DESIGN CONNECT

SPRING 2022

THE STONE QUARRY
chenango greenway conservancy

STONE QUARRY PROJECT

FINAL REPORT

In Partnership with:

DESIGN CONNECT

Cornell AAP

THE STONE QUARRY

PREPARED BY DESIGN CONNECT | CORNELL UNIVERSITY

PREPARED FOR CHENANGO GREENWAY CONSERVANCY

RELEASED MAY 2022

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ABOUT DESIGN CONNECT

Design Connect is a multi-disciplinary, student-run, community design organization based at Cornell University. We are rooted in collaborative, democratic, and sustainable principles for the advancement of towns in upstate New York.

Formed in 2008, Design Connect provides design and planning services for local municipalities and non-profits that may not have the resources to hire professionals while offering practical experience to students.

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EXECUTIVE SUMMARY

Chenango Greenway Conservancy tasked the Cornell Design Connect team with improving public access to the stone quarry, located on the west hill above the city of Norwich. The motivation of this effort was to help the Greenway with ushering in a new era as it has successfully raised funds to purchase the property where more than 20 miles of multiple-use trails have been threatened without any proper maintenance and management.

Throughout the entire design process, our team has been guided by the desire of our community partner as described in its initial application to Design Connect: to transform the quarry property into the centerpiece of a proposed community forest and set of recreational areas by enhancing public access.

In order to achieve this goal, our team had to take into consideration several key project requirements. These included creating: 1) a main entrance drive to the Stone Quarry property from Wheeler Ave., 2) a trailhead parking area, 3) signage/trailhead features, and 4) site improvements to the existing trails and the overlook.

Along with numerous project requirements, the vast size of the Stone Quarry property of nearly 550 acres allowed our team to narrow our focus to three specific issues and to be divided into three sub-teams accordingly. First, the entrance team focused on designing a new driveway from Wheeler Ave. and trailhead parking area addressing stormwater management. Second, the trail team focused on enhancing user experience on existing trails and overlooks by introducing new amenities. Last but not least, the signage team focused on designing trailhead features and improving way-finding within the property.

Each sub-team worked closely with others to give/receive feedback during our weekly team meetings. In addition, our team held a community meeting on April 14, 2022, to create a comprehensive design solution with the goal of successfully addressing and satisfying not only our community partner's needs, but also actual, potential users' desires.

