

CONSTRUCTING TERROIR:
Architectural Mitigation in Mono-economies at Risk to Climate Change

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ABSTRACT

Climate change will have enormous implications for the future of architecture and design at all scales. Architectural discourse has recently focused mainly on preparing major cities to become the future sustainable centers of living for the world. Little has been discussed, however, about the future of smaller communities on the periphery and the implications of their loss to the diverse American cultural landscape.

Napa Valley contains many communities threatened by a changing climate. Napa Valley plays a major role in America's culture as the heart of American winemaking. The success in Napa Valley wine is deeply rooted to the soil. Wine, like many agricultural products, places great importance on a sense of place. A key component of winemaking is "terroir", a combination of cultural heritage and scientific factors of the place where wine is grown that creates the taste characteristics of wine. Because of this, the physical ground on which Napa Valley rests has a direct relationship to the city's role as the heart of American wine. The city's economic, cultural, political, and architectural infrastructure is highly dependent on its geographical setting. Climate change threatens to shift these areas suitable for viticulture entirely out of the Napa Valley by 2050.

The thesis seeks to explore the capacity of architecture to not only embody and reflect these issues of place but also to mitigate climate change and preserve culture through architecture. The program proposal seeks to develop an architecture that provides strategies of resilience for viticulture and for the communities of Napa Valley. To accomplish this it must create new systems that mitigate negative changes in climate, strengthen the community through overlapping ecologies and programming as well as raise public awareness of climate change, of the sustainability impacts of viticulture and other forms of agriculture, and the cultural significance of wine making in Napa Valley. Napa Valley is not alone. These solutions can serve as a model for other agricultural communities facing the same uncertain future. By understanding the cultural context of small communities we can design architecture and landscape solutions that preserve important cultural landscapes and create resilient communities.

“The race is now on between the technoscientific and scientific forces that are destroying the living environment and those that can be harnessed to save it. . . . If the race is won, humanity can emerge in far better condition than when it entered, and with most of the diversity of life still intact.”

-Edward O. Wilson, *The Future of Life*

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PART ONE: FRAMING

INTRODUCTION

Climate change has and will have enormous implications for the future of design at all scales. Architectural discourse has recently focused mainly on its effects on major urban centers and how urban planning and design can respond to changing infrastructural needs. The assumption has often been that world's population will condense into these high density cores. However, these assumptions do not address the future of the smaller communities on the periphery. These communities have important cultural identities meaningful to themselves and also to the entire American cultural landscape. We are endangering the cultural heritage and diversity of the world by undervaluing the necessity to address the resiliency of these small, but highly important cultural landscapes.

Napa Valley is the epitome of this fear. (See figure 1) While its economy currently is one of the most vibrant in California, it is also almost completely focused on a single industry, winemaking. Dependence on a single industry is dangerous to begin with, as evidenced by Detroit, MI and Hale County, AL but Napa Valley is especially at risk because winemaking relies on an increasingly more delicate agricultural climate.

Napa's sensitivity to agricultural loss is heightened by the fact that most of its non-agricultural industries, such as restaurants and hospitality, depend on tourism and sales created by the local wine trade. There is a cyclical relationship between Napa's culture and its economy. Wine has a particular cultural identity embedded in it. Its terroir, "the combination of factors, including soil, climate, and environment that gives wine its distinctive character,"¹ has huge implications for the community.

The grape berry is a vessel for all the elements around it. Within it we find how the water ran from the glaciers, we find how the mountains forced the winds full of yeast, pollen, and living beings into its path, we find what gifts the ground would yield and what it would not. The grape carries a story. The plot twists and turns around human interventions and human history. A bottle of wine is not simply the end product, it is a timeline that began long before the first vines were planted. To taste wine is to taste the beginning. Terroir is not just a recipe of ingredients, it is a folk tale. Terroir is the combination of biological conditions, such as soil composition and climate, in combination with less definable conditions such as traditions of production that are tied to a definitive geographical point to create a constant taste. Terroir is the taste of place.

It is this that makes "place" so important and so delicate in viticulture. Terroir is the sense of place that makes Napa a destination for tourism that reinforces the wine industry as well as the

¹ "Terroir." Merriam-Webster.com. Accessed September 2, 2014. <http://www.merriam-webster.com/dictionary/terroir>

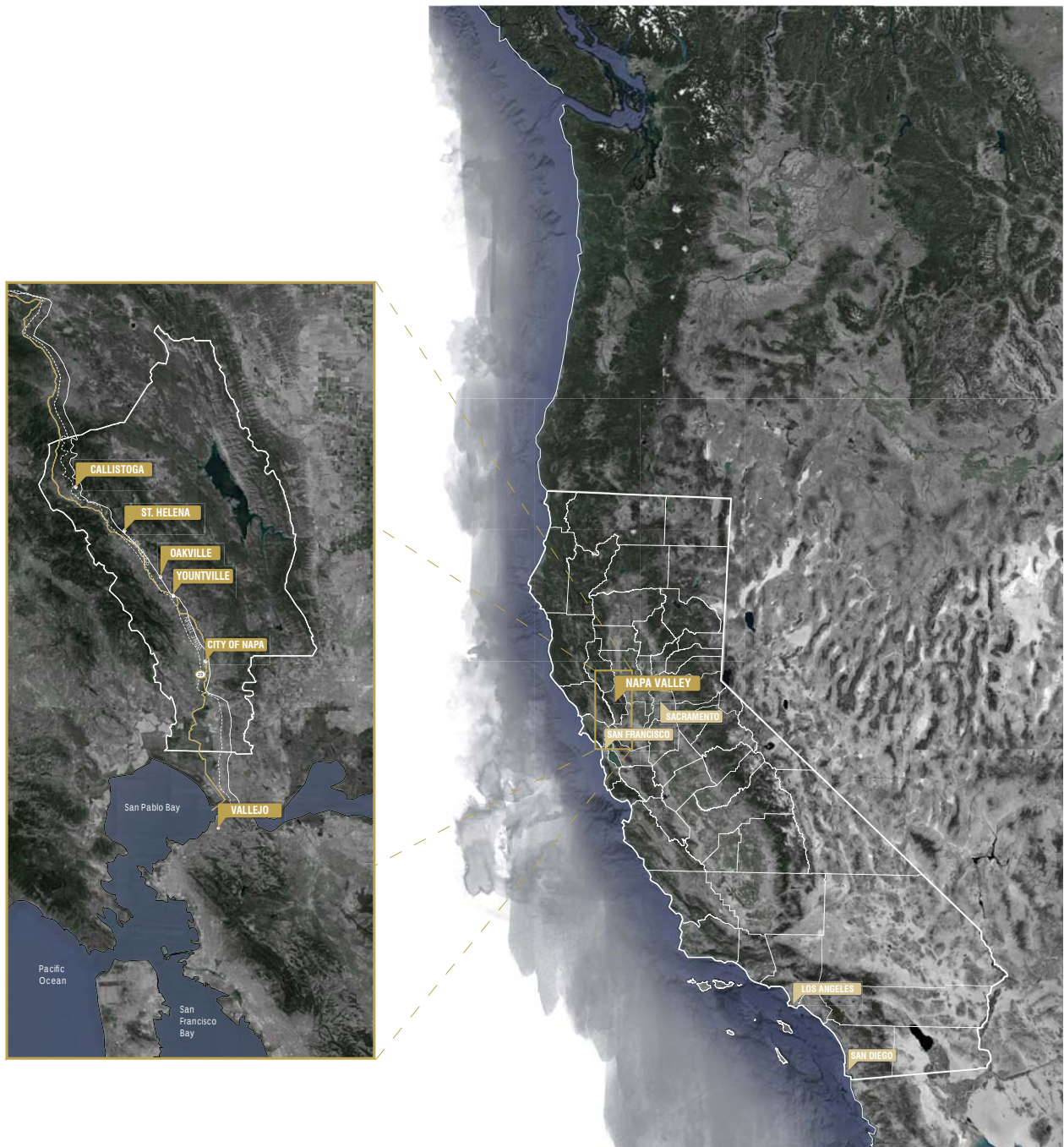


Figure 1: Map of Napa Valley

embedded identity created by it.

Climate change is already causing significant repercussions for all agricultural industries, but wine grapes are especially sensitive. Any change in temperature, hydrology, or geological conditions affects the taste of the final product, wine. Terroirs are rooted in the idea that the taste of a particular wine is strictly tied to a small geographical viticultural area. The soil twenty minutes down the road may produce an entirely different taste, therefore changing the identity of the place from which it came.

According to a 2013 study by the Proceedings of the National Academy of Sciences, the areas suitable for viticulture in California will decrease up to 73% and shift generally northward to areas previously too cool for wine grapes within the next 35 years.² This will mean major changes for Napa terroir and its cultural and physical identity. It is a community built around wineries, reflected in its architecture and infrastructure. A shift will not just have implications for the economy, but also what is physically left.

To simply leave and start over elsewhere is not an option. Shifting carries a whole host of other implications, including interruption of other biological pathways. What makes Napa wine and culture is tied to Napa. Its terroir is just as much cultural as it is physical. Napa's industry and culture in Napa are symbiotic, constantly feeding one another. There must be preemptive interventions to guarantee that Napa does not lose its ability to sustain its unique character and that the American cultural landscape does not see yet another icon disappear.

Community planners and architects now have access to accurate climate modeling and forecasting. This new data can inform the way we design, preventative, culturally sensitive, responses to a changing climate. The form and scale by which this takes place must be investigated. Napa Valley has the potential to serve as testing ground for the investigation of the role of architecture in mitigating the resiliency of small communities to major changes in climate.

² "Climate Change, Wine, and Conservation." Proceedings of the National Academy of Sciences 110, no. 17 (2013): 6907–6912. Accessed July 15, 2014. www.pnas.org/cgi/doi/10.1073/pnas.1210127110.

Historical Significance Napa Valley

The Napa Valley has a rich history dating far beyond its emergence as a commercial agricultural center in the Western United States. Napa's landscape is still imprinted to this day with the lives of the original Native Americans who once inhabited the land over 200 years ago. The Caymus, Canijolmano, and Mayacma tribes practiced large scale agriculture that shaped the land. They participated in burning of the land to clear fields for planting. Today one of modern Napa's most distinctive ecological features of "openness" is a direct result of the native people's interventions. When the first Europeans walked onto Napa soils in 1823 "the Valley was not a wilderness, but rather a landscape inhabited by long-standing cultures."³

By 1840 the indigenous inhabitants had been mostly pushed to the exterior and a few American ex-patriots owned most of the land. In 1850 Napa Valley became one of the first counties established when California gained statehood.⁴ Farming and ranching made up most of the land use, leading the community to start taking steps to change the hydrology of the valley. Large scale interventions were installed along the Napa River to reduce flooding and create a network of irrigation channels. Tidal marshlands at southern end of the Napa Valley were diked off for agriculture and the Napa River was dredged to benefit commercial transportation.⁵ Many of those original channels laid the foundation for the highly complex system of agricultural irrigation that works its way through the entire state of California still today. (See Figure 2)

While grapes grew naturally in Northern California, the grapes that now make up most of their wines, European *Vitis Vinifera*, were not introduced until 1858. In 1861 Charles Krug established the first commercial winery using these grapes in the Napa Valley. By 1880 most agricultural land use had shifted to vineyards and orchards. In contrast to much of today's methods, vineyard irrigation at that time focused mainly on dry-farming, a method often employed in the Mediterranean, which "utilizes residual moisture in the soil from the rainy season to conserve water during long dry periods primarily through a system of tillage, surface protection, and the use of drought-resistant varieties."⁶ This approach remained highly successful until the 1960s, when a more commercially focused industry realized higher profits with irrigation.⁷

By the 1940s a postwar population boom led to major residential expansion. In part, this was

3 Napa Valley historical ecology atlas exploring a hidden landscape of transformation and resilience. Robin Grossinger 1969-Berkeley : University of California Press c2012

4 Napa County Historical Society. "History of Napa County and the City of Napa | Napa County Historical Society." Napa County Historical Society | . Accessed December 8, 2014. http://wordpress.napahistory.org/wordpress/?page_id=1107.

5 Napa Valley historical ecology atlas exploring a hidden landscape of transformation and resilience. Robin Grossinger 1969-Berkeley : University of California Press c2012

6 California Agricultural Water Stewardship Initiative. (n.d.). California Agricultural Water Stewardship Initiative: Dry Farming. Retrieved from http://agwaterstewards.org/index.php/practices/dry_farming/

7 California Agricultural Water Stewardship Initiative. (n.d.). California Agricultural Water Stewardship Initiative: Dry Farming. Retrieved from http://agwaterstewards.org/index.php/practices/dry_farming/



Figure 2: California water features

driven an influx of workers for the New Mare Island Naval Shipyard in Vallejo at the southern end of Napa Valley.

In 1940s California, and Napa Valley specifically, winemaking changed entirely with Robert Mondavi's entrance into the winemaking industry. After an initial stint at Charles Krug winery, purchased by his parents, he left to start his own Robert Mondavi Wines. Mondavi's methods pushed winemaking in Napa to a large scale commercial force. His focus on quality opened up new opportunities in the mostly sweet "jug wine" market. More and more winemakers set down roots in Napa, making it a viticulture center in the United States.

With the attractive new culture and commercial promises came residential sprawl. To the south, Santa Clara went through a similar rejuvenation and became a very highly populated, low-density city, with few natural amenities. In 1968 in response to similar suburban and urban pressures, The Napa County Agricultural reserve was created to maintain the character of the valley. An urban-centered growth plan concentrated future business and residential development in the incorporated city center, leaving farmland and natural amenities preserved.⁸

In 1976 Napa Valley firmly established itself as a major player in the international winemaking industry. Several Napa wines beat out their European counterparts in a blind wine tasting in France at "The Judgment of Paris," shocking the viticulture world and shining the spotlight on California wines. California wine, seen as far less superior to French wine placed first in both the red and white wine categories. Both winning wines, Stag's Leap Wine Cellars Cabernet Sauvignon and Château Montelena Chardonnay, were from wineries in the Napa Valley.

"Catalyzed by the 'Judgment at Paris,' the region began to develop an international identity for its wines and became a tourist destination." **-Robin Grossinger, *Napa Valley Historical Ecology Atlas***

Napa Valley viticulture became more significant in the decades following 1976 "Judgment at Paris." From 1970 to 1990 the number of wineries in Napa doubled from 60 to 120.⁹ Land dedicated to viticulture has quadrupled since 1968.¹⁰ Today there are over 400 wineries within the Napa Valley and 45,000 vineyard acres.¹¹ Wine tourism emerged as an a major industry evidenced by the 1.4 billion dollars in tourism related sales generated by 2.9 million visitors annu-

⁸ General Plan Section - Agricultural Preservation and Land Use Element

⁹ Thelin, Emily K. "Uncorking Napa's History." Food & Wine Magazine (2012): <http://www.foodandwine.com/articles/uncorking-napa-history>.

¹⁰ Pinney, Thomas. A History of Wine in America From Prohibition to the Present. Berkeley: University of California Press, 2005.

¹¹ The Wine Institute. "The Appellations Of California Wine - North Coast - The Wine Institute." The Wine Institute - The Advocacy Group for the California Wine Industry. Accessed December 9, 2014. <http://www.wineinstitute.org/resources/consumerfeaturedstories/article338>.

ally.¹² The expansion helped further cement Napa's cultural and economic identity as a place defined by wine. (See Figure 3)

This expanded scope of viticulture and its constituent economies had significant effects on the environment. New watersheds, including 2500 small reservoirs, were created to meet the growing hydrological demands. While the economy and agriculture benefited from changes in the watersheds and general hydrology of the Napa Valley area many biological pathways were disrupted causing a major decline in aquatic flora and fauna. In response to these ecological strains Napa Valley became highly invested in conservation efforts to improve the ecological systems of the valley, creating many wine sustainability groups and watershed protection groups.

Major steps were taken in 2009 with the Napa County General Plan, outlining steps to focus on continued sustainability, preservation of agricultural lands, and creation of a diversified economic marketplace by implementation of affordable housing for agricultural workers, and watershed management and rehabilitation.

¹² Napa Valley Welcome Center. Napa Valley Visitor Industry: 2012 Economic Report. Napa, CA: Destination Analysis, 2012.

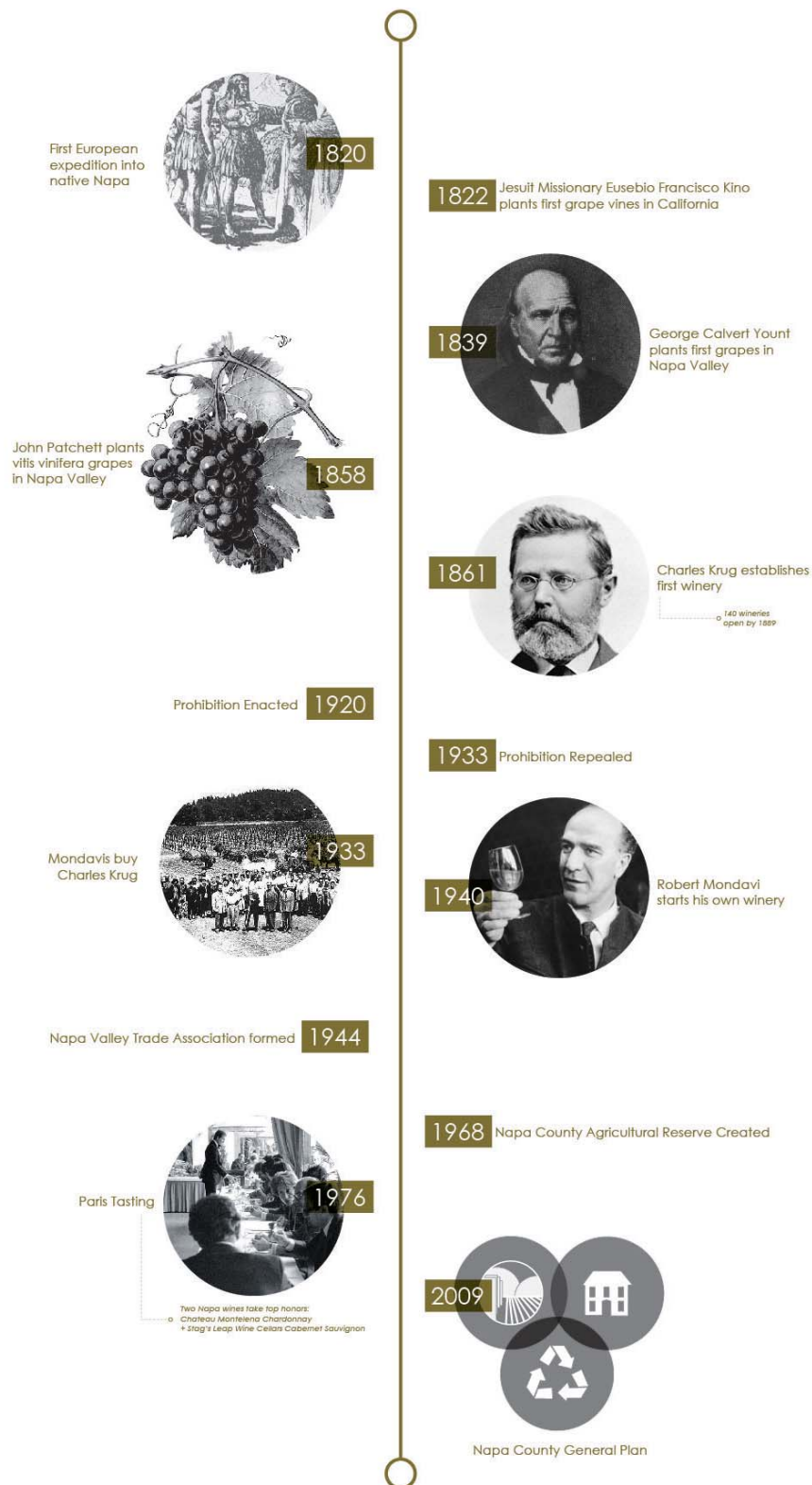


Figure 3: Timeline of Napa Valley

Embedded Identity: Cultural Significance of Wine

The implications of a loss of Napa Valley as a wine producer are far larger than economics, they are a loss of a binding cultural identity.

“The cultural landscape of viticulture can thus be seen to be an expression of transformations and interactions in the economic, social, political, and ideological structures of a particular people at a specific place.”¹³ -P.T. Unwin

Winemaking is a craft and winemakers are considered artists. Good wine was seen to have the ability transcend simple physical elements as evidenced by its importance in religious practices and communal rituals, such as Bacchic rituals and Christian Eucharist.¹⁴

“Beer is made by men, wine by God.” -Martin Luther

For many wine represents the spirit of living. The experience of drinking wine, interpreting its depth, understanding its relationship to the food it is consumed along side becomes a form of ritual for many. When we experience wine, we are reading a history of place. Wine’s terroir develops and evolves. Over time its life experiences are written in its complexity and depth. It lives as we live.

“Wine is a living liquid containing no preservatives. Its life cycle comprises youth, maturity, old age, and death.” -Julia Child

From the experience of wine we borrow a history that is not our own, it allows us to feel grounded in a world where we are no longer directly tied to the original civilizations. In America our heritage is a young mixture of thousands of traditions, ethnicities, and beliefs. We do not have the history of France or Italy, but the success of wine in Napa Valley reinforces a common respect for a craft thousands of years old that spans oceans and borders to remind us that we all came from one. Napa Valley has an embedded identity as the heart of American wine and therefore, our connection to a cultural identity of the world.

¹³ Unwin, P. T. H. *Wine and the Vine An Historical Geography of Viticulture and the Wine Trade*. London: Routledge, 1996.

¹⁴ Unwin, P. T. H. *Wine and the Vine An Historical Geography of Viticulture and the Wine Trade*. London: Routledge, 1996.

Symbiosis of Culture and Economy

“When you uncork a bottle of mature fine wine, what you are drinking is the product of a particular culture and tradition, a particular soil, a particular climate, the weather in that year, and the love and labour of people who may since have died. The wine is still changing, still evolving, so much so that no two bottles can ever be quite the same. By now, the stuff has become incredibly complex, almost ethereal. Without seeking to blaspheme, it has become something like the smell and taste of God.”

