1-1-2019

Safer Well Water: Exploring Environmental Screening Efforts For Family Child Care Homes

Devan Carr
devan.carr@yale.edu

SAFER Well Water:
Exploring Environmental Screening Efforts for Family Child Care Homes

A Thesis Presented for the

Master of Public Health Degree

Yale School of Public Health

May 2019

Devan Dennehy Carr

Advisor/Committee Chair: Megan Smith, Dr.PH, MPH

Committee Members: Sharee Major Rusnak, MSPH, ScD

Acknowledgements

I would first like to thank Dr. Megan Smith for her consistent support during my time at the Yale School of Public Health. Her guidance was instrumental during my years of study at YSPH and in the creation of this thesis.

I would also like to express my profound gratitude to Dr. Sharee Rusnak and the Connecticut Department of Public Health's Child Day Care SAFER program. I am greatly indebted for her invaluable feedback and tireless commitment to the children of Connecticut.

Lastly, I would like to acknowledge my dear family and friends who provided unwavering support and encouragement over the past two years. Thank you.

Devan Carr

Table of Contents

Abstract

Background

Children are widely recognized as particularly vulnerable to the harmful effects of environmental contaminants. As such, the physical environment in which they live, play, and breathe can have a significant impact on their health and development throughout their life. In 2007, Connecticut's Department of Public Health established the Screening Assessment for Environmental Risk (SAFER) program as a proactive, non-regulatory approach to screening child care centers in the state. Several screening methods are implemented in this voluntary process, including the identification of any hazardous waste sites within 1/8 of a mile of a proposed child care site. While successful, the SAFER program is only implemented for licensed child care centers and group child homes, not family child care homes. This is largely because residential sites are assumed to pose a lesser risk than providers located in industrial or non-residential spaces. However, SAFER has received referrals concerning environmental hazards in proximity to family child care homes, particularly in relation to well water. In this study, a proximity analysis is performed for family child care homes and two potential sources of well water contamination in five Middlesex County towns. These findings will be used to inform whether the SAFER program should consider efforts to improve well water testing among family child care homes in Connecticut.

Methods

Five towns in Middlesex County, Connecticut were selected for analysis. A total of 55 addresses of active family child care home licenses in Middlefield, Middletown, Portland, Cromwell, East Hampton were geocoded in ArcGIS. Pending and inactive family child care home licenses were excluded.

Addresses for open and controlled Significant Environmental Hazard (SEH) Sites identified by the Department of Energy and Environmental Protection (DEEP) were geocoded in the towns of interest as well as their bordering towns, resulting in a total 13 town SEH sites included in the analysis.[1] A buffer and near analysis were used to identify family child care sites within 1/8 and 1/4 of a mile of an SEH site, as well as find the average distance from family child care homes to the closest SEH site.

The University of Connecticut's Agricultural Land Use maps were used to identify agricultural land in the same aforementioned five towns of interest. Images of the land use maps were georeferenced in ArcGIS and a buffer analysis was used to identify homes within 1/8 and 1/4 of a mile of current and former agricultural land.

Results

Of the 55 family child care homes included in the analysis, 24 (44%) were within 1/8 a mile and 40 (72%) were within 1/4 a mile of former agricultural land. For current land use, 10 (18%) of family child care sites were within 1/8 a mile and 28 (39%) were within 1/4 a mile of

[1] DEEP classifies significant environmental hazard sites as open, controlled or resolved. Open sites require further investigation of the hazardous condition and indicate that mitigation/abatement efforts are necessary. Sites classified as controlled may require periodic action to ensure the hazard remains mitigated and poses minimal short-term risk. Resolved sites indicate the hazard has been permanently eliminated or that contamination no longer exists (DEEP, 2019). Resolved sites were not considered in this study.

agricultural land. There were 15 family child care homes (27%) not within the 1/4 mile radius of current or former agricultural land.

A total of 33 open and controlled Significant Environmental Hazard are located in the 13 towns studied. Four of these sites are classified as open and 29 are controlled. Among the 55 family child care sites included in the analysis, 2 were located within 1/4 a mile (4%), and 1 site was located within 1/8 a mile of an open or controlled SEH site (2%).

Discussion

The proximity of family child care homes to agricultural land in this rural region suggest a potential need for increased well water testing among family child care homes. SAFER may consider implementing a similar non-regulatory approach they have used previously to increase the recommended annual testing among family child care homes relying on well water.

There are important limitations to consider with these findings. The UConn CLEAR map used for current agricultural use is based on 2006 data. Furthermore, the farm activity or history of chemical use among the mapped agricultural in this study is not known. Future studies may consider identifying proximity to farms with current pesticide licenses or areas with known former pesticide use, especially in the case of banned pesticides.

This analysis also relied on geocoding addresses of homes as well as the significant environmental hazard sites reported by DEEP. While this provides insight on location, it is an important limitation as exact sites of the home, well, and contamination site may vary significantly on property lines. DEEP maintains an ArcGIS map with more exact longitude and latitude locations of SEH sites, which should be used for future SAFER screening.

Lastly, it must be reiterated that proximity to these sites does not imply exposure. Rather,

these findings demonstrate that the existing mapping methods used for child care center licenses may be useful for determining a need for future environmental screening among family child care homes.

Background

Connecticut SAFER Program

Over 12 million children under the age of five in the United States are enrolled in a child day care program (Laughlin, 2013). While most states have inspection requirements for licensing early childhood education (ECE) sites, many do not have a comprehensive screening process for environmental health exposures beyond lead and asbestos. This is of concern because young children are especially vulnerable to the harmful effects of contaminants. Children breathe, consume, and absorb more per body weight than adults and engage in activities that increase their exposure, such as crawling and hand to mouth behavior (EPA, 2015). Toxic exposure during critical periods of early life has also been shown to disrupt development of major body systems. For these reasons, federal agencies including the US Environmental Protection Agency prioritize the identification and assessment of environmental health risks that may disproportionately affect children (EPA, 1997).

Environmental screening for child care sites gained national attention following two widely reported events of childhood exposure at two commercial daycare centers. Tutor Time Daycare, operating in Mineola, New York from 1995 to 2002, was located less than 100 feet from a class 2 federal Superfund site. Indoor air monitoring of the child care center found levels of perchloroethylene (perc) exceeding state-recommended residential guidance levels (Johnson, Davis, Schreiber, 2003). In 2006, the Kiddie Kollege child care center was closed in Franklin, New Jersey when it was discovered that the building had previously been used for thermometer manufacturing. Air and surface sampling of the site found elevated levels of mercury throughout

the day care center (New Jersey Department of Health & Human Services, 2006).

