University of Cincinnati

Date: 3/6/2020

I, Cheyenne Culp, hereby submit this original work as part of the requirements for the degree of Master of Architecture in Architecture.

It is entitled:

Contextualizing the Use of Palimpsest to Reconstruct an Ephemeral Past

Student's name: **Cheyenne Culp**

This work and its defense approved by:

Committee chair: Michael McInturf, M.Arch.

Committee member: Elizabeth Riorden, M.Arch.

UNIVERSITY OF Cincinnati

36605

Contextualizing the Use of Palimpsest to Reconstruct an Ephemeral Past

Contextualizing the Use of Palimpsest to Reconstruct an Ephemeral Past

A thesis submitted to the Graduate School of the University of Cincinnati in partial fulfillment of the requirements for the degree of

Master of Architecture

in the School of Architecture and Interior Design of the College of Design, Architecture, Art, and Planning

by Cheyenne Culp

B.S. in Architectural Studies,
University of Cincinnati
April 2017

Committee Chair: Michael McInturf, M. Arch
Committee Member: Elizabeth Riorden, M. Arch

abstract

Every place has a history, but not every place has a future. What happens to a place once its time has run out is usually always a mystery and this mystery grows when the reason a place loses itself is sparked from tragedy. In certain cases, these places struggle to hold on to what once was, or an attempt to rebuild happens. But in other cases, these “lost” places are overgrown and forgotten, leaving the areas to disappear along with all the memories and stories of those that lived there.

Rather than follow the requirements of the Surface Mining Control and Reclamation Act of 1977, the Abandoned Mine Land (AML) program will be used to better solve the current underlying and possible future issues that the mining causes.

By creating a palimpsest landscape using the future terrain created by surface mining along with aspects of historical pieces of the borough of Centralia, the new overall landscape will be able to play homage to the town, while helping clean up the surrounding areas and waterways, and contributing to Pennsylvania’s growing tourism sectors.

acknowledgments

Thank you to my professors and friends that have been there for me throughout the last few years. This would not have been possible without your wisdom and advice.

There is one person above all to whom I owe all my successes to, my mother. I don’t know where I would be without you. Thank you for your undying love and support.

“Give My Regards to Old Centralia”

content

Fig. 0.1

figures

introduction

Background

Tourism accounts for a considerable amount of income for many states, and Pennsylvania is no different. Agritourism, specifically, is a growing sector that allows visitors to learn about and experience first hand the work that goes in to growing, harvesting, and processing crops and produce. More and more farms are participating in the practice, which leads to more opportunities for tourists to experience various types of educational vacation. This form of tourism will be the main basis of the project along with nature and historical tourisms.

Nature is also a large part of the state of Pennsylvania. With hundreds of nature parks, sites, and trails, people travel to Pennsylvania to get away from the hustle and bustle of every day life. This natural beauty is often taken advantage of, and many builders are starting to remove trees and other vegetation for commercial development.

Problem

Anthracite coal is found only in a few countries around the world. Vietnam and North Korea have a substantial amount, but the largest deposit is located in northeastern Pennsylvania. This deposit has been mined for decades and the materials exported to other countries, mainly China, for use in making steel. A fire seeped into a large mine with almost a dozen veins and covering multiple miles of ground, causing problems for the town above, as well as the surrounding neighborhoods and environment. This fire caused a mandatory evacuation and has left the region nearly abandoned.

The problem at hand is what to do with the vast part of northeast Pennsylvania that was affected by the fire. Much of the mine has been burnt out and there is no knowledge, as of yet, to the extent of the damage, but because of the demand for anthracite, excavating the entire area will most likely commence once there are no longer any residents in was once the borough of Centralia.

Hypothesis

The project seeks to explore the most environmentally cautious approach to reusing the land after mining concludes while playing homage to the town that was created from the mining industry. With this examination, the project will take various steps to achieve a healthier and profitable experience for visitors and residents. Extractions from various precedent studies that have been done around similar conditions in Pennsylvania and other parts of the world will set up a solid foundation to build upon.

origins

One thing has become synonymous with Centralia, Pennsylvania: tragedy. In December of 1908, a massive fire wiped out an entire block on Locust Street, destroying forty-two buildings, and leaving thirty-four families homeless.[1] A rumor was spread that the coal company intentionally set the fire to gain access to the vein below.[2] What they did not know was that this became an omen of the town's ultimate demise.

Fig. 1.1

[1] Deryl B. Johnson *Centralia*
[2] Ibid.

History

Centralia's origins date back to 1770 when colonial settlers surveyed the land while building the Reading Road. The road connected Reading, Pennsylvania to the outpost of Fort Augusta, where present-day Sunbury is along the Susquehanna River. In 1830, former French sea captain Stephen Girard purchased the land from an auction after he heard the area contained anthracite coal and two years later, the first structure was erected on the land, the Bull's Head Tavern, giving the town its first name of Bull's Head.3

Bull's Head was bought by the Locust Mountain Coal and Iron Company in 1841, headed by Alexander Rea, who then changed the town's name to Centreville. Due to another Centerville within the county, he changed the name to Centralia, meaning "center of commerce".[4]

Large-scale mining began in 1854 after the completion of the Mine Run Railroad, and almost overnight, massive amounts of anthracite coal was transported to market. Multiple mining camps popped up surrounding the area allowing for more people to move to the area. The Locust Run Mine and the Coal Ridge Mine opened in 1856 opening up even more jobs and opportunities. Finally, the Hazeldell Colliery opened in 1860, leading the way for Centralia's colliery to open in 1862.[5]

The borough was officially incorporated in 1866.

[3] History of Centralia, PA Before 1962. (2016)
[4] Quigley, Joan. The Day the Earth Caved in: an American Mining Tragedy. New York: 2009
[5] History of Centralia, PA Before 1962. (2016)

Fig. 1.2

After World War I, the coal industry started to decline allowing for the cleaner burning oil to start replacing coal used in heating houses. In 1929, the Lehigh Valley Coal Company closed five of its mines in around Centralia, which lead many miners to “bootleg mine.”[6] They would enter abandoned mines and “pillar rob” (removing coal that supported the roof of the mine). Consequently, the mines would collapse and the ground above would shift.

Mining picked back up in 1941 with the start of World War II, however, it was very short lived. By the early 1960s, nearly all the remaining mining companies closed and people began to look for work elsewhere.

The remaining residents continued their normal lives in the small borough, and that included eradicating their trash the only way they knew how, by burning it. When it was time to burn the landfill in 1962, no one realized the ground below it had shifted from the illegal bootleg mining from previous years, so the fire seeped through the cracks and into the mine below. The extent of the fire went unknown for years.

Fig. 1.3

[6] History of Centralia, PA Before 1962. (2016)

Fig. 1.4

Families started to leave their homes in 1969 from toxic fumes entering their basements. These houses were quickly demolished. Action to begin extinguishing the fire did not start until 1981 after a 12-year old boy fell into a sinkhole in his grandmother’s backyard. Families started selling their homes in fear that they would be in danger, but they received virtually nothing for their property. The rest of the town waited to see if the government they had put all their faith in, would come save them. It only took 2 years for them to vote in favor of the voluntary federal government buy-out program. In 1984, the government started tearing down houses. The buy-out program lasted through 1986, and after that, anyone remaining in Centralia, would not receive anything for his or her property.

The state of Pennsylvania came back in 1992 and ordered the remaining people out, giving them one more chance at the buy-out program. It then issued Eminent Domain and took legal possession of the few final houses. Only eight residents are living in Centralia, and are allowed to live out their lives there, but they no longer own their properties and cannot pass them down or sell.[7] Once the final resident either moves away, or passes, the town of Centralia will no longer exist, and the history of the people and the town will cease to exist.

Fig. 1.5

[7] Erin Blakemore “This Mine Fire Has Been Burning For Over 50 Years.” History.com.

Fig. 1.6

Fig. 1.7

tourism

Fig. 2.1

Pennsylvania's tourism industry accounts for a large portion of the state's annual income. According to the Pennsylvania Department of Community and Economic Development's 2013 study, travelers to the state's economy generated $37.2 billion on average annually. This same study shows that nearly 500,000 jobs are supported by travel and tourism. Three of the top Pennsylvania tourism industries, agritourism, history, and nature, have been studied and found useful for the project.

Agritourism

There are several definitions of agritourism but according to the American Farm Bureau Federation it “refers to an enterprise at a working farm, ranch or agricultural plant conducted for the enjoyment of visitors that generates income for the owner … refers to the act of visiting a working farm or any horticultural or agricultural operation for the purpose of enjoyment, education, or active involvement in the activities of the farm or operation that also adds to the economic viability of the site”.[8] The types of agritourism vary widely, but some examples that are popular in Pennsylvania include: Farmers markets, roadside markets, U-pick operations, corn mazes, pumpkin patches, wineries, and on-farm restaurants and cafes.

Agriculture is the Pennsylvania’s number one industry, generating a $50 billion impact on the state’s economy and provides one of every seven jobs.[9] However, in a 25-year period, the state lost more than 728,000 acres of agricultural land to development.[10] It should be known that agritourism is not meant to replace regular agricultural production, it is merely meant to supplement the farming.

[8] Centre Regional Planning Agency. “PDF.” State College, n.d.
[9] Ibid.
[10] Ibid.

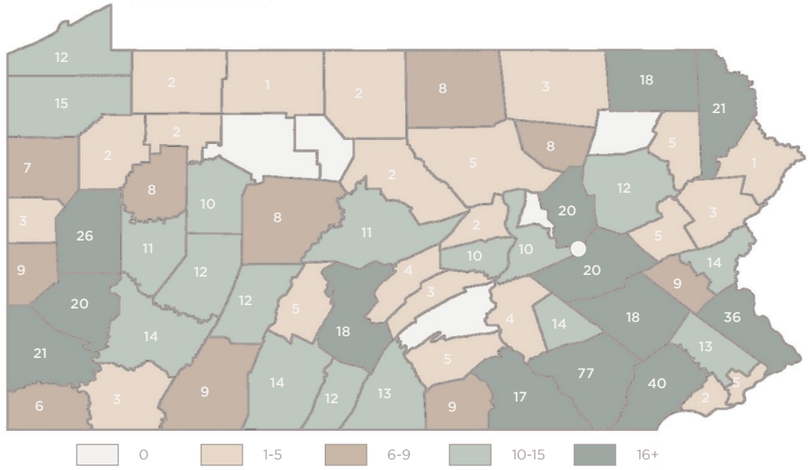


Fig. 2.2

The above map shows the number of farms engaging in agritourism in each county. The south-eastern part of the state has the highest number of participating farms, The white dot represents Centralia which is situated on the border of Columbia and Schuylkill counties, both of which have over a dozen agritouristic farms.

History

Pennsylvania is very proud of its history This is evident in all the museums spread around, primarily in Philadelphia, Harrisburg, and Pittsburgh. There are over 500 larger scale museums in the commonwealth, and more than half are history related. Technology and engineering type of museums were the second most popular, with many of them focusing on the history of the equipment and how it has transformed throughout the years.

The state receives millions of visitors every year that go to these museums to learn about the history of the state, as well as the country. Independence Mall, located in Philadelphia, is home to the Liberty Bell, the National Constitution Center, the Independence Visitor Center, and the President's House Memorial. In 2015 alone, the birthplace of the United States attracted 4.31 million people.[11]

[11] Maddux, Jason. "These Are the 10 Most Popular Pennsylvania Tourist Attractions." pennlive, May 23, 2016.

Nature

Nature plays a large role in Pennsylvania's tourism industry. Whether it is the Poconos, the Pennsylvania Grand Canyon, the Elk Country Visitor Center, or Presque Isle, there is so much to see throughout the entire state. This is why anything nature related remains so high up on the "Things to do in Pennsylvania" lists. Unfortunately, with the rise in development, many parks and forests have been shrinking to make way for new buildings and growing cities.

As much as the construction industry has taken away from natural landscapes, people will continue to desire scenic beauty with breathtaking views and foliage. The state's park systems keep seeing a rise in visitors every year and plan on continuing to see this trend in the coming years. The 121 parks saw a rise of almost 4 million visitors between 2011 and 2016, especially in the Lehigh Valley and surrounding region, which is just forty-five miles east of Centralia.[12]

Two other tourism sectors were looked into as being beneficial to the project. Rural and sustainable tourism, while not very well known, are growing in popularity with each coming year. As society because more urban-based and leans more towards green energy and green building, interest in the opposite living conditions and where green energy stems from is forming a growing tourism market. These markets are outlined on the following page.