-Neel Burton, *The Concise Guide to Wine and Blind Tasting*

Today the Napa Valley is eponymous with wine. Viticulture has been deeply embedded in the way of life since Charles Krug first started selling wine. After the Paris 1976 successes Napa wine culture became an iconic draw.

“When I moved here 43 years ago, there were about 1,000 tourists coming per year, and no good restaurants and no good hotels,” recalls Mike Grgich, who was Chateau Montelena’s winemaker back in 1976. The tasting transformed his life as well. With his wine dubbed one of the best in the world, he soon got backing to start his own winery, Grgich Hills Cellar in Rutherford. “My life is divided into two parts --before the Paris tasting and after.”¹⁵

Napa currently has a vibrant economy, centered on winemaking. Wine and grape production alone account for \$13.3 billion dollars flowing into their economy as well as the creation of 46,000 production related jobs.¹⁶ In 2013 California exported \$1.43 billion dollars of wine internationally.¹⁷ (See Figure 4) According to the U.S. census the majority of jobs in Napa are agricultural and restaurant/hospitality related.¹⁸

Napa’s wine industry drives a major tourism industry as well. Tourism brings in a total of \$1 billion in revenues annually with 3.8 million winery visits. The tourism industry, including tasting rooms, restaurants, and hospitality accounts for 8,700 jobs and \$218 million in salaries. This also has a major impact on public funds availability. Tax revenue related to all Napa’s wine related activities is \$5.2 billion annually.¹⁹ Many of Napa’s public works, including multiple Napa

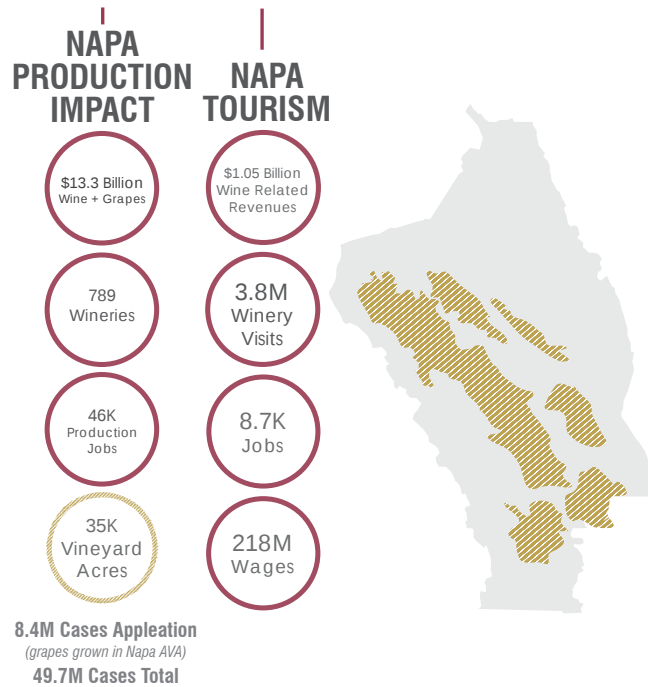
¹⁵ Businessweek.com. “The Day California Wines Came of Age - Businessweek.” Last modified May 7, 2001. <http://www.businessweek.com/stories/2001-05-07/the-day-california-wines-came-of-age>.

¹⁶ The Economic Impact of Napa County’s Wine and Grapes, Napa Vintners Association

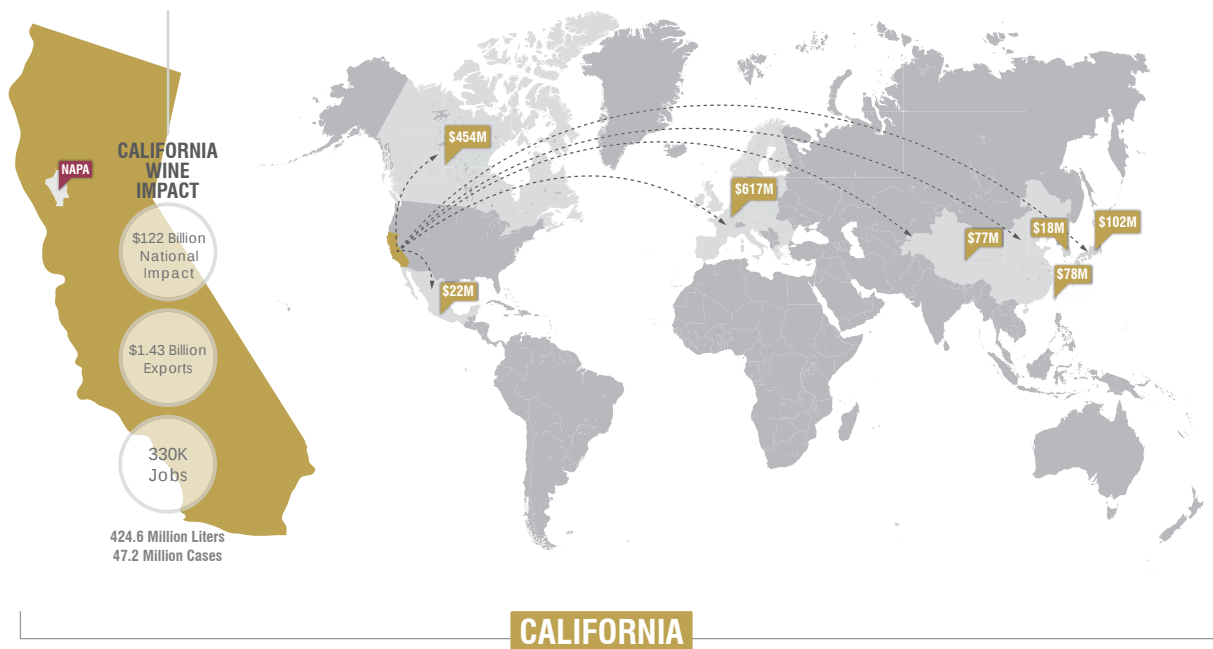
¹⁷ “California Wine Exports Reach All Time High in 2013.” The Wine Institute (2014): http://www.wineinstitute.org/files/2013_US_Wine_Exports_Reach_All-Time_High_WI_0.pdf.

¹⁸ 2010 US Census

¹⁹ The Economic Impact of Napa County’s Wine and Grapes, Napa Vintners Association



NAPA



CALIFORNIA

Figure 4: California + Napa's Economic Impacts

River watershed restoration projects and Agricultural Preserve Act depend on those incomes.

“It starts with the earth, the legacy of what we have received from our ancestors and what we are going to leave for the future generation,” she says. “We must work to maintain the land, to grow so that we all live in symbiosis: the earth, the vines, the people – care creates quality.”

-Geneviève Janssens, *Robert Mondavi Winery*

Napa Valley has a symbiotic relationship between economics and its cultural identity. The widespread recognition of Napa’s cultural identity as a viticultural icon drives sales and tourism revenues which in turn lead to greater investment in the county, making it that much more attractive. Without economic return, wine making would dwindle and entirely change the cultural identity. Without the wine-related identity there would be no tourism. Napa Valley has tried many different crops, none has ever touched the success of wine grapes.

As a relatively young wine region compared to its European counterparts, Napa Valley is not nearly as bound very specific traditional methods of winemaking that have little or no focus on sustainability. This flexibility has allowed Napa to explore new methods of viticulture and wine-making to efficiently produce some of the highest quality and most sustainable wines in the world.

This progressive innovation and research has become part of Napa’s evolving identity. One third of all vineyard land has been green certified with “farm-specific plans tailored to protect and enhance the ecological quality of the Napa Valley.”²⁰ More than 85 wineries also participate in the Napa Green Certified Winery production program, which “includes water conservation, energy conservation, pollution prevention, and solid waste reduction elements and requires vintners to perform a comprehensive analysis of their operations.”²¹ Many additional local and statewide programs have also been created to preserve the agricultural heritage and biological diversity of the Napa Valley. (See Figure 4.1)

Napa Valley also has access to advanced research and innovation tools, with direct connections to the U.C Davis and U.C. Berkley Viticulture and Enology programs as well as many smaller colleges and universities sprinkled throughout the Central Valley. Many wineries also have on site research labs. Robert Mondavi Wineries have invested heavily in one the most advanced viticulture research labs and an in-house sustainability task force.²²

20 Napa Vintners Association. “Napa Green Facts and Figures.” Napa Vintners Association. Accessed December 1, 2014. https://www.napavintners.com/press/docs/napa_green_fast_facts.pdf.

21 Napa Green. “What is Napa Green?” Accessed December 1, 2014. <http://napagreen.org/about/>.

22 Robert Mondavi Winery. “Winemaking - Napa Green Certified.” Accessed December 1, 2014. <http://www.robertmondaviwinery.com/>

Napa also boasts a more progressive winemaker group, with the highest female wine-maker percentage in the U.S.²³ In 2010 Geneviève Janssens, Director of Winemaking for Robert Mondavi Winery in the Napa Valley, was named Wine Enthusiast's 2010 Winemaker of the Year, one of the highest industry honors. Female enrollment in the U.C. Davis Viticulture and Enology program is nearly 50%.²⁴ Compared to Europe, where as recently as 2000 women were still fighting to be allowed in major vintner associations, Napa Valley winemaking equality is quite progressive. As the image of the wine-making industry changes, Napa proves to be ready to lead that shift.

Napa Valley has a unique status as a deeply-embedded culture that is ever evolving and open, making resilience to climate change through mitigation more possible than in strict traditional European viticulture areas. The future of Napa Valley will affect the entire wine industry. With so much progressive sustainability and cultural movements already occurring, Napa Valley has great potential as a test site for architectural explorations that catalyze a new way of looking at wine production and all agriculture as it adapts to a new climate.

Winemaking/Napa-Green-Certified.

23 Albino Gilbert, Lucia. "Women Winemakers of California | Facts & Figures." Introducing Webpages at SCU | Webpages at SCU. Accessed December 1, 2014. <http://webpages.scu.edu/womenwinemakers/facts.php>.

24 Starke, Geroge. "Female Winemakers." Madonna Estate: Home. Accessed December 1, 2014. <http://www.madonnaestate.com/?-method=pages.showPage&pageid=5fdb4e34-e022-368d-2e96-68f172f384c1>.

Environmental Future

Napa Valley is also leading the industry in terms of Environmental Stewardship. It has already invested greatly in environmental initiatives are driven by an increasingly delicate ecological balance in the agricultural world.²⁵ Figure 5 illustrates many of the county's existing environmental programs. As water and energy resources become scarcer Napa's singularly focused economy and cultural identity is further at risk than ever. Despite the coming environmental risks, Napa Valley has the potential to lead a changing industry as a resilient and successful wine center through innovative architecture, urban planning, and landscape architecture.

Napa's greatest asset is its climate. The current climate is considered "Mediterranean" (warm and dry summers; cool and wet winters), and is ideal for growing wine grapes. The average temperature in December is 57° and 83° in July, with an average annual precipitation of 28". The average growing season in Napa Valley lasts 9 months from March to December. Because grape vines have very specific phenological dates²⁶ associated with creating a particular character in wine, even slight changes in climate have a dramatic effect on the quality of the wine produced. (See figure 6a)

It is precisely this delicate system that puts viticulture and winemaking at such great risk in the coming years. In April 2013 the National Academy of Sciences published their findings on forecasted environmental impacts on the wine grape growing industry. According to the study areas suitable for viticulture will decrease 25% to 73% in California's major wine producing regions by 2050 due to extended periods of high temperatures during the regular growing season.²⁷ Areas suitable for wine grape growing will shift significantly north, further towards the interior of the country and closer to the coastline on Pacific side of California. (See Figure 6b) Napa Valley will see an increase in the average annual temperature of 4-8° F. As a result periods of high temperature will last longer.

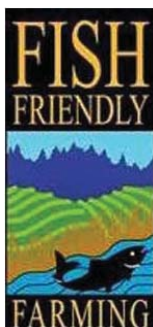
Napa Valley gets most of its water as a result of melting ice packs in the Sierra mountains. However, as temperatures increase less snowfall will occur and less yearly melt will lead to major drought issues in the valley. Also, as a result of the high temperatures less direct rain will fall in Napa Valley increasing the drought concerns.²⁸

25 Hoffman, Matthew, Mark Lubell, and Vicken Hillis. "Sustainability Practice Adoption and Management Goals of Napa Valley, CA Winegrape Growers." University of California, Davis (2012):

26 Phenological Dates: Relationship between climate and annual biological phenomena, such as bud break on the grape vine.

27 Hannah, Lee, Patrick Roehrdanz, Makihiko Ikegami, Anderson Shepard, Rebecca Shaw, Gary Tabor, Lu Zhi, Pablo Marquet, and Robert Hijmans. "Climate change, wine, and conservation." *Proceedings of the National Academy of Sciences* 110, no. 110 (2013): 6907-6912.

28 Pierce, David W., Tapash Das, and Daniel Cayan. "Sustainability Practice Adoption and Management Goals of Napa Valley, CA Winegrape Growers." University of California, Davis (2012): "Climate Dynamics: Observational, Theoretical and Computational Research on the Climate System" 40, no. 3-4 (2012): 839-856.



**Figure 5: Sustainability Initiatives
Actively Used in Napa Valley**

The California Sustainable Winegrowing Alliance

"The California Sustainable Winegrowing Alliance (CSWA) developed a third-party certification program related to the California Sustainable Winegrowing Program (SWP) to increase the sustainability of the California wine industry by promoting the adoption of sustainable practices and ensuring continual improvement. The goals of the certification program, Certified California Sustainable Winegrowing (CCSW-Certified), are to enhance transparency, encourage statewide participation and advance the entire California wine industry toward best practices in environmental stewardship, conservation of natural resources and socially equitable business practices."¹

Napa Green Certified Land

"The Napa Green Certified Land program is a third-party certified, voluntary program for Napa County vintners and grape growers that seeks to restore, protect and enhance the regional watershed. The program includes not only farmed or vineyard land, but also non-farmed and wild land, roadways, stream banks, drainages, and more within a specific property."²

Napa Green Certified Winery

"The Napa Green Certified Land program is a third-party certified, voluntary program for Napa County vintners that focuses water conservation, energy conservation, pollution prevention, and solid waste reduction elements and requires vintners to perform a comprehensive analysis of their operations."³

Fish Friendly Farming

"The Fish Friendly Farming Environmental Certification Program is run by the California Land Stewardship Institute, a non-profit organization located in Napa County, California. It encourages practices that protect endangered fish in the Sonoma, Mendocino, Napa, Solano, and El Dorado county watersheds."⁴

The Code of Sustainable Wine Growing

"The foundation of the Sustainable Winegrowing Program (SWP) and a tool for program participants to measure their level of sustainability and to learn about ways they can improve their practices. It addresses ecological, economic and social equity criteria through an integrated set of 15 chapters and 191 criteria, which includes a built-in system with metrics to measure performance."⁵

The Lodi Rules For Sustainable Winegrowing

"The Lodi Rules for Sustainable Winegrowing is California's first 3rd party-certified sustainable winegrowing program. It promotes practices that enhance biodiversity, soil and water health, community and employee well-being, while meeting our needs today without compromising the needs of future generations."⁶

California Certified Organic Farmers

"CCOF is a full-service organic certification agency and trade association passionate about being the leading voice for organic, and certifying, educating, advocating, and promoting organic."⁷

1 California Sustainable Winegrowing Alliance. "California Sustainable Winegrowing Alliance | About CCSW-Certified." California Sustainable Winegrowing Alliance. Accessed December 9, 2014. <http://www.sustainablewinegrowing.org/certified-sustainable-winegrowing.php>.

2 Napa Green Certification Program. "What is Napa Green?" Napa Green. Accessed December 9, 2014. <http://www.napagreen.org/about/>.

3 Napa Green Certification Program. "What is Napa Green?" Napa Green. Accessed December 9, 2014. <http://www.napagreen.org/about/>.

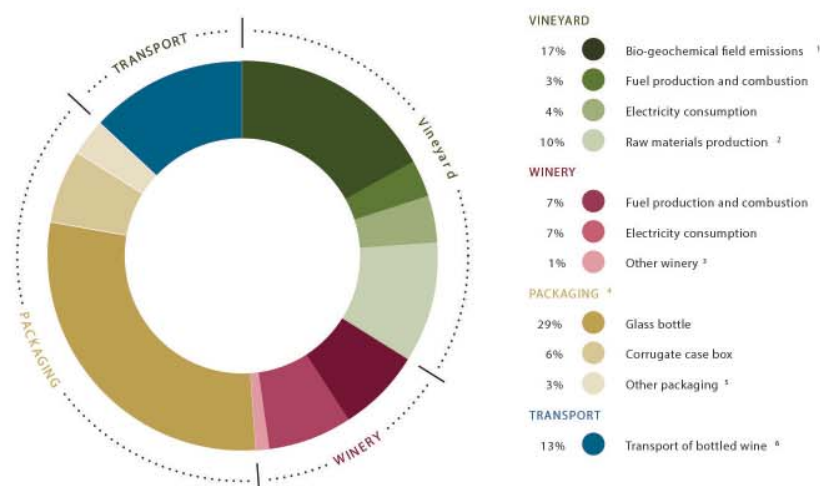
4 California Land Stewardship Institute. Fish Friendly Farming. Accessed December 9, 2014. <http://www.fishfriendly-farming.org/>.

5 California Sustainable Winegrowing Alliance. "California Sustainable Winegrowing Alliance | SWP Workbook." Accessed December 9, 2014. <http://www.sustainablewinegrowing.org/swpworkbook.php>.

6 Lodi Rules. "Lodi Rules." Lodi Wine. Accessed December 9, 2014. <http://www.lodiwine.com/certified-green/lo-di-rules-for-sustainable-winegrowing>.

7 California Certified Organic Farmers. CCOF | Organic certification, education and outreach, advocacy and leadership since 1973. Accessed December 9, 2014. <http://www.ccof.org/>.

FIGURE 1 Relative impacts for the carbon footprint of packaged wine, cradle-to-retail gate



- ¹ Footprint associated with greenhouse gas emissions that are a result of natural bio-geochemical processes and impacted by local climate, soil conditions, and management practices like the application of nitrogen fertilizers.
- ² Footprint associated with the manufacture and shipment of materials used at a vineyard such as fertilizers and pesticides.
- ³ Footprint associated with the transport of grapes from vineyard to winery, raw material production, refrigerant losses, and manufacturing waste treatment.
- ⁴ Footprint associated with the manufacture and shipment of materials used for packaging wine.
- ⁵ Footprint associated with the natural cork closure with aluminum foil and treatment of waste at packaging manufacture.
- ⁶ Footprint associated with fuel production and combustion in trucks and trains based on typical distances for the industry when shipping in the United States to retail facilities.

Environmental Impact Of Wine

A single bottle of Terre della Baronia

Produces more than a pound of waste and releases 16 grams of sulfur dioxide into the air.

2014 Production of 100,000 bottles of wine

Produces 22,000 pounds of plastic waste, 11,000 pounds of paper, and oceans of wastewater.

Water

It takes 31 gallons of water to make a single glass of wine.

Carbon Footprint

Producing a bottle of wine produces 1.28kg CO2-equivalent emissions.

Minor sources of CO2-Equivalent emissions:

fermentation process, pesticides and fertilizers

Major sources of CO2-Equivalent emissions:

Fossil fuels used in grape growing

Vineyard Field processes produce emissions from combustion of fossil fuels to operate farm equipment and irrigation systems, N2O from bio-geochemical processes, and nitrogen applications to

Transportation/Distribution

Fossil fuels produced by shipping also account for a large amount of emissions. Most wine shipped by truck. Shipping a bottle from Napa to NY produces 4.4 lbs CO2-equivalent emission.

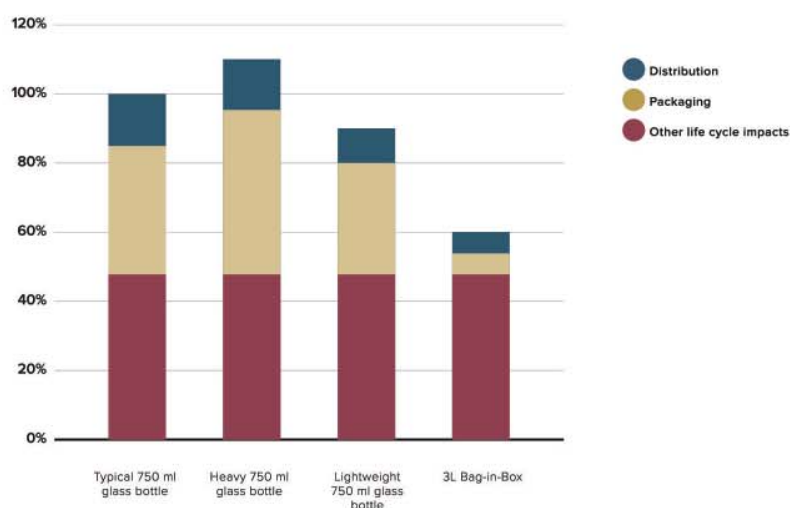
Raw Materials For Packaging

The manufacturing and shipping of glass used for wine bottles accounts for 29% of emissions. Cardboard accounts for 6% and cork and foils account for 3%.

Alternative "greener packaging" bag-and-box format, box tetrapack, boxed wine, and even some distributors now are producing wines in plastic bottles. (See Figure 9.1)

FIGURE 2 Packaging alternative assessment for the carbon footprint of packaged wine

Using an average 750 ml bottle as the baseline (100%) and a fixed impact for all upstream life cycle stages (grape and wine production), this graph illustrates packaging impact of various types of glass bottles (traditional, heavy and light weight) and 3L bag-in-box scenarios.