Prompted by the events in New Jersey and New York, Connecticut's Department of Public Health established the Screening Assessment for Environmental Risk (SAFER) program in 2007. The SAFER program developed as a partnership between the state's Environmental and Occupational Health Assessment Program (EOHA) and the Child Day Care Licensing Program in the Office of Early Childhood. The state describes SAFER as a proactive, non-regulatory approach to screening licensed child care centers and group day care homes. It utilizes three methods for screening sites for environmental hazards: 1. Mapping centers within 1/8 of a mile of known hazardous waste sites as noted by Connecticut's Department of Energy and Environmental Protection (CT DEEP); 2. Including a property history questionnaire included in new licensing applications; and 3. Implementing an environmental inspection referral form for state and local health departments conducting day care inspections. While voluntary, the SAFER property history questionnaire and inspection referral forms have been well received and widely used by both applicants and inspectors. Furthermore, the Office of Early Childhood's Child Care Licensing Program may withhold a family child care home license if recommended by the SAFER program (Somers, Harvey, & Rusnak, 2011).

The Agency for Toxic Substances and Disease Registry (ATSDR) provides funding for 25 state health departments through the ATSDR Partnership to Promote Local Efforts to Reduce Environmental Exposure (APPLETREE). In the 2017- 2018 fiscal year, ATSDR granted 10.5 million dollars to APPLETREE states. As part of this grant, grantees must work towards developing a Choose Safe Places for Early Childhood Education (CSPECE) program by 2020. Connecticut's SAFER program has been noted by ATSDR as a successful framework that is now being used as a model for states developing their CSPCECE program (ATSDR, 2019).

Family Child care Homes

Connecticut has separate licenses and requirements for child care centers, group child care homes, and family child care homes. Child care centers are providers that care for more than 12 children in a commercial facility. Group child care home licenses are for providers that operate in their home with 7 to 12 children, or outside their home with 6 children or less. Family child care home licenses are for programs with six children or less in the providers' private home. There were 5,912 children in Connecticut enrolled in a licensed family child care home program in 2018 (211 Childcare, 2019).

The state has existing requirements for the physical environment of family child care homes, which are then subject to regular inspections by the Office of Early Childhood. License applicants must provide the year the home was built and those built before 1978 are given a comprehensive lead inspection, which tests the facility for lead in paint, soil and water. The regulations set for the home are defined in Family Day Care Homes Requirements for the Physical Environment (regulation 19a-87b-9i) which states that family child care home applicants that rely on well water must submit water test results from a state certified lab from within the last year (Office of Early Childhood Division of Licensing, 2019).

While successful, the SAFER program screening has only been implemented for licensed child care centers and group child homes. Commercial sites have been deemed a priority because industrial sites may pose greater risk than residential sites, specifically due to the former use of the property and proximity to businesses that pose environmental risks, such as nail salons or auto repair shops. However, the SAFER program has also received referrals from the Office of

Early Childhood regarding family child care home sites. Concerns reported include potential exposure to groundwater contamination and environmental hazard sites.

Well Water Contamination

Private wells collect and pump out water from underground aquifers. There are three types of wells: dug, driven, and drilled wells. Dug wells are typically 10 to 30 feet deep, driven wells are about 50 feet deep, and drilled wells are between 100 to 400 feet deep. Dug and driven wells are more common at camp sites and vacation homes whereas driven wells are more common in year-round residential areas (American Academy of Pediatrics, 2009). Aquifers are recharged by precipitation and runoff that filters through the soil into the groundwater, which can introduce the water to naturally occurring and man-made contaminants. Local activity and geological characteristics are therefore important considerations when studying the composition of well water.

A wide range of contaminants with known or suspected health effects have been detected in well water. The National Water Quality Assessment (NAWQA) program conducted a data synthesis of well water sampling from 1991 to 2004. Researchers found that 23% of private wells tested had at least one chemical greater than human-health benchmarks, largely from naturally occurring contaminants like radon and arsenic. Over half of wells tested (60%) also had trace amounts of man-made organic compounds, such as VOCs and pesticides, however less than 1% were above human health benchmarks (DeSimone, Hamilton, & Gilliom, 2009).

These findings have significant implications for private well water quality, especially when considering childhood exposure. Elevated levels of drinking water contaminants have been

associated with acute illnesses and chronic conditions, including developmental disorders and cancer in children (EPA, 2015). The EPA recognizes that children are a sensitive population and at an increased risk of harmful effects of certain well water contaminants, such as microbial contaminants (E.coli, giardia, cryptosporidium) and nitrates. The American Academy of Pediatrics (AAP) also issued recommendations in 2009 on child exposure to well water due to the risk it poses to child development. Both the EPA and APP recommend private well owners test for nitrates and total coliforms every year (EPA, 2015) (AAP, 2009). The AAP also recommended pediatricians ask about home water source during visits and encouraged parents to ask day care providers about nitrate and coliform water test results if the site relies on well-water. If recent results were not available, AAP recommended using bottled water for infants until concentration levels are confirmed (AAP, 2009).

The AAP also note conditions that warrant further water testing, such as activity in the area and proximity to industry (AAP, 2009). An excerpt from the AAP well water testing Flow Chart can be found in Appendix A. Proximity to agriculture was one condition noted due to contaminants associated with farming activity. Fertilizer and manure can cause elevated nitrate levels in the soil, which may leach into groundwater sources. Elevated nitrate levels in drinking water are particularly dangerous for infants who rely on formula, as nitrate contaminated water can cause a life-threatening condition called methemoglobinemia, or blue baby syndrome. Consuming high levels of nitrates have also been associated with thyroid dysfunction in children and pregnant women. Arsenic, which is a tasteless and colorless water contaminant usually found from naturally occurring sources, is also used in some fertilizers and animal feeds. Arsenic has been associated with a number of adverse health outcomes, including childhood cancer, reduced cognitive function, and poor birth outcomes. Lastly, pesticides from agricultural runoff

and abandoned farms have been found to contaminate water (EPA, 2015). Pesticides refer to a large classification of chemicals that are most commonly used in agriculture as a means of protecting crops from weeds, insects, and pests. (Roberts & Karr, 2013). Approximately 1 billion pounds of pesticides are used in the United States every year (DeSimone, Hamilton, & Gilliom, 2009). Because there are so many pesticides in use and studies often focus on acute exposure to a single pesticide, health effects of long term low levels of exposure, especially to mixtures of pesticides, are not well known. However, research associating pesticide exposure with cancer, adverse neurodevelopment, behavioral disorders, endocrine disruption, and adverse birth outcomes have lead the American Academy of Pediatrics' Council on Environmental Health to recommend children's exposure to pesticides be limited as much as possible (Roberts & Karr, 2013).

Connecticut Well Water Testing

Approximately 23% of Connecticut residents rely on private well water in their home. While local health departments regulate where new wells can be built, private wells are not regulated by the state or the Environmental Protection Agency (Connecticut Private Well Program, 2018). The state recommends private well owners have a basic indicator test for their water every year, which includes total coliform bacteria, nitrate-nitrogen, nitrite nitrogen, pH, odor, chloride, hardness, apparent color, sulfate, turbidity, iron, and manganese (Environmental Occupational Exposure Assessment Program, 2013). Lead testing, which includes a draw sample and a flushed sample, is recommended "at least once, also when planning a pregnancy or have a child under 6 years old in the home" (EOHA, 2013). arsenic, uranium, and radon are

recommended every 5 years, as is fluoride when a child under 12 is present. Volatile organic compounds (VOCs) are also recommended at least once for all well owners, and more often if there is a suspected problem (EOHA, 2013).