PROJECT BRIEF

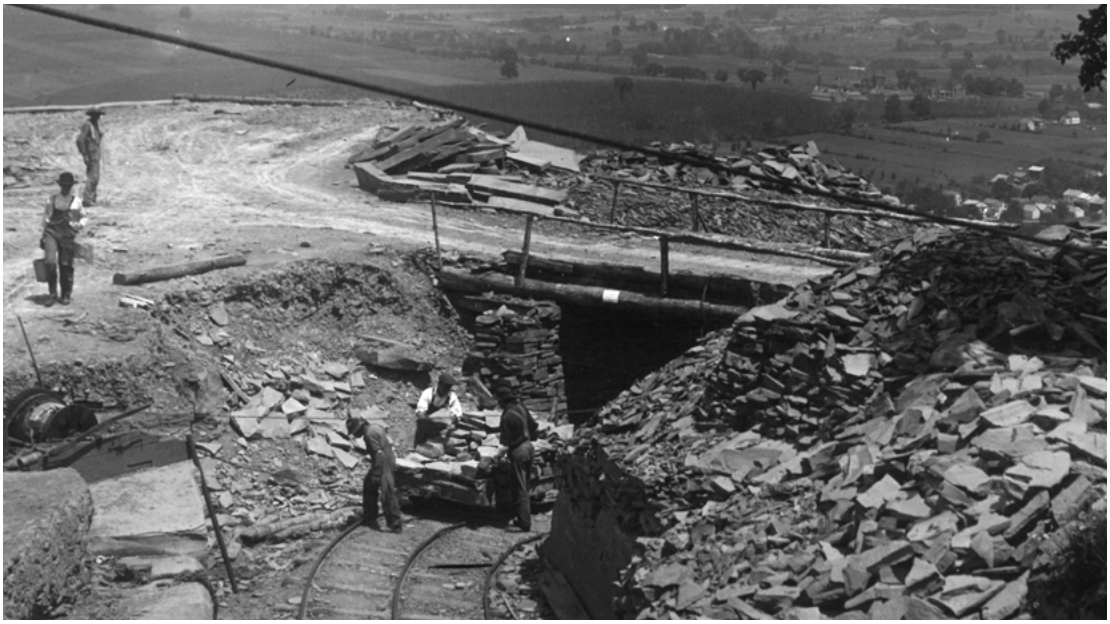
HISTORY OF SITE

In about 1840, the first blue stone quarry was opened in Albany County, NY. The blue stone's superiority for walking, curbing, and crossings was quickly recognized, and the demand for the hard blue stone increased, eventually causing more quarries to be opened along the Hudson River. However, the increased demand soon exhausted the quarries' easy access to the Hudson River transportation, and quarries started to open at greater distances from the Hudson River. This extension ranged from the Hudson River on the east, to the Delaware River on the south, and the Chenango River on the west.

In particular, an inexhaustible deposit of this hard blue stone was found in the Chenango Valley, where nature formed a particularly fine quality of blue stone, both in color and quality unexcelled by any other locality in the entire "North River" belt. The blue stone from Chenango Valley was very durable, with great power of resistance to compression, a compact nature, and resistance to abrasion and wear, making it unparallelled for walks.

The stone quarry in Chenango Valley, Norwich, was initially opened in the early 1900s but was operated in a very limited manner until 1901, when the firm of Ryan, Conroy & Co. was formed. In December 1904, Clarke, Conroy & Co. succeeded Ryan, Conroy & Co. and operations were enlarged by erecting a large mill in the southeast part of the village, purchasing the plant of the F. G. Clarke Blue Stone Co. of Oxford, NY, and constructing a gravity railroad to carry heavier loads. Since then, however, the Chenango Stone Quarry has had repeated openings and closings due to World War II and multiple business reasons.

After the Chenango Stone Quarry was finally closed in the 1960s, nature returned and transformed a barren landscape into picturesque views that we can appreciate today. Now the site invites various outdoor excursions including hiking, biking, snowshoeing, and cross-country skiing.



PROJECT SUMMARY

The Greenway seeks to conserve the Norwich stone quarry property located on West Hill above the city for its scenic and historic value, as well as its importance as a destination for public recreation. Previous landowners have generously allowed unrestricted public access to the property. However, public access to the quarry parcel and more than 20 miles of multiple-use trails became threatened when the owner's estate prepared to sell the property. The Greenway negotiated a purchase contract with the Estate contingent on the completion of a successful community fundraising campaign. The Greenway has raised sufficient funds to purchase the property and is now beginning the process of planning for site improvements to enhance public access.

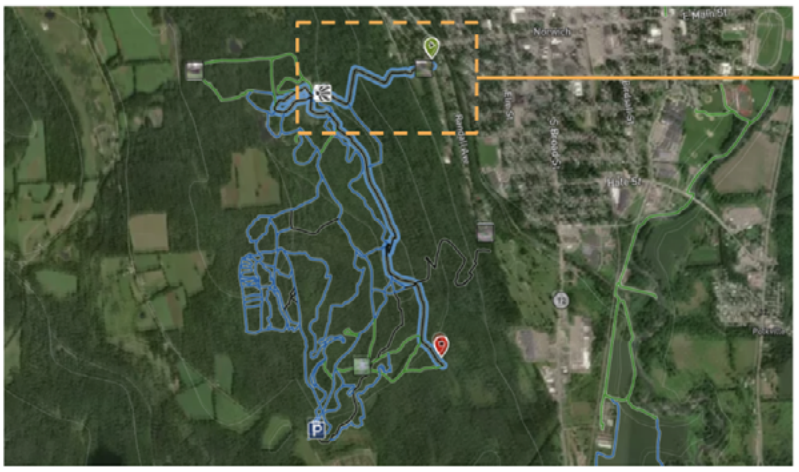
The 192-acre stone quarry property is not only a popular outdoor recreation destination for Norwich residents, but also an important aesthetic resource that serves both as the scenic backdrop to the City of Norwich and provides a spectacular view of the city from the overlook at the quarry face. The quarry parcel is a keystone property, providing connectivity among several large, forested properties on West Hill. Along with the adjoining land owned by the County of Chenango, the Norwich School District, and the Norwich Cemetery Association, the quarry property will form the centerpiece of a proposed community forest and recreational area of nearly 550 acres.

