

# L.E.A.P.

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## *Linganore Environmental Action Plan*



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# Table of Contents

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<i>Mission Statement</i> .....	2
<i>History of Linganore</i> .....	2
<i>Current Linganore</i> .....	3
<i>Overview</i> .....	3
<i>Land Use</i> .....	4
<i>Water Use</i> .....	4
<i>Water Impairment</i> .....	5
<i>Goal Matrix</i> .....	6
<i>Part I: Sedimentation and Erosion</i> .....	6
<i>Problem Identification</i> .....	6
<i>Recommendations and Solutions</i> .....	7
<i>Part II: Urbanization and Agriculture</i> .....	8
<i>Problem Identification</i> .....	8
<i>Recommendations and Solutions</i> .....	8
<i>Part III: Public Outreach and Engagement</i> .....	10
<i>Problem Identification</i> .....	10
<i>Recommendations and Solutions</i> .....	10
<i>Conclusion</i> .....	12
<i>Works Cited</i> .....	14

# Linganore Environmental Action Plan

## Mission Statement

The ultimate goal of L.E.A.P is to ensure that the Linganore Watershed continues to provide quality municipal drinking water for this quickly growing community by restoring the rapidly shrinking capacity of the reservoir and reaching swimmable, class B, water standard by 2040.

## History of Linganore

In the 1960s a Lake Linganore was dug out surrounding Linganore Creek. The intention of the developer was to create a camping/vacation site with some permanent housing and recreational areas such as the two beaches that are currently on the lake. During development, the developer went bankrupt leaving road systems and an empty lake. The land was sold to many developers, who did not work together. This resulted in haphazard road systems and unmonitored urbanization. Development has continued through the years, but recent there has been a boom in the residential development with three new neighborhoods planned within five miles of the lake. These new developments have clear cut surrounding forests in preparation of construction.

In the mid 2000s Frederick County and the City of Frederick saw the potential of Lake Linganore and connected the lake and the surrounding communities to the municipal water supply. In doing so, the lake had been turned into the county's only reservoir. However, Frederick County being historically an agricultural county, and the lake has taken a damage from the surrounding farm lands. Corn, soybeans, and cattle are the major products of these farms. The runoff from these farms has caused eutrophication of the creeks and lakes in the watershed as well as increased sedimentation and rises in E-coli levels.

There are three agencies that are directly connected to the lake: LLA, LLCS, and Land Stewards Inc. (The Lake Linganore). The Lake linganore Association (LLA) is the government of the residents in the area around the lake. The Lake Linganore Conservation Society (LLCS) is a non-profit formed to improve stormwater management within the nearby neighborhoods. Land Stewards, Inc. is the one of the major developers in the area.

The Linganore creek, located in Frederick county Maryland, was altered in 1972 by placing a dam across it, forming what we know today as Lake Linganore. Lake Linganore has mainly two inflows which are Bens Branch and of course Linganore creek. Lake Linganore ultimately empties into the Chesapeake Bay, although it's contents run through the Monocacy River and Potomac River on its journey to the ocean (Maryland: Bens Branch). Years later The Chesapeake Bay Agreement(1983 & 1987) was introduced and included the involvement of Virginia, Maryland and Pennsylvania, which seeked to restore the Chesapeake bay with the smaller watersheds in mind. Linganore was included in this restoration for it is a contributor to the Chesapeake watershed, but such modifications never were actively constructed. While Linganore was still subject to agricultural runoff and continually polluted by sediment and