The various child care licensing applications have different requirements for water testing depending on the site and location. Child care center and group child care homes using a non-public water source must submit water supply testing results every 2 years for bacterial and chemical quality.[2] These sites are also required to submit a Lead Water Test every 2 years, regardless of water source. The regulation is written as follows:

> *Water supply, food service and sewage disposal facilities shall be in compliance with all applicable sections of the Public Health Code.*
>
> *(A) All water supplies shall be tested every two (2) years for lead content and the results submitted to the local and state health departments.*
>
> *(B) Whenever water is obtained from other than a department-approved public water supply, it shall be of a safe and sanitary quality and tested every two (2) years for bacterial and chemical quality[3] and the results submitted to the local and state health departments.*
>
> *(C) Sanitary drinking fountains or individual disposable drinking cups shall be provided and accessible to the children at all time*s. (Office of Early Childhood, 2019).

[2] It is important to note that day cares serving 25 or more children are considered a public water supply and therefore subjected to more rigorous monitoring requirements.
[3] "Chemical quality" refers only to potability, there is no VOC testing required.

These requirements are distinctly different from the water testing requirements for family child care homes. In the initial application, family child care homes must submit a well water test if the residence relies on well water. The test must include bacteria, physical parameters, and sanitary chemicals, e.g. nitrogen series, chloride, surfactants, hardness, iron, manganese, and sodium. These are the same contaminants included in the Basic Indicator Test recommended annually for all private well owners.

Adequate and Safe Water

> *If the facility is not served by a public water supply, the provider shall show proof from analysis by a state certified laboratory dated no more than one year prior to the application date at initial registration and as often as the Department deems necessary, that its water supply is potable, adequate, and safe. The water test shall include, but not be limited to tests for bacteria, physical parameters (color, odor, turbidity, pH), and sanitary chemicals (nitrogen series, chloride, surfactants, hardness, iron, manganese and sodium). Additional tests may be required as deemed necessary by the Commissioner* Office of Early Childhood, 2019).

While the regulation states that "additional tests may be required as deemed necessary by the Commissioner," there is no lead testing required for water as they are for child care centers and group child care homes (Office of Early Childhood, 2019). Additionally, the water testing is a one-time submission for family child care homes, compared to child care centers and group child care homes which must submit testing every two years. Lastly, well water testing at family

child care homes are only required upon the initial license, not for license renewal applications which occur every four years (Office of Early Childhood, 2019).

As stated previously, the Environmental Protection Agency (EPA) and American Academy of Pediatrics (AAP) both recommend annual well water testing for private well owners. Both agencies recognize children as especially vulnerable to well water contamination, and recommend further water testing based on children in the home, pregnancy, and nearby activity, including agriculture, chemical or fuel spills, and proximity to specific industrial operations (EPA, 2015) (APA, 2009). Despite these recommendations, the only well water testing requirement for family child care homes are in the initial application. This demonstrates potential for increased environmental screening and well water testing outreach for family child care home providers that rely on well water.

Study Objective

This study aims to identify if there are conditions that may warrant further well water testing near family child care homes. Background research was conducted on relevant contaminants, existing regulations and recommendations, and existing data sources for sites of interest. Based on this information, proximity of family child care homes to Significant Environmental Hazard Sites (SEH) and agricultural land were identified as the sites of interest. The Department of Energy and Environmental Protection (DEEP) maintains SEH sites with detailed reports of contaminants of concern, thus the risk of environmental exposure is more easily assessed. Agricultural land was also identified as a concern based on AAP and EPA recommendations and the lack of well water testing requirements for associated contaminants,

such as pesticides or arsenic.

By using existing public data source to measure proximity of family child care homes to sites of interest, this study aims to inform potential SAFER well water guidelines. Connecticut's SAFER program is in a unique position of influence because it is a model for other ATSDR Choose Safe Places for Early Childhood Education programs. By exploring the potential of environmental screening for family child care homes, SAFER may able to improve well water testing in Connecticut and influence efforts of other APPLETREE states across the country.

Methods

Family Child Care Homes

Street addresses for family child care homes in Cromwell, Portland, Middlefield, Middletown, and East Hampton were identified using the Connecticut Office of Early Childhood licensing database. Only family child care homes with active licenses were included. Addresses were geocoded into ArcGis to perform proximity analyses with agricultural land and significant environmental hazard sites. A total of 55 family child care homes with active licenses were geocoded in the four towns: 25 in Middletown, 12 in East Hampton, 9 in Portland, 7 in Cromwell, and 2 in Middlefield.

DEEP Significant Environmental Hazard Sites

The Department of Energy and Environmental Protection maintains a public inventory of Significant Environmental Hazard Sites (SEH). The state requires property owners and technical environmental professionals to report conditions that meet SEH conditions to DEEP. Section 22a-6u of the Connecticut General Statutes states that the six following conditions must be reported:

1. *Public or private drinking water supply wells with detected pollution (above or below the groundwater protection criteria),*
2. *Polluted groundwater 500 feet upgradient of or within 200 feet in any direction of a drinking water supply well with pollution detected above the groundwater protection criteria,*
3. *Polluted groundwater within 15 feet of an occupied building with the potential to pose a short-term risk to indoor air quality,*
4. *Polluted groundwater discharging to a surface water body with the potential to pose a short-term risk to aquatic life,*
5. *Polluted soil present within two feet of the surface with the potential to pose a short-term direct contact risk to humans, and*
6. *The presence of vapors from polluted soil, groundwater or residual free product at levels posing a potential explosion hazard and imminent threat to human health, public safety and the environment.* (DEEP, 2019).

SEH sites are classified as either open, controlled, or resolved. Addresses for open

and controlled sites in Cromwell, Portland, Middlefield, Middletown were geocoded as well as the sites in bordering towns of Glastonbury, Marlborough Colchester, East Haddam, Haddam, Durham, Wallingford, Rocky Hill, Berlin, and Meriden. A total of 39 Significant environmental hazard sites were mapped, four of which are classified as open and 35 classified as controlled. Addresses were geocoded for 35 SEH sites with the exception of 4 sites (1 in Middletown, 1 in Marlborough, 1 in Haddam, and 1 in Easthampton) which were identified in the SEH inventory by an approximate location. Longitude and latitude estimates were used for these sites based on their location in the DEEP ArcMap of SEH sites (DEEP, 2019).