[11] Merlin, Michelle. "As State Park Attendance Climbs, Pennsylvania Looking to Prevent Them from Being Loved to Death." mcall.com, September 30, 2017.

Rural

Rural tourism has a different meaning depending on where it is used. In the United States, this kind of tourism is defined as including farm tourism, eco-tourism and other nature-based forms of tourism. In Greg Richards' paper "Creativity and Tourism: The State of the Art", he states that tourists show an increasing interest in being an active part of their holiday experience. They want to have hands on experiences during their vacations instead of just being a bystander.

Culture also plays a part in rural tourism as well, but does not necessarily have a direct relation with agricultural tourism. Pennsylvania's Dutch Country is perfect example of this. When people visit, they want to learn about the culture of the people and their homemade food, not necessarily about how the farming and harvesting happens.

Sustainable

The UN World Tourism Organization defines sustainable tourism as "tourism that takes full account of its current and future economic, social and environmental impacts, addressing the needs of visitors, the industry, the environment and host communities".[13] Eco-tourism, or green tourism, is a subcategory of sustainable tourism and is an "important education and interpretation component, used to raise awareness on the necessity of natural and cultural capital preservation".[14]

Sustainable tourism will most likely because a very popular practice in the near future based on the growing popularity of sustainable buildings and living. Most visitors to state parks and forests are already more conscience of the environment and treat it with respect, but with climate change becoming a pressing topic, the need to treat any and all remaining wildlife with the utmost care will be vital to sustain the ecologies of regions if they are to last for future generations.

These touristic areas have important aspects that the future state of Pennsylvania, and more specifically, the area of Centralia, and how they will be incorporated will be discussed in a later chapter. The impact of what will happen to Centralia in the next half century will determine how these sectors will best fit into the project scope and how they can help change a damaged landscape regain its allure and sense of place in Eastern Pennsylvania.

[13] "Sustainable Development of Tourism." Definition | Sustainable Development of Tourism.
[14] Juganaru, Ion-Danut, Mariana Juganaru, and Andreea Anghel. "PDF." Constanta, n.d.

site changes

The question of what to do with Centralia after the remaining residents leave has been answered a long time ago. The question of what to do after that original answer, though, has not been. While there are invariably numerous options, knowing whether or not they will be the most viable solutions is still a mystery. An attempt to answer the second question will be made using logical and articulated steps, starting with how the process of mining will happen.

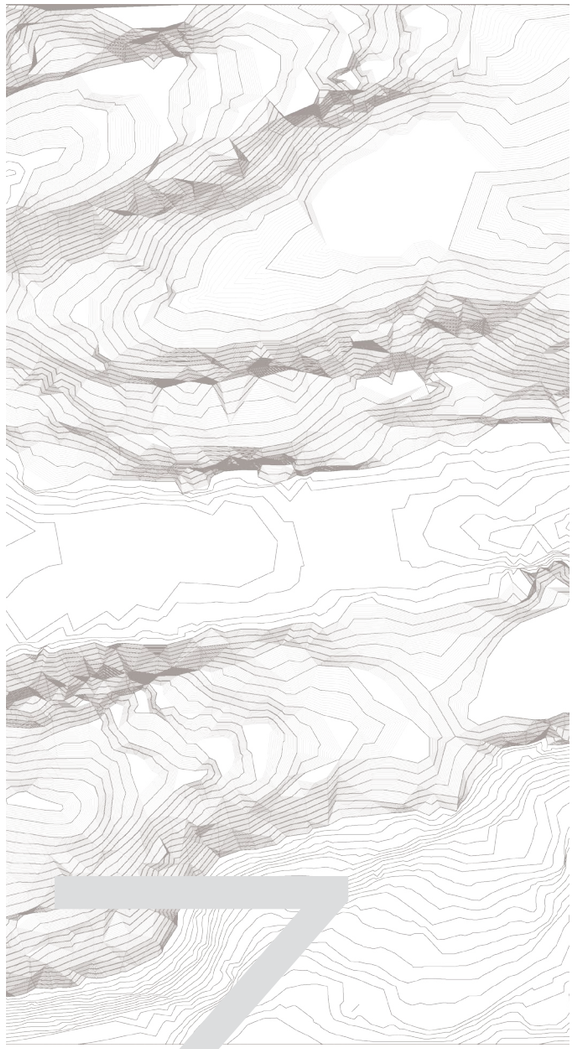


Fig. 3.1

03

Centralia is situated within a hilly region of Eastern Pennsylvania between the Blue Mountain and Susquehanna Lowland sections. This area is known as the Anthracite Upland Section because of its pocket of anthracite coal mines and it is considered a part of the Ridge and Valley Province. Any changes to the Anthracite Upland Section will have a massive impact on the surrounding sections as well because any new water run off will flow in directions other than the current water discharge and this can lead to flooding in lower regions. A look at ways to prevent this issue will be detailed later.

There are two main factors that will influence the site changes, the plans by the government, and the architectural plans that will occur after the implementations of the governmental plans. The potential outcomes of these are defined below and these will become the basis of the future project site.

Governmental Plans

Anthracite coal can only be found in a small number of places, making up about two percent of the entire coal preserves in the United States. This makes it a valuable export to countries that rely on the use of the hard coal for steel making. Almost three-quarters of the world's anthracite coal can be found under and around the borough of Centralia, making it a vital area for the rare material.[15] This makes the attempt to recover any salvageable coal necessary. The mine directly underneath Centralia reaches depths of almost six hundred feet, half a mile wide in some places, and over a mile in length, but some of the deeper veins spread under multiple miles of ground. The exact extent of the fire's damage is still uncharted, but there has been much research as to the spread of the fire since it's ignition. Tests using boreholes, thermal infrared imagery, direct observations, false color imagery and aerial photographs have been used.[16] Mining the entire range of the mine will be the only way to determine the degree of damage done.

[15] Gill, M. (2019, November 15). This Town Set Itself on Fire in 1962 and It's Still Burning 57 Years Later.
[16] Elick, Jennifer M. "Mapping the Coal Fire at Centralia, Pa Using Thermal Infrared Imagery." International Journal of Coal Geology. Elsevier, July 21, 2011.

There are multiple ways that mining can be carried out, however, each has their own benefits and drawbacks. This can affect the possible uses of the ground after the mining operation has concluded. Without completely knowing which method will be used, research on the contour mining, area strip mining, and open-pit mining approaches will be evaluated and one will be chosen based on the ability of site usage once mining ceases.

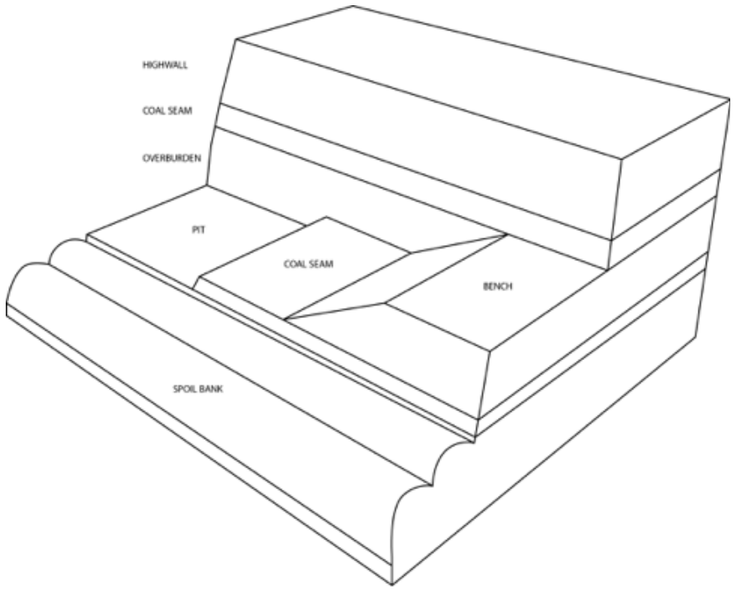


Fig. 3.2

Contour Mining

This type of mining occurs primarily in the Eastern United States, mainly in the Appalachian areas. The steep terrain and heavily wooded areas make it difficult for the use of other mining techniques.[17] The contour, or bench method starts with an initial cut into a hillside where an outcrop of coal occurs, then continues along the contour of the hillside. The overburden is removed and what is left are flat slops known as benches, or shelves. Once the reachable coal is removed, Augers are used to bore holes into the outcrop of the seam to extract the coal that is not visible from the face of the cut. Once this has been done, the holes are filled and the benches are reclaimed in accordance to state and local laws.[18]

This approach is used when it is not feasible to extract the entire seam.[19] It can be used in more than one location on the same mountain because of the ability the linearity of the progress. Instead of creating a large crater like in pit mining (noted later) the work site can be smaller in scale, which can allow for more sites to be mined simultaneously.

Contour mining creates a linear configuration in the landscape and is highly criticized for the environmental destruction.[20] Any type of application built upon a contour mined area would also have to be linear in some form to prevent erosion and further damage to the site.

[17] Burley, J. B. (2001). Environmental Design for Reclaiming Surface Mines. 223.
[18] “Contour Mining.” Coal Surface Mining, Contour Mining. Mine-engineer.com, 2018.
[19] Ibid.
[20] Burley, J. B. (2001). Environmental Design for Reclaiming Surface Mines. 223.

Area Strip Mining

Strip mining happens over large areas of land, typically in the northern Great Plains and other flat terrain with shallow overburdens and thick seams.[21] This approach starts with a box cut, or trench. The overburden is then moved to the side until the mining process is almost completely finished. The deep cuts are made parallel to each other with the soil from the new cut placed onto the previous box cut, basically replacing the missing earth.

Strip mining leaves the site in a more favorable condition than other techniques because it replaces the removed dirt as the project continues along. Other mining practices either do not replace the dirt, or fills it in at the very end of the process, which leads to unnatural landscapes.

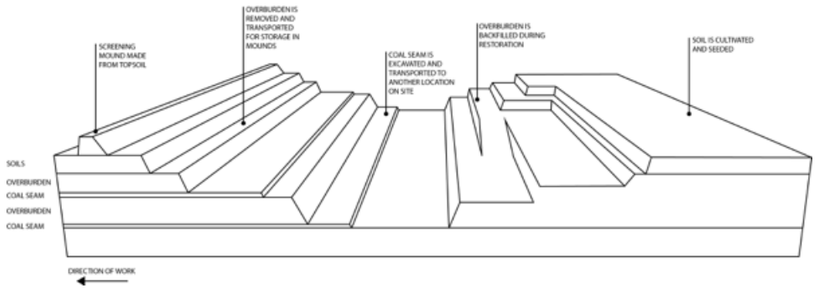


Fig. 3.3

[21] Burley, J. B. (2001). Environmental Design for Reclaiming Surface Mines. 223.

Open Pit Mining

Open pit mining, also known as opencast or open-cut, is almost the total opposite of contour mining in configuration. This is used when coal seams are extremely thick (between 50-100 feet). These mines are simply benches arranged in a spiral form with connecting ramps. The benches ranges in widths with safety and equipment the determining factors of the width used in each mine and the length of the bench as well as the working slopes are determined mostly by the type of rock formations in the area.[22]

Open pit mining has limitations when it comes to how far down the operation can go. The pit is started along an outcrop and continues downward, usually in a spiral formation. This works until the thickness of the overburden above prevents and further economic exploitation.[23] The benefit of open pit mining is that it usually produces much more coal than other operations but only because of its massive scale.

Other forms of mining are more efficient and easier to reclaim. Open pit mines can be overwhelming in scale not only in depth, but width, length, and even height. The non-ore material that is removed from the pit is piled around the edges of the mine which then creates a large ridge surrounding the crater, making it just that much deeper.

[22] Burley, J. B. (2001). Environmental Design for Reclaiming Surface Mines. 225.
[23] RPMGlobal. “PDF,” 2019.

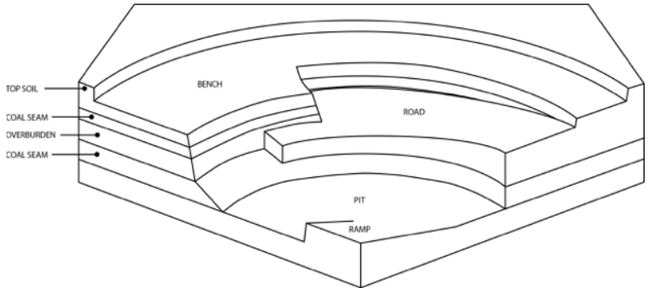


Fig. 3.4

In 1977, Congress passed the Surface Mining Control and Reclamation Act that states all mining that occurs after 1977 must adhere to the mandated post-mining environmental cleanup and reclamation standards. There were already a large number of mines that were abandoned before 1977, however, so the SMCRA created the Abandoned Mine Lands fund. This fund helps pay for the reclamation of the sites dotting Appalachia.[24]

[24] Fennell, Anne-Marie. COAL MINE RECLAMATION Federal and State Agencies Face Challenges in Managing Billions in Financial Assurances, (2018).