⁷ Glass Packaging Institute (GPI), 2010, Environmental Overview, Complete Life Cycle Assessment of North American Container Glass, www.gpi.org/sites/default/files/N-American_Glass_Container_LCA.pdf

Figure 10: Carbon Footprint of Winemaking

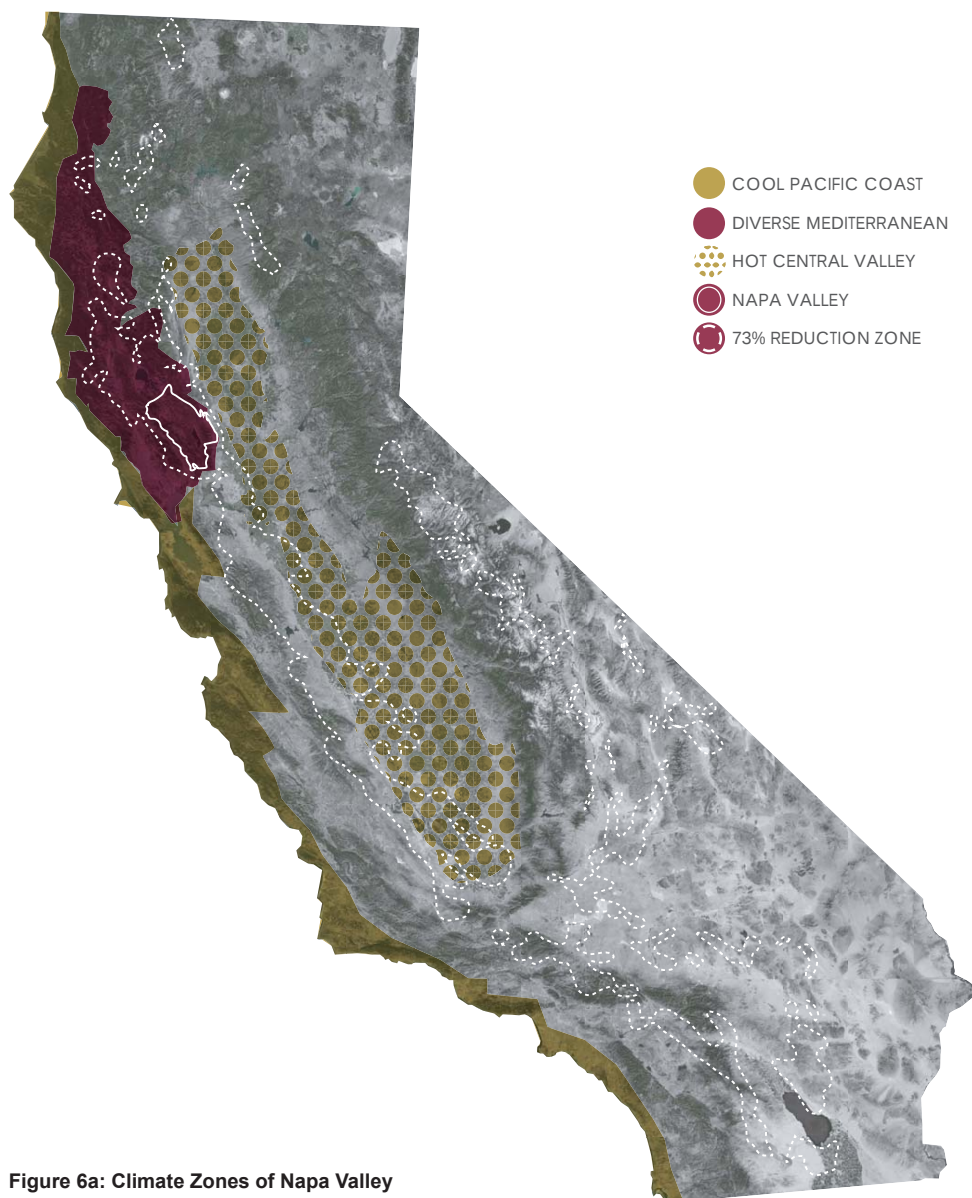


Figure 6a: Climate Zones of Napa Valley



Figure 6b: Growing Cycle of *Vitis Vinifera*

The current Napa varietals, wines made from a particular type of grape with specific characteristics, are matched directly to environmental needs that are fulfilled by the Mediterranean climate currently available in the valley. The extended high temperatures will lead to an increase in sugar production within the grape berry. During the fermentation in the process of winemaking these sugars are converted to alcohols. (See Figure 7)

An increase in sugar will produce a much higher alcohol content in wine which will mask the desired tasting characteristics that make Napa wine so popular. Figure 8 illustrates the wine making process. Essentially, as is, production of wine from grapes grown in Napa will no longer be feasible within the next 35 years. Climate change will fundamentally alter terroir. Prices of grapes grown in Napa Valley currently sell at a higher price than any others in the United States, in part because they are believed to produce a specific preferable terroir. Because terroir is tied both metaphorically and physically to the soil of Napa Valley its continued success depends on remaining in place.

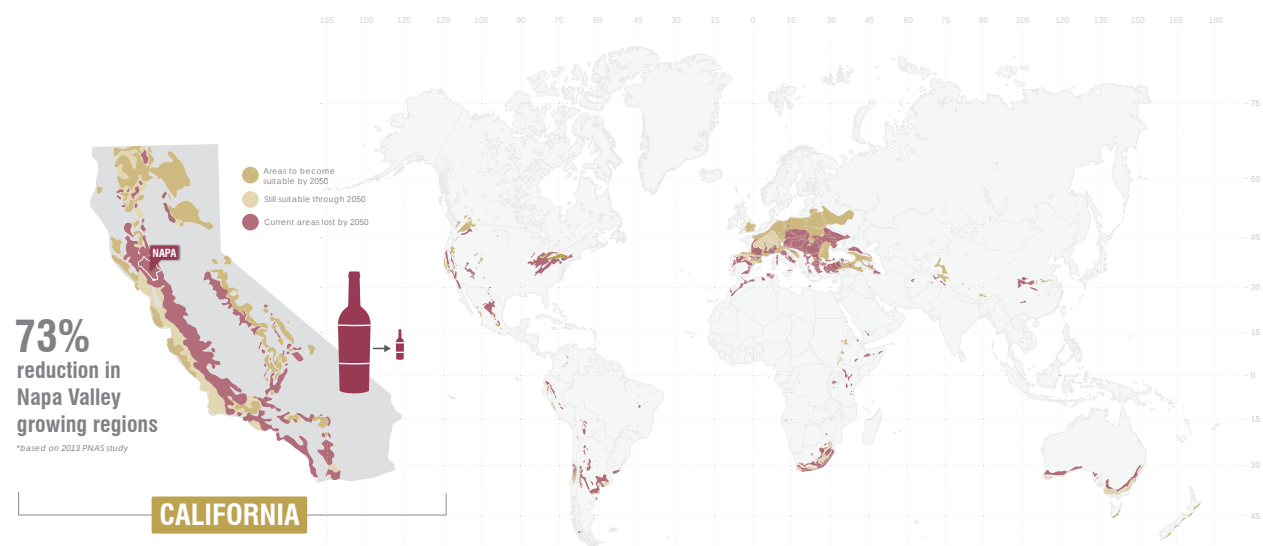


Figure 7a: Shifting Agricultural

HOW RED WINE IS MADE

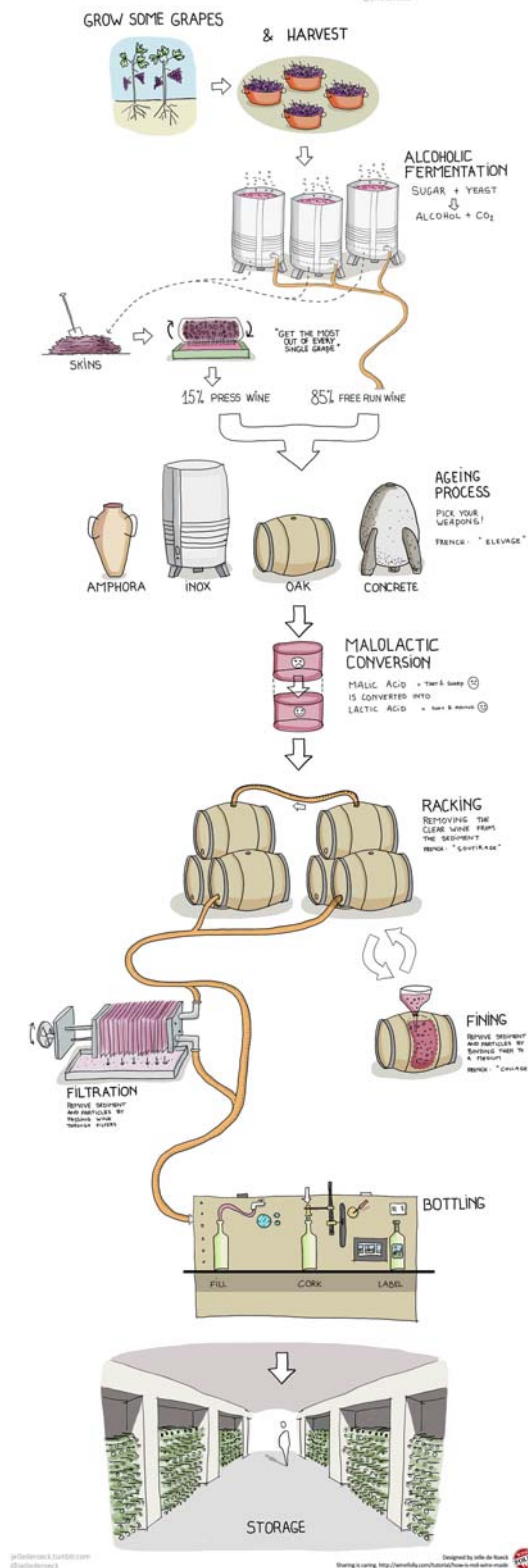


Figure 8: Winemaking Process

Terroir Significance of Place

So one might ask then, whether production of wine can continue with grapes sourced from the new growing areas? This is where science and culture collide in what is known as “Terroir”. The word *terroir* is derived from the French term for land. It is defined as “the complete natural environment in which a particular wine is produced, including factors such as the soil, topography, and climate.”²⁹ Viticulturists actively maintain, monitor, and choose soils that match particular grape varieties in order to express elements of the *terroir* in the taste character of the wines they are producing. Figure 9 shows the interrelation of all the scientific factors involved in *terroir*. Wine historian, Robin Grossinger, explains that Napa Valley has an especially strong interests in the soil ecology of its agricultural landscape:

“More so than in many places, the land is still appreciated in Napa. The subtleties of alluvial fans and weather patterns are studied and discussed, respected as the foundation for the local culture and economy. Within the agricultural community there is tremendous knowledge of the topography, soils, and microclimates of the valley, and their expression in the subtle characteristics of local wines.”³⁰

What cannot be seen in the chemical makeup of the final grape is the sense of *terroir* as an undefinable cultural idea. The grape berry itself is a vessel for all the elements around it. Within it we can find how the water ran from the glaciers, and how the mountains forced the winds full of yeast, pollen, and living beings into its path, and what gifts the ground would yield and what it would not. The grape carries a story. The plot twists and turns around human interventions and human history. A bottle of wine is not simply the end product, it is a timeline that began long before the first vines were planted. To taste wine is to taste the beginning. *Terroir* is not just a recipe of ingredients, it is a folk tale. It has a perceived essence that cannot be proven by science, but that reminds us of our connection to the first civilizations. We no longer retell the tale in Greek, but we do not forget that Achilles and Priam, enemies, drank wine together lamenting the pain and loss of war.

*“Then I lamented and brooded over my endless sorrows, and groveled in the dirt in my courtyard. Now I have tasted food and wetted my throat with red wine, who until now tasted nothing.”*³¹

-Homer, The Illiad Bk XXIV:621-676

29 Oxford Dictionaries. “*terroir*: definition of *terroir* in Oxford dictionary (American English) (US).” Accessed December 1, 2014. http://www.oxforddictionaries.com/us/definition/american_english/terroir.

30 Grossinger, Robin, Ruth Askevold, and Julie Beagle. Napa Valley Historical Ecology Atlas Exploring a Hidden Landscape of Transformation and Resilience. Berkeley: University of California Press, 2012.

31 Homer. Homer, The Illiad Bk XXIV:621-676. n.d.

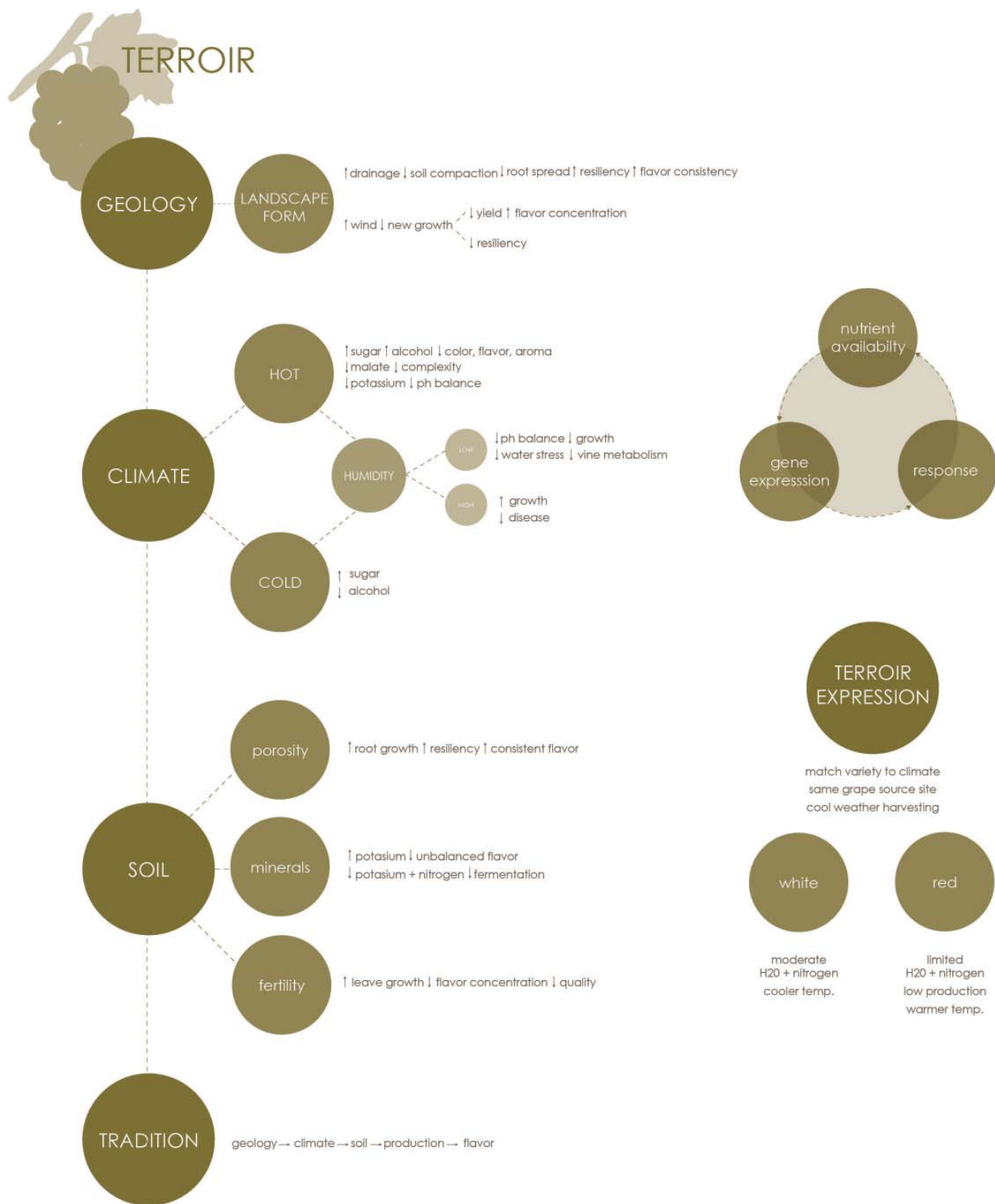


Figure 9: Factors of Terroir Expression in Wine

Through wine we are connected to worlds that danced in tune with the ebb and flow of nature. It is this that makes the place in which the soil resides so important and so delicate.

The idea of *terroir*—the influence of the land on the nature of a wine—may be the fundamental concept underlying today’s Napa Valley, expressed in the quality of its wines, the diversity of appellations, and the economic value associated with the Napa name. In Napa, the sense of place is still celebrated. At the same time, the Napa Valley has become an iconic landscape, a powerful international symbol. Orderly vineyards and grand estates convey an image of a harmonious, pastoral landscape.³²

The essence of *terroir* has great relevance to architecture. Wine is fundamentally formed and informed by place. Architecture should to be formed and informed by place, a sense of geography, history, climate, people, and culture. Architecture’s role in the changing climate of Napa Valley is to preserve the essential cores of culture through a careful understanding of and response to place. The thesis seeks to explore the capacity of architecture to not only embody and reflect these issues of place but also to mitigate and preserve culture through architecture. The solution must take a holistic approach that preserves the non-physical “*terroir*” that is the heart of the cities through inventive architecture that functions ecologically as well as culturally.

³² Grossinger, R. (2012). *Napa Valley Historical Ecology Atlas: Exploring a Hidden Landscape of Transformation and Resilience*. CA: University of California Press.

Scales

“At first glance, the loss of cultural diversity may seem insignificant in comparison with climate changes like sea-level rise, ocean acidification and mass extinctions of plants or animals. But just as biophysical diversity improves the resilience of natural systems and acts as buffer against adverse conditions, cultural diversity offers a resilient knowledge base for adapting to and counteracting the effects of climate change.”

-Dylan Walsh, *Climate Takes a Toll on Cultures*

What seems to be most ignored by current architectural dialogue on climate change response is a focus on smaller communities, like Napa Valley. While it is fair to say that suburban sprawl is irresponsible in a world of scarce resources and climate concerns, assuming that we all must live in dense urban centers ignores the cultural importance of many outlying communities, especially agricultural. Instead we must find solutions that view sustainability and preservation in a holistic manner, maintaining important cultural identities through the highest efficiency.

Intervention and mitigation solutions must address multiple scales. On the international scale we must look at how or if Napa Valley can continue to compete at an international level while not increasing its carbon footprint through high resource dependent importing and exporting. Figure 9 shows the environmental impact of winemaking. Napa's identity as a major tourist destination in the United States will also affect its world view, as many of its visitors are international.

Napa's victories in Paris and the continued success of Napa Valley wines has had a great impact on the nation's identity as a major wine producer. Without Napa Valley, America will have lost a major historical icon that will certainly affect its credibility as a wine producer in the international market. The majority of tourism in Napa Valley is also from the United States.

The state of California has an even greater stake in Napa's health, as wine country has become synonymous with California as an epicurean center and tourist destination. Napa Valley works as part of a collective wine identity for the United States along with its sister American Viticulture Areas (AVA's), such as Sonoma and Woodbridge. As shown in Figure 4, wine-related sales and tourism in Napa have a major impact on the state's economy. Everything from tax income to salary redistribution fertilize California's economy.

On a small scale, individual towns within the Napa Valley will see the most direct impact from changes in climate. To understand how to frame the solution we must understand the individual identities that make up Napa Valley. We must illustrate the unique place it holds in the world that will be lost.

The wine industry is not alone in its vulnerability to climate change. “These impacts are of broad significance because they may be illustrative of conservation implications of shifts in other agricultural crops.”³³ Agricultural areas all over the world and in America will face the hurdles to survival. Areas, like Napa Valley, that have an economy almost entirely focused on a product that may not be able to thrive in a much warmer and drier future are all at risk. Many have already seen significant adversity as resources become scarcer forcing the industry into the hands of only the few corporations with the financial backing to withstand changes. It is vital to the American landscape that we find a way to prevent future decay of agricultural communities that were once the backbone of the country. Towns and communities are held together by cultural identities created by how they fit into the economic cycle of the world. Technological communities drive innovation and better standards of living, educational communities teach future generations, and agricultural communities feed the world.

“We need to view the fragility of the planet and its resources as an opportunity for speculative design innovations rather than as a form of technical legitimation for promoting conventional solutions. By extension, the problems confronting our cities and regions would then become opportunities to define a new approach. Imagining an urbanism that is other than the status quo requires a new sensibility — one that has the capacity to incorporate and accommodate the inherent conflictual conditions between ecology and urbanism. This is the territory of ecological urbanism.”

-Mohsen Mostafavi, *Ecological Urbanism*

33 “Climate Change, Wine, and Conservation.” *Proceedings of the National Academy of Sciences* 110, no. 17 (2013): 6907–6912. Accessed July 15, 2014. www.pnas.org/cgi/doi/10.1073/pnas.1210127110.

Statement of Thesis

The thesis seeks to explore the capacity of architecture to not only embody and reflect these issues of place but also to mitigate climate change and preserve culture through architecture. The program proposal seeks to develop an architecture that provides strategies of resilience for viticulture and for the communities of Napa Valley. To accomplish this it must create new systems that mitigate negative changes in climate, strengthen the community through overlapping ecologies and programming as well as raise public awareness of climate change, of the sustainability impacts of viticulture and other forms of agriculture, and the cultural significance of wine making in Napa Valley. Napa Valley is not alone. These solutions can serve as a model for other agricultural communities facing the same uncertain future. By understanding the cultural context of small communities we can design architecture and landscape solutions that preserve important cultural landscapes and create resilient communities.

PART TWO: REFERENCING

Worst Case Urban Scale - Detroit, MI

It does not take much imagination to understand the impact of loss of industry on the singularly focused economy. Major interest in adaptive re-use in recent years is a direct result of the crumbling economic infrastructure in several major cities, particularly Detroit, Michigan.

Detroit was once a booming city. Early successes and strategic planning along the Great Lakes made it a major transportation hub.³⁴ At its peak in 1950 Detroit was home to 1.8 million people in ³⁵ and ranked as the fourth-largest U.S. city.³⁶ (See figure 12a) Its largest success came at the hands of the manufacturing industry, primarily cars. Detroit became synonymous with the notion of manufacturing for the American car, with Ford, Dodge, and Chrysler, making it their home of operation.