UConn CLEAR Agricultural Land

The University of Connecticut (UConn) Center for Land Use Education and Research (CLEAR) program is a land use partnership funded by UConn as well as state and federal grants. In 2008, researchers at UConn CLEAR studied changes in agricultural land use in Middlesex County, Connecticut. Funding was provided by the River View Cemetery Fund at Middlesex County Community Foundation, the Department of Earth & Environmental Sciences at Wesleyan University, the UConn Department of Extension, and the Middlesex County Extension Council. The 1970 land use was digitized by the UConn CLEAR researchers using the Connecticut Department of Financial Control's 1970 land use inventory. Researchers compared this map to aerial images of the same region in 2006 used to classify agricultural land of at least 10 acres. The results of their work include changes in land use as well as maps of both 1970 and 2006 agricultural land (UConn CLEAR, 2008). These maps are a valuable resource due to the significant changes in agricultural regulations since 1970. Using ArcGis, images of current and

former agricultural land maps for Middlefield, Cromwell, East Hampton, Middletown and Portland were georeferenced to a town boundary base map developed by the Connecticut Environmental Conditions Online (CT ECO) program. A buffer analysis was then performed for active family child care homes in the five towns to identify current and former agricultural land within 1/4 and 1/8 a mile of family child care homes.

Results

Agricultural Land

Of the 55 family child care homes included in the analysis, 24 (44%) were within 1/8 a mile and 40 (72%) were within 1/4 a mile of former agricultural land. When considering current land use, 10 (18%) of family child care sites were within 1/8 a mile and 28 (39%) were within 1/4 of a mile of current agricultural land. There were 15 family child care homes (27%) that are not within the 1/4 mile radius of current or former agricultural land.

Table 1. Family Child Care Homes & UCONN CLEAR Agricultural Land Use

	1970 Agricultural Land		Current Agricultural Land	
Town	1/8 mile	1/4 mile	1/8 mile	1/4 mile
Middlefield (2)	1 (50%)	2 (100%)	1 (50%)	2 (100%)
Cromwell (7)	3 (42.86%)	7 (100%)	1 (14.28%)	4 (57.14%)
Portland (9)	3 (33.33%)	8 (88.89%)	0 (0%)	4 (44.44%)
East Hampton (12)	2 (16.67)	6 (50%)	0 (0%)	4 (33.33%)
Middletown (25)	15 (60%)	17 (68%)	8 (32%)	14 (56%)
Total (55)	24 (43.64%)	40 (72%)	10 (18.18%)	28 (50.91%)

Significant Environmental Hazard Sites

A total of 33 open and controlled Significant Environmental Hazard are located in these 13 towns. Four of these sites are classified as open and 29 are controlled. The proximity analysis found 16 SEH sites to be nearest to family child care homes. Of these 16 sites, seven were reported due to pollution detected in groundwater above standards that may threaten a drinking water well and five were reported due to below standard pollution detected in drinking water wells. One site was reported due to pollution detected above standards in six drinking water wells and below standards in two drinking water wells. Three of these sites were reported due to pollution in top two feet of soil which may pose a risk to human health as a result of direct contact. One site was reported due to polluted groundwater that may affect indoor air quality of an occupied building and another was reported due to pollution in groundwater that may pose a risk to aquatic life. The date of these reports range in 19 years, with the earliest reported in 1998 and most recent in 2017 (DEEP, 2019).

Among the 55 family child care sites included in the analysis, 2 were located within 1/4 a mile (3.70%), and 1 site was located within 1/8 a mile of an open or controlled SEH site (1.81%). The closest site is 20 Mill Street in Middletown, which is .11 miles from a family child care home. This is an active Significant Environmental Hazard Site opened in 2007 due to "pollution detected in groundwater that discharges to a surface water body may pose a risk to aquatic life" (DEEP, 2019). DEEP is currently working with the owner and third party to resolve the case.

Another family child care home is located .22 miles from 13 Watrous Street in Easthampton. This site is the location of a former Summit Thread Powerhouse and Ghezzi Motors. In 2005, pollution was detected in the groundwater above standards that may threaten a drinking water well, and in 2009 pollution was detected in the top two feet of soil which may pose a risk to human health as a result of direct contact. DEEP continues to monitor 7 off-site wells and determined the polluted soil site has been secured with limited potential for contact (DEEP, 2019).

Table 2. Family Child Care Homes & DEEP Significant Environmental Hazard Sites

Town	Average distance to nearest SEH Site (miles)	Minimum	Maximum
East Hampton	1.07	0.22	1.87
Middlefield	1.53	1.46	1.59
Middletown	1.29	0.11	2.72
Portland	1.64	0.82	2.27
Cromwell	3.05	2.42	3.4
Total	1.53	.11	3.4

Conclusion

Performing a proximity analysis with existing DEEP data is a low-cost method for screening existing and future family child care sites, especially those that rely on well water. Strengths of this study are the public availability of its information and its replicability for DEEP significant environmental hazard sites across the state. The findings of this study suggest there may be a need to include pesticides in the existing water testing requirements for initial application.

This proximity analysis relied on geocoding addresses of family child care homes and significant environmental hazard sites. This is an important limitation as exact sites of contamination may vary significantly based on property lines. DEEP maintains a map with more exact longitude and latitude locations of reported sites, which should be used for future screening. Furthermore, there are a number of conditions that were not considered, such as brownfields and potentially contaminated sites, which are both maintained by DEEP. While we have public information on agricultural land use and reported significant environmental hazards, exact contaminants are not known in this report. For sites where this is of concern, such as the two sites within .25 miles of an SEH, SAFER may consider collaborating with the investigators at DEEP for more information.

There are important limitations to consider with these findings. The UConn CLEAR map used for "current" agricultural use is based on 2006 data. It is not known what land is being used for agricultural activities today based on these maps. Studies on more recent land use would therefore be valuable as changes have likely occurred over the last 13 years. Furthermore, the pesticide use history of the agricultural land mapped in this study is not known. Future studies may consider mapping farms with current pesticide licenses or areas with known former pesticide use, especially in the case of banned pesticides. It is also important to note that the information on agricultural land use is only available for 17 Connecticut towns. Increased research in the former and current agricultural land use for the entire state may improve screening process for all child care centers.

Lastly, it must be reiterated that proximity to these sites does not imply exposure. Rather, these findings demonstrate that the existing mapping methods used for child care center licenses may be implemented for family child care homes to inform possible well-water testing

recommendations.

Recommendations

There are a number of methods SAFER may consider if they choose to implement well water testing efforts for Family Child Care Homes.

1. Use existing DEEP data to screen for potential environmental concerns for family child care homes upon initial application. As discussed, SAFER screens for hazardous waste sites within 1/8 a mile of family child care center applicants. This method may be applied to family child care homes as well.
2. Consider implementing a voluntary screening approach for family child care homes that rely on well water. Similar to the SAFER property history questionnaire that is given to family child care centers, a questionnaire asking about conditions near the home upon application may inform if additional well water testing is recommended. For example, an applicant reporting they are within 1/8 a mile of agriculture may be asked to submit pesticide testing in addition to the required nitrate and bacterial coliform tests.
3. Regulators may also consider extending well water testing requirements for family child care homes for license renewal. Family child care homes must renew their license every four years, however well water testing is only required upon initial application. Because bacterial coliform and nitrate testing is recommended every year, license renewal may provide an opportunity to reach family child care home providers.