phosphorous, Linganore was able to be taken under consideration by the *Maryland Economic Growth , Resource Protection and Planning Act of 1992* which allowed Frederick county to evaluate and concentrate on the sensitive areas around Linganore that need restoration and protection. Such places included: boundaries of development and agriculture, Monocacy Scenic River, ground water resources, wetlands, sedimentary rock formations, and historical sites (“The Lake Linganore”). These areas finally were brought to the surface and six years late in October 1998, the Countywide Environmental Resource Policies from the Frederick County Comprehensive Plan stated that the county will be conducting on going studies of surface water-related policies, stream valley buffers/corridors policies, steep slopes and moderately steep slopes policies and vegetation and wildlife habitat policies which will implement regulations that citizens will need to abide by and/or also encourage to abide by. No force seems apparent, but goals and standards are set (“The Lake Linganore”). More current strides toward restoration and protection was done by The Maryland Department of Agriculture (MDA) in 2006 who teamed up with a local farm owner to correct his issues regarding cattle and sediment erosion. Structures such as stream crossings, fencing along the streambank, buffer zones/tree planting, and natural springs for livestock drinking were implemented. By 2007, the Linganore creek’s banks were sturdy and secure from the vegetation growth. MDE reported in 2006 and 2007 that phosphorous and sediment accumulation has decreased. This project cost the farmer \$100,000, but \$79,000 was funded by the state of Maryland and The Maryland Agriculture Cost Share program (Maryland: Bens Branch). This program seemed to be a big incentive toward the agricultural movement and funds/funded 87.5% of cost toward restoration. In 2012 and 2013 the Town of Mount Airy put together a tree planting day to help restore the Linganore watershed. They targeted a ten acre plot in the Carroll county area of the Linganore watershed to basically convert grass areas into a wooded lot. The trees and tools were partially funded by the Maryland Agriculture Cost Share Program (“TREE PLANTING OPPORTUNITY”). This more local scale operation allowed for residents to get a hands on approach that benefits their community’s water qualities.

## Current Linganore

### Overview:

The Linganore Watershed has a drainage area of approximately 47,000 acres, as shown in Figure 1. The Linganore Watershed’s main feature is Lake Linganore, a 833 million gallon reservoir, created by the man-made dam at Linganore Creek. Figure one below details the geographic boundaries of the watershed which extends from the eastern border of Frederick County westward towards the City of Frederick and also southward towards the Potomac River. The Linganore Watershed neighbors the Lower Monocacy River Watershed, which feeds into the Potomac River Watershed. Eastern Frederick county, where the Linganore Watershed is located, is a suburban area inhabited by approximately 25,000 people. The climatology of the

area, which is located along the Piedmont Plateau north of Baltimore, is humid subtropical which entails warm, wet summers and cool winters with snowfall (Table 1).

Table 1: Average Climatology

Average Annual High Temperature	66.6 F
Average Annual Low Temperature	45.9 F
Average Annual Rainfall	40.59 inches
Average Annual Snowfall	18.7 inches