The Abandoned Mine Lands Pilot Program, started in 2016 by Congress, allocated nearly $30 million to show what could be accomplished with these mines on a larger scale rather than just apportioning some money for each abandoned mine. This new program has some issues though, including not needing community input, not requiring any environmental remediation, and states and governments using the money for unrelated projects.[25] The upside of the program is that states and local governments now have a greater ability to create more beneficial and useful landscapes and areas that may have been wasted under the Surface Mining Control and Reclamation Act. As long as the funds are to be used “for the reclamation of abandoned mine lands in conjunction with economic and community development and reuse goals”, the state can develop areas in any way they see fit.[26] Pennsylvania submitted fourteen project areas to the pilot program. These projects ranged from an underground mine fire to coal refuse piles to mine drainage treatment. Some of these projects will be used as precedents later.

[25] Report on Abandoned Mine Land Reclamation Economic Development Pilot Program (Aml Pilot Program) for Fy 2016 – Fy 2017. (2017).
[26] Ibid.

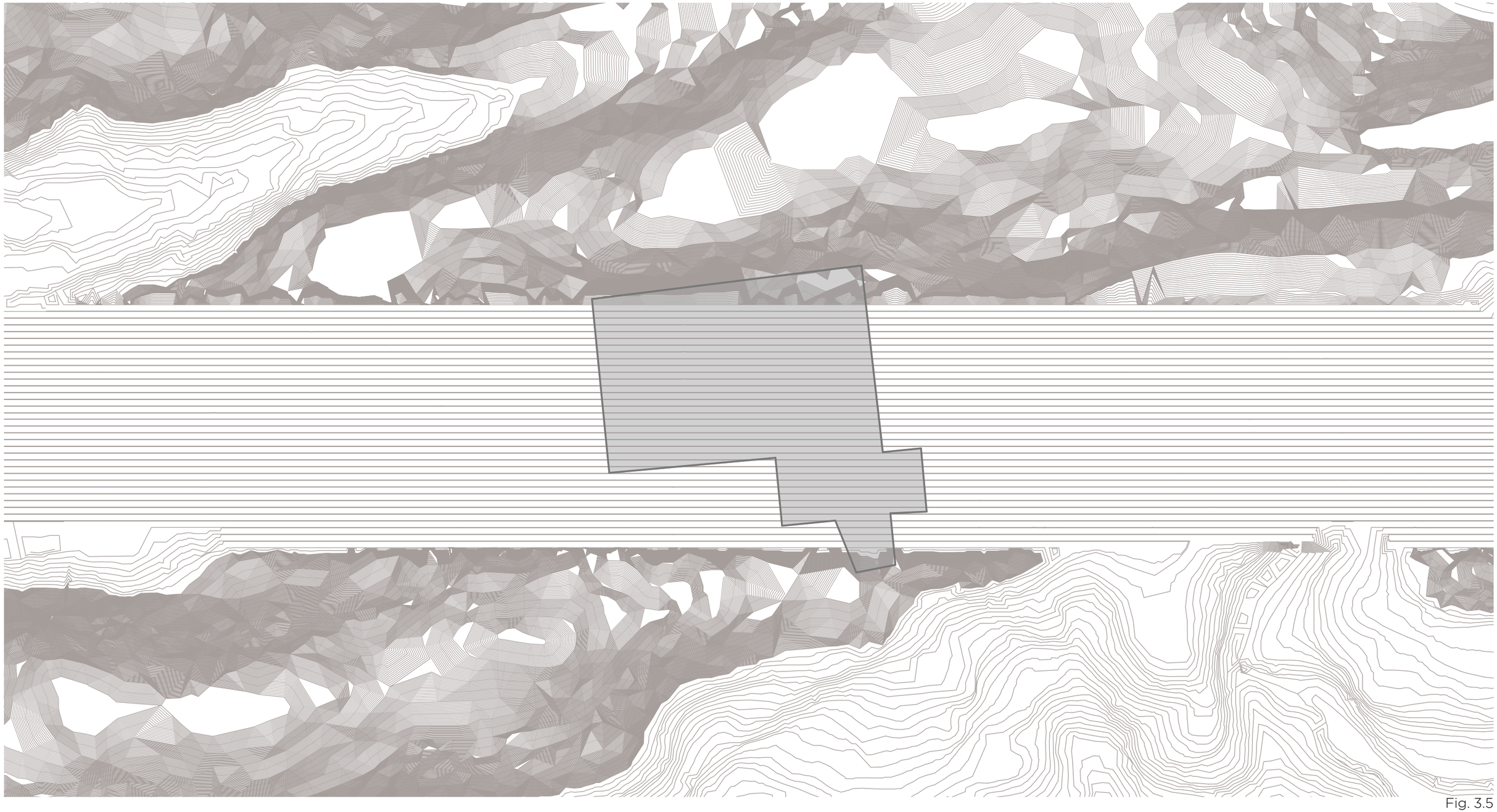


Fig. 3.5

Architectural Plans

Centralia originally started as a settlement along the Reading Road (now known as Route 61), the connecting road from Reading to Fort Augusta (present-day Sunbury). Nearly a hundred years later the Lehigh and Mahanoy Railroad branched off from the Lehigh Valley Railroad to connect Centralia to the coal transportation system. This history of connection continues today with Routes 42 and 61 intersecting in the middle of the borough serving as main passage north-south and east-west from the neighboring towns. Keeping this connection is vital to the populations of these areas as they are direct paths of commute as a consequence of lack of highway system through this region. One goal is to maintain the significant transportation routes through the territory while also allowing for the possible development of growth opportunities.

The landscape also plays a considerable role in the physical and emotional connections since the underground coal mine was what allowed people to settle and work in the mid-1800s. Creating a sort of man-made palimpsest landscape can help overlay the new, terraced landscape with one from the past. Historical and important pieces from the past and present conditions will combine to make eye-catching and educational statements throughout the terrain, which will help visitors see and learn about what was once there. This concept of palimpsest will be examined further in chapter 6: design process.

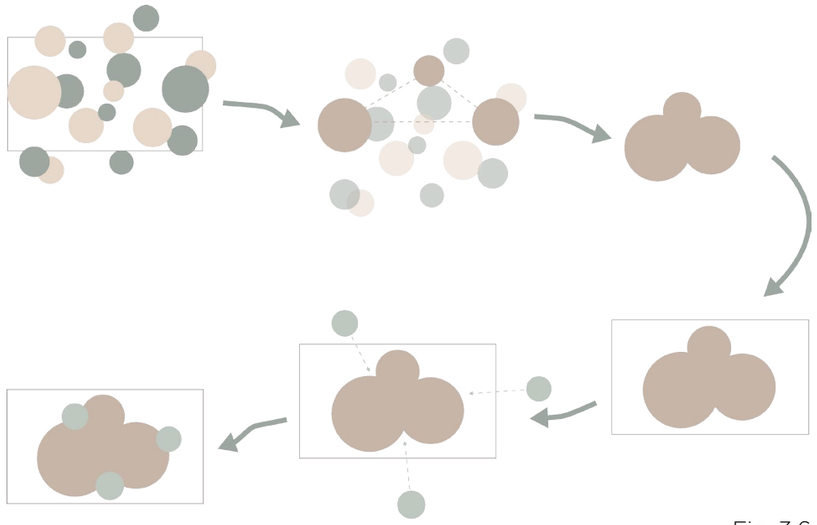


Fig. 3.6

agriculture

Pennsylvania has a rather large agriculture industry, resulting in twelve major crops. A comparison of the crops to see which ones would be suitable for the steep, mined terrain and are represented in the graphs on the following pages. These graphs represent how well the selected crops grow on steep slopes (figure 4.2) and in poor soil qualities (figure 4.3). Soil quality is probably more important than the slope because mining results in stripping the earth of its nutrients and mixes rocky soils within any remaining topsoil.

Fig. 4.1

04

As shown figure 4.2 on the next page, more vine-like crops tend to do better on steeper slopes than crops that are planted in rows and need to be cultivated. Crops that stay close to the ground and tend to “creep” along the surface do not do as well because they create unstable soil conditions, which lead to erosions.

Soil quality is extremely important in determining which crop would produce the most harvest. Many plants require perfect soil conditions and careful management to get the ideal output. Some, however, are more lenient on soil quality, and some even flourish in poor dirt. The soil above the Centralia mine, which covers Columbia, Schuylkill, and Northumberland counties, is all sandstone, conglomerate (see figure 4.4). Sandstone and other sandy soils dry out quickly, making for easier cultivation. The problem with these kinds of soils is that they hold fewer nutrients and can be easily washed away during rainstorms.

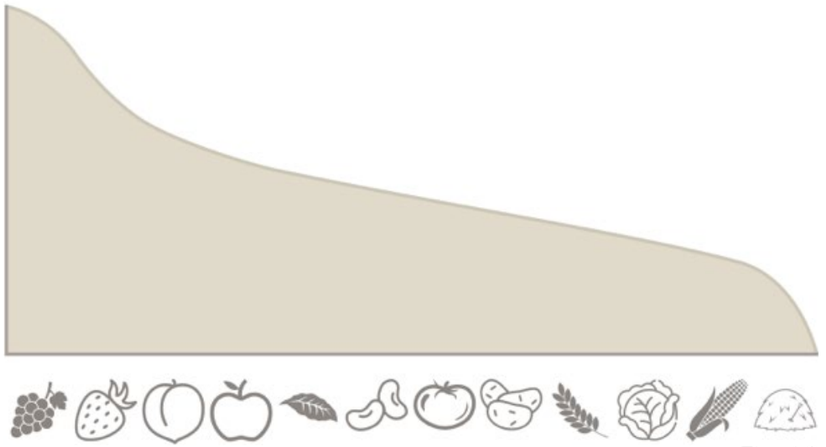


Fig. 4.2

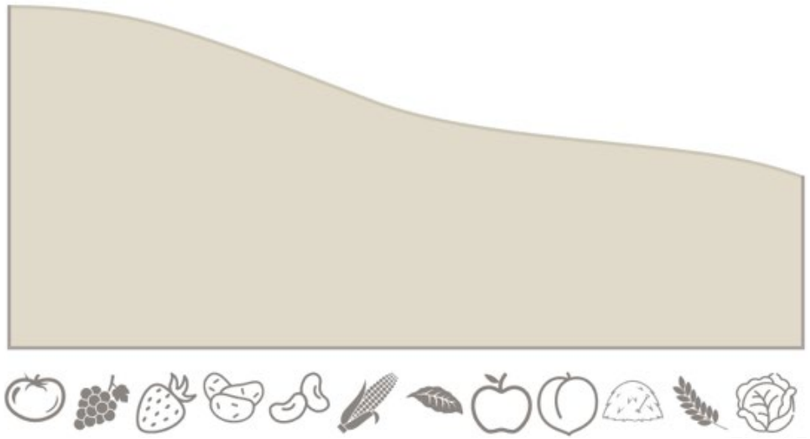


Fig. 4.3

Based on the two graphs on the previous page, grapes and strawberries were the only crop types to be in the top three. The two fruits have varying harvest times which will prevent any lull times during production. Using both crops will also give more variety to the options available to consumers and allow for more diversity that will be incorporated into the palimpsest landscape. Grapes, however, will be the primary focus moving forward for the ease of understanding and implementation.

According to Peter Mead in his 1867 original An Elementary Treatise on American Grape Culture and Wine Making, being particular on selecting the proper location for planting a vineyard is not necessary, as wild vines grow almost everywhere. He continues, however, to say that vines grown in wet places produce ill-flavored, thick skinned, tough and acrid grapes, but the same vine planted in dry soil has vastly different characteristics. That is to say that using a location that is naturally dry is most appropriate. Hillsides are always favorable spots because of their inability to hold water for very long.

Mead progresses on to say “the location must not only be dry, but the grade must be such that no surface water can remain on it at any season of the year. Surface water, especially in the winter, is a prevalent cause of the winter-killing of vines.” Because of Pennsylvania’s northerly location, the winter season may cause some issues with the harvest, especially if it gets too cold too soon. In order for the grapes to survive, primarily in their fragile youth, work must be done to ensure frost and cold weather does not harm them.