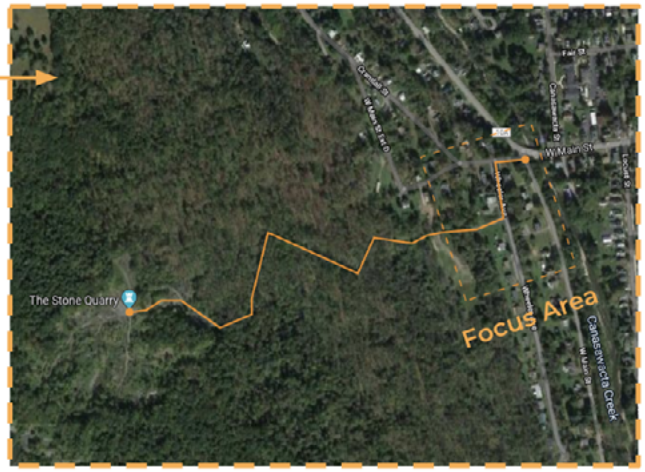
Currently open for all to use, the trails on West Hill benefit Norwich area residents and visitors alike. There are many long-standing hiking trails, unique stone features, and many miles of new bike trails created by mountain biking enthusiasts. These new trails are now attracting mountain bikers from outside the Norwich area and turning a local hidden gem into a regional destination. After purchasing the quarry property, the Greenway plans to improve public access by adding new amenities such as designated parking areas with information kiosks and trial maps, renovating old trails and building new sustainable trails, and designating pedestrian routes to connect with the existing trails within the city. Full development of the quarry and surrounding properties will be a multi-year undertaking. The one immediate task the greenway hopes could be completed by Design Connect is a conceptual design for the main entrance to the property and the main trail and overlook.

SITE

The Stone Quarry Site is located on West Hill above the city of Norwich, NY, in Chenango County, with the main entrance off of Wheeler Avenue. The 192-acre stone quarry property is not only a popular outdoor recreation destination for Norwich residents, but also an important aesthetic resource that serves both as the scenic backdrop to the City of Norwich and provides a spectacular view of the city from the overlook at the quarry face.

Norwich, NY





SUMMARY OF STAKEHOLDER CONCERNS & NEIGHBORHOOD IDEAS

The Design Connect Team acknowledges that the Stone Quarry project would not be possible without the support from community members. In terms of financial support, the Chenango Greenway Conservancy has received $5,000 from the Thomas & Esther Flanagan Charitable Trust, $25,000 from the Goger Follet Foundation, &50,000 from the Greater Norwich Foundation, $50,000 from the Frederick B. & Ramona E. Mirabito Foundation, and $25,000 from the A. Lindsay and Olive B. O'Connor Foundation, as well as hundreds of donations from individuals, in support of this project. Moreover, several different community leaders, including but not limited to Joe Angelino (NYS Assemblyman), Fred Akshar (NYS Senator), Shane Butler (Director of Chenango County Planning Department), and Rob Baker (Coach of Galena Growler's Mountains Bike Team), have endorsed the project.

SITE VISIT

With these community support and endorsement, our team paid closer attention to their needs and unspoken desires through the community engagement. First of all, as part of the insight gathering process, our team conducted a site visit to the Stone Quarry property February 2022. During the site visit, our team was able to learn the neighborhood's concerns on encroachment issues and the possibility of stormwater runoff in the entrance driveway from Wheeler Ave.