4. Educational outreach to family child care home providers that rely on well water may also ensure well water quality in homes. It is possible that many providers are unaware of well water testing recommendations. SAFER may consider developing well-water specific materials for the licensing site as well as for distribution among existing homes may inform providers.

Discussion

Well water contamination is only one environmental health concern that was considered in this analysis. There are a number of sites that could present environmental health concerns and may be considered when screening family child care homes. While this study focused on well water testing, future screening or proximity analyses may consider using other environmental sites maintained by DEEP, such as potentially contaminated sites and the Connecticut brownfield inventory.

There are important logistical considerations when implementing further well-water testing requirements. Family child care homes are one of the most common child care providers, especially among low income families and for children of color (Ramos et al., 2018). While well water testing is extremely important, the financial burden must be considered as the cost of testing falls on the provider. Pesticides may also present a challenge in terms of testing because they are such a large classification of chemicals. There are 25 well water testing labs certified by the state of Connecticut to test drinking water. Of these sites, 19 test for "some or all of the following: pesticides, herbicides, and PCBs" (Connecticut Department of Public Health, 2018). Labs may only have capacity to test for select pesticides and testing water for multiple pesticides

can be difficult and costly. Thus, well water testing efforts may consider financial support for well water testing, particularly for sites with potentially contaminating conditions near the home.

References

American Academy of Pediatrics. (2009). Drinking Water from Private Wells and Risks to Children. https://doi.org/10.1542/peds.2005-1497

Agency for Toxic Substances and Disease Registry. (2018). Choose Safe Places for Early Care and Education. Retrieved February 23, 2019, from https://www.atsdr.cdc.gov/safeplacesforece/index.html

Connecticut Private Well Program. (2018). Private Wells. Retrieved February 26, 2019, from https://portal.ct.gov/DPH/Environmental-Health/Private-Well-Water-Program/Private-Wells#48151

CT ECO (2017). Base Map (Connecticut): Town. Retrieved April 30, 2019, from https://cteco.uconn.edu/map_services.htm

Department of Energy and Environmental Protection. (2019). Significant Environmental Hazards. Retrieved March 21, 2019, from https://www.ct.gov/deep/cwp/view.asp?a=2715&q=324976&deepNav_GID=1626

DeSimone, L., Hamilton, P., & Gilliom, R. (2009). The Quality of Our Nation's Waters: Quality of Water from Domestic Wells in principal Aquifers of the United States, 1991-2004. Retrieved April 9, 2019, from https://pubs.usgs.gov/circ/circ1332/includes/circ1332.pdf

Environmental Law Institute (ELI). *Reducing Environmental Exposures in Child Care Facilities A Review of State Policy*. (2015). Washington DC. Retrieved April 9, 2019, from https://www.eli.org/sites/default/files/eli-pubs/reducing-environmental-exposures-child- care_4.pdf

Environmental Occupational Health Assessment Program (EOHA). (2013). Private Drinking Water in Connecticut: Private Well Testing. Retrieved March 21, 2019, from https://portal.ct.gov/-/media/Departments-and-Agencies/DPH/dph/environmental_health/eoha/pdf/24ResidentialDrinkingWaterWellTestingpdf.pdf?la=en.

Environmental Protection Agency. (2013). Drinking Water Contaminants. *America's Children and the Environment, Third Edition*, (72-84). https://www.epa.gov/sites/production/files/2015-06/documents/ace3_2013.pdf

Environmental Protection Agency Office of Water. (2006). Protect your Homes Water. Retrieved March 21, 2019, from https://www.epa.gov/privatewells/protect-your-homes-water

Environmental Protection Agency (EPA). (n.d.). Contaminants to Which Children May Be Particularly Sensitive. Retrieved April 9, 2019, from

https://www3.epa.gov/safewater/kids/kidshealth/pdfs/brochure_childrenstandards_table.pdf

Laughlin, L. (2013). *Child Care Arrangements: Spring 2011*. Retrieved November 30, 2018, from https://www.census.gov/prod/2013pubs/p70-135.pdf

Liu, J., & Schelar, E. (2012). Pesticide exposure and child neurodevelopment: summary and implications. *Workplace Health & Safety*, *60*(5), 235–42; quiz 243. https://doi.org/10.1177/216507991206000507

Johnson, G. J., Davis John, & Schreiber, J. (2003). Daycare Center Located Near Toxic Waste Site. Retrieved February 23, 2019, from https://ag.ny.gov/press-release/daycare-center-located-near-toxic-waste-site

New Jersey Department of Health and Senior Services. (2006). *New Jersey Department of Health and Senior Services, Agency for Toxic Substances and Disease Registry National Center For Environmental Health Mt. Sinai Pediatric Environmental Health Specialty Unit Response to Kiddie Kollege*. Retrieved February 23, 2019, from https://www.state.nj.us/health/ceohs/documents/eohap/haz_sites/gloucester/franklin_township/kiddie_kollege/timeline_10_16_06.pdf

Office of Early Childhood Division of Licensing. (2019). *Statutes and Regulations Child Care Centers and Group Child Care Homes*. Hartford.

Postma, J., Butterfield, P. W., Odom-Maryon, T., Hill, W., & Butterfield, P. G. (2011). Rural children's exposure to well water contaminants: implications in light of the American Academy of Pediatrics' recent policy statement. *Journal of the American Academy of Nurse Practitioners*, *23*(5), 258–65. https://doi.org/10.1111/j.1745-7599.2011.00609.x

Ramos, A., Cervantes, A., Kelly, D., Elbashir, G., Elliott, G., Reyes, J., … Trimble, T. (2018). *Family Child Care Providers' Perspectives on Partnering with Early Head Start*.