However, after this peak in the 1950s the Detroit auto industry started to see a steady decline, as did the city's population as a result. Fueled by suburban flight, many manufacturing plants moved facilities to the outside of the city, effectively spreading job opportunities further from a centralized and accessible core. Additional hits to employment resulted from automation in plants.³⁷

By the 1980s, foreign competition destroyed profits and by the next major recession in 2007, the industry had significantly declined further. The city was left with pension and retiree healthcare costs for an aging population and no younger work force to supply tax funding. By 2010, the population had dropped to fewer than 714,000 people. On December 3, 2013, Detroit officially declared bankruptcy, with \$18.5 billion in debt.³⁸

Though Detroit's manufacturing industry differs from the natural world of agricultural, it provides a clear illustration of collapse as a result of lack of preparation for a changing industry. The politics behind Detroit's health are more complex than that of Napa Valley, mostly in part to its role

³⁴ Replace

³⁵ 1950 census

³⁶ Padnani, Amy. "Anatomy of Detroit's Decline." The New York Times (New York, NY), December 6, 2013, U.S.. http://www.nytimes.com/interactive/2013/08/17/us/detroit-decline.html?_r=1&.

³⁷ Padnani, Amy. "Anatomy of Detroit's Decline." The New York Times (New York, NY), December 6, 2013, U.S.. http://www.nytimes.com/interactive/2013/08/17/us/detroit-decline.html?_r=1&.

³⁸ Lichterman, Joseph, and Bernie Woodall. "In largest-ever U.S. city bankruptcy, cuts coming for Detroit creditors, retirees." REUTERS (Detroit, MI), December 3, 2013. <http://>



Figure 12a: Detroit Neighborhood Decline Right: 2010 Left: 1950

as an major urban center, but Napa Valley and other agriculturally focused economies are all at the same risk because of shifting climate conditions.

Most importantly, Detroit shows that the city is a living organism. Removing a single organ creates a domino effect. All parts of a city—no matter its size—become part of a symbiotic system, requiring health of every individual part for health of the whole. The decline in the auto industry effectively dried up a stream of revenue that feed the entire city through a trickle down effect. Detroit's decline is a black scar on the American cultural landscape. (See Figure 12b)



Figure 12b: Detroit: Decline of city growth

Worst Case Rural Scale - Hale County, AL

Hale County is on a long list of rural farming communities that have been left behind by a shifting industry. One might look at the farming industry in terms of two distinct industries: small farming and large scale corporate farming. Before the question of climatic impacts even entered the conversation small farming, owned by individual families fell victim to a different, inherently political shift.

“In Hale County, Alabama, you see ghost buildings, abandoned barns, tumbledown shanties, and rustier trailers — fragile remnants of a more prosperous agrarian past...Hale is a left behind place.”

-Andrew Oppenheimer, *Rural Studio*— Samuel Mockbee and an Architecture of Decency

Large corporations employed industrial methods to food production, benefiting from the efficiencies of scale and mechanization that the small family farmer could not afford. This allowed them great privilege to essentially run the industry, setting prices, influencing regulations, and gaining exclusivity to scientific gains in crop resistance and resilience. The small farmer became the victim of the new playing field. Without the financial pool to invest in these items himself, he had to choose to either to work under large agri-corporations with little power or entirely give up farming. The 1990 Census of Hale County shows per capita income as \$8,164, and 1,700 families still living in low-quality housing.³⁹

In recent years the spotlight has been put on Hale County as interest in the future of smaller agriculture towns grows as the downside of industrial farming becomes more apparent to the consumer. It has been a favorite site of the rural studio, led by Sam Mockbee which investigates revitalization of small financially weak towns through obtainable economically efficient design. (See Figure 13b) The county, made up of several small towns, Greensboro, Akron, Moundville, and Newbern, was once a thriving cotton town. Today the towns struggle to get by on catfish farming that is becoming increasingly at the will of industrialized food systems.⁴⁰

Hale County exemplifies a systemic problem across America, a shift away from a defining agricultural way of life for thousands of small towns leaving them without a means to sustain themselves. What is left behind are the shells of communities that once thrived. On a small scale, these towns see the same domino effect that occurred in Detroit: The major industry moves out and a population heavily dependent on this single industry is suddenly unemployed. Most

³⁹ Oppenheimer Dean, Andrea. "The Hero of Hale County: Sam Mockabee." Architectural Record <http://archrecord.construction.com/people/interviews/archives/0102mockbee-1.asp>

⁴⁰ Rupinski, Patrick. "Catfish farmers seeking answers." Tuscaloosa News (Tuscaloosa, AL), June 8, 2012, 1-3.

residents move to find work elsewhere and those that stay struggle financially while tax funded civic projects, including educational systems, crumble furthering the problem of unemployment. Businesses see no opportunity therefore decide not to build. Eventually you are left with a once booming town struggling to survive and a ghostly main street as shown in Figure 13a.

“Today, industrial farmers are the most efficient food producers history has ever known. One farmer produces food for 117 people. A remarkable accomplishment, but with unintended negative consequences for the environment, and for the health of people and communities. And for traditional small scale non-industrial farmers.”

-Michael Pollan, *The Omnivores Dilemma: A Natural History of Four Meals*

Towns, such as those in Hale County, are continually absorbed into the system and ruins are left behind. These strongholds of American agricultural heritage slowly fade from memory to as if they never existed. It is not Thoreau’s idyllic natural landscape that is lost, but functional rural communities that worked as part of the system of survival, a cycle of life cultivated by man’s hands.

Towns, like these and Napa cannot become collateral damage of a drastically changing world. Too much is at stake for the individuals living there, the diversity of the American cultural landscape, as well the health of food and economic systems. Instead of moving away from small farming we should address the short-comings that made them sensitive to changes. Through them we can explore how to create better built, self-sufficient communities with stronger connections to the dense centers that continue our nation’s agrarian heritage.



Figure 13a: An Empty Main Street Greensboro,Hale County, AL



**Figure 13b: Rural Studio, Hale County
Left: Butterfly House, Right: Safe House**

So how have others dealt with a declining cultural community as a result of major environmental or economic changes? Many tangible small scale solutions have resulted from research outside of the discipline of architecture but incorporate built design elements.

Case Studies: Fog Catchers

On the outskirts of Lima, Peru, hillsides that surround the city are occupied by small impoverished villages.⁴¹ Few jobs are available for the communities made up mostly of people who have migrated from rural exterior lands seeking employment. The hillsides provide inexpensive land, but little else. Water is the largest issue, with only ½ inch annual rainfall.⁴² In the city below an extensive water network is able to access a greater watershed, pulling in water from long distances. However, on the hillside no such system exists, leaving the villages without a vital resource to cook, clean, eat, or grow food.

Alimón, a nonprofit run by two biologists studying solutions for Latin American development, offered the solution. Looking back at passive solutions from over a hundred years ago they implemented Fog Catchers, large low-tech wood frames with a simple mesh screen. (See Figures 14-15) The Fog Catchers capture the mountain fog that sweeps across the mountain from June through November.⁴³ The water is collected and fed down into the villages through a series of channels into underground cisterns.

With a few thousand dollars and some volunteer labor, a village can set up fog-collecting nets that gather hundreds of gallons of water a day—without a single drop of rain falling.⁴⁴

Surrounded by fog, the simple structures also become activated sculptural elements in the landscape. The channel networks that lead down the hill are beautiful collages of colorful tiles reclaimed from a trash site. They serve as highly visible reminders of conservation, and also become part of the traditional landscape in these relatively new developments.

These small steps lead to a adaptive landscape and a permanently sustained system similar to what once existed. As water availability increases so will vegetation and tree life, which act as

41 Fields, Helen. "Fog Catchers Bring Water to Parched Villages." National Geographic (2009): <http://news.nationalgeographic.com/news/2009/07/090709-fog-catchers-peru-water-missions/>.

42 Fields, Helen. "Fog Catchers Bring Water to Parched Villages." National Geographic (2009): <http://news.nationalgeographic.com/news/2009/07/090709-fog-catchers-peru-water-missions/>.

43 Fields, Helen. "Fog Catchers Bring Water to Parched Villages." National Geographic (2009): <http://news.nationalgeographic.com/news/2009/07/090709-fog-catchers-peru-water-missions/>.

44 Fields, Helen. "Fog Catchers Bring Water to Parched Villages." National Geographic (2009): <http://news.nationalgeographic.com/news/2009/07/090709-fog-catchers-peru-water-missions/>.

natural fog catchers and make the regions microclimate more temperate. The residents then can rely on an agricultural system that provides livelihood and sustenance, while strengthening a sense of community through shared goals.

This is not just a simple retrofit solution to a pre-existing problem, it is the first of many tests in an area that will continually be changing in the coming years as a result of climate change. As glacial snow packs melt and annual snowfall in the Andes Mountain shrinks, water will become far scarcer for all of Peru, creating shortages for all industries, particularly the agriculture needed to feed the city. Similar results are predicted for Napa because of its dependence on the Sierra snow pack.⁴⁵ Small solutions and investment in sustainable research will be key to adapting in the years to come. Alimon's approach started at the human scale, understanding who they were helping. By doing this they were able to understand the core issue from which a multitude of opportunities spread to benefit all cultural scales.

⁴⁵ Napa County Transportation and Planning Agency. Napa County Community Wide Climate Action Framework. Napa, CA: Napa County Transportation and Planning Agency, 2009. http://www.napawatersheds.org/files/managed/Document/4269/Draft_napa_climate.pdf.



Figure 14: Fog Catchers Lima, Peru



Figure 15:
Fog Catchers - Lima, Peru
 [From right] Catcher runoff channel, villagers moving recycled materials, young trees planted to eventually replace fog catchers.

Case Studies: Wadi Hanifa Comprehensive Development Plan

On a larger scale the Wadi Hanifa Comprehensive Development Plan Watershed in the arid central highlands of Saudi Arabia is an example of another response to urban development that combines small scale interventions at the level of fog catchers along a much larger context to create a system that changes the way a whole city will potentially work.

The Wadi Hanifa watershed runs through the capital of Saudi Arabia, Riyadh. The city owes much of its success and expansion to the watershed. A multi-disciplinary team of researchers and designers have conducted multi-year study of these issues. Their preliminary reports explain, “with its palm groves and cool waters, Wadi Hanifa played a vital role in the establishment of Riyadh as a center for trade and travel in the midst of the desert landscape.”⁴⁶ It provided large water and mineral resources as well as becoming means of controlling groundwater. It also became a primary destination for the city’s storm water runoff and waste dumping.

Urbanization, material sourcing, and rapid development have left portions of the watershed polluted and full of water-born diseases. The researchers explain, “Despite amazing ecological diversity, lush vegetation and animal life, the people of Riyadh have little appreciation or understanding of the surrounding ecosystem or the consequences of their activities on its recuperative capacity.”⁴⁷ (See Figure 16)

In 2001 the High Commission for the Development of Riyadh commissioned the joint venture of Moriyama & Teshima Planners Limited (MTPL) and Buro Happold to develop a comprehensive development plan for Wadi Hanifa in order to prevent further damage and remediate the weakened sections, to better the health of the entire watershed.

The approach is “holistic and multi-disciplinary,” understanding the importance of creating a system that integrated human cultural needs, economics, ecology, and conservation.⁴⁸ The first goal of the new plan was creating a long-term vision for the Wadi as a clean sustainable public amenity. MTPL describes the future “Living Wadi” and Riyadh’s new “urban waterfront”, as a park that extends across the city connecting surrounding rural areas to the urban center. The project is “a sustainable setting where residential neighbourhoods, farming, recreation, cultural

46 Moriyama & Teshima Planners Limited. “Case Study: Comprehensive Development Plan for Wadi Hanifah.” Moriyama & Teshima Planners Limited. Accessed October 5, 2014.

47 Moriyama & Teshima Planners Limited. “Case Study: Comprehensive Development Plan for Wadi Hanifah.” Moriyama & Teshima Planners Limited. Accessed October 5, 2014.

48 Moriyama & Teshima Planners Limited. “Case Study: Comprehensive Development Plan for Wadi Hanifah.” Moriyama & Teshima Planners Limited. Accessed October 5, 2014.



Figure 16a: Wadi Hanifa after years of neglect and urban expansion.

activities, and tourism would co-exist in harmony.”⁴⁹

The plan acknowledges the complex relationship between human systems and the natural environment, understanding the need to integrate the needs of tourism, agriculture, recreation and continued housing demand. MTPL focuses on meeting all these in a manner that “repairs and sustains the natural environment.”⁵⁰

The last key principle is to understand the complexity of the Wadi watershed’s role in ground-water availability, storm water movement, and treatment of plant resources. As water is such a scarce resource steps must be taken to create a system that uses it much more efficiently and makes it “capable of constant regeneration so that the Living Wadi can be passed on to future generations.”⁵¹

The plan was multi-tier, starting with restructuring the governmental authorities and creating a new separate entity focused solely on the project issues, The Wadi Hanifa Reserve Directorate. It “would guide the type, scale and pace of restoration and development throughout the watershed, coordinate with overlapping jurisdictions, establish standards for environmental quality, monitor conditions, enforce protection measures, create an environmental database, and provide public education.”⁵²

To return the Wadi zone to its original desert regenerative abilities the new plan “re-profiled and re-graded” the terrain around it. MTPL describes design as “a series of naturalized landscapes would be created on publicly-owned wastelands along the water’s edge with water features and indigenous trees, grasses, and shrubs. These naturalized landscapes would stabilize riverbanks and deter the migration of contaminants from urbanized areas.”⁵³

Water is treated as efficiently as possible. Multiple catchment interventions minimize extensive irrigation systems and promote water movement. Landscaping strategies that incorporate indigenous plants increase water retention and protect significant animal species with minimal human intervention after the initial development.

49 Moriyama & Teshima Planners Limited. “Case Study: Comprehensive Development Plan for Wadi Hanifah.” Moriyama & Teshima Planners Limited. Accessed October 5, 2014.

50 Moriyama & Teshima Planners Limited. “Case Study: Comprehensive Development Plan for Wadi Hanifah.” Moriyama & Teshima Planners Limited. Accessed October 5, 2014.

51 Moriyama & Teshima Planners Limited. “Case Study: Comprehensive Development Plan for Wadi Hanifah.” Moriyama & Teshima Planners Limited. Accessed October 5, 2014.

52 Moriyama & Teshima Planners Limited. “Case Study: Comprehensive Development Plan for Wadi Hanifah.” Moriyama & Teshima Planners Limited. Accessed October 5, 2014.

53 Moriyama & Teshima Planners Limited. “Case Study: Comprehensive Development Plan for Wadi Hanifah.” Moriyama & Teshima Planners Limited. Accessed October 5, 2014.

Bioremediation of the watershed will also provide a “cost-effective, long-term solution” of clean fresh water instead of the current high energy usage desalination process that provides most water in the urban center. Microhabitats enabled by the new system “provide the building blocks for a complex food web” producing sustenance for local residence.⁵⁴

In addition to direct river interventions the plan will create a new eight-meter deep clean water reservoir to provide water to the urban center via a pipeline infrastructure. According to the MTPL case study release “by 2021, one million cubic meters of recyclable water daily should be available in the Wadi channel, achievable for the most part through bioremediation.”⁵⁵

Through a system of trails a series of public open spaces, natural landscapes interpretation centers, cultural and heritage sites, and commercial ventures are connected along the Wadi. MTPL says “encouraging people to venture into the Wadi’s natural landscapes will help to educate them about nature and raise consciousness about the importance of ecological sustainability.”⁵⁶ (See Figure 16a).

The plan also hopes to bolster cultural connections that attract regional and international tourism and benefit a difficult economy. Archaeological sites, recreation and entertainment programs, as well as ecotourism destinations will be developed along the Wadi to drive private investment as well.

The Wadi Hanifa restoration exemplifies a holistic approach. In Napa Valley similar interests are at play. To maintain a culture that is becoming more and more at odds with nature steps need to be taken to connect the human system back with the natural systems around them. The Wadi plan also incorporates this understanding of the greater political and economical factors at play. By creating educational and tourism destinations they promote community understanding of the issues and further investment in the future of the Wadi.

The fundamental issue at the heart of these case studies is that within all of them is a sense of loss much greater than anything financial or material. It is the loss of heritage and identity. Many Americans felt a self-awareness when Detroit crumbled. This icon of the core values of the

54 Moriyama & Teshima Planners Limited. “Case Study: Comprehensive Development Plan for Wadi Hanifah.” Moriyama & Teshima Planners Limited. Accessed October 5, 2014.

55 Moriyama & Teshima Planners Limited. “Case Study: Comprehensive Development Plan for Wadi Hanifah.” Moriyama & Teshima Planners Limited. Accessed October 5, 2014.

56 Moriyama & Teshima Planners Limited. “Case Study: Comprehensive Development Plan for Wadi Hanifah.” Moriyama & Teshima Planners Limited. Accessed October 5, 2014.



Figure 16b: Wadi Hanifa Remediation

industrious vision we had for ourself had suddenly shown its weakness. In Hale County we see the loss of the small farmer as a loss of our connection to the land.

Lima and Riyadh give us hope in the face of an unknown future. From the small to large scale they show an adaptive inventiveness that ignites large change. They show the importance of collective energy from all levels of a community, of education being a key element in the design, of working with the natural rhythms of our landscape, and of continued research through a multi-disciplinary approach.

PART THREE: SITUATING

Moving Forward: Migration, Adaption, and Mitigation

There are three main options to deal with the coming changes to Napa's climate. The wine industry can migrate to areas in the northwest U.S. that will develop ideal growing conditions by 2050, leaving Napa Valley behind. If the wine industry does migrate another option would be accepting loss and adaptively re-using what is left behind to invigorate the economy through creation of a new industry. Last, Napa Valley could mitigate the effects of climate change, creating architecture and infrastructure of resilience that maintain the existing geographical and cultural context.

“We come quickly to the realization that addressing greenhouse gas production is tied to a massive shift in not only the forms of energy we use for transportation, manufacture, and heating, but also therefore a massive shift in the ways of relating to the rest of the world—socially, culturally, environmentally—”⁵⁷

-Sarah Strauss, Cultural Anthropologist

Migration: Shift with the climate

Migration means taking a stance that nature is unstoppable and that the most passive option is to accept its inevitable force and move with it. It is the path of least resistance. Migration is the most likely solution because it does not require any architecture or agricultural innovation and additional financial investment in Napa Valley viticulture can be avoided. (See Figure 17a)

Accepting a changing climate instead of fighting it ties back to an earlier time in our human history of semi-nomadic patterns. To fight nature is seen as our inevitable defeat. Instead we must learn to adapt and evolve with nature. As the wine grape growing conditions move further into formerly cooler areas new industry opens up for those who inhabit these places. The residents of the new northwest wine growing regions will have new opportunities available. New terroirs can be explored, potentially created a new demand.

However, it also requires a lot of resources to start all over. The wine industry will not simply get up and move. A new pool of investment from those that aren't devastated from the decline of Napa's industry will be necessary. There will be great financial loss for those already heavily invested in Napa Valley, further hurting a California economy still rebounding from the 2007

⁵⁷ Strauss, S. (2012) Are Cultures Endangered by Climate Change? Yes, but...WIREs Climate Change 2012. doi: 10.1002/wcc.181.

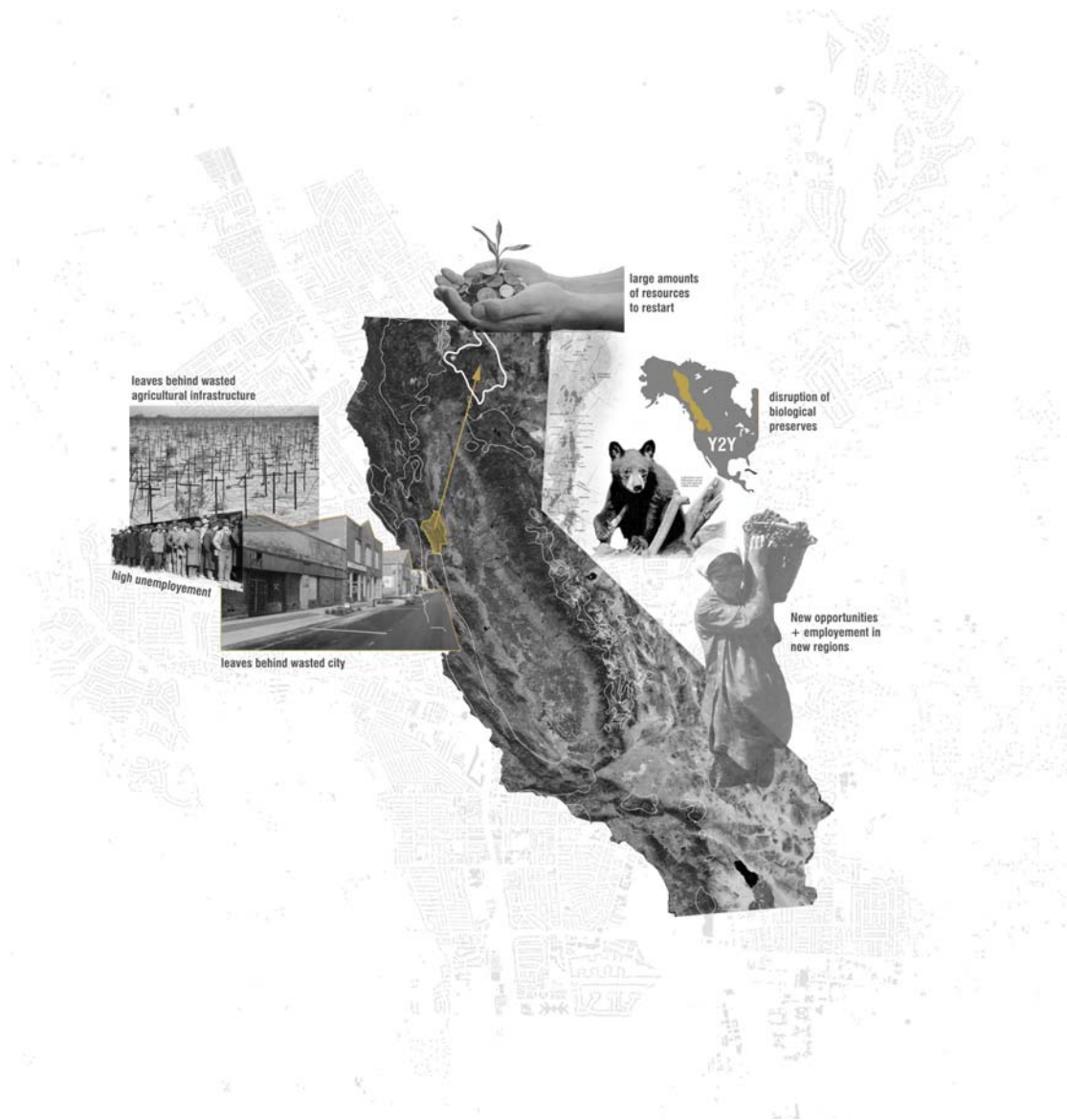


Figure 17a: Migration

recession.