Exposure is an often-debated topic in grape growing, but most would agree that some form of southern-facing slope is the most ideal. The sun is able to hit the vines for much of the day without any shadows casting over the plot of land. The argument occurs over whether a southeastern facing slope is better than a south or southwestern facing slope. For the sake of this project, and the primarily straight hillside created from mining, this argument does not apply.

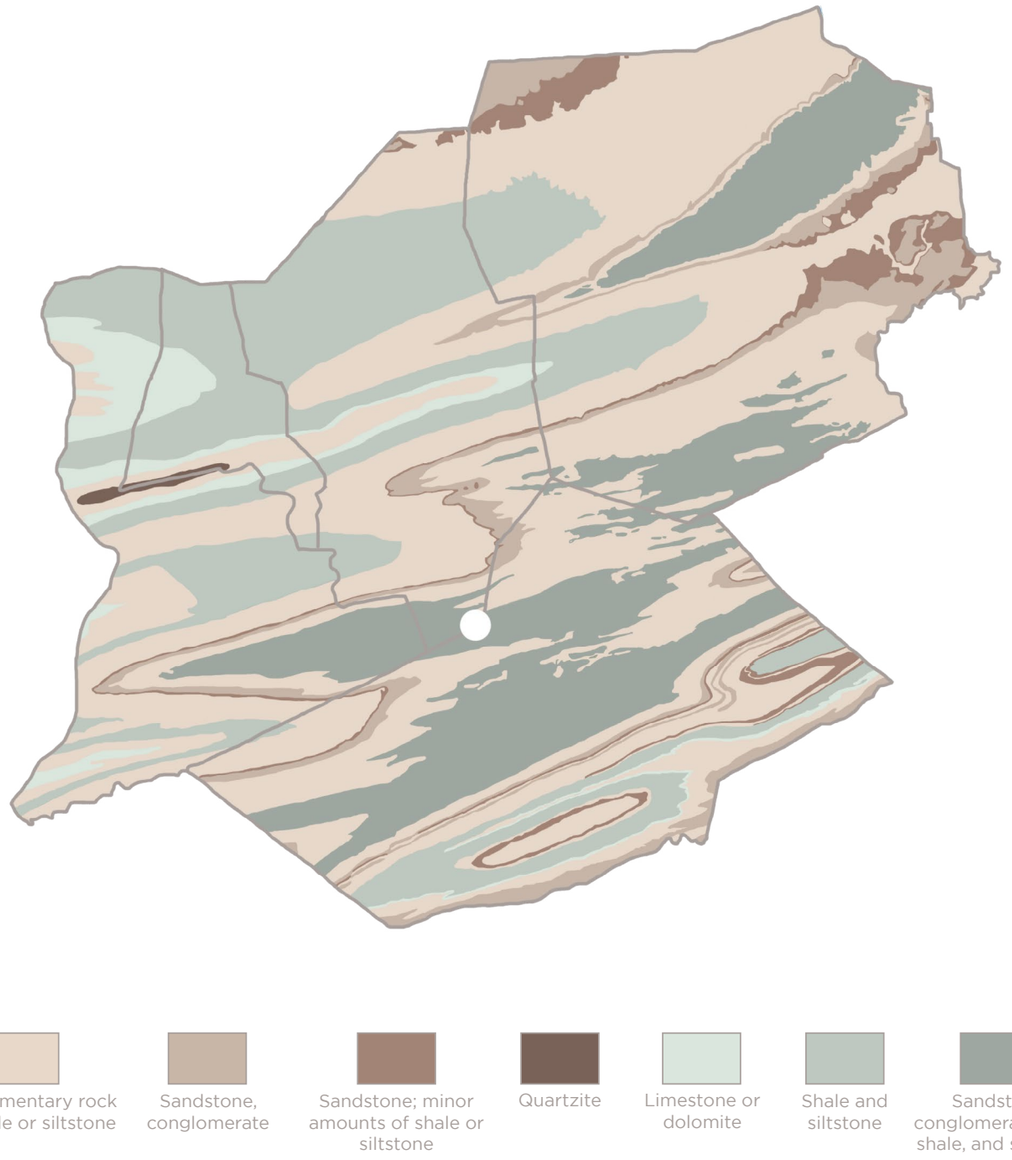


Fig. 4.4

The next step is assessing the grape types, as well as the varietals within each type that will be used. The grape family is split into two categories: table and wine. Even though they both fall under the category of “grape”, table and wine grapes contrast vastly. Table grapes are those that are used for eating fresh and come from the Vitis Labrusca and Vitis Rotundifolia species, while wine grapes are used for making wine and come from the Vitis Vinifera species.

To start, table grapes are not as sweet as their fellow family members as they are picked at around 15-18 percent sugar so as to not be too sweet to consume.[27] They are also grown on trellises that allow for more bunches to hang without overcrowding and to allow the vines to stand under heavier loads, since the actually size of each grape is much larger. This type of grape also is seedless, or has extremely small seeds, and has much thinner skin, which can be considered a luxury for the consumer. These types of grapes can be used to make wine, but they always tend to produce a very unremarkable vintage.

[27] Muñoz-Robredo, Pablo, et al. “PDF.” Santiago, 2011.

Grapes used for wine-making, on the other hand, are almost the complete opposite of table grapes. They are picked when their sugar content reaches closer to 22-30 percent, making them more susceptible to deterioration faster than table grapes.[28] Wine grape vines produce a very small yield of grapes compared to Vitis Labrusca. Their small yields mimic their small stature as well, but the fruit has a surprisingly thick skin, notably the red grapes. This is to hold in the tannins that play a large part in many wines.

Pennsylvania has a hardy grape variety record with more than two-dozen varieties. Not all of them will be useful because they grow in regions of the state that have varying growing conditions. Nevertheless, looking at just three current wineries, all less than thirty miles from the site, twenty-one varieties are planted. Within these varieties, the most popular are Riesling, Chardonnay, Gewurztraminer, Merlot, Zinfandel, Niagara and Cayuga.

[28] Teeter, Adam. “The Difference Between Wine Grapes And Table Grapes.” VinePair, June 12, 2019.

Even though some grapes have adapted to colder climates, sun exposure is still vital to producing perfect sugar levels. This cannot be achieved on north facing slopes, which is what covers half the mine. This side of the slope would best be used for other crops that do not need as much sunlight.

Based on the slope graph on page 36, strawberries, peaches, and apples are the next three crops that would grow well on slopes. Planting these on the northern slope will allow for visual variation rather than just a sea of grape vines. The fruit can also be used to make specialty wines for unique occasions or experimentation.

Biodynamic farming is the final part of the vineyard considered, even though it would technically be implemented first. According to the Biodynamic Assoiciation, biodynamics “is a holistic, ecological, and ethical approach to farming, gardening, food, and nutrition”.[29] The farm is considered a living organism as a whole. It is made up of assorted elements like plants, animals, soils, compost, and people. The farms use natural ecosystems as inspiration to create landscapes that are unique to each place. Animals can have a special relationship to the land and provide a particular quality of manure that has its own effects on the plants.

Natural ecosystems include both plants and animals, which work together to fill complementary roles in the web of life.[30] Plants grow and flourish better with the addition of animals and animals benefit from being around plants and crops. Separating the two creates an imbalance of soil nutrients, from only growing plants, and pollution from excess manure, from only raising animals. Biodynamic farming use both simultaneously in order to achieve balance.

The process starts with stuffing cow horns with manure and buried underground for six months in the winter. The horn silica increases plant immunity, strengthens photosynthesis, and enhances ripening.[31] The horns are then dug up and the manure spread around the plants, being used as a fertilizer. From there, animals can continue to naturally fertilize the land, or the cow horn process can be repeated.

[29] Biodynamic Principles and Practices | Biodynamic Association.
[30] Ibid.
[31] Ibid.


Fig. 4.5


Fig. 4.6


Fig. 4.7


Fig. 4.8

wineries

Fig. 5.1

Centralia is right on the border of what is considered the North Central and South East wine regions, but sits just within the South East region. The area is home to many wineries, which is shown in Figure 5.3 on page 59, and includes five wine trails, but there is a gap exactly where the site is located. By placing a new winery here, it helps fill in the gap, and allows for a shorter travel distance for wine tourists traveling in the northwestern section of the region.

05

Wineries are designed around the wine-making process. There is a particular sequence that the grapes must go through in order to achieve the end result. The first step in the wine-making technique is the harvesting of the grapes. Many vineyards are picked by mechanical equipment but there are still a number that are handpicked, and some utilize both methods. Depending on the site conditions of the vineyard including the slope, size, and climate, it may be more beneficial to choose one picking approach over the other. There are advantages and drawbacks to each, so it is up to the owner to determine what he or she thinks is best for their wine.

The vineyard industry saw a major growth in the development of mechanical harvesting in the early to mid-1960s.[32] The equipment uses either pivotal strikers or trunk shakers to remove the grapes from the vine. The pivotal strikers use flexible rods that hit the canopy and shake the fruit loose while the trunk shakers, on the other hand, use rails that move back and forth over the upper trunk to shake the plant.[33] The use of mechanical harvesting can reduce labor costs, sometimes up to 75%.

[32] Grapes. "Introduction to Mechanical Harvesting of Wine Grapes." Grapes, June 20, 2019.
[33] Ibid.

The downside to using this kind of equipment is that it can remove more than just the fruit. Most times, stems, leaves, bugs, and rotting grapes are picked up and thrown in with the ideal grapes. Sometimes the equipment is too harsh on the fruit, notably grapes with thinner skins. This damage can lead to oxidation and bacterial growth, which can hurt the end result.

Handpicking in some cases may be more useful to the owner when they are attempting to establish their flagship wine (the wine that is either the most popular or the most awarded for that winery). It also may help if the winery tends to produce more late-harvest and noble rot dessert wines, since the grapes must be botrytized. This would possibly require multiple passes through the vineyard over a span of a couple weeks picking certain bunches over others. Handpicking also allows the owner to be selective and pick the absolute best from the season's yield.

