monitoring data, the calculated risk is close to the RfD, and with the potential for dermal and inhalation exposures in addition to ingestion, the lack of risk to workers may be overstated.

ATSDR Response – There is limited monitoring data which was expressed in the data limitations section. Although we considered worker exposure to the drinking water, occupational exposures are generally handled by OSHA. In addition, there was no personal monitoring data to evaluate what the workers were exposed to through other routes of exposure.

Comment 12 – Page 18, discussion of the Hazard Quotient (HQ) approach for exposures to mixtures – Provide an explanation of how the HQ is determined, i.e., "HQ = exposure concentration / RID. HQs for chemicals acting on the same target organ or through the same mechanism are summed to evaluate combined effects."

ATSDR Response – A more detailed explanation of how the HQ and Hazard index is determined has been included in the *Noncancer Health Effects* section.

Comment 13 – Page 18, tetrachloroethylene cancer risk discussion - EPA's updated RfD and CSF reduce the apparent risk associated with the interim guidance values. Recommend discussion of updated values and their implications in the apparent risk.

ATSDR Response – The updated RfD and cancer slope factor was used in the calculations.

Comment 14 – Recommend sampling for VOCs any residential or commercial wells currently or recently in use for drinking water or industrial/process sources down gradient of the Exxon or DOT #45 sites.

ATSDR Response – Downgradient wells utilize the municipal water supply and the plumes are mostly contained within the sites' boundaries.

Comment 15 – Exposure Dose and Health Risk Estimates - It appears the parameters used for the dose and risk calculations were selected from a variety of references. In some instances, updated parameters were taken from EPA's 2011 Exposure Factors Guidance (body weights), while some other appear to be from other, older guidance (water ingestion rates and residence times, ATSDR PHAGM, 2005). Some parameters selected do not match those specified in DHAC's draft SOPs. DPH recommends using a consistent source of these parameters, or provide an explanation of the selections that were used.

ATSDR Response – The document has been updated to include all of the recommended age ranges, body weights, and ingestion rates that are recommended by EPA's 2011 Exposure Factors Handbook. Table 1 displays the age ranges, body weights, and ingestion rates used in the dose calculations.

Comment 16 – Risk estimates were not calculated for children <6 years old (31.8 kg BW, 6 - <11 year aids). Was this intentional? Please explain the rationale.

ATSDR Response – The document has been updated to include all of the recommended age ranges, body weights, and ingestion rates that are recommended by EPA's 2011 Exposure Factors Handbook.

Comment 17 – Recommend providing a summary table of calculated dose estimates for contaminants exceeding screening values, and the MRLs or RfDs used for determination of potential adverse health effects. Show frequency of detections, average and range of detections, number of detections exceeding screening criteria.

ATSDR Response – A summary table was included that listed the calculated doses and their respective comparison values. Table 2 displays the requested information.

Comment 18 – Recommend providing a summary table of exposure does estimates, health comparison values, and calculated cancer risk estimates.

ATSDR Response – Summary tables were included to display the requested information. Table 2 and 3 were added to the document.

Comment 19 – Vapor intrusion - Would it be useful to use EPA's default attenuation factors to develop estimates of potential indoor exposure until measurements can be taken, or to provide some indication of whether measurements should be considered?

ATSDR Response – ATSDR conducted calculations using the attenuation factors for benzene to determine if there was potential for vapor intrusion. Ultimately, the state has better knowledge of the local conditions and geology, and they would be the most appropriate entity to evaluate the potential for vapor intrusion and determine if further investigation is necessary.

Comment 20 - The dry cleaner is officially referred to as the Highlander Center Laundry

ATSDR Response – The change was made throughout the document.