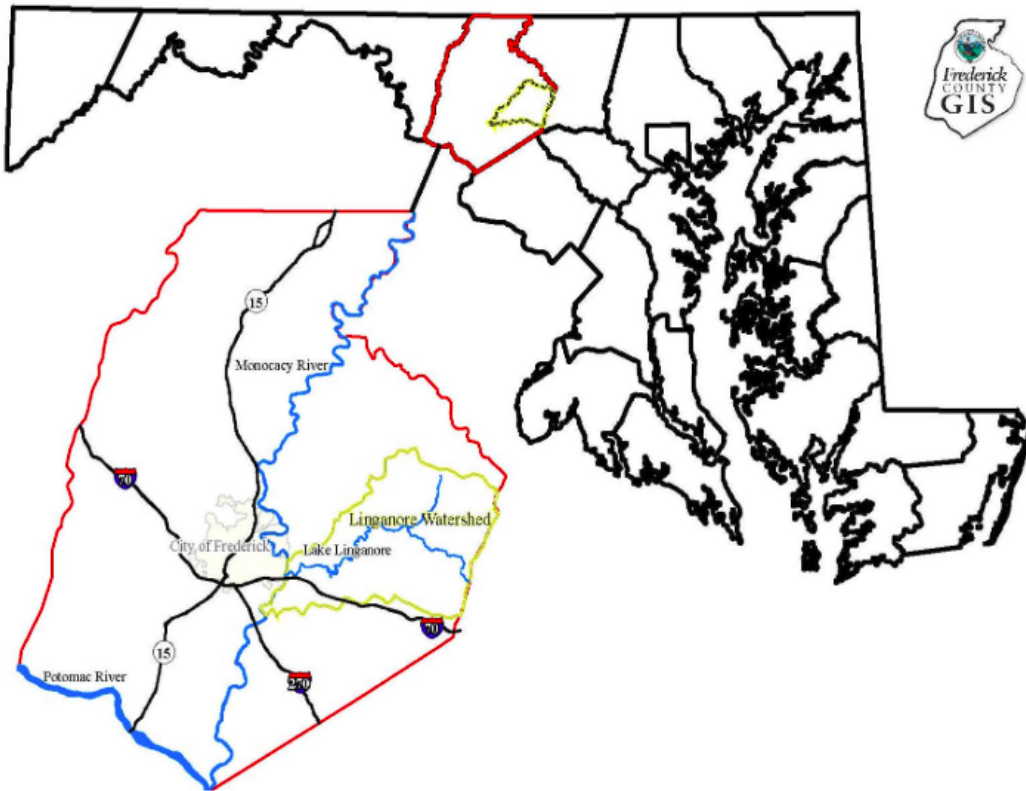


Figure 1: Map of Linganore Watershed Geographic Boundaries

**Land and Water Use in Linganore Watershed:**

The region’s lands are almost entirely zoned for agricultural industry, with nearly 65% of the lands being used for agriculture. The remaining 35% of land is used for neighborhood tracts and small business zoning. The northern and eastern segments of the shoreline along the Linganore Creek in the watershed consist mostly urbanized neighborhoods and businesses. To the east a development (Spring Ridge) contains nearly 2,000 units and trails on the perimeter of

the development that also line the Linganore Creek. Additionally, on the southeastern end of Lake Linganore a large planned unit development (Eaglehead) has a current population of around 6,500 people, but has room for expansion for maximum capacity estimated at 20,000. Southern shoreline along the Linganore Creek has agriculture land lining the creek and any urbanized neighborhoods are more than 0.25 miles from the water. The Linganore Watershed's water is designated for municipal water use and recreational activities, including trout fishing.