Roberts, J. R., Karr, C. J., Council On Environmental Health, C. O. E., Wruk, K. M., Kulig, K. W., & Rumack, B. H. (2012). Pesticide exposure in children. *Pediatrics*, *130*(6), e1765-88. https://doi.org/10.1542/peds.2012-2758

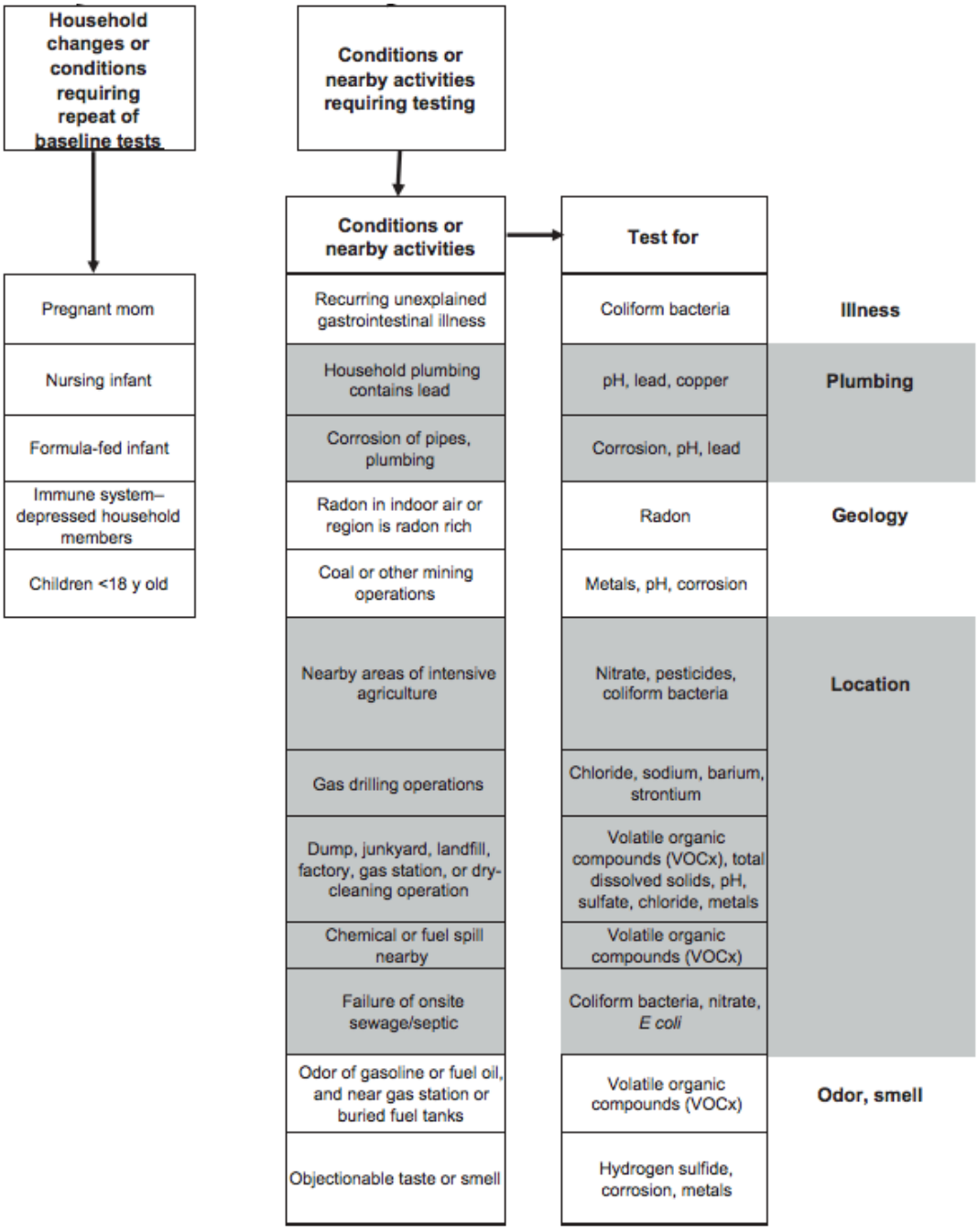
Somers, T. S., Mph, /, Harvey, M. L., & Rusnak, S. M. (2011). *Making Child Care Centers SAFER: A Non-Regulatory Approach to Improving Child Care Center Siting*. *Public Health Reports* (Vol. 126).

UConn CLEAR. (2008). Changes to Agricultural Land. Retrieved March 21, 2019, from http://clear.uconn.edu/research/mini_projects/ag_middlesex/ag_active.htm

211 Child Care. (2019). *Child Care Capacity Availability and Enrollment Report Summary*. Retrieved April 21, 2019 from https://www.211child care.org/reports/annual-survey-2018/.

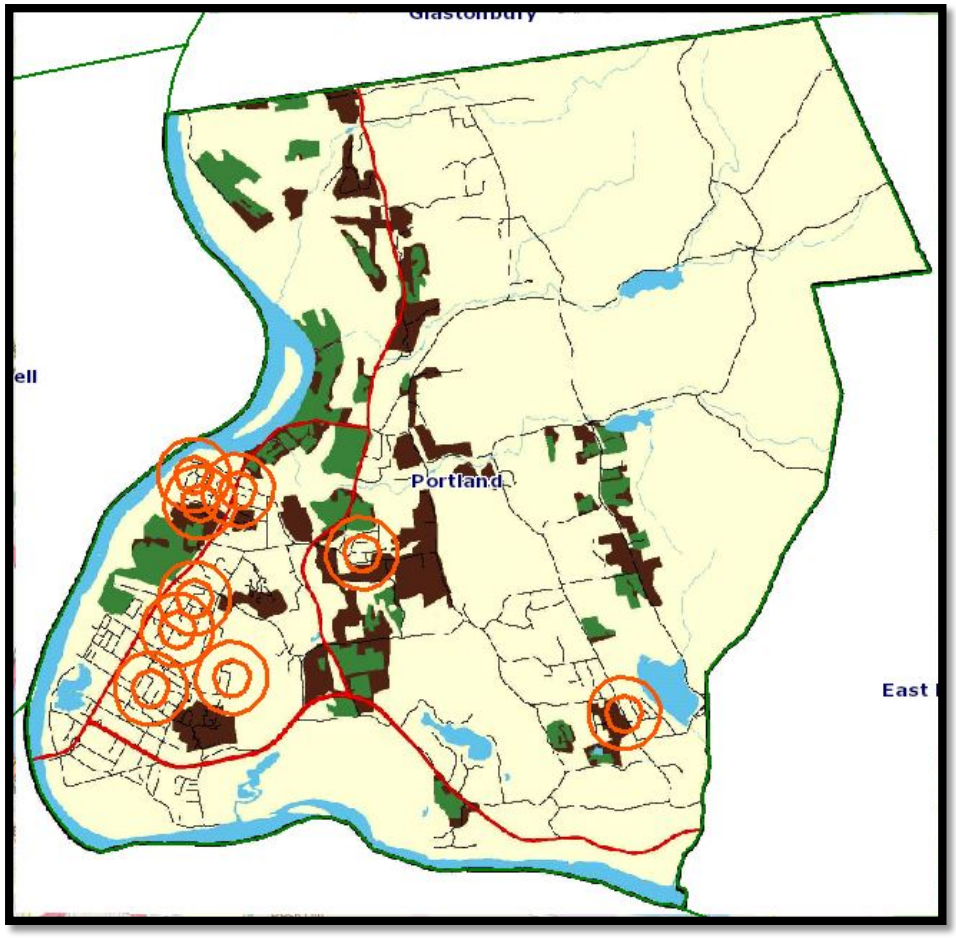
Appendix A

American Academy of Pediatrics Flowchart for Testing Well Water (AAP, 2009).