Another important factor to consider is that a complex ecological landscape already exists in Napa Valley. Migrating into new territories will potentially disrupt and harm the existing animal and plant life that depend on those specific geographic areas for protection from climate changes. Wine grape growing requires cleared land to aid circulation, solar access, and specific soil water drainage. This requires drastic changes to lands that already are home to much biodiversity, likely having devastating effects on the native plants and animals. Much of the new area falls within the “Yellowstone to Yukon” Corridor, a region encompassing five US states that provides protected land and refuges for wildlife. “The Y2Y region is one of the world’s few remaining landscapes with the geographic variety and biological diversity to allow species stressed by a changing climate to adapt.”⁵⁸

Last, migration leaves behind a destroyed city. Napa’s dependence on viticulture as the core economic driver makes it extremely vulnerable to the industry’s shift away. Suddenly an infrastructure that was designed around it becomes useless. The culture that was once so deeply tied to wine no longer has an identity.

Adaptively Re-use: Creating a new industry

As the industry shifts elsewhere or worse disappears, Napa will be left with an abandoned viticultural infrastructure. The effects will mimic that of Detroit and Hale, with a slow digression of economics and population. However, there lies an opportunity to find a new use for what is left behind through development of a new industry in its place. Napa is not alone, many communities are culturally and economically defined by climate-sensitive industries. Drought issues alone will have enormous effects on all livestock and produce farmers. Developing smart strategies for adaptive re-use may serve as a useful model for many other communities. (See Figure 17b)

By adaptively re-using existing Napa we can create a resilient economy to preserve the financial health of the community. In creating this new use, we also have the potential to diversify the industries, making the cities much less dependent on the health of a single production. If one industry fails, the economy can shift to another for support.

Adaptive re-use has the ability to continue the environmental agenda already in place in Napa Valley. Re-using existing structures, irrigation systems, and farm equipment can ease the transition as well as prevent unnecessary waste and energy intensive demolition. Additionally, the focus on preserving ecological diversity and continued remediation of habitats will continue to

58 Yellowstone to Yukon Conservation Initiative. “Y2Y Region — Y2Y.” Yellowstone to Yukon Conservation Initiative — Y2Y. Accessed December 1, 2014. <http://y2y.net/our-vision/y2y-region>.



Figure 17b: Adaptive-reuse

be funded by a healthy economy. When re-designing the use of the city great potential can be put of sustainable design, potentially boosting opportunities for ecotourism.

There is great potential for exploration of architecture and design that creates cultural spaces that open up the dialogue of what was, what is, and what will be. Adaptive re-use can respect the heritage of place while giving it a new sustainable life.

Napa Valley has historically been home to many times of agriculture: dates, walnuts, and various fruit. When viticulture became popular these crops took a backseat. Napa Valley still has the potential to switch to a less climate-sensitive crop. There also is potential for production of different grape based products that aren't as affected, such as vinegar or grape seed oil. However, wine culture has a unique draw. The history, process, somewhat mythological aura that surrounds wine making attracts tourism, wine-related sales, and sister industries. Without that distinct culture Napa Valley will likely see a major decline in tourism and investment. A new industry is unlikely to every come close to touching the cultural success of modern Napa Valley.

Additionally, though there are less sensitive agricultural crops and production, eventually they, too, will see a decline due to resource scarcity and unpredictable and extended seasons. Even if a new agricultural industry finds success it will only delay the inevitable.

Mitigate: Preventive adaptation and intervention

To maintain the industry at the core of Napa's cultural identity steps can be taken to prevent and adapt to the future climatic shifts. Continued research and design can provide educational testing grounds that help develop a future plan of resilience applicable to many other agricultural areas.

Mitigation provides the opportunity to ensure the continued success of wine-making in Napa Valley. (See Figure 17c) Napa's already deep investment in sustainability as well as its ties to research and academic institutions makes it an ideal testing ground. Land-forming, landscape design and architecture have the ability to greatly affect temperature, humidity, and soil hydrology to create micro-climates that act independently of the broader climate shifts. Small scale and large scale elements, similar to the fog catchers or the bioremediation elements of Wadi Hanifa, can be developed and tested to create better more efficient landscape elements that also drive micro-climate conditions. Sophisticated sensors can be deployed to more precisely monitor and respond to specific environmental conditions across complex agricultural sites.

Mitigation can also create a better urban system of resilience for smaller communities like Napa Valley, a system that can self-sustain with little help from the outside. Instead of sourcing from far away and driving for amenities that don't exist locally, a more thoughtful infrastructure, plan-

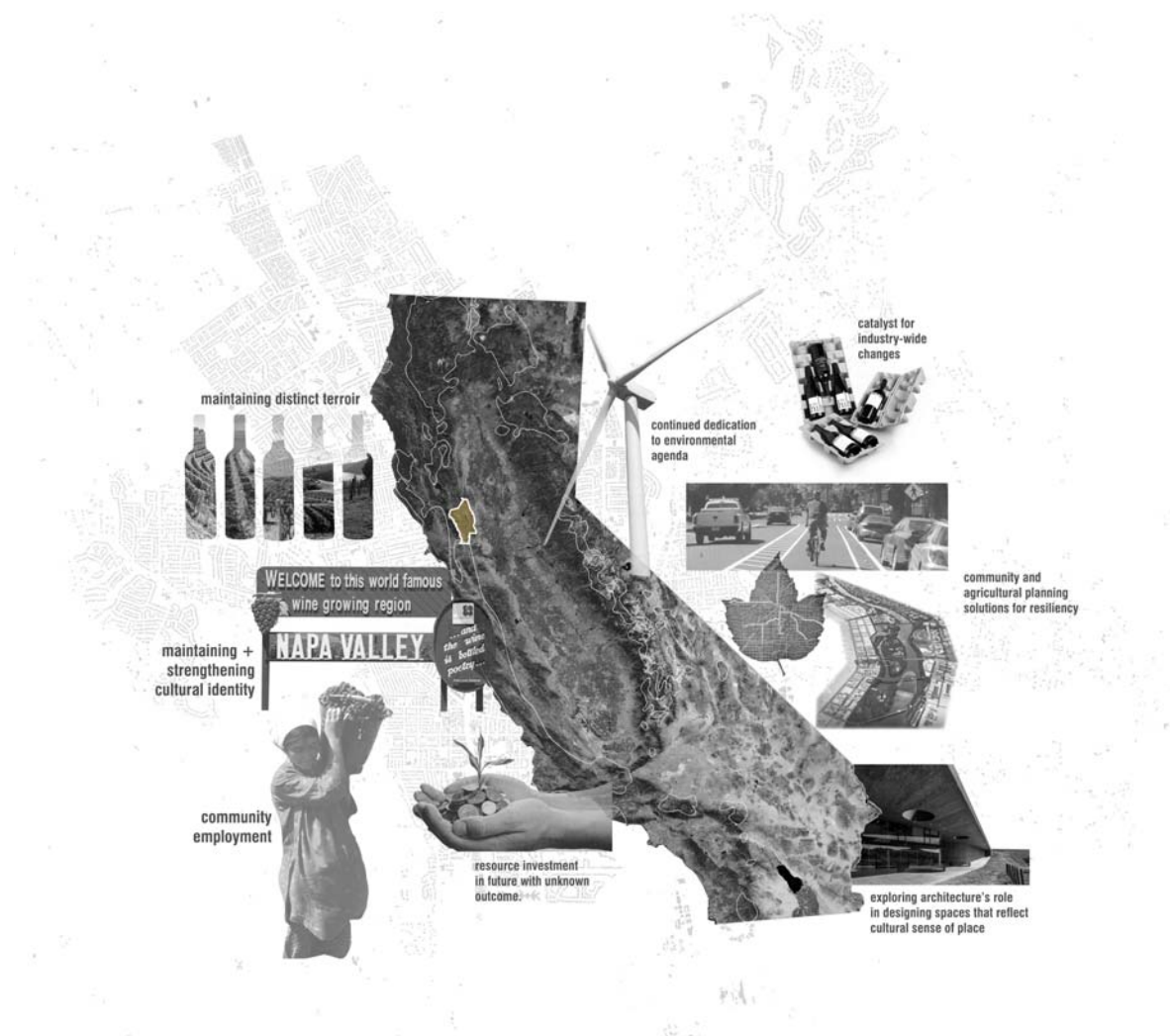


Figure 17b: Mitigate

ning, and policy-making should create a holistic small urban center that works on its own while still having the ability to connect to major urban centers.

Mitigation also provides great potential for architectural exploration. Architecture can be looked at not only for its sustainable strategies on interior conditions but also its ability to play an active role in the landscape, especially how it can function as an agricultural tool and micro-climate facilitator.

A building that pursues a necessary function in its context exemplifies a type of vernacular that is missing from the hodge-podge architecture of modern Napa. The type of architecture that can come out of this has the potential to create a recognizable identity for the region. This architecture can be the vehicle for creating new cultural spaces. Within them the community as well as visitors can be reminded to the importance of Napa Valley. They can connect to the shared values that makes preservation through a resilient city of such great importance.

The key to making a larger impact in the minds of the majority of the people at risk to climate change is to bringing it back to an individual scale. The conversation about climate change is so daunting and the solutions so large scale that we feel it is out of our reach to solve it. By using Napa's high visibility and cultural importance we can connect individuals to a tangible example of the greater cultural loss we all will suffer throughout the American landscape. The conversation will no longer only be about high efficiency skyscrapers, but instead about the farmer, the family owned business, or the production worker that could easily be one of us. The right mitigation in Napa Valley makes individuals characters in the story of climate change. Identifying ourselves in that story that gives back the power to the individual to make choices and investments in a sustainable future.

“I saw an enormous increase in hope for the future—in contrast with past years in which the students’ response to discussions of climate change impacts has been either indifference or horror. In part, this was accomplished through using the power of stories to connect the students with the lived experiences of others around the world who have been experiencing the effects of climate change more directly. As we have noted above, all cultures are learned and shared across generations, and one of our most effective strategies for conveying our knowledge and experiences is storytelling.” ⁵⁹

-Sarah Strauss, Cultural Anthropologist

59 Strauss, S. (2012) Are Cultures Endangered by Climate Change? Yes, but...WIREs Climate Change 2012. doi: 10.1002/wcc.181.

PART FOUR: FORMING

The City of Napa

Mitigation is the strongest solution. It preserves the identity of an American cultural icon, while maintaining the context and sense of place so key to Napa's heritage.

Mitigation uses existing conditions, whereas both migration and adaptive re-use require an entire redevelopment of the infrastructure of Napa and completely new development in new areas viticulture shifts. Mitigation acknowledges that the culture of Napa Valley is tied to the people that live there. There is a healthy, vibrant culture already in place. On any given night a downtown restaurant may be full of viticulturalists, vintners, chefs, artists, musicians, farmers, and visitors from all over the world. Napa is home to a unique cultural setting that is deeply rooted in the vineyard soils.

The Napa Valley consists of many viticultural areas and small cities within them. At the south end of the Napa River lies the county seat, The City of Napa. It was founded in 1847 by Nathan Coombs, a prominent historical figure in California's early years. Development of the city spread outward from the Napa river. The City of Napa's position on the river in close proximity to the San Pablo Bay made it a successful trade and shipping hub within the interior of the state. Agriculture quickly took over the ideal growing fields on the hills of the periphery of the city, creating an iconic golden landscape.

By the early 20th century the City of Napa was the most economically successful city of the Napa Valley. Further success came as the San Francisco, Napa, and Calistoga Railways were established to transport freight and passengers from southern cities to the City of Napa and to northern cities.

By the mid 20th century, though, Napa's economic growth had become stagnant compared to its northern sister cities. While they took advantage of the new interest and success in wine-making Napa lagged behind promoting its viticultural industry. However, starting in the 1970s the wine culture of Napa, highlighted by victories at the Paris tasting in 1976, started to gain prominence. In the early 2000s an epicurean revolution began in the historic downtown and gained international recognition for its quality, craft, and conscious use of organic and local methods. This was paired with a renewed interest in Napa's wine and history in the American viticultural landscape to create a vibrant city.

Napa continues to be at the forefront of a thoughtful agrarian, epicurean, and viticultural discourse. Adjacent to the civic heart of downtown Napa is the Oxbow Market, an epicurean restaurant cooperative with international recognition. Across the street fallow agricultural gardens have been taken over by local chefs and small farmers to grow organic produce to be

used in the city's restaurant kitchens. These interventions are a direct response to a renewed public interest in sustainable agriculture as an alternative to industrial farming.

In addition to small business investment in ethical practices, Napa also has strong ties to sustainability research being done in combination with the Mondavi Wine Institute on the U.C. Davis campus as well as ongoing collaboration with U.C. Berkley and culinary and business programs at Cornell University. There are major possibilities for further investment in those partnerships with field research to be done in the heart of wine producing country, the City of Napa.

This progressive sustainability and research mixed with a strong terroir heritage have established the City of Napa as the most significant and innovative viticultural center of the United States. A new architecture and landscape program in Napa could have a great impact on the 1.9 million visitors that flow into the city each year, especially in the ecotourism industry. More public interest will lead to more private sector investment in more sustainable and climate adaptable design, whether it's in the vineyard or in production facilities.

Jack's Bend: An Urban Vineyard

A key untapped site within the City of Napa is Jack's Bend. The currently mostly undeveloped site lies adjacent to the south of the historic downtown. The Napa river forms its west boundary and on the east a series of fairly recent commercial developments—car lots, big box store, and strip malls—cap its side. The north boundary narrows at the intersection of the river and the northwest running commercial developments. Highway 121 crosses over the sites southern end. The site culminates in John F. Kennedy Memorial Park, characterized by athletic fields and recreation spaces.

A paved greenway, known as The San Francisco Bay Trail, runs down the center of this site. The greenway connects the more southern neighborhoods, as well as Napa Community College adjacent to JFK Memorial Park. No landscaping has been done along the greenway to enhance the experience of users. It is simply a path through grass, with no landscaping on either side.

The Napa Valley Wine Train's final stop is just north of the site in the Oxbow District. The line continues through the site as a commercial freight line and has a train yard at the north end of the site. Figure 19 shows additional site analysis of Jack's Bend in relation to all of the City of Napa.

The site's proximity to the Oxbow District, a highly visited area, has the potential to drive traffic to the site. The new development across the river from the site has invested heavily in developing and cleaning the waterfront to provide public amenities, such as outlooks and public plazas. (See Figure 20) These can be further enhanced by views across to Jack's Bend's potentially redesigned waterfront as a major landscape element. This too, will bring more public awareness to the thesis of the site.

The undeveloped land is essentially a blank canvas for a plethora of programmatic landscape and architectural opportunities. Continued investment in bioremediation of the Napa watershed and flood control measures make developing the land as a ecological public amenity an ideal option. Development of big box stores and strip malls along the eastern edge will continue to move onto the undeveloped land if another program does not seek to preserve its natural heritage and provide a more useful public amenity and program.

The site also has the potential to become a major transportation stop for tourists through further development of Napa Wine Train as well as creating a ecotourism angled passenger schedule from the south and north outside of Napa country.

As the climate changes so will the hydrology of the river and the pathways it irrigates. This

Downtown Napa 30% Hispanic Median income \$56k House worth: \$715k Rent: \$1k Median age: 34 Education: 40% less than high, 12% bach Employment: highest in service 1.Napa City hall 2.Napa County courthouse 3.Napa Library 4.Napa County administration building 5.Napa County hall of justice 6.Napa Parks + Rec 7. Napa district attorneys 8.Napa water	Los Robles (694) 55% Hispanic Median income \$60k House worth: \$715k Rent: \$1k Median age: 32 Education: 38% less than high, 10% bach Employment: highest in material moving service & sales	South Napa (18,770) 35% Hispanic Median income \$55.4K House worth: \$599k Rent: \$1.1K Median age: 35 Education: 57% less than high, 10% bach Employment: highest in service & materials moving
	Westwood Neighborhood (6,906) 50% Hispanic Median income \$62k House worth: \$715k Rent: \$1.2K Median age: 34 Education: 67% less than high, 5.2% Bach Employment: highest in service & office	East Napa (18,770) _ % Hispanic Median income \$_ House worth: \$_ Rent: \$_ Median age: 35 Education: 57% less than high, 10% bach Employment: highest in service & materials moving
		● Affordable housing project



Figure 19a: Jack's Bend, Napa, CA Site Analysis

provides real opportunities to explore how those changes will effect the soils along the river and how we can start to create architecture and landscape that counteracts any drainage and soil saturation conditions that may not be ideal currently for growing grapes.

Lastly, the urban context provides a new testing ground. It allows us to explore what the future of viticulture will look like as space becomes sparse and accessibility to long-distance food transport becomes more difficult with fossil fuel scarcity. The site will allow an exploration of how built structures affect micro-climates as well.

Benefits of Jack's Bend site

Proximity to a large audience/high impact

Need for further development along greenway

Eco-commuting tourism opportunities

Public amenity

Symbiotic relationship between downtown waterfront development and Jack's Bend waterfront.

More meaningful, locally-supported, development opposed to big box

Urban context research opportunities

New climate change adaptation research opportunities

Located in the cultural heart of the City of Napa

Program Proposal: Center for Sustainable Viticulture

Proposed Program: Center for Sustainable Viticulture

The program proposal seeks to develop strategies of resilience for viticulture and for the community of Napa. To accomplish this it must raise public awareness of climate change, of the sustainability impacts of viticulture and other forms of agriculture, and the cultural significance of wine making in Napa Valley. It also seeks to develop a strong architectural identity for Napa Valley while still exploring an evolving community.

There are four main components to the proposed program, a public food forest, research facilities, urban vineyards, and data collection. Figure 21 shows the programmatic diagram of the site.

The first component, a public food forest, consisting of lands planted with readily available produce, will be located along the west side of the site from the existing greenway to the water of the Napa River. As a public entity, fruit, vegetables, and nuts will be available at no cost to anyone who wants to forage for them.

Providing this public amenity will attract more traffic through the site. For the program to achieve its public awareness value it needs high community engagement. The food forest will speak to the big picture of the site as well as highlighting issues of food nutrition and production ethics issues key to the future of small entity farming, such as that of Napa vineyards. The types of plants chosen can create a dialogue about Napa's long agricultural and ecological heritage. Small educational installations throughout can also reinforce the message.

Creating a well designed natural setting along the waterfront will promote water activities, such as kayaking or fishing, as well as reinforcing more commercial development across the river. The newly built plazas, restaurant patios, and river walk will now have an activated natural view and connection to the site.

The second component, and the largest, is the research facility focused on agricultural climate response. This will consist of multiple components. Within the main facility a research lab looking at issues of climate change on the wine grape and other related agriculture will collaborate with additional research into wine production methods, packaging and shipping standards and design, and cultural research and history related to terroir and wine in the U.S. Inherent in this research is the need for a smaller on site winery. Support spaces, such as offices, conference space, and maintenance will also be included.

The built research center will be a highly visible testing ground for the interrelating cultural, ecological, and economic elements of the issue. It will create connections between research

Proposed Program: Center for Sustainable Viticulture

Public Food Forest [39 acres]	Agriculture
	Nut trees (native walnuts & almonds)
	Fruit trees
	Public Vineyard (non-wine grapes)
	Low crops (tomatoes, strawberries, lettuce, Melons)
	Public Spaces + Trails
	Waterfront Redevelopment: seating, water recreation
	Redeveloped Greenway/Bikeway
	Educational Displays
Urban Research Vineyard [114 acres]	Vineyards 114 acres
	Artificial Climate Research
	Irrigation Research
	Terroir Research
	Flexible public spaces
	Public walking trail
Research Residency Facility [1 acre]	Main Research Lab 15,000 sq. ft*
	Research Lab-private
	Support-private
	Conference-private
	Office-private
	Wine Production-semi public
	Packaging/Shipping Research-semi public
	Cultural Research/History-public
Extended Community	Parking/Transportation Hub
	Redeveloped Greenway/Bikeway
	Pedestrian Bridge Infrastructure (New + Improved)

Figure 21 [continued]: Site Program Diagram



Figure 21: Jack's Bend, Napa, CA Existing Site Images

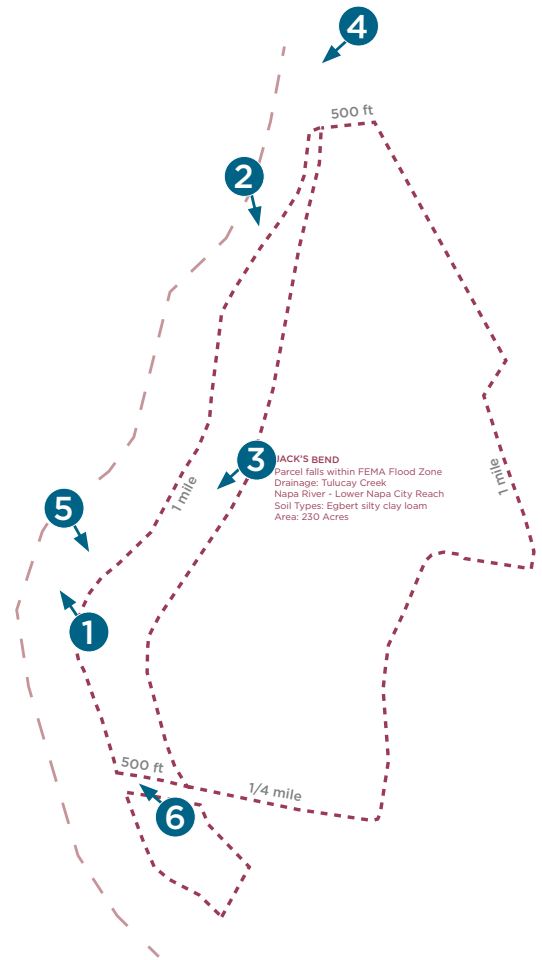


Figure 21 [continued] : Jack's Bend, Napa, CA Existing Site Images

throughout California, pulling the conversation to the heart of wine country. Components of the program, especially packaging and production research will help acknowledge wine's current carbon footprint and develop steps to greatly reduce it.