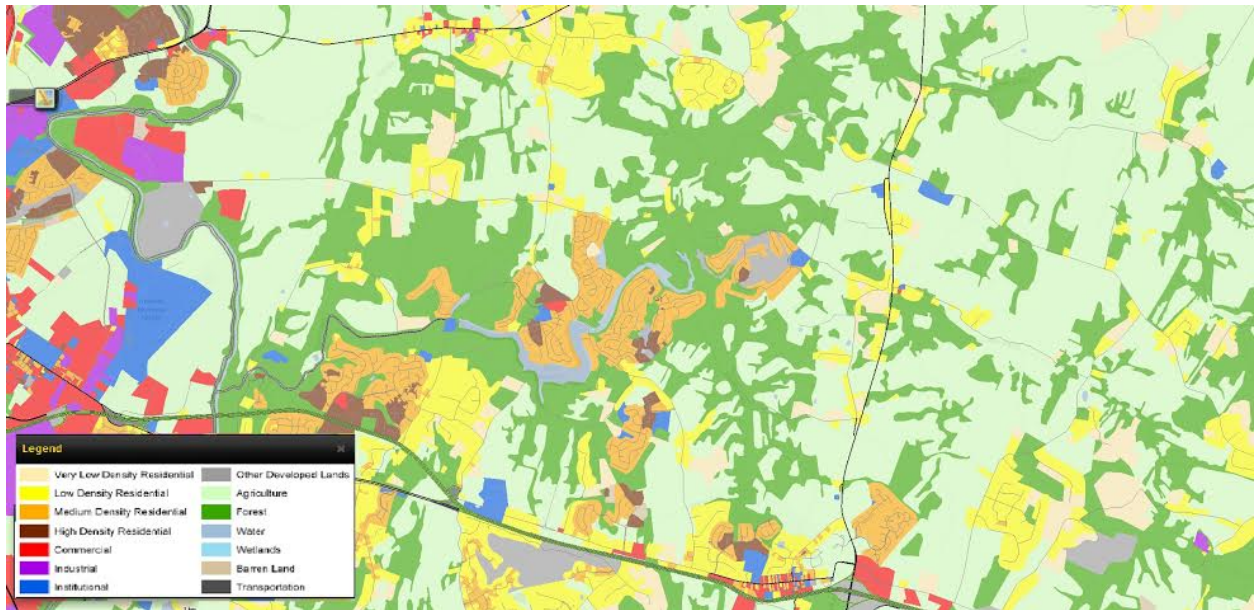


Figure 2: Map of Land Use Within Linganore Watershed

### Water Impairment:

Water temperatures, which affect rate of chemical processes and vitality of aquatic plants, throughout the Linganore Watershed were consistent with cool water systems. Linganore Watershed supports fish propagation and a multitude of other biota. The aquatic biota in the Linganore Watershed have a healthy amount of dissolved oxygen to thrive on, according to testing of the water quality taken in years previous. The watershed's biodiversity was also on a level field with other regional watersheds, reflecting the region's agricultural lands and recent urbanization as Frederick county grows. A current impairment of the water quality is seasonal changes of turbidity in Linganore waters. During summer months when thunderstorms are most common, turbidity measured at stations within the watershed above the dam is much higher than measurements taken during the spring.

## Linganore Goal Matrix

<b>Goals:</b>	<b>Problems:</b>	<b>Solutions:</b>
G1: Reduction in sediment deposition by 90%	P1: Runoff from farm lands and urban developments erodes sediment into Linganore Watershed	S 1.1: Installation of riparian buffer zones
G2: Land being development and used for agriculture are subject to review and necessary enforcement as master plan moves forward.	P2: Rapid urban development, surrounding historical agricultural lands, is being poorly planned according to its impact possible.	S 2.1: Agricultural lands will be required to install natural buffers and properly manage their flow of water on their lands  S 2.2: Proposed future developments will require significant analysis of master planning for drainage and land use
G3: Engage the community in lifestyle changes regarding their water usage	P3: Current public outreach programs are ineffective at engaging the public	S3: Plan and build a public outreach project that engages the community (2,500 of the community's youth will use the park for learning)

### I. Sedimentation and Erosion

#### **Problem Identification:**

Pollution of Lake Linganore's water by fine particulates consistent with clay and silt is causing a loss in capacity for municipal water. The sediment pollution has quickly accumulated at the bottoms of the watershed where it is extremely undesirable. A 2002 assessment of the lake, which was funded by the county, revealed that lake had lost 13% of its capacity since its inception 30 years ago. This 13% loss is quantitatively a loss of 104.5 million gallons of water that has been replaced with dislodged sediments. The issue within this reduction of capacity is that with any major drought pattern that develops in the future, the 78 day water supply in Lake Linganore would be significantly reduced as rainfall supply dwindles.

This siltation issue is rooted in the increasing erosion of the land lining the watershed and its lack of maintenance over the course of time. These lands bordering the watershed contribute the most to the turbidity of the watershed because much of the land within the Linganore watershed is high upland with short steep slopes that lead into deep, narrow streams and valleys. These steep slopes lead to fast moving excessive runoff that is overloading the streams. Much of the land has become too steep for vegetation and plants that are crucial to holding the soil along the shore in place. With increasing urbanization in surrounding areas, maintenance and service have been focused elsewhere and much of the land lining the watershed is not easily accessible through private properties. This increased urbanization potentially requires more land input for development which would increase the total acreage of exposed land because as of today the land that would be used for development is semi-forested and is subject to little erosion. Additionally, the southward area of the watershed is almost entirely zoned for agriculture and many of these sites are contributing towards the increased sediment load with non-point source runoff.

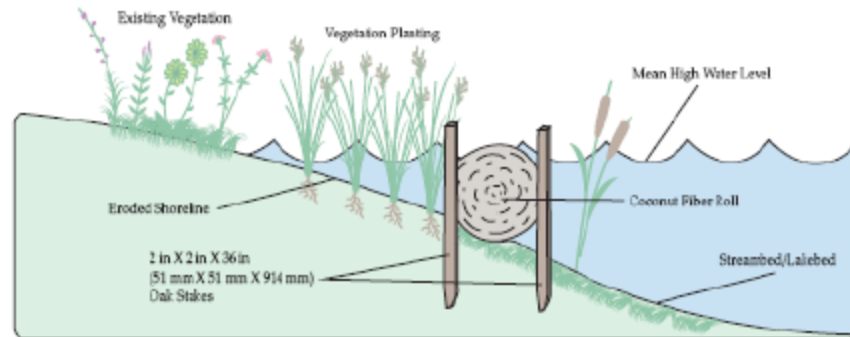
### **Recommendations and Solutions:**

With the large amounts of silt built up along the bottom of the lake that takes up almost 105 million gallons. Dredging is an option by which the silt could be pumped out of the bottom of the lake and moved to another location. This option is estimated to cost anywhere from \$4-\$8 million dollars. Another option to clean up sediment would be to place a forebay upstream of the reservoir. A forebay would be most beneficial for future uses to prevent sediment from entering the lake.