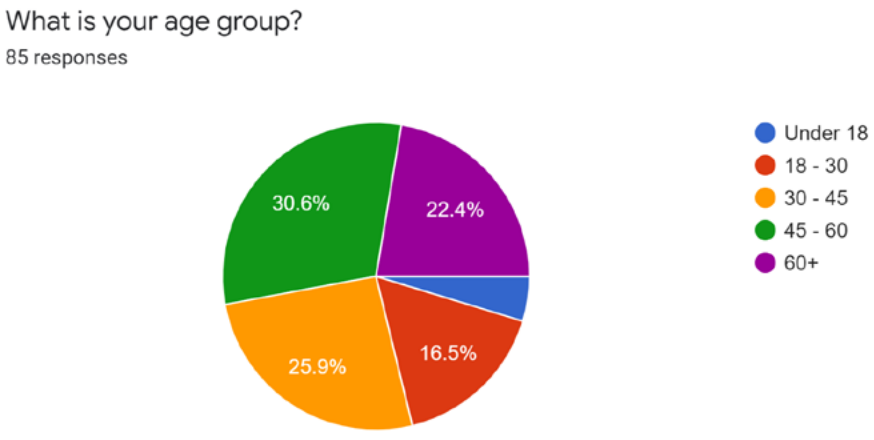
STAKEHOLDER INTERVIEWS

Following the site visit, we reached out to our contacts at the Chenango Greenway Conservancy and Chenango County Historical Society & Museum to conduct a series of interviews with stakeholders and to gather a deeper understanding about some key issues that our community partner would like to address. Through these interviews and discussions, it became clear that we would focus on three main issues -Entrance/Parking Area, Signage, and Trail/Overlook. In the early stages of the design process, our preliminary ideas were presented to community partners, stakeholders, and local residents for feedback and adjustments to the final design were made.

COMMUNITY SURVEY

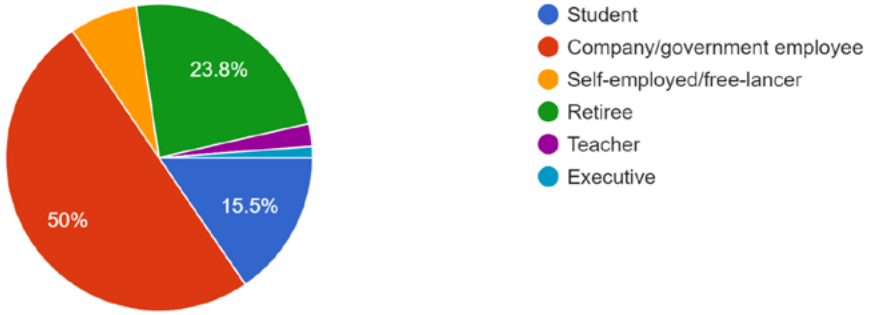
In addition to the site visit and community meeting, we also reached out to 85 community members through an online questionnaire. Below is a summary of our key findings:

- There is a wide range of diversity in user demographics (ex. age group and occupations)
- Most of the respondents use the Stone Quarry property for hiking/biking (83.5%), followed by mountain biking, other outdoor sports (ex. skiing), and camping.
- More than half of respondents (61.1%) visit the Stone Quarry at least several times a year.
- In terms of modes of transportation, most of the respondents walk to the site. (Biking ranked 2nd and Driving ranked 3rd).
- 43.5% of the respondents believe that improving access from Wheeler Ave. is the top priority.
- A great number of respondents want to see a new trail from Wheeler Ave. in the near future.
- A great number of respondents want to see more diverse community events at the site (ex. Music events, art festivals, and school field trips).