A building designed with a specific functional purpose with the ecological and agricultural landscape has the potential to create a new icon for the adaptation to climate change. It has the potential to create a vernacular form currently lacking in the context-ignorant hodge-podge of high design and the suburban styles attempting to mimic a non-existent historic typology.

Because of its greater implications nationally, a program like this has great possibilities for federal support and grant programs instead of dependence on private funding. The job creation of a program like this will also help to diversify the skills and economics of Napa, strengthening its resilience to changes in viticulture. Visiting researcher residencies creates great possibilities for on site sustainable development of housing. The main program of the research facilities would be reinforced by these extensions throughout the site.

For this site to have a major impact on the general visitor it is very important the movement through the programs and site be choreographed. Entry into the facility should set the issues and help visitors understand the purpose of the center. This could be accomplished through a museum component early on that tells the story of what Napa was, what it is now, and what it could become with and without intervention to stop shifting the wine industry. The rest of the building and site helps educate the visitor on the methods and technology that offer the solution to preserving Napa.

The remainder of the site will be used as an urban vineyard. The vineyard will be used also as a testing ground for the future of wine grape growing within the changing climatic context. Several vintners and wine collectives have already begun successful viticulture and winemaking in post-industrial central London. Urban Wine Company, a cooperative of 100 small backyard vineyard owners was able to explore the advantages of the urban micro-climate created by the built environment to produce 1300 bottles of wine.⁶⁰

Various experimental settings for soil, hydrology, and temperature can be created. A major component should focus on terroir research to enhance the cultural aspects of "place" in viticulture, further explaining the need to preserve Napa. Structural components, similar to fog catchers, can include high and low-tech solutions can be tested for their effects on creating micro-climate zones specific to grape production needs.

60 Cockrall-King, Jennifer. *Food and the City: Urban Agriculture and the New Food Revolution*. Amherst, N.Y.: Prometheus Books, 2012.

Additional sculptural elements throughout the site will also exemplify micro-climate conditions that are activated at different times of day and year. They will serve as way-finding landmarks along the path through the vineyard that connect back to the research center and help guide the story, as well as community gathering spaces for cultural exchange.

Site Plan

The site design is intended to create an overlapping of ecologies and programs. Following the logic of genetic biology in evolution the diversity of these entities working as one holistic setting strengthens resilience to changes in natural balances and economics, giving it a greater potential for survival. Essentially, if one component is weak the others can help support it. The site contains four major components: The Center for Sustainable Viticulture Research, American Viticultural Area test berms, a greenway/eco-transit system, and a public food forest. (See Figure 21a)

Design

A series of viticultural berms dispersed throughout the site provide an opportunity to explore how landscape design can push and pull the site topography to create visually intriguing forms that also have the ability to change climate impact through creation of micro-climates. Each berm is designed to be a highly efficient exploration of individual geographically anchored factors that have created the distinct viticultural terroirs throughout the Napa Valley. Each berm has specific soil construction based on that of the AVA it belongs to, creating an ideal drainage for root types. This construction works in combination with specific irrigation needs and ideal slope percentages.

Each individual AVA also has very unique sun and wind factors. The berms are fractalized forms to conform to correct sun angles or protection for high intensity sun, depending on the grape type. The row design and spacing also help reinforce these factors as well as giving the vines the ability to take advantage or protection from prevailing southeastern site winds. The berms are placed specifically on the site as well to take advantage of naturally occurring temperature and marine influence differences between the water's edge and the more inland locations.

The berms are also intended to serve as an educational component. As visitors move throughout the site they can learn about the importance and diversity of each AVA and just how delicate a balance is needed to maintain the entire industry. Each berm connects back to an exhibit within the main research building, creating a continuous connection between building and landscape. Seven of the berms are inhabited, while the rest are landform only. The landform only follow a specific formal language, while the inhabited follow another.

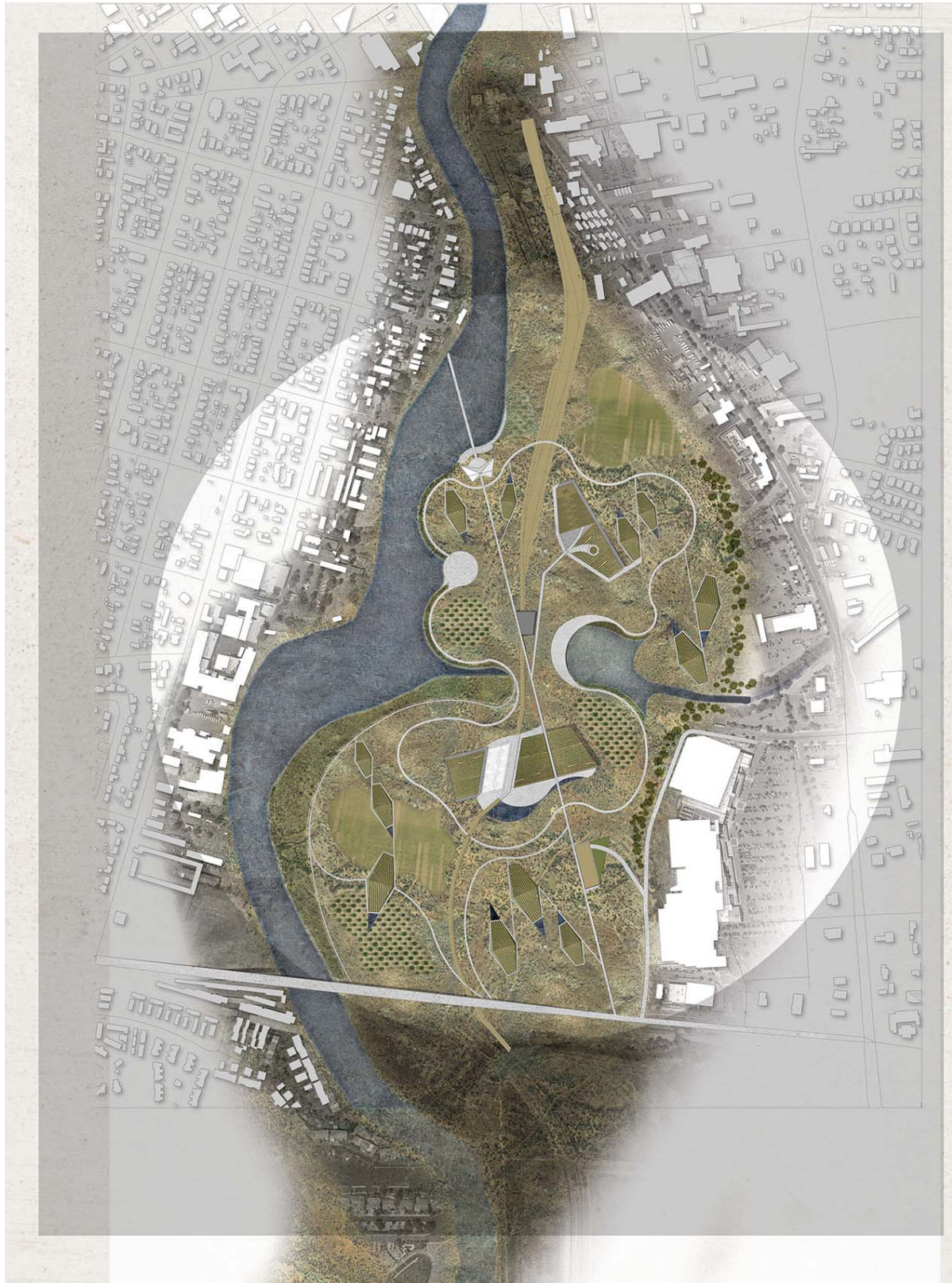


Figure 21a: Site Plan (NTS)

- VEHICULAR
- TRAIN
- MAIN PEDESTRIAN AXIS
- AUXILIARY PATHS
- BUS
- GREENWAY
- VINEYARDS
- PUBLIC FOOD FOREST
- PHYTOREMEDIATION ZONES
- a PARKING GARAGE
- b VITICULTURE RESEARCH FACILITIES
- c WINE CELLAR RESEARCH
- d PASSENGER TRAIN STATION
- e IRRIGATION RESEARCH FACILITIES
- f PACKAGING RESEARCH FACILITIES
- g NORTHERN FOG CATCHING BERMS
- h PUBLIC AMPHITHEATER
- i BOAT LAUNCH
- j SOUTHERN FOG CATCHING BERM
- k JFK PARK (EXISTING)

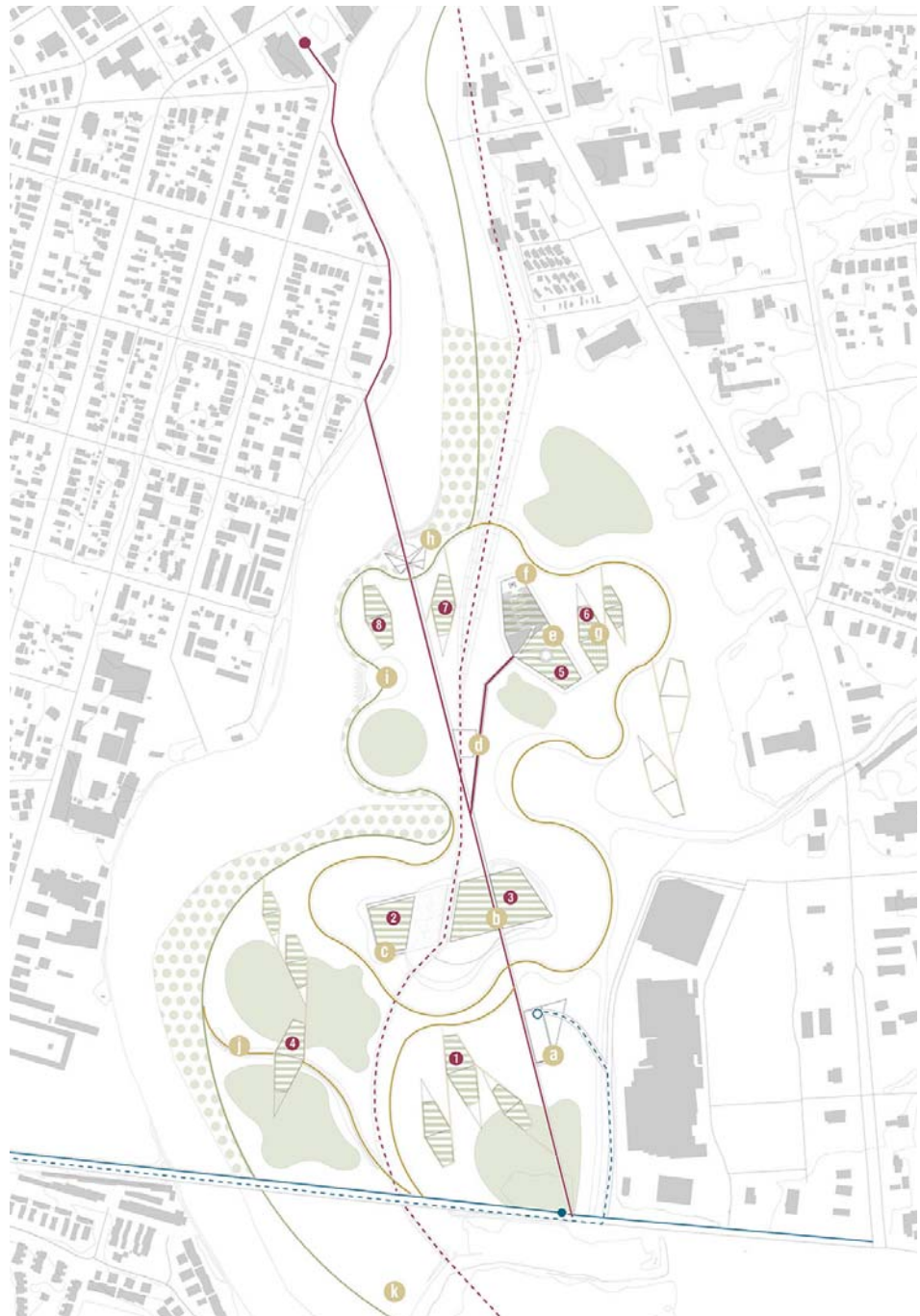


Figure 21b: Site Program & Circulation

The Center for Viticulture Climate Research (CVCR) building anchors the site, creating a clear visitor entry point and the beginning of the choreographed educational path. It is also the first point at which visitors are confronted with the fog making mechanisms employed throughout the site.

The facilities are split into two parts, an east and west wing. Visitors enter the west wing to begin the educational tour, shown in Figure 21c. They pass through an outer, inhabitable, second skin. The skin is composed of re-purposed wine bottles printed with historical and literature artifacts that illustrate the importance of wine to the local, national, and international cultural landscape. The facade continually changes and evolves, with the ability to interchange bottles as new visitors and experiences occur on the site. (See Figure 21f)

Once inside the building visitors enter the “Terroir Exhibit”. As shown in Figure 21f, light tubes exhibit a single plant from all the main AVA terroirs of the Napa Valley. The tubes are printed with facts about the AVA's, creating a storyline about the people of the Napa Valley, giving visitors a tangible medium to understand how climate change affects culture. The light tubes puncture the ceiling and roof vineyard bringing in natural light and highlighting the exhibit.

Beyond the exhibit a glass wall reveals the layers of wine-making research occurring within the building. A sunken research floor allows room for large batch fermenters and a series of cat-walks for top access. Above this floor a open research laboratory is visible through the glass at grade, while a mezzanine floor above provides office and conference space. The highly transparent and open plan is intended to encourage visibility and understanding for visitor viewing the space from the entry gallery. Appendix B contains additional section and detail drawings.

The east wing is a semi-public space. The program here focuses mainly on office and large and small conference space. Immediately off the main entry gallery is an flexible-use auditorium space. Above the entry gallery sky-lighting is accomplished through fiber-optic filled wine bottle tubes. Artificial lighting embedded in the same system transitions the concept during overcast or night conditions. This play of light has the ability to transform the space from general conference during the day to evening ballroom and event space at night.

A key component of the site is its transformation and cycles throughout the day and night, just as in a biological vineyard. By creating spaces that can also transform program activation possibilities increase, aiding in resilience through continuous, multi-dimensional uses.

The two wings are connected through a series of utility tunnels for efficient movement of large equipment as well as access to the site's greywater reclamation and sanitation infrastructure. The Main Research centers sit on a large public plaza with a prominent bio-remediation water

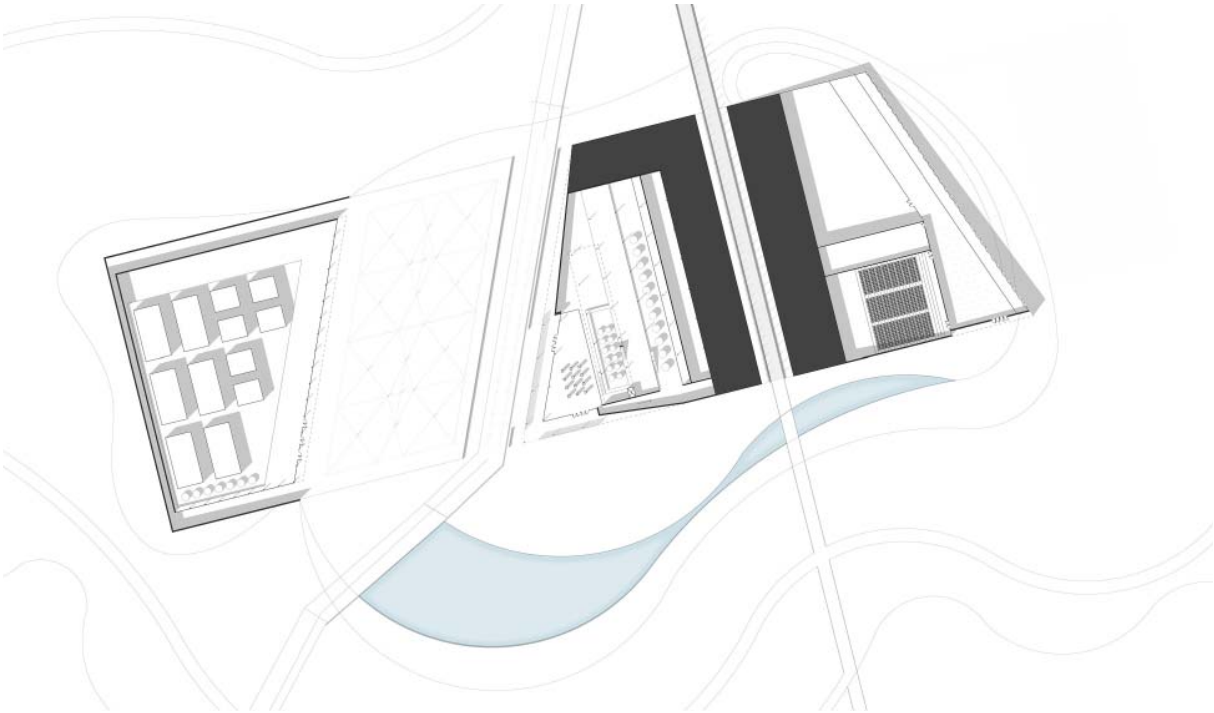


Figure 21c: Center for Viticulture Climate Research Plan

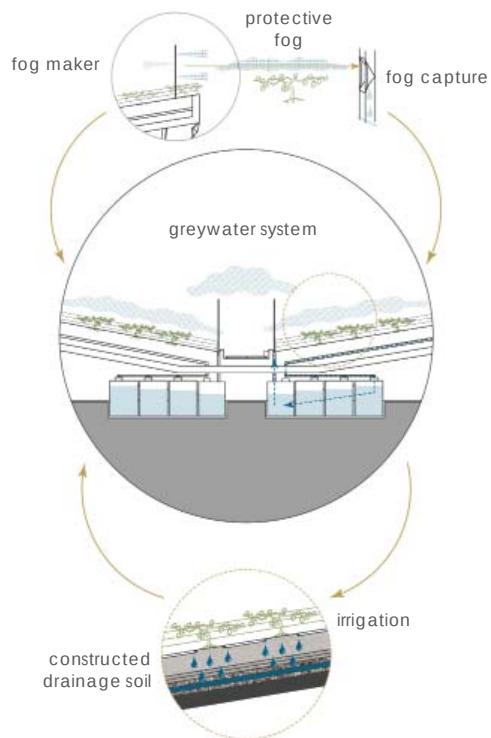


Figure 21d: Closed Loop Water Systems



Figure 21e: Center for Viticulture Climate Research



Figure 21f: Terroir Exhibit

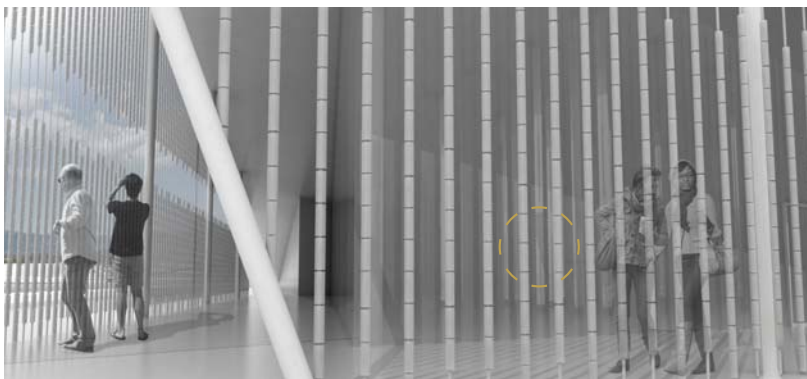
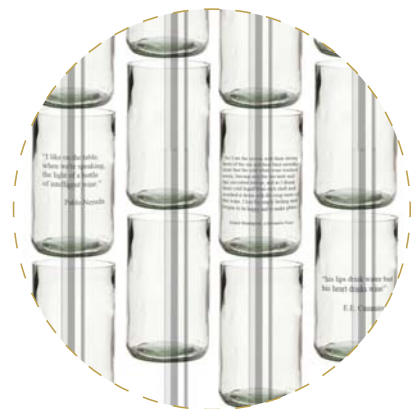


Figure 21g: Re-purposed Bottle Facade



feature where visitor groups can gather to begin their exploration of the site. This plaza connects to a smaller, fog-maker plaza, where visitors can interact with the mechanisms and learn how they work.

Currently the Napa Valley Wine Train, a passenger line that runs between Calistoga to the north and the City of Napa to the south ends just north of Jack's Bend. The design proposes an infrastructural change that would allow the Northern California rail line to now double as a passenger line, creating a continuous line all the way to the San Pablo Bay area, connecting the wine country to the larger urban center of San Francisco. This connection would strengthen eco-tourism initiatives of California. The line would pass by the main research center, with a major stop between the public plazas.

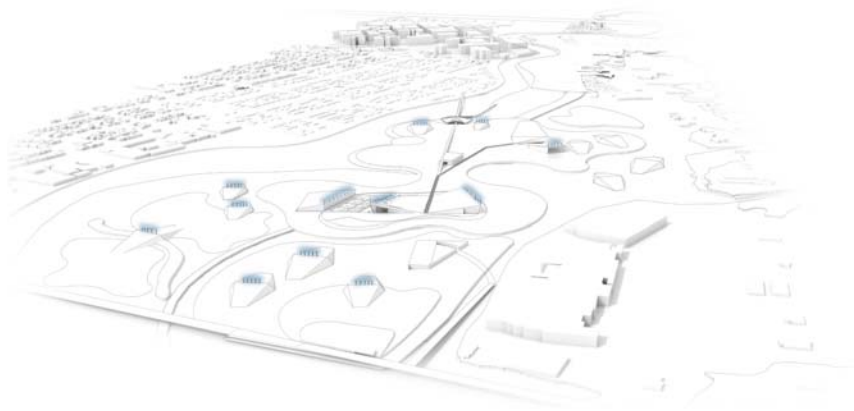
Adjacent to the stop, the fog plaza connects the main research building to the Center for Cellar Research (CFCR). Within the building a public mezzanine and a series of catwalks allow visitors to view small cellar "pods" that test varying conditions and use of new sustainable technologies for wine storage. This building embeds itself in the landscape as its roof serves as a vineyard that continues the topography into the public food forest for a more subtle transition than the CVCR, allowing those buildings to take hierarchy in order to emphasize their position as the anchor of the site.