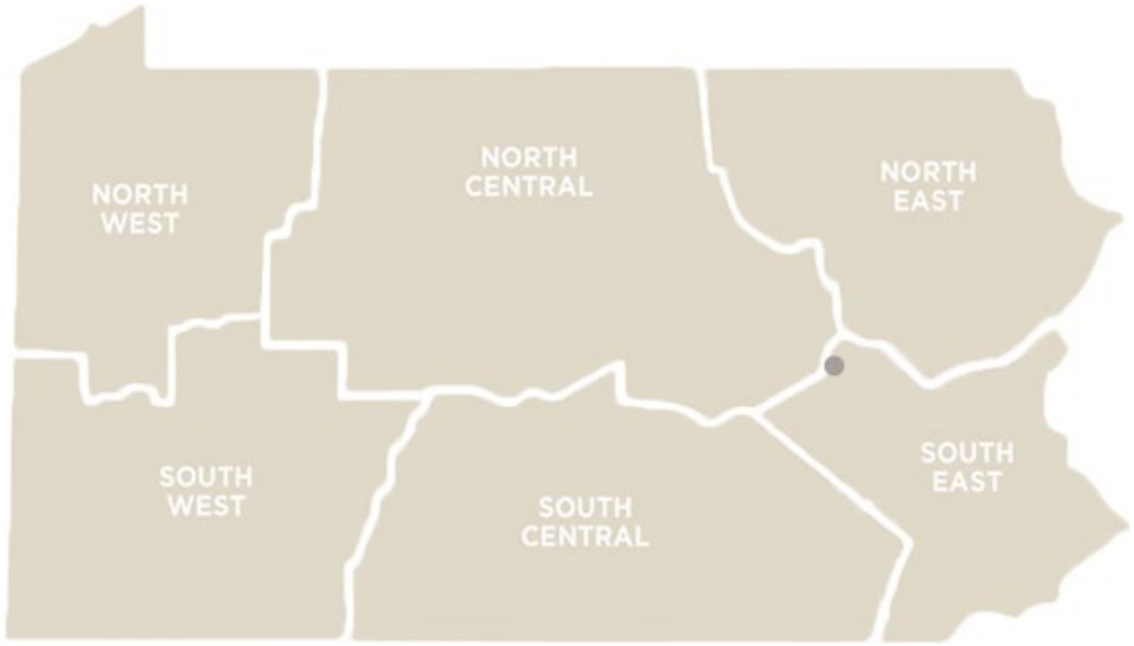

NORTH WEST
NORTH CENTRAL
NORTH EAST
SOUTH WEST
SOUTH CENTRAL
SOUTH EAST

Fig. 5.2

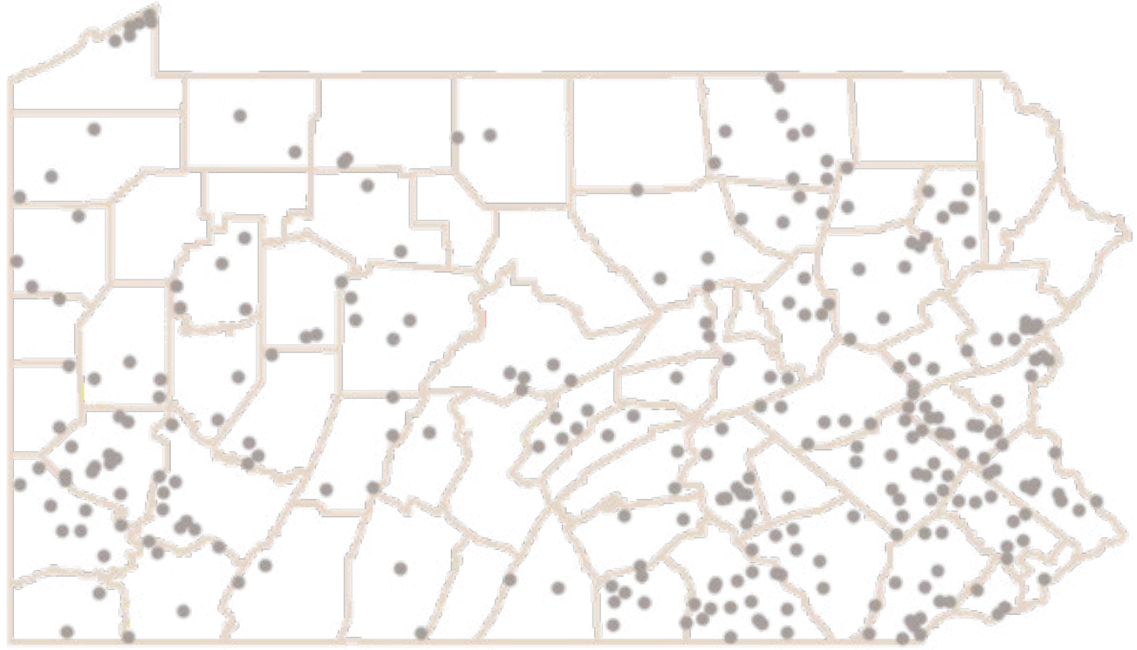


Fig. 5.3

While handpicking has more beneficial aspects than stated above, it also has just as many detriments. The first being that it is much more labor intensive. Not just anyone can go out and pick the grapes. It requires training, and this training is becoming more of a problem as experienced seasonal workers are quickly disappearing.[34] A speculation of why this can be has been traced to the United States' stricter immigration policies. Another downfall to handpicking is that is takes much longer. A mechanical harvester can cover about an acre of land in under an hour on average, while it can take humans over five hours per acre.[35] Depending on the size of the vineyard, this can be a big issue.

Once the grapes are harvested, they begin their production to become wine. Two processes are typically used to accomplish this task, pumped and gravitational. Pumped processing requires the use of pumps to move wine from one production step to the next. Gravitational processing uses gravity to help the wine flow, usually from level to level, throughout the production.

[34] Fink, Jameson. "Are Hand-Picked Grapes Better Than Machine-Harvested?" Wine Enthusiast Magazine, April 1, 2019.
[35] Ibid.

Pumped Wineries

This type of winery is the most popular because it allows the winery to transfer the liquid faster and more efficiently and since many wineries are built on flat land, the most sensible. The use of pumps and conveyors helps move the product wherever it needs to go, even if it is against the pull of gravity. In reality, this means that there does not need to be any logical order or level of the equipment in the system because the pressure is enough to push the wine anywhere. This does require quite a bit of power to do, however.

Gravitational Wineries

Unlike the pumped process, the gravitational winery uses gravity to its advantage. As long as there is enough vertical distance to allow for the proper pressure, see figure 5.5 on the next page. The layout of the building must be taken into account, as the production line has to be tiered. Hillside wineries can take advantage of these tiers. The process is also much more gentle on the grapes, preventing any bruising and oxidation, and helping negate astringent wine.

Gravitational wineries are comprised of a minimum of four tiers, with bottle and shipment being the final level. The grapes are brought to the topmost area and gently make their way down the building, working their way through the various stages of crushing and destemming, fermentation, storing, and then bottling. Figure 5.6 shows these various steps in the order they need to be in the process. The technique uses very little power, if any, and is regarded somewhat of a "dream winery" by gravity flow wine makers.

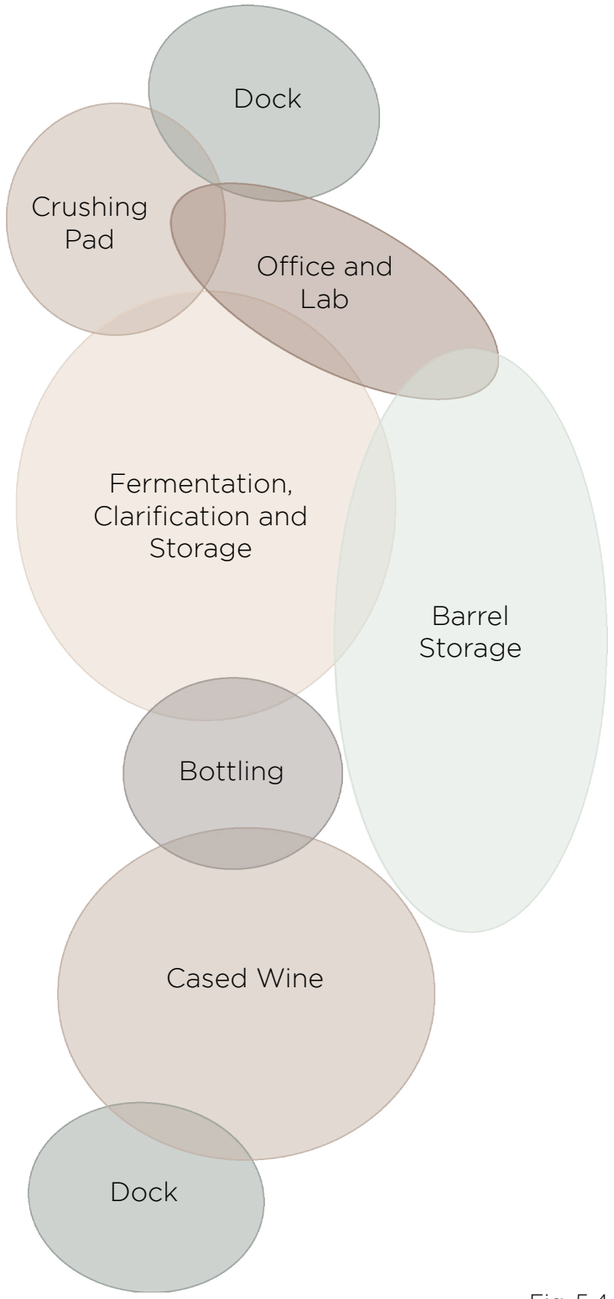


Fig. 5.4

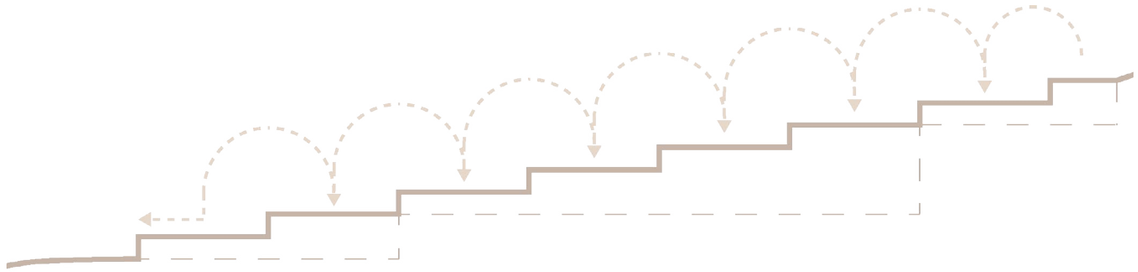


Fig. 5.5

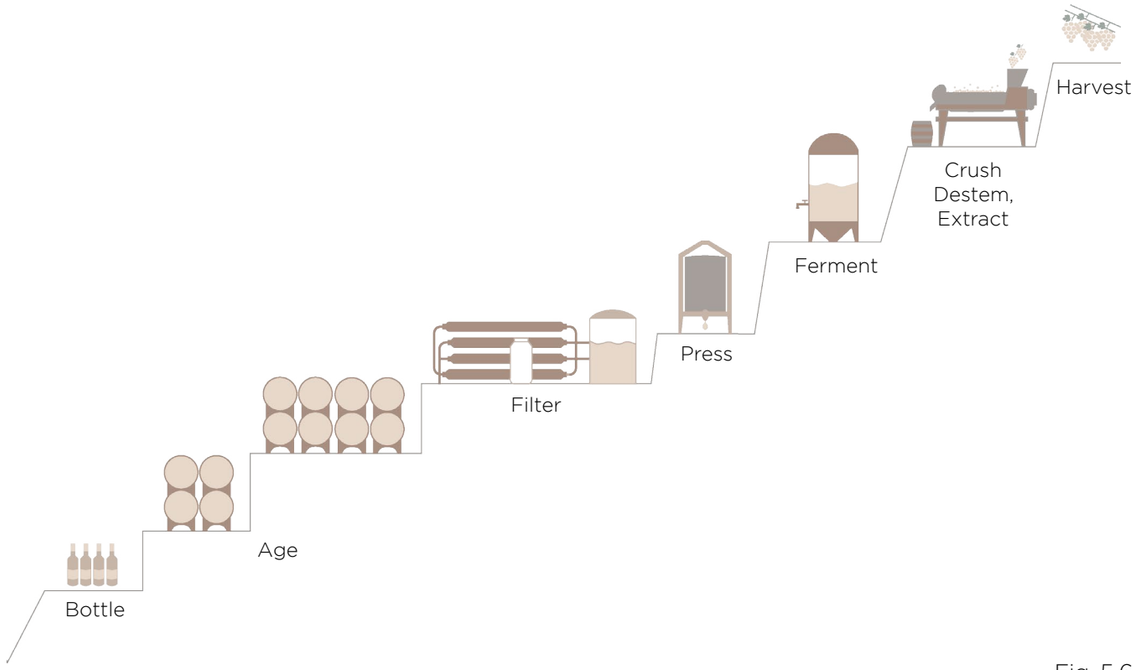


Fig. 5.6

design approach

Four segments of design have been looked at to be incorporated into the overall project. These segments include the site, the program, connection, and palimpsest. Each one will be broken down into how they are useful to the project design on the following pages, but their main importance is that they work cohesively to establish a practicable solution to combating the harmful effects of mining.

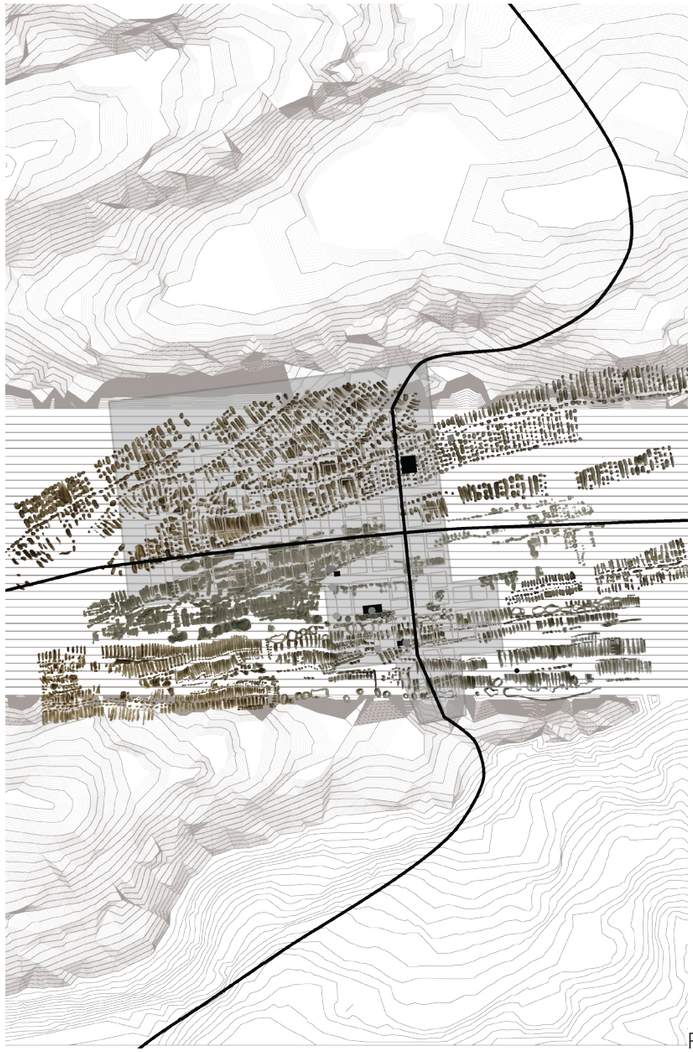


Fig. 6.1

06

Site

After looking at the mining methods, contour mining seems to be the one that makes the most sense. The mine is fairly straight and fits almost perfectly within the ridges of the hills, so the dig would result in a long and linear trench. Creating a trench, especially in an undulating landscape, will cause issues with erosion and polluted water run off. The discharge then enters small rivers and tributaries that lead to the Susquehanna River, causing large-scale pollution problems. Because of Pennsylvania's abundance of abandoned mines, water pollution and poor water quality is a major dilemma.