One solution to prevent erosion within the watershed could be to regrading the land upstream to the known points of erosion. The slope in most areas of the linganore watershed is generally around 25% and should be shaped to be anywhere from a 2:1 to a 10:1 horizontal to vertical ratio. Slopes in this range are ideal for soil bioengineering. After resloping the terrain vegetation with strong roots that prefers moist soil should be planted to hold the dirt in place. Some examples of these plants could be the polystichum acrostichoides, or the tiarella cordifolia which are both examples of native plants to Maryland that prefer moist soil. After all this has been done rolls of coconut fibers should be placed on the hills to slow down water runoff, prevent erosion, and hold the water in place long enough for sediment to drop out before it enters the stream.



## Coconut Fiber Roll



Another factor that will help prevent erosion is rezoning of the land. Creating a buffer zone near all perennial streams within the watershed will reduce the amount of impervious and agricultural land near these streams. The farther these lands are from the streams the less overload from runoff these streams will have.

## II. Unplanned Urbanization and Agricultural Impact

### Problem Identification:

Unconstrained growth of suburban development throughout Frederick has strained infrastructure maintenance throughout the municipality. Lake Linganore is currently surrounded by housing developments, and more specifically the sewer line belonging to these developments run parallel to Lake Linganore. As the housing tracts in the area age, so does the underground network of piping, and recently the sewage piping has began experiencing leakage along the border of Lake Linganore.

Current zoning regulation within municipalities containing the Linganore Watershed do not place any limits on continued growth in developments through the eastern side of the Linganore Creek are also a potential future hazard to spreading the aforementioned threat of extreme sediment deposition. Agreeably, the unchecked growth of these developments along the watershed are also causing issues regarding regulation of dumping for contractors contracted out to do work for developers. As construction in this real estate market continues, the need for contracted work on new and pre-owned homes has grown exponentially and often these contractors are looking to prevent additional cost beyond labor and materials. Therefore, members of the community have already noted illegal dumping of materials in at least one site that is directly above an intake, where the sloping hillside can bring any contaminants directly down into the intake area. Most importantly, this rapid growth of local developments is directly related to an increase in impervious surfaces throughout local lands. Typical of piedmont ecology, the land in Linganore was once heavily forested lands, but with incoming development over the past 40 years the amount of impervious land has increased to include over 13% of the total land.

For farmers in the Linganore Watershed, their primary concern is maintenance of the land being utilized for their crops and livestock, but anything beyond that boundary is perceived as unimportant and a possible additional cost accrued. This evidenced poor planning is painting a bigger picture of rushed community development that is caused by high real estate market demand.