Appendix B

Georeferenced UCONN CLEAR Agricultural Land Use Map & Portland Family Child Care Homes

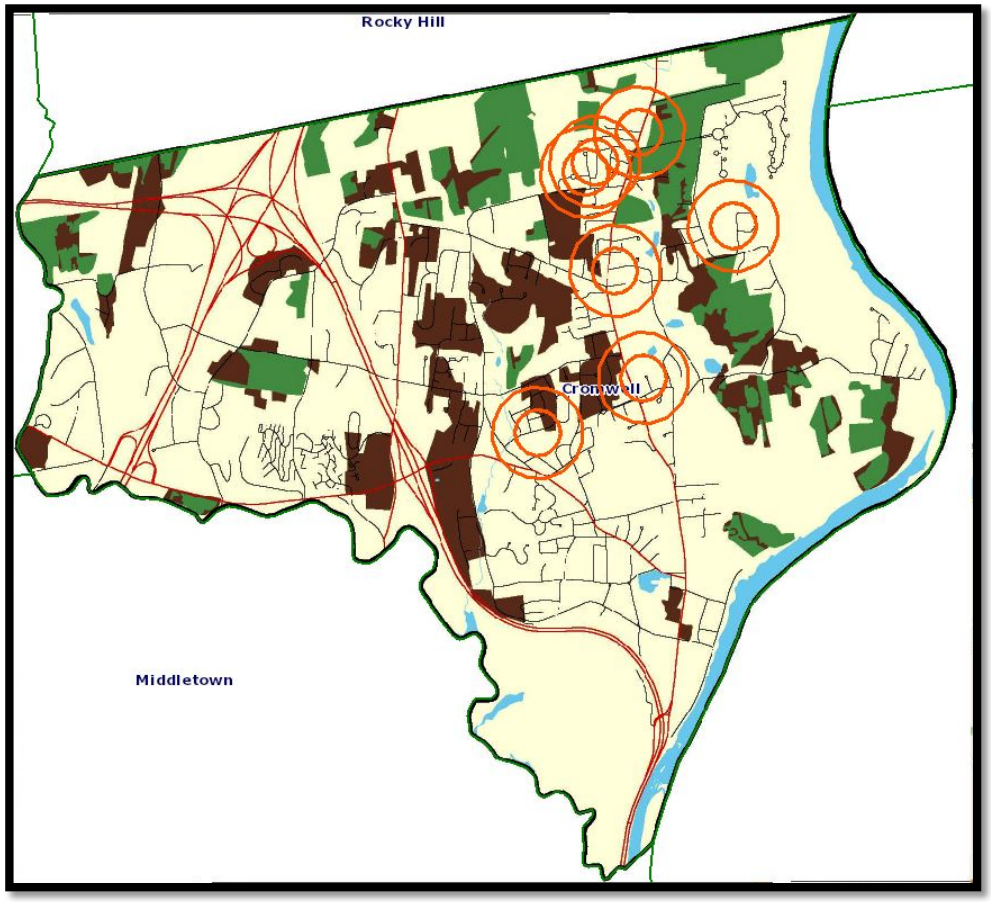


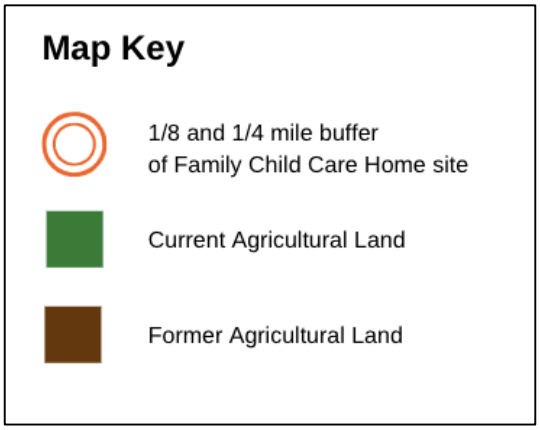
Map Key

- 1/8 and 1/4 mile buffer of Family Child Care Home site
- Current Agricultural Land
- Former Agricultural Land

Appendix C

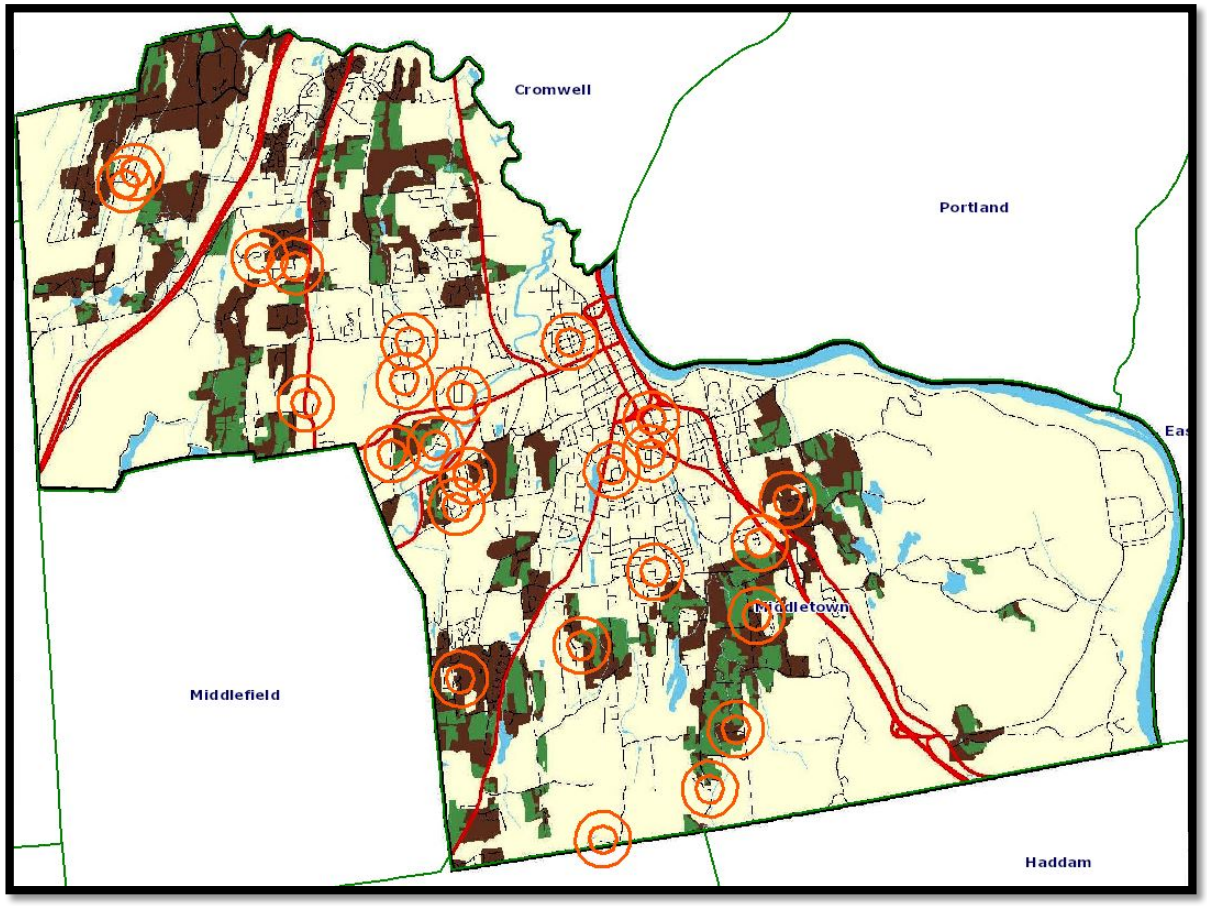
Georeferenced UCONN CLEAR Agricultural Land Use Map & Cromwell Buffer Analyses of Family Child Care Homes