According to the U.S. Government Accountability Office's Coal Mine Reclamation report, "an operator must reclaim the land to a use it was capable of supporting before mining or to an alternative post-mining land use that OSMRE or the state regulatory authority deems higher or better than the premining land use." In its current state, there is nothing in, or around, Centralia aside from some roads, cemeteries, a few houses, and a wind farm. Everything else is untouched so reclaiming the land to its original condition would not fix the water run off concerns.

Like many mined locations, water pollution is a result of the high iron and sulfates in the ground dug. In the case of the Centralia Mine runoff, a water quality report was conducted in 1991. At the time, the pH in the surface water tested was 3.4.[36] The normal range for surface water is between 6.5 and 8.5.[37] The report also showed iron to be at 6.8 mg/L. The United States Environmental Protection Agency set a maximum contaminant level of 300 µg/L for iron in streams and rivers.[38] These high iron levels mean everywhere the water flows has been covered in rust, further damaging wildlife and the environment. Preventing most of the water from leaving the site will help contain the amount of iron abundance and not allow it to continue to spread throughout the region, polluting tributaries and rivers. Evaporation and reuse of surface water for irrigation can help alleviate the high iron levels that are harmful to aquatic life.

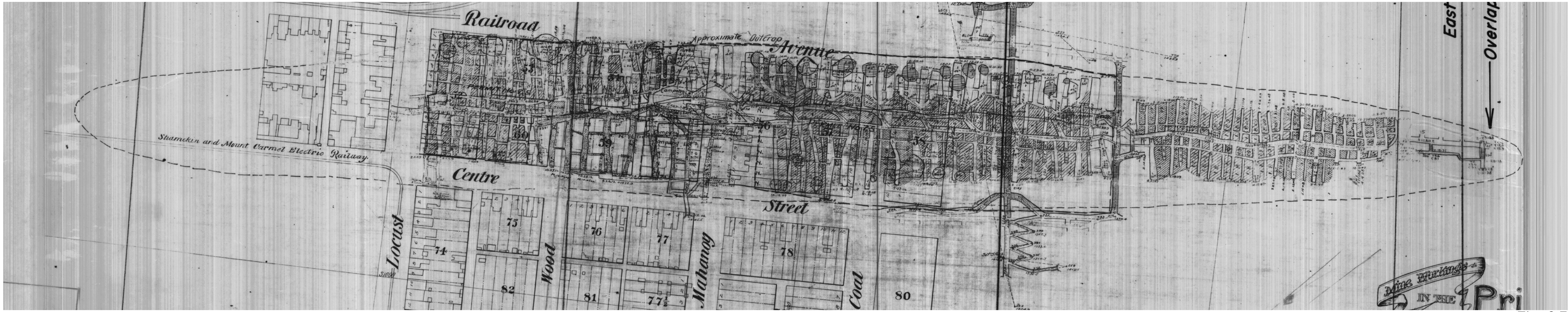
Fig. 6.2

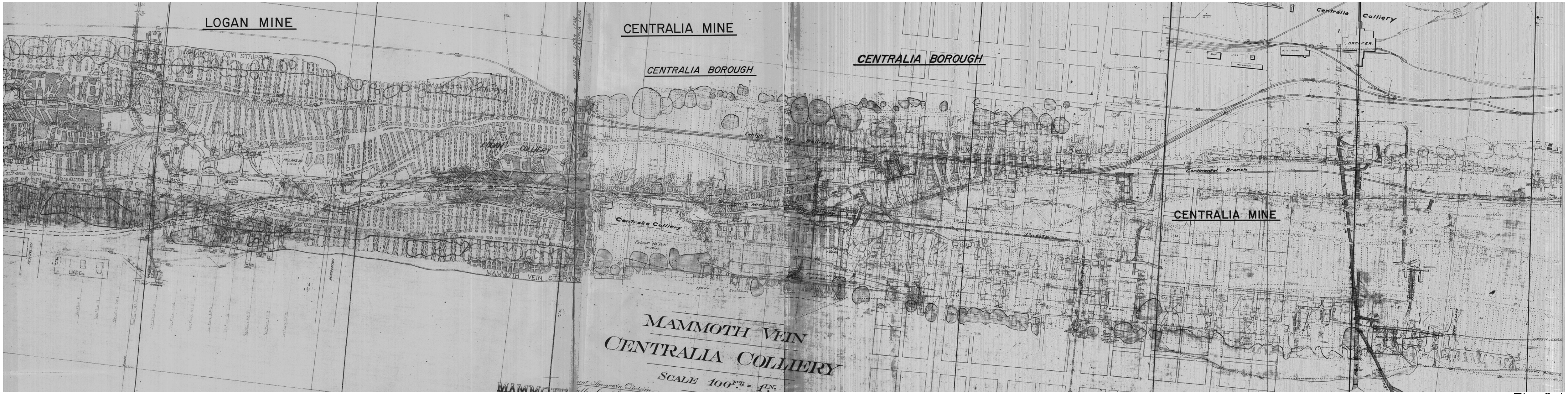
[36] Wood, Charles R. Water Quality of Large Discharges from Mines in the Anthracite Region of Eastern Pennsylvania. 1996
[37] Oram, Brian. "The PH of Water." Water Research Center - pH.
[38] Anderson et al. "NAWQA - Water Quality in the Allegheny and Monongahela River Basins - Major Findings." USGS.

Because not all of the removed ground will be replaced, the excess can be spread to other abandoned mine projects for infill or regrading needs. The state has several abandoned mine projects that need to be reclaimed, but are lacking the amount of dirt needed to return the ground to its premining land use.

Once the ground has been mined, small amounts of soil preparation can be done to prep the ground to be planted. This can range from adding fertilizers, new topsoil, or slight tilling to break up the compacted dirt. During this process, the owner, or owners, can build walls along the length of the benches to hold up each level and further prevent erosion and shifting of the sandy soil. After this is done, the grape vines are planted along the benches, leaving pathways, or rows, that will allow the harvesters to move.

To integrate other historic elements to the design, vines will be laid out to cover the size and shape of each of the mine veins. The thickest coal seam, the Mammoth vein, will be located directly in the place it once was since that is the one that is believed to originally house the fire, and the other veins will be spread throughout the trenched area. The coal pillars shown on the underground mining maps from the mid-1900s will be where the crops are planted, and the chutes will be the rows in-between. Figures 6.3 through 6.6 shows the plans of the various mine veins in the Logan and Centralia Mines.


Railroad
Approximate Outcrop
Avenue
Shamokin and Mount Carmel Electric Railway
Centre
Street
Locust
Wood
Mahanoy
Coal
74
75
76
77
78
80
81
82
East
Overlap
Fig. 6.3


LOGAN MINE
CENTRALIA MINE
CENTRALIA BOROUGH
CENTRALIA BOROUGH
Centralia Colliery
BREAKER
MAMMOTH VEIN STRIPPING
LOGAN COLLIERY
Lehigh Valley Railroad
Centralia Colliery
CENTRALIA MINE
MAMMOTH VEIN STRIPPING
MAMMOTH VEIN
CENTRALIA COLLIERY
SCALE 100 FT. = 1 IN.
Fig. 6.4


Locust
Centre
PERMIT No 4107
74
75
76
77
78
82
81
80
79

Fig. 6.5

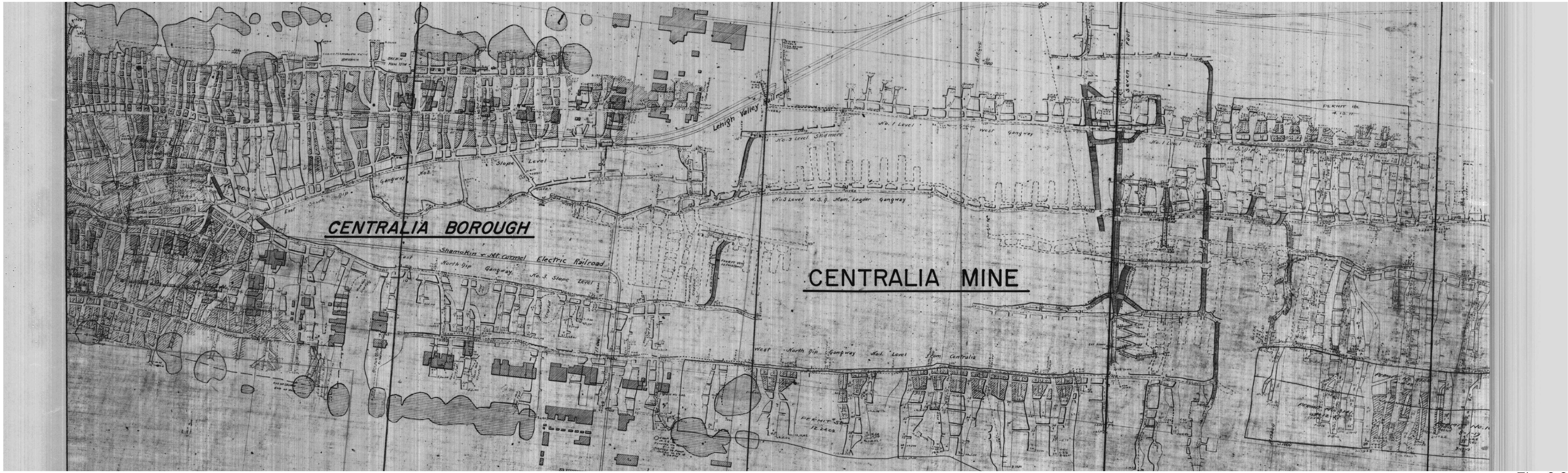

CENTRALIA BOROUGH
CENTRALIA MINE
Lehigh Valley Railroad

Fig. 6.6

Fig. 6.7

Program

The program that would fit into the site the best would need to be one that uses the slope of the mine to its advantage. This means that the exterior aesthetic, the plan, and the flow of the structure all should use the site to the best of its ability. The main feature in the area is the benches, or tiers, in the trench. As mentioned earlier, the gravity fed winery has several levels, with the wine-making process working its way down these floors. This method works the site naturally so it is the direction the project will go in.

The next characteristic of the structure is what the exterior will look like. Keeping with the theme of bringing history into the design, the winery will intend to pull in features from important structures from the town including, but not limited to, Town hall, the general store, Madden Saloon and Hotel, St. Ignatius church, and the First English Baptist Church.

The winery, utilizing an off the grid approach, will help to make up for the amount of work and environmental damage that will have occurred beforehand. As of today, there is already a wind farm built on Locust Ridge just north of the site. This wind farm, started by Joe Green in 2003 and then picked up by an energy company, is part of the largest wind farm in Pennsylvania with 64 turbines that stretch fifteen miles.[39] This one wind farm can supply electricity for thirty to forty thousand homes every year.[40]

[39] Jacobs Renée. (2010). Slow Burn: A Photodocument of Centralia, Pennsylvania. University Park, PA
[40] Ibid.

To go with the natural wine-making process, the vineyard will be handpicked each season to reduce the use of gas-powered equipment. This will help eliminate carbon dioxide emissions and also prevent further compaction of the soil that would need to be tilled later.

By designing an area that is as ecofriendly as possible, the project will fit into the sustainable, nature, and rural tourism sectors by allowing itself to be a teaching moment for visitors and preserving the site and the surrounding environment from further damage.