## **Recommendations and Solutions:**

With the increase of urbanization in the Linganore watershed area, also comes an increase in impervious cover. When impervious cover outweighs the pervious cover, the water runoff has no chance to be filtered through the soil. While Linganore is already heavily surrounded by agricultural land, the runoff is tainted with high levels of phosphorous from excess fertilizer use. This allows the phosphorous rich, polluted water runoff, from the combination of agricultural and urbanization development, to flow directly into Lake Linganore which consequently erodes sediment that settles in the lake. The correlation between impervious/pervious cover and water flow is easily acknowledged and land/water quality can be improved dramatically if there is a sense of awareness from Linganore's inhabitants. Farmers shall be educated on the effects agriculture has on water resources for much of the procedures they make have a direct response toward the water quality. They shall be knowledgeable of the correct amounts of fertilizer and pesticides they use per acre and be subject to incorporate buffer zones of natural vegetation to absorb the excess runoff. Also using irrigation that spreads, already dissolved, contents can be used. To lower the fertilizer and pesticide use even further, farmers will be mandated to employ popular methods for erosion reduction, like crop rotation, which will sustain a more nutrient rich soil in the long run, and keep weeds and insects at bay for they need to adapt to a constant change in environment. As for erosion, farmers will be asked to begin implementation of procedures that help combat soil degradation such as: planting/tilling with the contours of the land instead of straight down them, incorporating a cover crop for out of season growing periods, and increasing water capacity of the soil with natural additives. Many of the irrigation systems used on farms come from an on-site holding pond, which livestock excrements/runoff could be funneled into for future use. Although nearby streams and waterways shall be protected from such runoff with the use of a buffer zone. Once agricultural mandates determined for farmers to be aware of, regulations shall be put forth and abided by in regards to the effects of agriculture and water quality. These buffer zones are also crucial for developing new infrastructure and should be used. Infrastructures such as compounds and development of houses should be planned out with runoff in mind and should be approached properly. Local homeowners shall also be educated/informed about the precautions they may take to help improve the Linganore watershed and it's water quality. When individuals are fully aware of what preventative technology is available for use, they will likely act and with pre-existing organizations already seeking answers to current problems in the Linganore Watershed, these individuals can strengthen them by following implemented mandates that are assigned according to their current zoning status. Since the developments already in place are out of the hands of developers, it is entirely up to homeowner's associations, homeowners and farmers to choose the best combination of procedures for their specific scenario, which will be entirely reiterated through publicized hearings and notification.

Although, beyond engaging these residents, there must be engagement with those who have decided how these communities are implemented. With each new neighborhood that is built around Lake Linganore specifically, there is a disconnect between county planners and the master plans being provided by developers. In order to ensure that these communities are being properly analyzed for important components such as land contouring that controls the flow of runoff from neighborhoods is crucial to a cohesive master plan for Linganore. It would appear that thus far, each development has been looked at in singularity, when the unrealized consequence is that the watershed is threatened by these developments in totality.

### III. Community Outreach and Engagement

#### **Problem Identification:**

A substantial problem in the Linganore watershed is the community's collective lack of awareness and urgency concerning the condition of their recreational and drinking water. An even greater problem, perhaps, is the lack of truly effective educational tools being utilized to educate the public regarding watershed management. Many agencies pour money into distributing brochures, designing web pages, and posting watershed street signs around the community. These strategies may educate a community to an extent but they do not engage it nor influence it enough to change its attitude toward water resource management. Effective public outreach programs can not only change an individual's water use tendencies, they can cultivate community pride and enjoyment of a clean home watershed.

#### **Recommendations and Solutions:**

##### *Oakdale High School Stormwater Park*

One of the best ways of engaging and educating the public is by building nice things for them. Stormwater Wetlands and Stormwater Parks are becoming a great way for a community's watershed actors to come together on an effective public outreach program. The parks are designed as a series of forebays, bioretention areas, ponds, infiltration trenches, etc. that are all effective in treating stormwater runoff. They include walking paths, benches, and even miniature amphitheaters that can be used by the students, faculty, and parents when they drop by the school. Informational signs are installed throughout the park detailing the watershed's native vegetation and animal species. Lastly markers are installed at the corresponding water surface elevations in the park during 1,5,10,50,and 100 year storm events. The parks provide the community with a more engaging experience related to the protection of their watershed.

Oakdale Elementary, Middle, and High Schools are all located on one campus in Frederick County. They were built recently to accommodate the rapid urban development in the region. The high school's 2012-2013 enrollment was 1,158. The elementary and middle school added another 622 and 621 students to the total campus enrollment, respectively (National Center for Education Statistics).