Passing through the CVCR wings, visitors enter the main axis pathway. The wooden boardwalk differs from the materials of the pathways elsewhere on the site to heighten its significance. This also allows for a sense of permeability to accentuate the dynamics of layering occurring. Along the edge water collected through the site enters channels which then trickle through indentations in the retaining structure into a stone rain pool underneath the boardwalk.

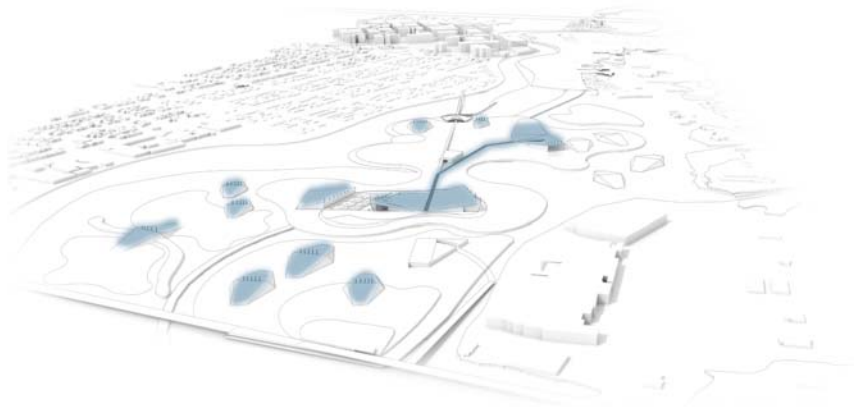
Within these collection channels, fog makers sit and line the length of the boardwalk. During daylight hours they create an overhead cloud. The cloud and water sounds enhance the experience and reinforce issues of site hydrology as well as opening up the discussion on the possibilities of artificially created micro-climates. It also reinforces the choreographed site movement along the main educational pathway connecting site artifacts. Figure 21m shows the daily fog experience on the site.

The main axis splits in the center of the site with one path continuing the visitor experience, while the other creates a main pedestrian and bike axis connection to the rest of the city, specifically the residential neighborhood across the river who will benefit the most from the site amenities.

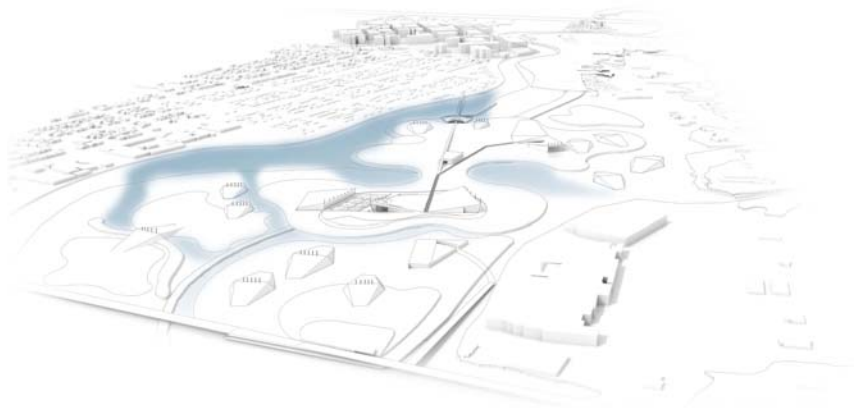
At the water's edge this pathway passes through a public amphitheater with a performance



10AM {ONSET}



12PM {HEIGHTENED SITE}



7PM {REPOSE}

Figure 21m: Fog Activation

stage that can double as a public gathering space. The stage is covered with a semi-permeable structure constructed with fog catching canvas stretched across a light-weight rigid frame structure, shown in Figure 21h. Channels frame the footprint of the structure to collect water caught by the structure during early morning and evening fog. This water is then returned to the grey-water system to be filtered and re-used in irrigation.

The amphitheater steps decline in both directions creating an additional public space along the river, for swimming, small boats, and public gathering. This is lined with phyto-remediation and marine habitat zones to continue Napa Valley's efforts to restore the watershed to pre-industrial conditions. The waterfront programming is intended to serve as an amenity for the public, a much needed connection in the city, an educational component for the passive systems at work, and an iconic gateway into the site. (See Figure 21i)

At the split in the axis pathway an elevated transit system stop is strategically placed to create a pedestrian connection above the train-tracks. Placing it centrally in the site allows the greatest access to all components of the site as well as a direct path back across the river for residents of Napa. The transit stop reinforces eco-tourism initiatives and overlapping site programming, making it available to a wider audience.

The fog path culminates splitting between the last two buildings. The right path enters the Irrigation Research Center (IRC) courtyard. Here visitors are confronted with "The Last Snow Melt", a raised water feature with a single *Vitis Vinifera* vine. (See Figure 21L) The water level that surrounds the exhibit changes, depending on how much water is available to site from the Sierra snow pack in the given year. One of the greatest challenges facing the Napa Valley are the changes in water availability from the snow pack's annual melt. Each degree increase in temperature means drastic reduction in the annual amount of water frozen every year. This artifact is intended to use simple moves to portray a clear message through a tangible and highly visual representation of the issues at hand.

On the northeast side of the building visitors can walk through the fog-catcher research berms, strategically placed to capture the greatest possible fog on the site as well as creating a direct relationship with hydrology issues being explored at the IRC adjacent.

To the west of the IRC are the Packaging Research Facilities (PRF). Here visitors can explore new packaging technology development and design as well as exploration of high efficiency, low waste, manufacturing systems. By following the axis path visitors can work their way through the rooftop vineyard to the final site artifact, "The Last Tasting". (See Figure 21j) The highest point on the site, The Last Tasting, sits above the fog on the northwest tip of the roof, visible from anywhere on the site. Here visitors become characters in the story of climate change.

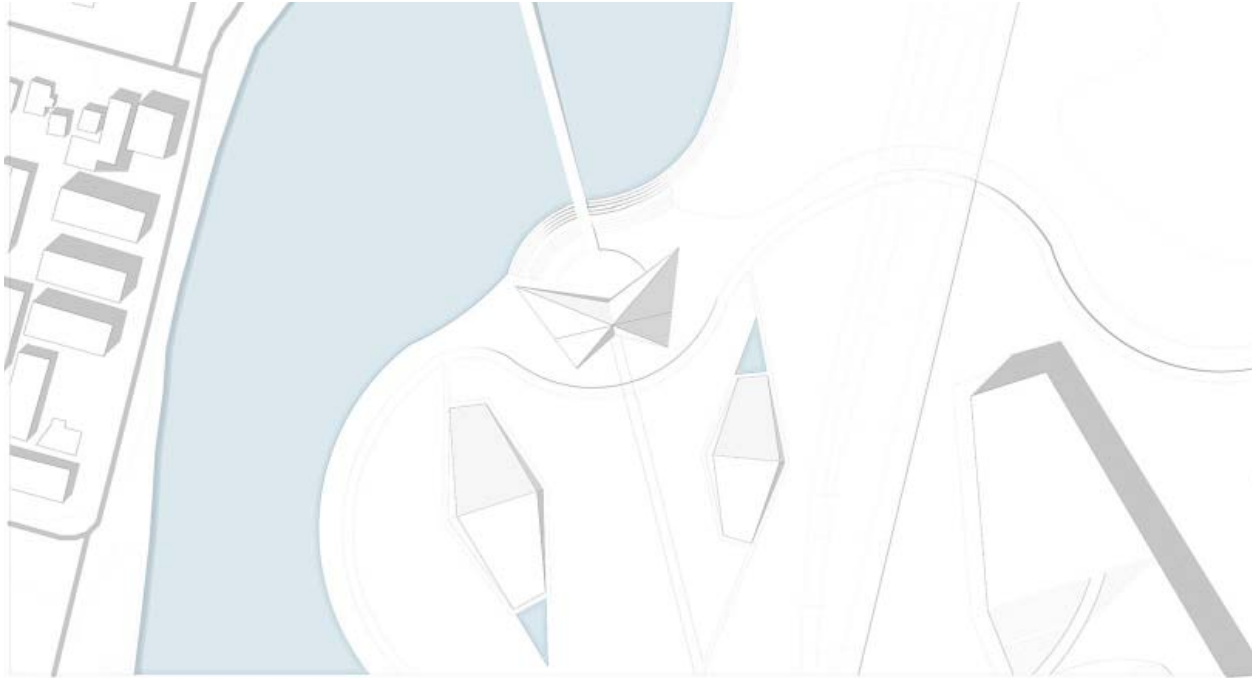


Figure 21i: Fog Catching Amphitheater



Figure 21L: Fog Catching Amphitheater

Wine tasting is such an integral part of the experience of the Napa Valley. At tasting tables people of all different walks of life and culture come together and share wine. (See Figure 21k) The Last Tasting mimics this experience, providing a long table and seats for visitors to sit together and partake in the ritual. From this location they can see out to every corner of the site as well as downtown Napa and the adjacent neighborhoods, allowing them a moment of repose to think about the implications of climate change on the Napa Valley. When they are done, they leave behind the empty bottles in rebar racks meant to mimic the patterning of the vine rows on the lower part of the roof. Bottles from the racks are then re-purposed in the wine bottle face at the main research center. When a visitor first enters the site they are engaged by installations that exhibit an external understanding of the implications on the inhabitants of Napa Valley. By this point at The Final Tasting, they have become part of that story. By leaving something behind from the tasting ritual they have a permanent connection to the site and the issues it faces now matter where they go after.

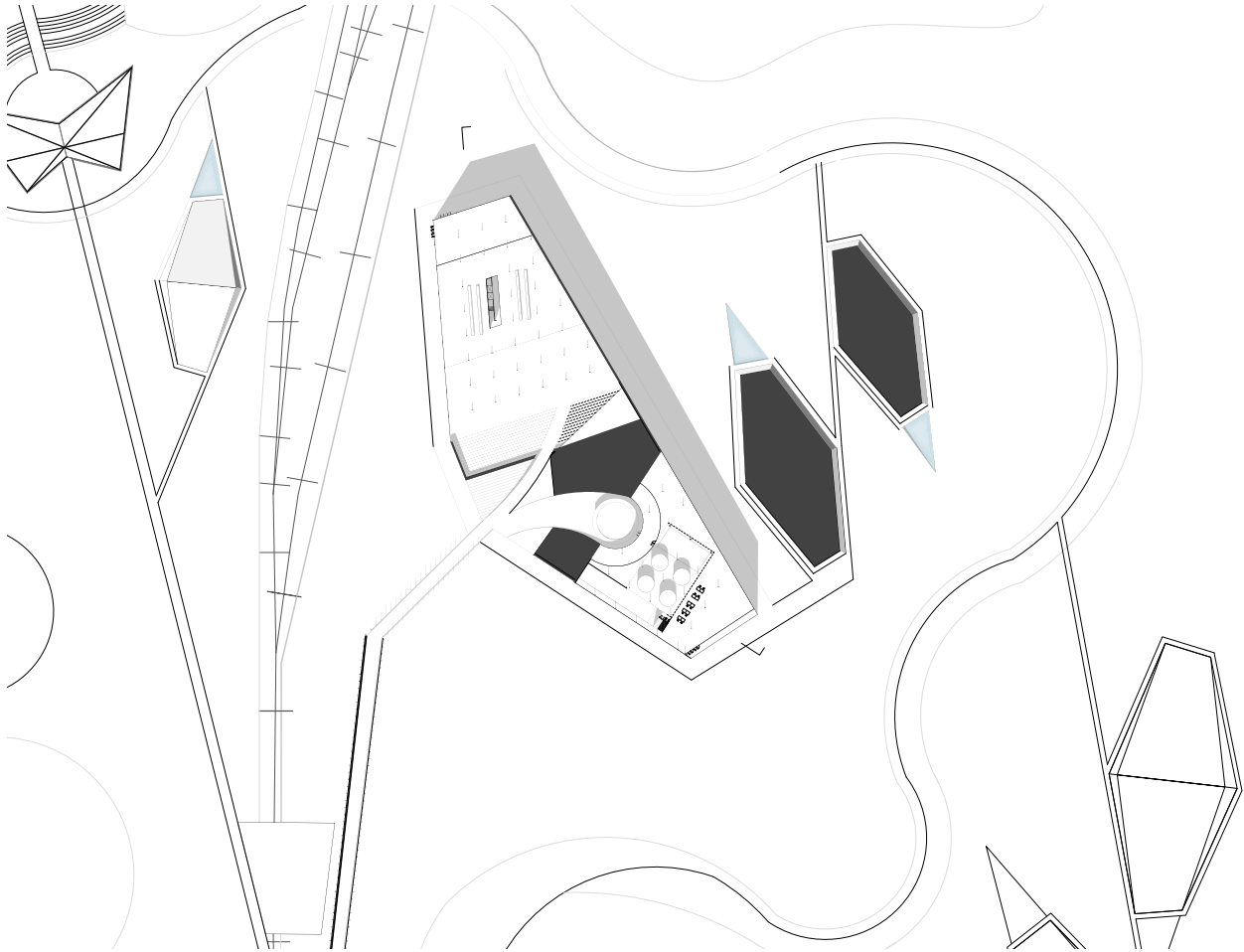


Figure 21j: Fog Catching Amphitheater



Figure 21k: Last Tasting

PART SIX: CONCLUDING

To truly have an impact and call the world to act we must allow them to actually see tangible results of inaction. They must understand that climate change affects them externally and internally. They must understand the worse outcomes while giving them the opportunity to see the possibilities to prevent these. The Jack's Bend design attempts to inspire to create a positive future.

The thesis sought to explore the capacity of architecture to embody and reflect issues of place, but also to mitigate climate change and preserve culture through architecture, landscape, and urban design. The goal of the design was to create a resilient community through multi-dimensional programming and planning, education and reform, and long term solutions that are applicable anywhere. The site overlaps public amenities of the food forest and greenway with the research facilities and agricultural exploration, creating that multi-dimension programming and planning. Visitors specifically on tour obtain a dynamic look into the issues of climate change, which occasional local visitors using public amenities are able to casually explore and learn. Last, the research on site provides a testing ground to explore architecture and landscape design's possibilities to create new environment interventions that can strengthen the resilience of agricultural communities all over. The design is intended to reflect the possibilities of the exploration of the thesis and provide the initial steps to accomplishing a long-term vision of a world designed and constructed to provide not only functional resilience but also cultural.