The site, while technically a new landscape with new buildings, will have pieces reminiscent of the history of Centralia. This plays in with historical tourism as visitors can learn about the history of the town, and its eventual demise.

Agricultural tourism is the final category to show incorporation. Tourists to the winery can learn about the natural gravity-fed process and the way the grapes are grown and harvested. While people may not be able to pick their own food like other types of horticulture and produce farms, the ability to walk through the site to see how it is done is still a valuable learning moment.

It should be noted that because of the shear size of the dig, multiple vineyards and multiple wineries could be placed. This project is focused on just one section that would be used as the model for the rest.

Fig. 6.8

Fig. 6.9

Fig. 6.10

Fig. 6.11

Because of Pennsylvania's northerly location, unwanted frost and early winter can cause difficulties in the harvest. To prevent any possible loss to the harvest from the cold, bore holes, similar to the ones used to measure the underground mine fire in the late 20th century, can be dug to bring geothermal heat from the ground up to the surface.

This is possible through a borehole heat exchanger, similar to the one shown on the next page. The hole extend deep into the ground where the natural earth is warmer than the surface temperature. This warmer ground then heats up the brine solution that runs through the pipe, coming to the surface where it would typically flow through the building. In the case of the vineyard, the pipes will run along the length of the rows radiating the heat to the surround vines. The pipe will then dip back into the ground to warm the solution back up. This process will continue throughout the landscape in order to help prevent the plants from freezing.

The benefits of this process is that is uses natural ways of heating, keeping with the theme of green and renewable energy uses. The brine solution never leaves the pipes, and due to the fact that it is a mixture of water and non-freezing liquids, there is no fear of the fluid freezing and the pipes breaking. The lifespan of borehole heat exchangers are also much longer than other options because it is a closed-loop system.

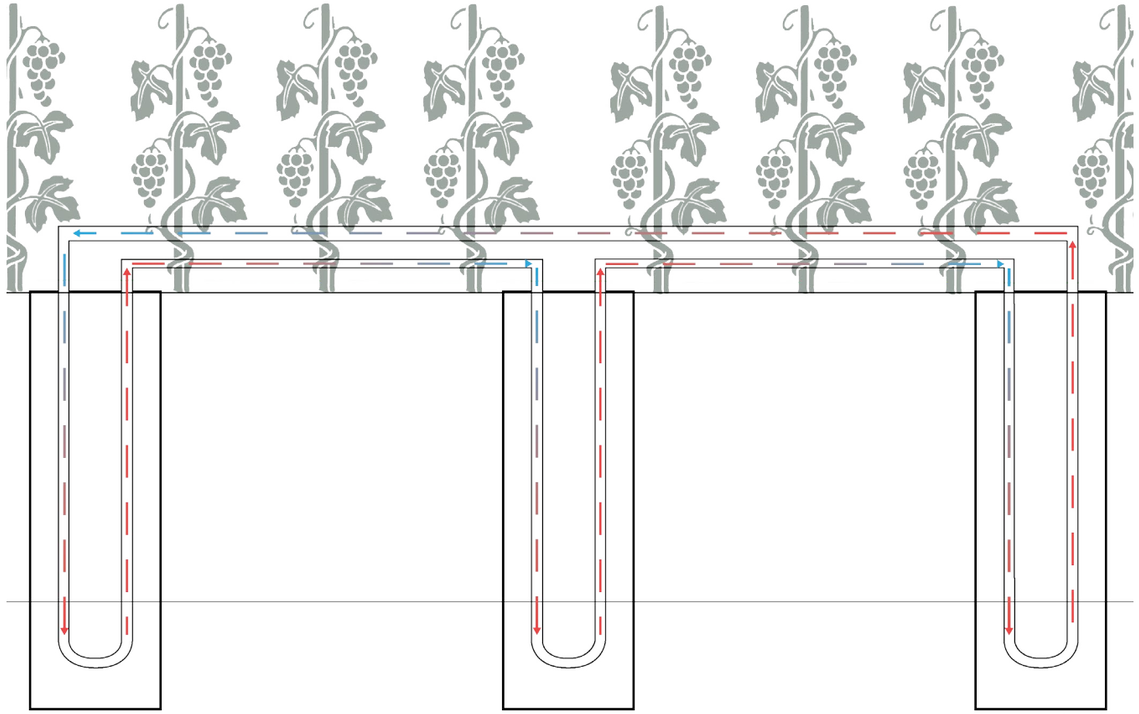


Fig. 6.12

Connection

The thought of wineries used as connection points is not usually at the top of anyone's list, but in reality they make great tourist attractions, places to relax during road trips, and through work and determination, can be known worldwide. Wineries, both large and small, have the ability to advertise and sell their wine all over the world. The United States in 2018 consumed a total of 966 million gallons of wine.[41] This is after an upward trend that has lasted since 1993. As more and more people drink wine, or more people drink more wine as some cases may be, the demand for more production is growing significantly. This has led to a large jump in wine tourism. Many states that have a large number of wine vineyards have created websites that advertise the various wine trails throughout the land. As mentioned earlier, Pennsylvania has six wine regions, with the Southeast region having the most wineries and wine trails.

On top of the tourism portion, the ability to distribute wine can greatly enhance a winery's following and interest. Good wineries and winery regions can attract people from all over the world. Sonoma Valley in California, or Burgundy, Champagne, Bordeaux, Alsace, and the Côte d'Or in France are a few examples.

The existing intersection of Routes 61 and 42 mark a great location for a winery, since it is a daily commuter path for many people of the surrounding towns. These routes also stretch the to other large incorporated communites, meaning easy access to the site from outside locations.

[41] "The Wine Institute." Wine Consumption in the U.S. - The Wine Institute, June 24, 2019.

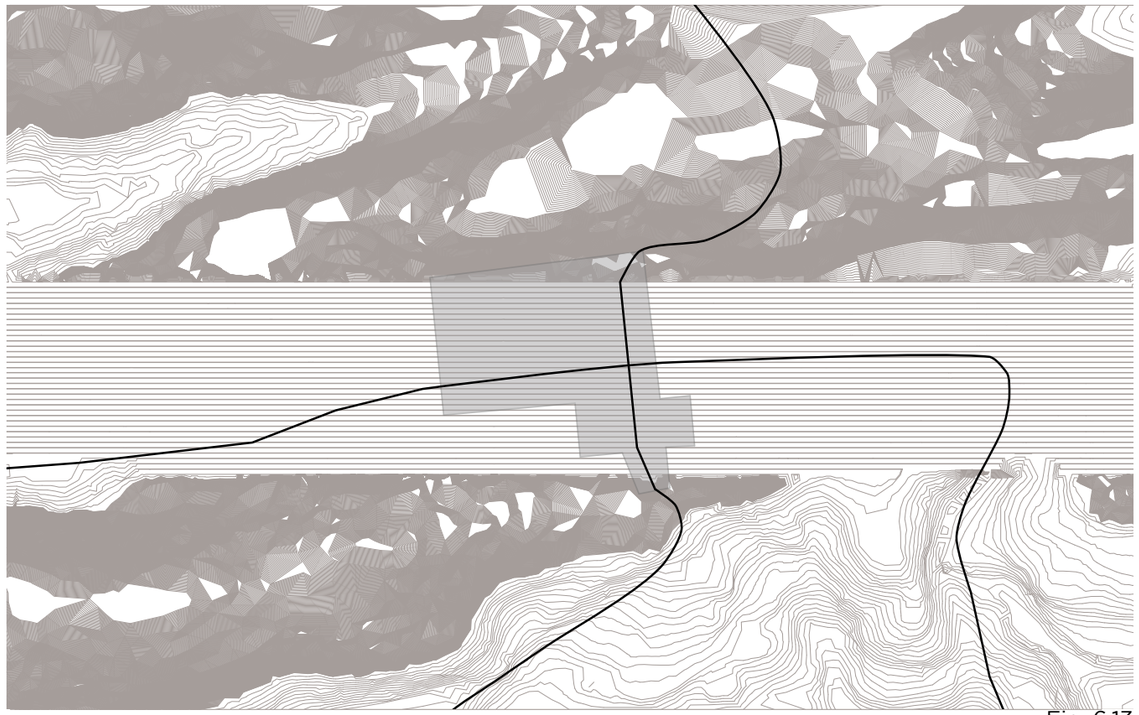


Fig. 6.13

Palimpsest

The way to implement all of these pieces is through development of a form of palimpsest. Combining man-made and more natural elements together and having them interact within their respective categories, and with each other. By doing this, the notion of the whole living organism of a biodynamic farm, is extended throughout the entire site. Each piece selected serves a specific purpose, so only those that are considered important aspects are added to the fabric.

Jonathan Raban in his book *Driving Home: An American Journey* wrote the following paragraph describing how palimpsest is created in landscapes:

> "Trying to understand the habitat in which we live requires an ability to read it - and not just in a loose metaphorical sense. Every inhabited landscape is a palimpsest, its original parchment nearly blackened with the cross-hatching of successive generations of authors, claiming this place as their own and imposing their designs on it, as if their temporary interpretations would stand forever. Later overwriting has obscured all but a few, incompletely erased fragments of the earliest entries on the land, but one can still pick out a phrase here, a word there, and see how the most recently dried layer is already being partially effased with fresh ink."[42]

The pieces that have been considered for the project are former iconic or important buildings, Routes 61 and 42, the layouts of the mine vein maps, boreholes, and the mine vein thicknesses. These were selected because of their ability to visually bring information about the town's history to the surface.