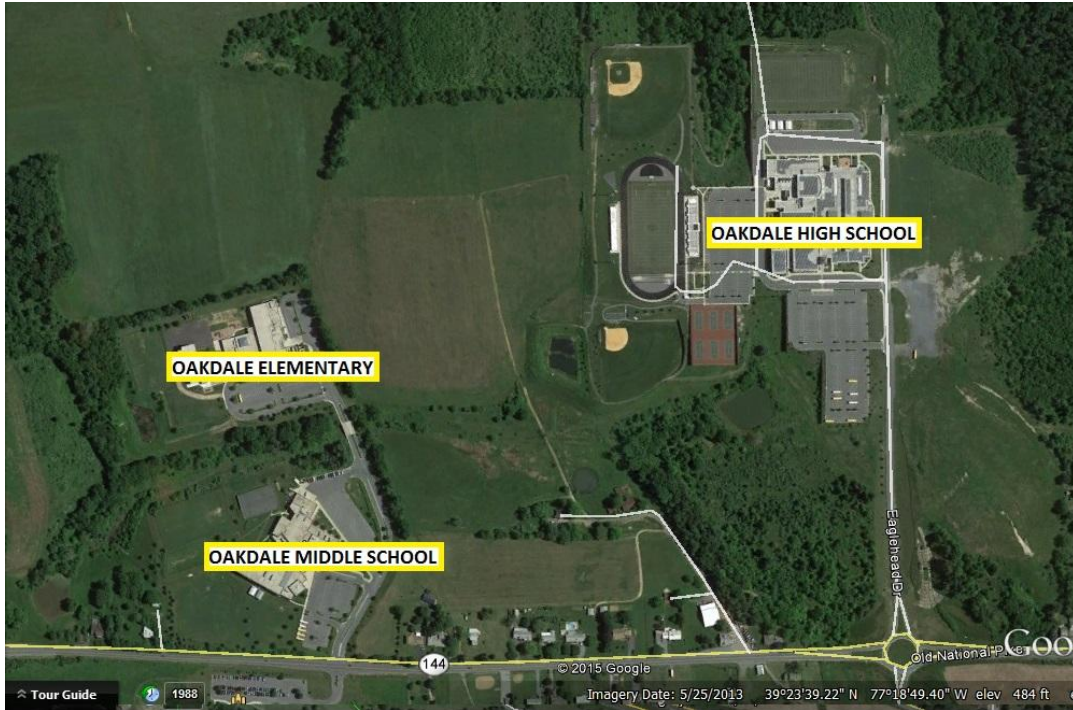


Fig. 3.1 Aerial Image of Oakdale School Campus. Base Map: Google Earth Imagery

The location of the campus provides a unique opportunity for watershed, water quality, and stormwater management public outreach and education. There are over a dozen tributary streams of the Linganore Watershed less than a mile from the Oakdale Campus. One tributary runs directly through the campus. Two wet ponds on campus intercept the stream providing extra storage before draining to Long Branch (a tributary of Linganore Creek). The campus entrance is located off of two Maryland State Highway Administration-owned roadways: MD-144 and I-70. In addition to the campus' several acres of impervious roofs and parking lots, the paved highways are detrimental to the Linganore watershed.