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APPENDICES

APPENDIX A

ADDITIONAL SITE ANALYSIS

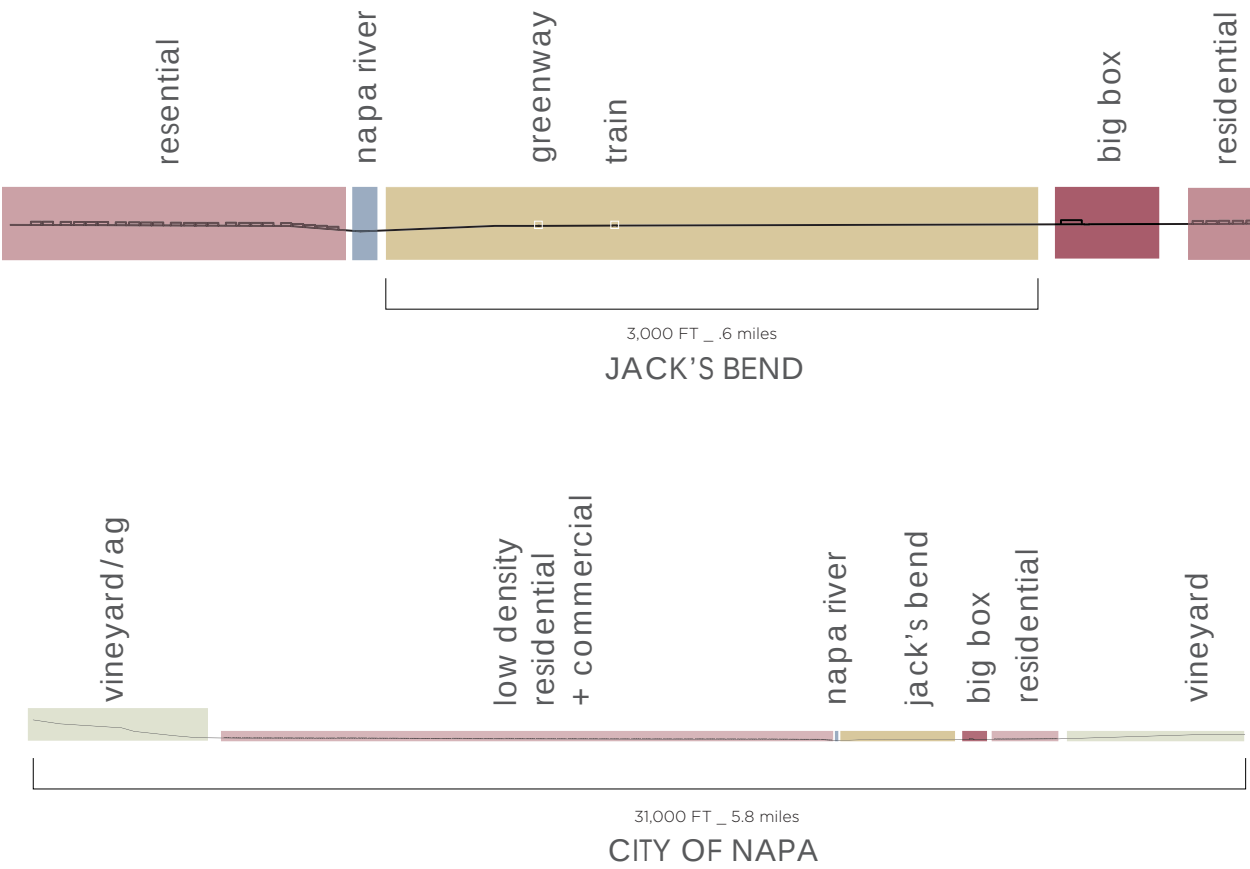


Figure 22: Sectional City Program

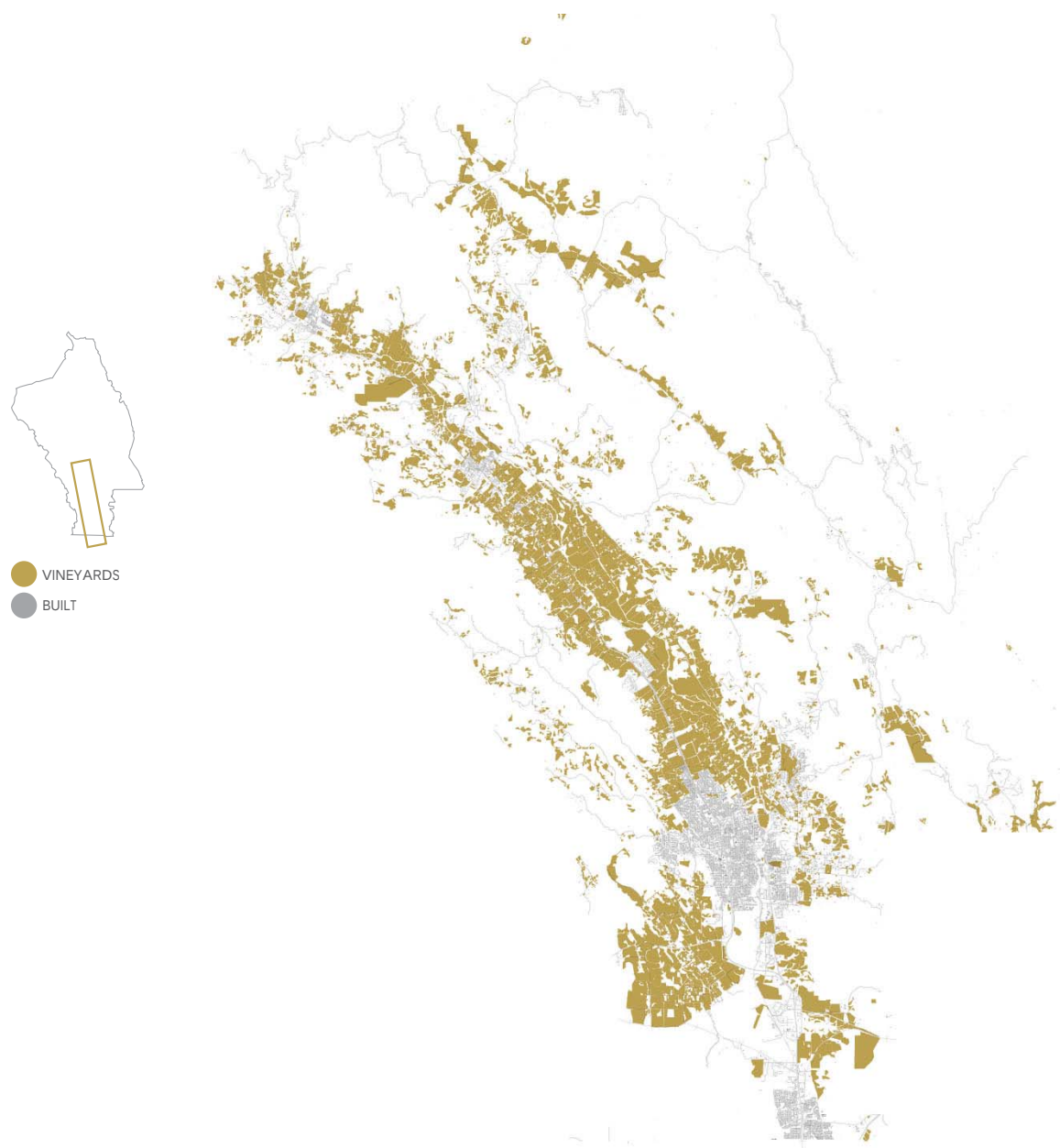


Figure 23: Land Use



Figure 24: Existing Public Green Space

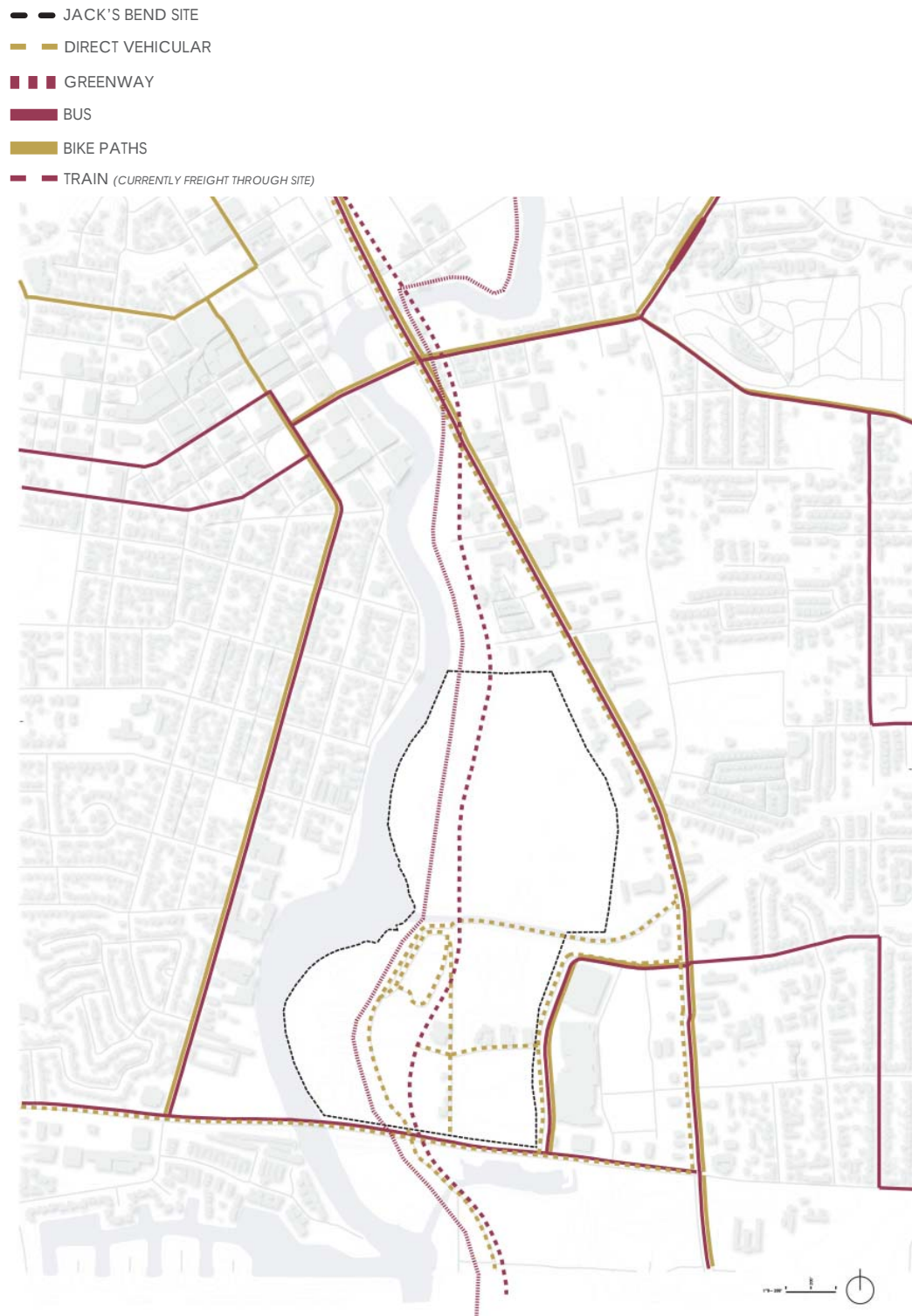


Figure 25: Existing Site Circulation



Figure 26: Existing Site Adjacencies



Figure 27: Vineyard Grain

APPENDIX B

FINAL PRESENTATION BOARDS

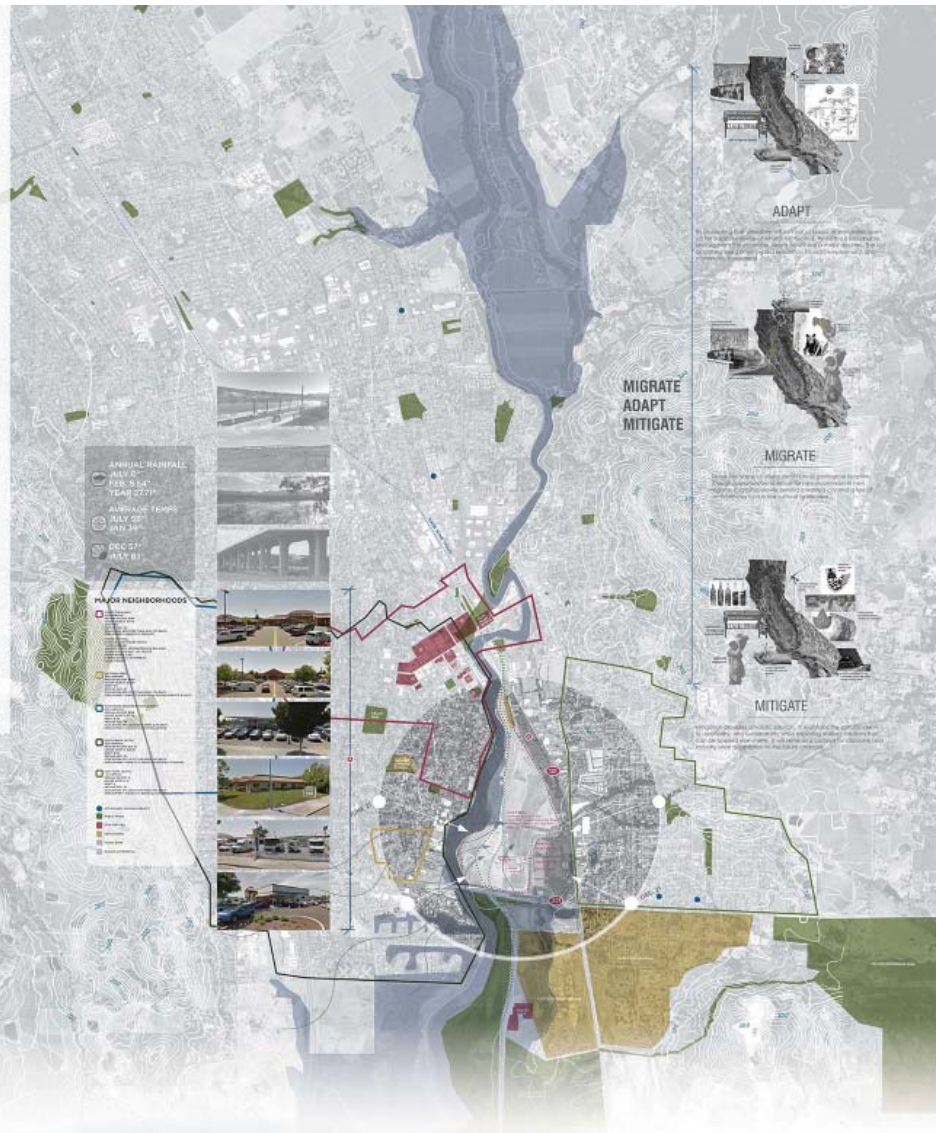


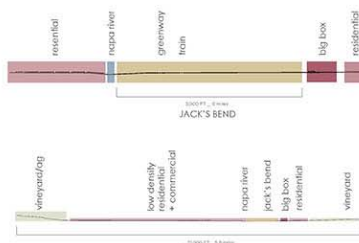
SITE PLAN 1"=128' 

Constructing Terror: Architectural Mitigation in Mono-Economies at Risk to Climate Change

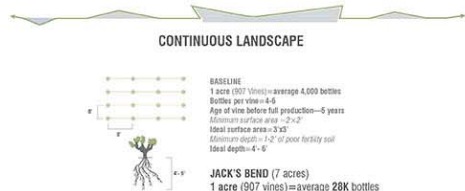
Climate change has and will have enormous implications for the future of architecture and design at all scales. Architectural discourse has recently focused mainly on preparing major cities to become the future sustainable centers of living for the world. Little has been discussed, however, about the future of smaller communities on the periphery and the implications of their loss to the diverse American cultural landscape.

The thesis seeks to explore the capacity of architecture to not only embody and reflect these issues of place but also to mitigate and preserve culture through architecture. The program proposal seeks to develop an architecture that provides strategies of resilience for viticulture and for the communities of Napa Valley.

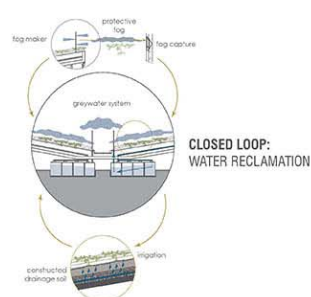




EXISTING SITE PROGRAM

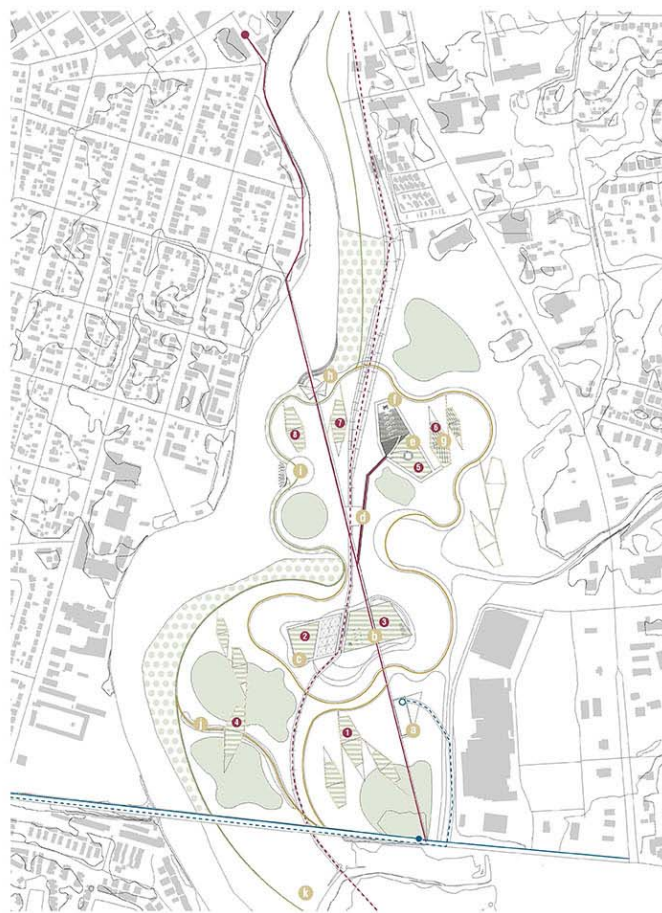


BY THE NUMBERS: CAPACITY



AMERICAN VITICULTURAL AREA TEST SITES

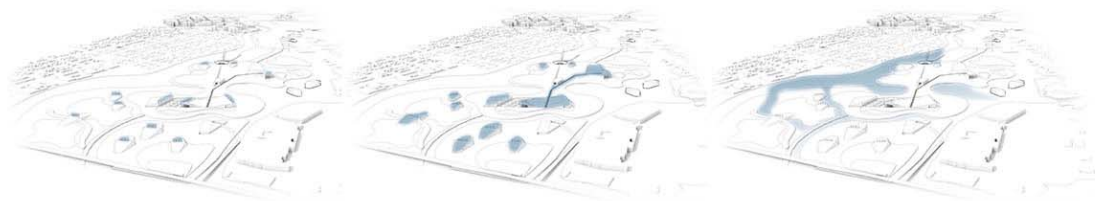
- 1. ATLAS PEAK (CHARDONNAY)**
Climate: Cool, mountain-influenced, with temperatures about 10 to 15° cooler than the valley floor in summer. Above the fog line, there is a less diurnal change, with summer temperatures rarely above 90°.
Elevation: 740 to 1,000 feet
Rainfall: 35 inches annually
Soils: Volcanic in origin, with basaltic red color, shallow and limited water retention, so irrigation is often essential.
- 2. CAUSTOODA (Syrah)**
Climate: Warm to hot, lower humidity, summer temperatures peak to 90° (32.2°C) and fall to the low 50° (11°C), the result of marine air entering from the northwest, cool afternoon and evening breezes.
Elevation: 300 to 1,200 feet
Rainfall: up to 40 inches annually
Soils: Almost completely of volcanic origin, soils range from rocky, stony top on the ridges, to gravelly or cobbly loams on the alluvial fans, and heavier clay all soils in the valley center areas.
- 3. CITY OF NAPA (CABERNET SAUVIGNON)**
Climate: Temperate climate moderated by close proximity to the San Pablo Bay and the influences of marine air.
Elevation: Most vineyards are in the 100-500 foot zone, though a small portion tops 1,000 feet.
Rainfall: 25 inches annually
Soils: Primarily weathered volcanic rock and
- 4. FORTYFIVE (MERLOT)**
Climate: Moderate, with cool marine influence and fog contributing to cool summer mornings and the strong breezes of San Pablo Bay, mid-summer peak temperatures may reach 100° with moderate diurnal fluctuation to the mid-30° range.
Elevation: 20 to 200 feet
Rainfall: 32 inches annually
Soils: Primarily gravelly alluvium, sedimentary in origin, and gravelly alluvial soils with rocks, moderately fertile.
- 5. HONOL MONTE (CHARDONNAY)**
Climate: Similar to the foggy spring mountain area, but slightly warmer and drier overall due to strong afternoon sun influence. Folly cool nights help maintain good acidity.
Elevation: 400 to 1,000 feet (150 to 475 m)
Rainfall: 40 to 50 inches (100 to 125 cm) annually
Soils: Predominantly volcanic, shallow and infertile. Drainage is high, fertile soil.



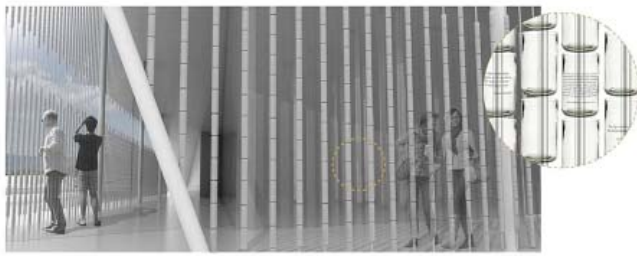
- 6. ST. PETERIA (SAUVIGNON BLANC)**
Climate: Warm, due to greater protection from western hills, with less fog or wind than sites. This provides more heat reflection on the hillsides. Midsummer temperature peak is often in the 85 to 90° range.
Elevation: 150 to 500 feet
Rainfall: 35 to 40 inches annually
Soils: South and west borders are more sedimentary, gravelly soils, with lower fertility and moderate water retention. Further north and to the east soils are predominantly volcanic in origin and are deeper and more fertile.
- 7. COOKSVILLE (CABERNET SAUVIGNON)**
Climate: Temperate climate moderated by close proximity to the San Pablo Bay and the influences of marine air.
Elevation: Most vineyards are in the 100-500 foot zone, though a small portion tops 1,000 feet.
Rainfall: 25 inches annually
Soils: Primarily weathered volcanic rock and alluvial deposits from the Vaca Range that surrounds the region.

SITE CIRCULATION

- Creating strong pedestrian and bike pathways that connect through the site and to the adjacent neighborhood + businesses is key to city connections.
- VEHICULAR
 - RAIL
 - MAJOR PEDESTRIAN AXIS
 - AUXILIARY PATHS
 - BIKE
 - GREENWAY
 - VINEYARDS
 - PUBLIC FOOD FOREST
 - PHYTOREMEDIATION ZONES
 - PARKING PLAZAS
 - VITICULTURE RESEARCH FACILITIES
 - WINE CELLAR RESEARCH
 - FOODWINE RESEARCH
 - RESEARCH RESEARCH FACILITIES
 - PACKAGING RESEARCH FACILITIES
 - NORTHERN FOOD CATERING BEAM
 - PUBLIC AMPHITHEATRE
 - ROCK LAUNCH
 - SOUTHERN FOOD CATERING BEAM
 - PAK PARK DISTRICT



FOG MITIGATION 10AM {ONSET} 12PM {HEIGHTENED SITE} 7PM {REPOSE}



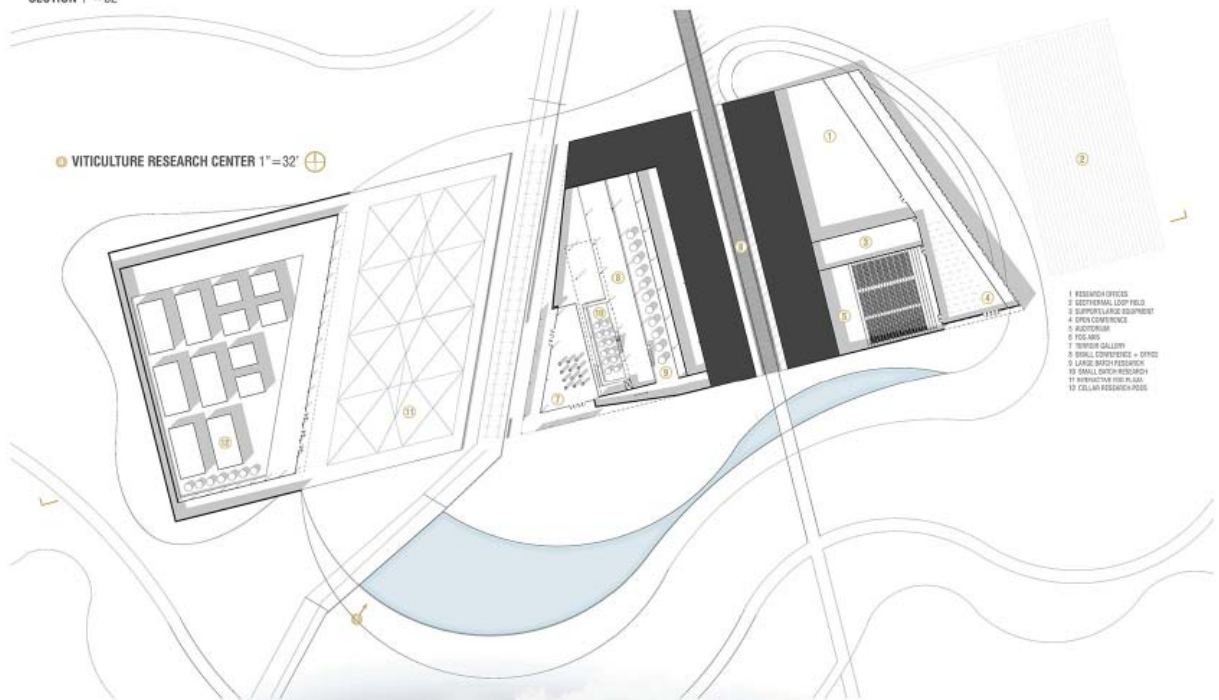
RECLAIMED BOTTLE SKIN

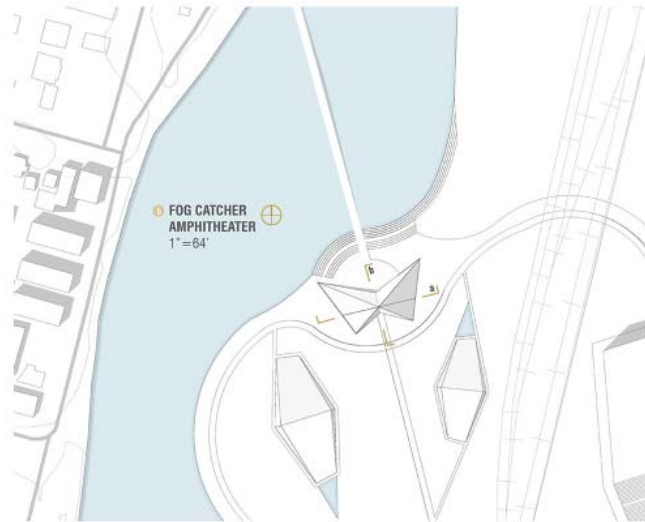
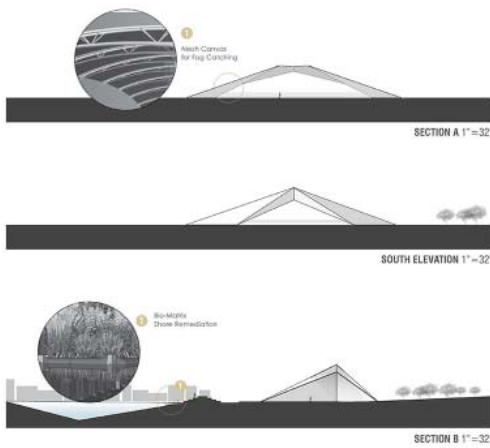


TERROIR EXHIBIT



SECTION 1"=32'





LAST SNOW MELT



SECTION A 1"=32'

VIEW FROM LAST TASTING



OVERLAPPING PROGRAM

The site is never standing alone on a single entity. By creating an overlapping program of varying scale of public, private, and government components, the site is resilient to a weakness in any part, guaranteeing a constant audience and long-term impact.

VITA

Geneva Hill grew up in Oak Ridge, Tennessee. She studied Advertising at the University of Tennessee, Knoxville and received a BSC in 2010. After graduating she worked at the Statistics and Data Systems Lab at NorthEastern University that focused on statistical modeling and representation of climate change effects on the world. She returned to the University of Tennessee, Knoxville to earn a Master of Architecture degree in 2012. She plans to start her architectural career in Knoxville, Tennessee.