[42] "Landscape as Palimpsest." Kelly Research & Outreach Lab

Fig. 6.14

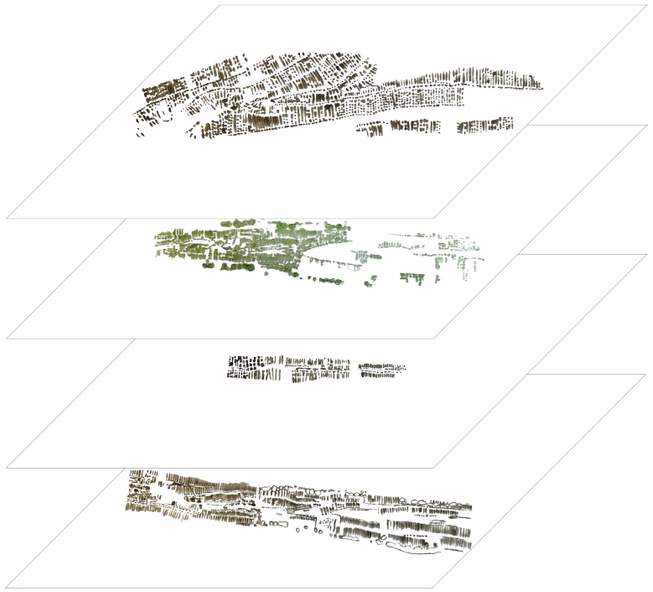


Fig. 6.15

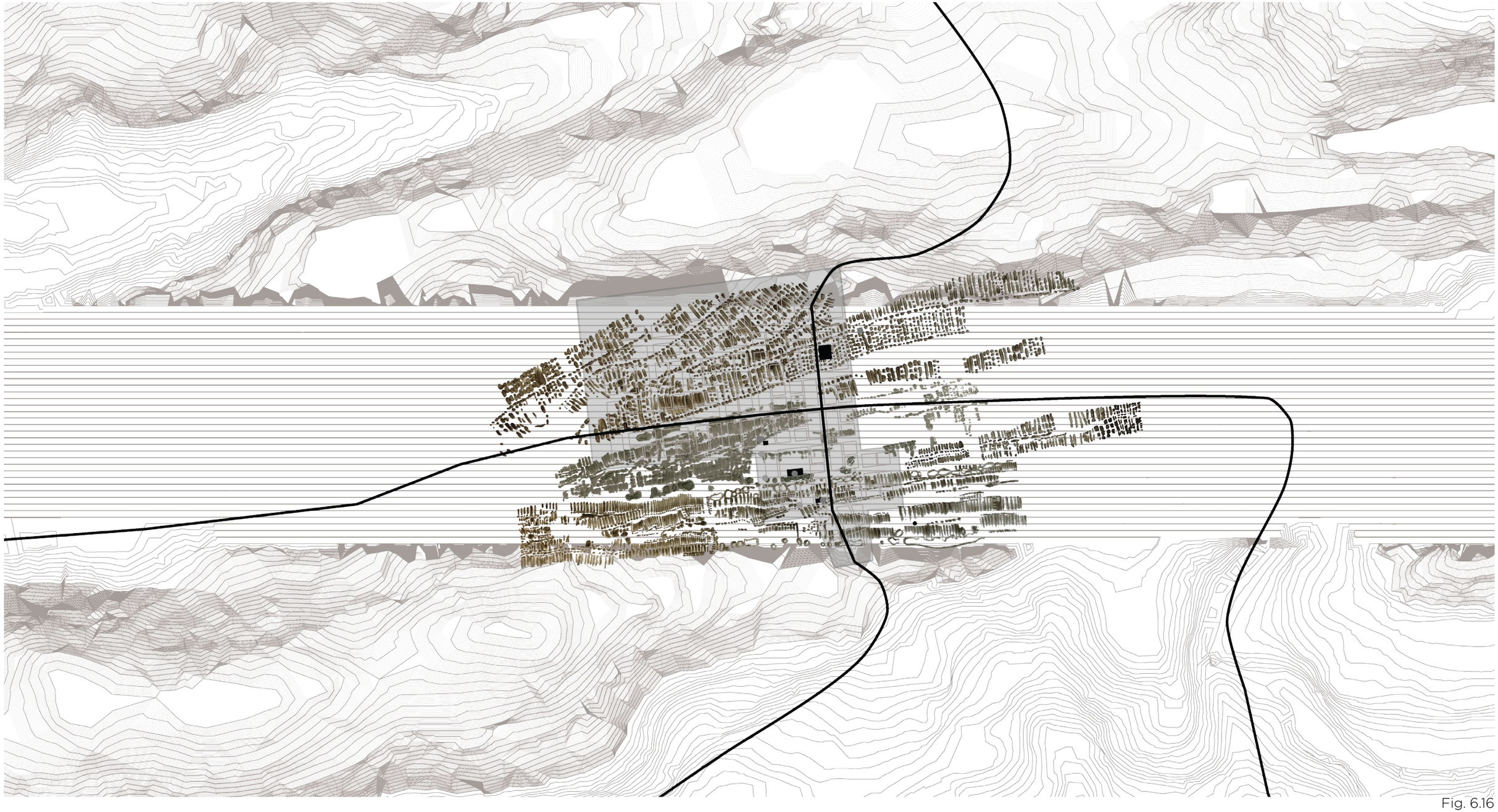


Fig. 6.16

bibliography

Book:

Burley, J. B. (2001). Environmental Design for Reclaiming Surface Mines. Lewiston, NY: Edwin Mellen Press.

Centre Regional Planning Agency. “PDF.” State College, n.d.

Jacobs Renée. (2010). Slow Burn: A Photodocument of Centralia, Pennsylvania. University Park, PA: Pennsylvania State Univ. Press.

Johnson, Deryl B. Centralia. Charleston, SC: Arcadia Pub., 2004.

Johnson, Hugh, and Jancis Robinson. The World Atlas of Wine. 7th ed. Great Britain:cOctopus Publishing Group, Ltd., 2013.

Juganaru, Ion-Danut, Mariana Juganaru, and Andreea Anghel. “PDF.” Constanta, n.d.

Muñoz-Robredo, Pablo, et al. “PDF.” Santiago, 2011.

Quigley, Joan. The Day the Earth Caved in: an American Mining Tragedy. New York: Random House Trade Paperbacks, 2009.

Richards, G. Creativity and tourism – The state of the art. Annals of Tourism Research, 38, 1225-1253.

RPMGlobal. “PDF,” 2019.

Schor, H. J., & Gray, D. H. (2007). Landforming: An Environmental Approach to Hillside Development, Mine Reclamation and Watershed Restoration. Hoboken: Wiley.

Wood, Charles R. Water Quality of Large Discharges from Mines in the Anthracite Region of Eastern Pennsylvania. Lemoyne, PA: U.S. Dept. of the Interior, U.S. Geological Survey, 1996.

Website:

Anderson et al. “NAWQA - Water Quality in the Allegheny and Monongahela River Basins - Major Findings.” USGS. Accessed November 24, 2019. https://pubs.usgs.gov/circ/circ1202/major_findings.htm.

“Biodynamic Principles and Practices.” Biodynamic Principles and Practices | Biodynamic Association. https://www.biodynamics.com/biodynamic-principles-and-practices.

Blakemore, Erin. “This Mine Fire Has Been Burning For Over 50 Years.” History.com. A&E Television Networks, June 12, 2018. https://www.history.com/news/mine-fire-burning-more-50-years-ghost-town.

“Contour Mining.” Coal Surface Mining, Contour Mining. Mine-engineer.com, 2018. http://www.mine-engineer.com/mining/coal/contour.htm.

Denig, Vicki. “Biodynamic Wine, Explained.” VinePair, July 5, 2018. https://vinepair.com/articles/biodynamic-wine-explained/.

Elick, Jennifer M. “Mapping the Coal Fire at Centralia, Pa Using Thermal Infrared Imagery.” International Journal of Coal Geology. Elsevier, July 21, 2011. https://www.sciencedirect.com/science/article/abs/pii/S0166516211001510

Fennell, Anne-Marie. COAL MINE RECLAMATION Federal and State Agencies Face Challenges in Managing Billions in Financial Assurances, (2018). https://www.gao.gov/assets/700/690476.pdf.

Fink, Jameson. “Are Hand-Picked Grapes Better Than Machine-Harvested?” Wine Enthusiast Magazine, April 1, 2019. https://www.winemag.com/2017/07/06/are-hand-picked-grapes-better-than-machine-harvested/.

Gill, M. (2019, November 15). This Town Set Itself on Fire in 1962 and It’s Still Burning 57 Years Later. Retrieved from https://rare.us/rare-life/centralia-mine-fire-pa-burning/.

Grapes. “Introduction to Mechanical Harvesting of Wine Grapes.” Grapes, June 20, 2019. https://grapes.extension.org/introduction-to-mechanical-harvesting-of-wine-grapes/.

History of Centralia PA Before 1962. (2016, July 11). Retrieved from https://www.centraliapa.org/history-centralia-pa-before-1962/.

Inskeep, S., & Westerman, A. (2019, April 29). Why Is China Placing A Global Bet On Coal? Retrieved from https://www.npr.org/2019/04/29/716347646/why-is-china-placing-a-global-bet-on-coal.

Kelly, Maggi. “Landscape as Palimpsest.” Kelly Research & Outreach Lab. Kelly Research & Outreach Lab, January 18, 2012. http://kellylab.berkeley.edu/blog/2012/1/17/landscape-as-palimpsest.html.

Maddux, Jason. “These Are the 10 Most Popular Pennsylvania Tourist Attractions.” pennlive, May 23, 2016. https://www.pennlive.com/life/2016/05/pennsylvania_top_tourist_desti.html.

Mead, Peter B. Elementary Treatise on American Grape Culture and Wine Making. Hansebooks, 2017. https://babel.hathitrust.org/cgi/pt?id=uc2.ark:/13960/fk76t0hb9c&view=1up&seq=26.

Merlin, Michelle. “As State Park Attendance Climbs, Pennsylvania Looking to Prevent Them from Being Loved to Death.” mcall.com, September 30, 2017. https://www.mcall.com/news/pennsylvania/mc-nws-state-parks-survey-20170714-story.html.

Oram, Brian. “The PH of Water.” Water Research Center - pH. Accessed November 24, 2019. https://water-research.net/index.php/ph.

Pennsylvania Department of Community and Economic Development. “PDF.” Harrisburg, 2013.

Report on Abandoned Mine Land Reclamation Economic Development Pilot Program (Aml Pilot Program) for Fy 2016 – Fy 2017. (2017). Retrieved from http://files.dep.state.pa.us/Mining/Abandoned Mine Reclamation/AbandonedMinePortalFiles/AMLProgramInformation/PilotProject/OSMRE_Annual_Report_2016_AML_Economic_Development_Pilot_Program.pdf

“Sustainable Development of Tourism.” Definition | Sustainable Development of Tourism. Accessed November 21, 2019. https://sdt.unwto.org/content/about-us-5.

Teeter, Adam. “The Difference Between Wine Grapes And Table Grapes.” VinePair, June 12, 2019. https://vinepair.com/articles/difference-between-wine-grapes-and-table-grapes/.

“The Wine Institute.” Wine Consumption in the U.S. - The Wine Institute, June 24, 2019. https://www.wineinstitute.org/resources/statistics/article86.

“Water Quality.” NASA. NASA. Accessed November 24, 2019. https://www.grc.nasa.gov/www/k-12/fenlewis/Waterquality.html.

Images:

“An Introduction to Biodynamic Wine.” Into The Vineyard, April 13, 2018. http://www.intothevineyard.com/blogbiodynamics/.

Anson, Jane. “Anson: Why a Decline in Soil Health Should Worry All Wine Lovers.” Decanter, December 4, 2017. https://www.decanter.com/wine-news/opinion/news-blogs-anson/wine-and-soil-health-bourguignon-352159/.

Arndt, Christopher. “Greetings from Pennsylvania Postcard.” Christopher Arndt Postcard Co. https://www.christopherarndtpostcards.com/product/greetings-from-pennsylvania-postcard/.

“Centralia Pennsylvania.” Centralia Pennsylvania Photography - Underground Mine Fires burning since 1962 in Centralia PA. Accessed February 20, 2020. http://www.offroaders.com/album/centralia/photos21.htm.

“County Rock Maps.” Pennsylvania Department of Conservation & Natural Resources. Accessed November 24, 2019. https://www.dcnr.pa.gov/Geology/GeologyOfPA/CountyRockMaps/Pages/default.aspx.

Douglas, Ellie. “Yealands Babydoll Sheep.” Decanter. Accessed February 20, 2020. https://www.decanter.com/wine-pictures/gallery-vineyard-animals-unlikely-helpers-289138/attachment/yealands_babydoll-sheep_004/.

Elick, Jennifer M. Fire Spread. September 30, 2014. Centralia. https://www.centraliapa.org/centralia-mine-fire-burn-zone/.

Hein, Mitch. “Centralia – Page 3.” MHBLOG, January 5, 2014. https://mitchhein.wordpress.com/category/centralia-2/page/3/.

Jacobs Renée. (2010). Slow Burn: A Photodocument of Centralia, Pennsylvania. University Park, PA: Pennsylvania State Univ. Press.

Johnson, Deryl B. Centralia. Charleston, SC: Arcadia Pub., 2004.

Johnson, Hugh, and Jancis Robinson. The World Atlas of Wine. 7th ed. Great Britain: Octopus Publishing Group, Ltd., 2013.

Kundig et al. Gravity Flow Winery. Martin’s Lane Winery. Architizer, Inc. Accessed November 23, 2019. https://architizer.com/projects/martins-lane-winery/.

Pennsylvania Winery Association. “Wine Trails.” Pennsylvania Wines. Pennsylvania Department of Agriculture. Accessed November 23, 2019. https://pennsylvaniawine.com/wine-trails/.

Schmidt, Claudia. “2017 Census Update on Agritourism in Pennsylvania.” Penn State Extension, November 12, 2019. https://extension.psu.edu/agritourism-in-pennsylvania-2019-update.

“Sevon, W. D., compiler, 2000, Physiographic provinces of Pennsylvania: Pennsylvania Geological Survey, 4th ser., Map 13, scale 1:2,000,000.”

Swartz, Sophia. “Burn, Bacteria, Burn: A Fiery Ghost Town Holds Promising Microbial Secrets.” Medium. Show Some STEMpathy, June 30, 2019. https://medium.com/show-some-stempathy/burn-bacteria-burn-a-fiery-ghost-town-holds-promising-microbial-secrets-9b06c20decbe.

Tekweni. “What Goes into Making a Good Organic Wine.” Youtube, May 12, 2016. https://www.youtube.com/watch?v=Badh8y88SKc.

“The Fellowship Of Preparation Makers Conference 2017:” Demeter Canada, December 31, 2016. https://www.demetercanada.ca/2016/12/31/the-fellowship-preparation-makers-conference-2017-cultivating-sharing-perspectives-horn-manure-march-3-5/.

The Center For Rural Pennsylvania. The Center For Rural Pennsylvania: A Legislative Agency of the Pennsylvania General Assembly. 2014. https://www.rural.palegislature.us/demographics_datagram_limited_wineries_pa.html.

trconrad2001. “Centralia, PA.” Flickr. Yahoo!, March 22, 2009. https://www.flickr.com/photos/trconrad2001/3376481174/.

Weinstein Vaadia Architects. Galil Mountain Winery Plan. ArchDaily. ArchDaily, November 19, 2011. https://www.archdaily.com/184483/galil-mountain-winery-weinstein-vaadia-architects?ad_ medium=gallery.