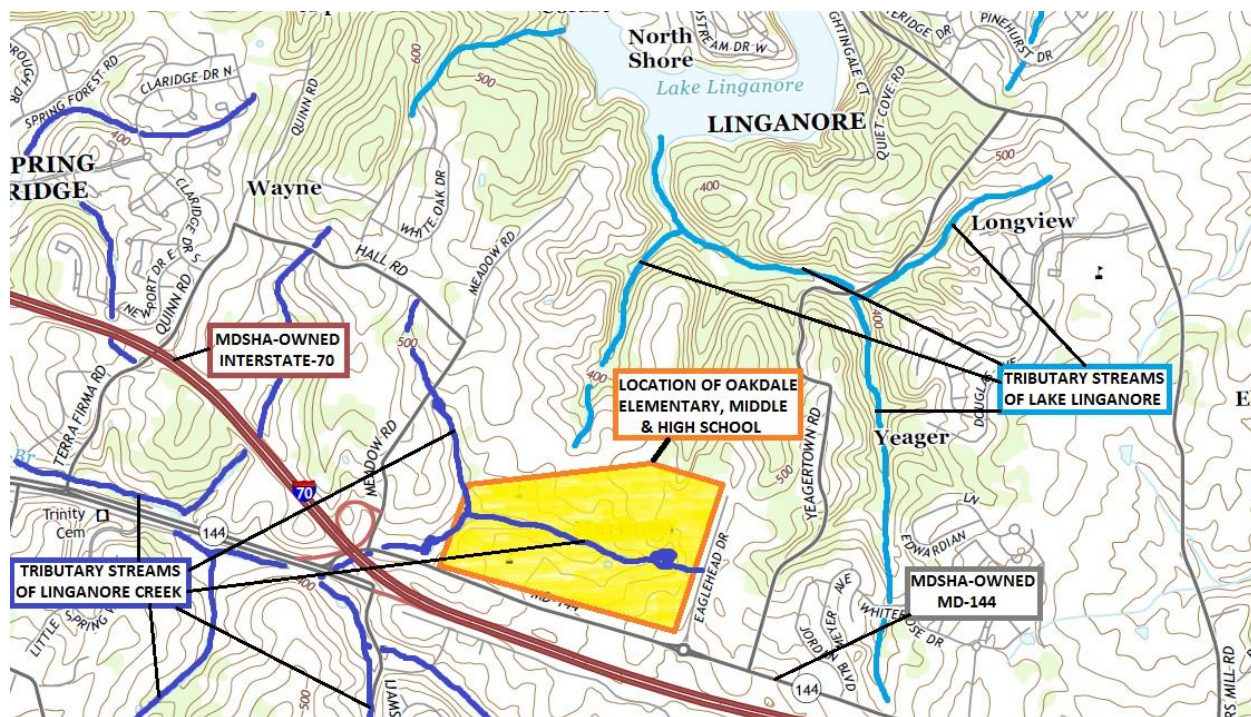


Fig. 3-2 Context Map of Oakdale School Campus. Base Map: USGS Topographic Map, Frederick, 2014.

The Stormwater Park Project will be beneficial to all the actors who get involved. The Maryland SHA and Department of the Environment benefit from the additional runoff treatment provided by the park's many water quality BMP's (helping to avoid EPA audits). The schools benefit from having a diverse ecosystem with which they can supplement their teaching of biology, environmental science, and public policy. Interest groups that lobby for watershed protection will be in the driver seat when deciding what information will be presented on the park's various signs and markers. The public benefits from having a unique new park to enjoy. With nearly 2,500 students coming and going every day, the park will not go unnoticed in the community's households. It will serve as an aesthetically pleasing reminder of the lengths the public will go to restore and protect their home watershed. Every time someone drops off their child or drives past Oakdale on route 70, they will think about the Linganore watershed.

## Conclusion

Historically, the Linganore Watershed has faced unchecked and mismanaged agricultural and development practices that have continued to impair watershed health to this day. As urbanization puts further pressure on the surrounding area it is more necessary than ever for the Linganore community and municipal government to act in the interest of watershed protection and management. Currently, localized flooding causes the deposition of phosphorus and

sediment consistently during summer months. Eroding sides of the creek and lake are increasing the influence of surrounding urban developments and agriculture. Sediment entering watershed is being deposited onto floor of creek and lake, causing decreased total volume of drinking water available. It is important to note that Lake Linganore is the only aquifer in Frederick County and even at full capacity it is still extremely vulnerable to the possibility of drought conditions. Much of the development along the sides of the watershed contains impervious surfaces without any planted areas between impervious surface and the watershed itself, contributing to water quality impairment. Finally, community involvement and awareness at present is insufficient in engaging the public, the agricultural stakeholders, and urban developers, in behavior modifications that could sustain a healthier watershed and community.

As a result, this report recommends that action be taken to address the problem of erosion and sedimentation through a means of infrastructure and maintenance, namely the creation of riparian buffer zones and the construction of forebays and/or dredging of the lake. The problem of urban and agricultural runoff is believed to be best addressed through the allocation of resources toward managing and enforcing current and future agricultural activity and urban development regarding sustainable runoff practices. Finally, effective community engagement is vital for the health of the watershed to be managed by those that most impact it. One recommended solution is to involve the Oakdale High School in the construction of a Stormwater Park. By involving developers, parents and homeowners, and the county's future generation in the development of a sustainable management plan that directly affects their drinking water, the community will gain an active interest in the future management of the Linganore Watershed. These recommendations will continue to serve as a model for future watershed practices and contribute to L.E.A.P's ultimate goal of ensuring that the Linganore Watershed continues to provide quality municipal drinking water for its quickly growing community by restoring the rapidly shrinking capacity of the reservoir and reaching swimmable, class B, water standard by 2040.

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