Appendix D

Georeferenced UCONN CLEAR Agricultural Land Use Map & Middletown Buffer Analyses of Family Child Care Homes

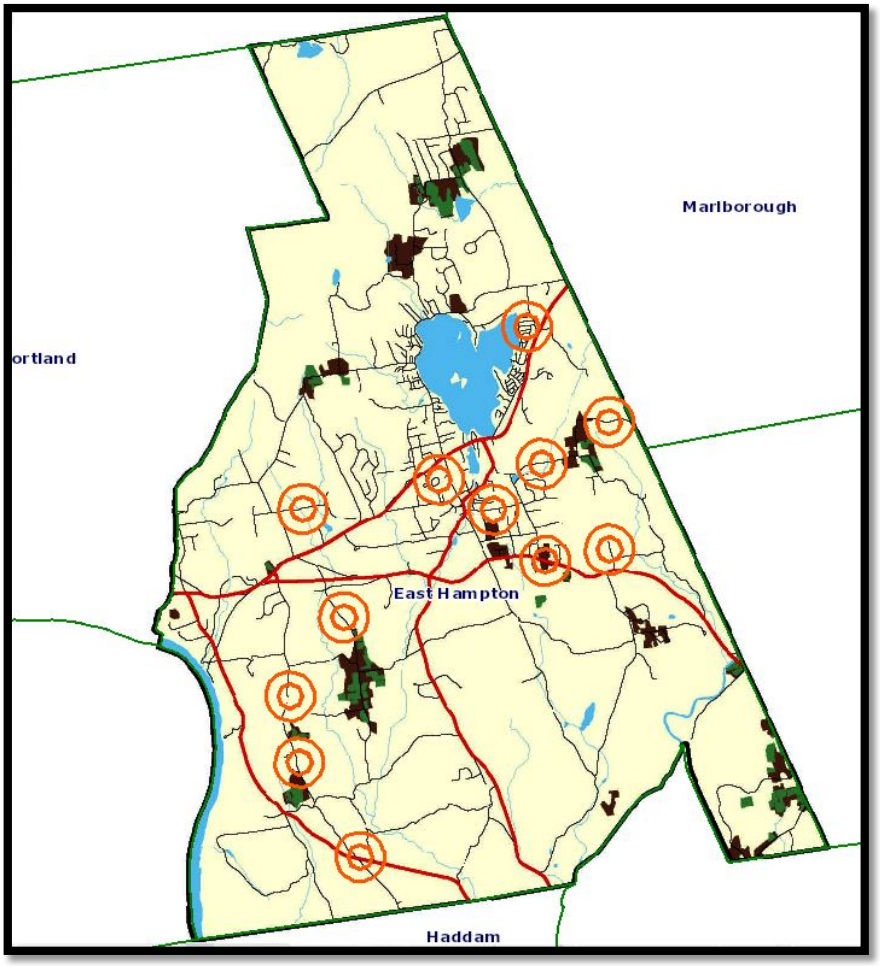


Map Key

- 1/8 and 1/4 mile buffer of Family Child Care Home site
- Current Agricultural Land
- Former Agricultural Land

Appendix E

Georeferenced UCONN CLEAR Agricultural Land Use Map & East Hampton Buffer Analyses of Family Child Care Homes



Map Key

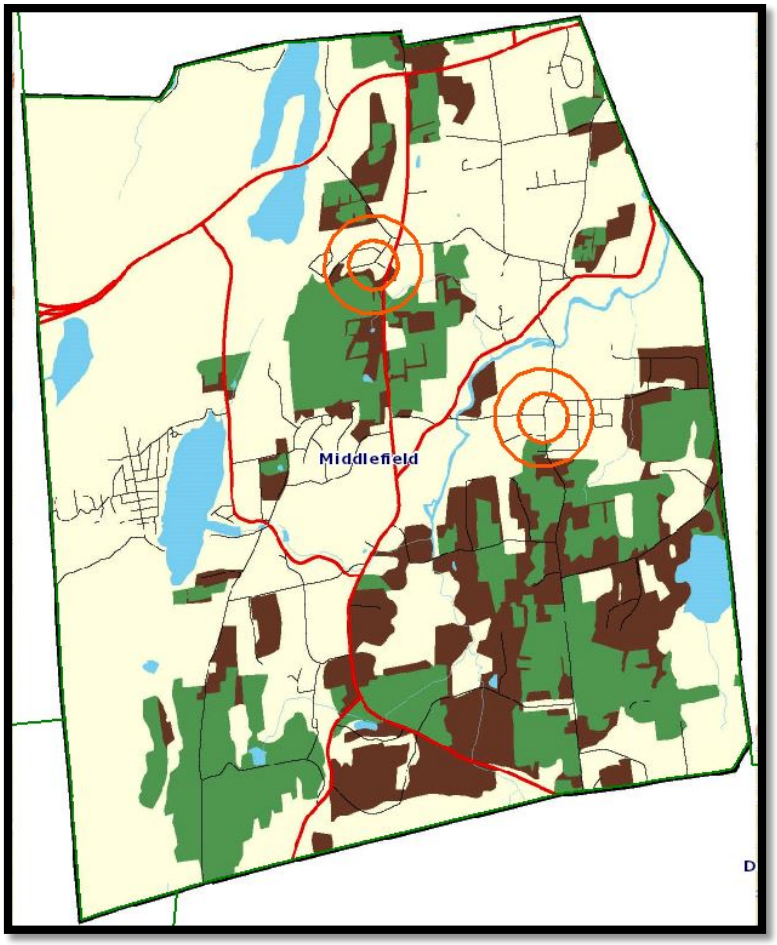
1/8 and 1/4 mile buffer of Family Child Care Home site

Current Agricultural Land

Former Agricultural Land

Appendix F

Georeferenced UCONN CLEAR Agricultural Land Use Map & Middlefield Buffer Analyses of Family Child Care Homes



Map Key

1/8 and 1/4 mile buffer of Family Child Care Home site

Current Agricultural Land

Former Agricultural Land

Appendix G

DEEP Significant Environmental Hazard (SEH) Sites and Family Child Care Homes