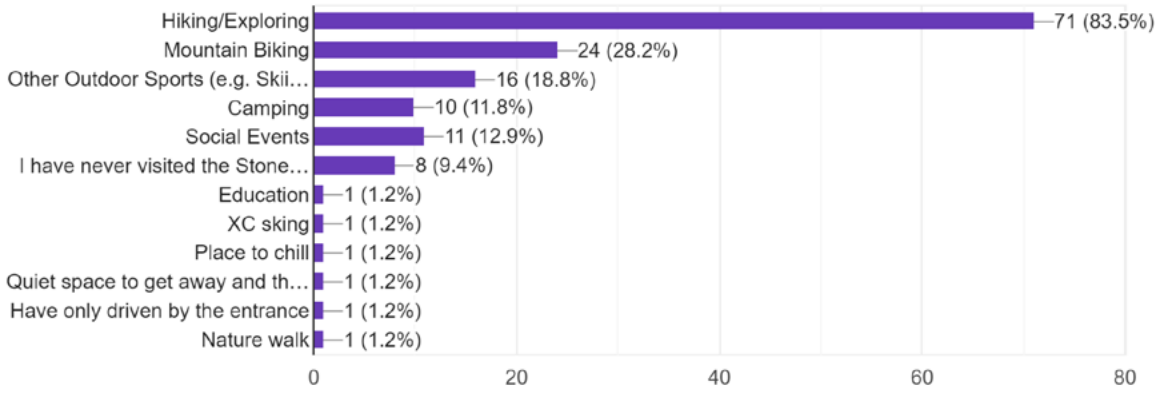
How would you describe your occupation?

84 responses



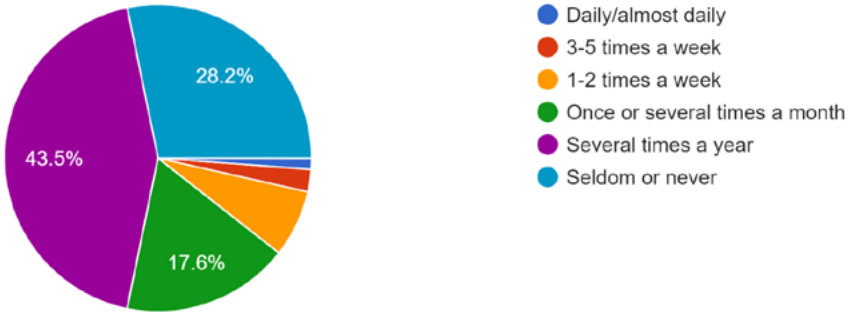
What best describes your use of the Stone Quarry?

85 responses



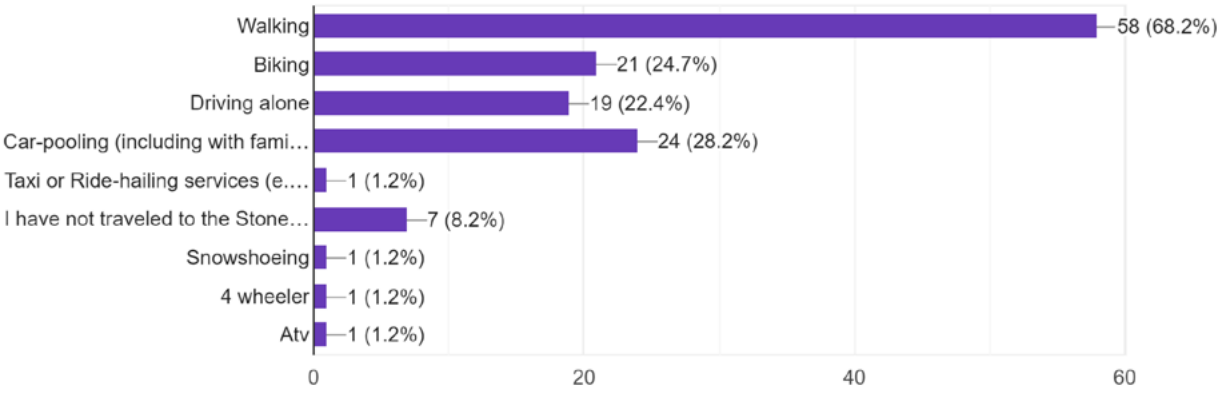
How often do you visit the Stone Quarry?

85 responses

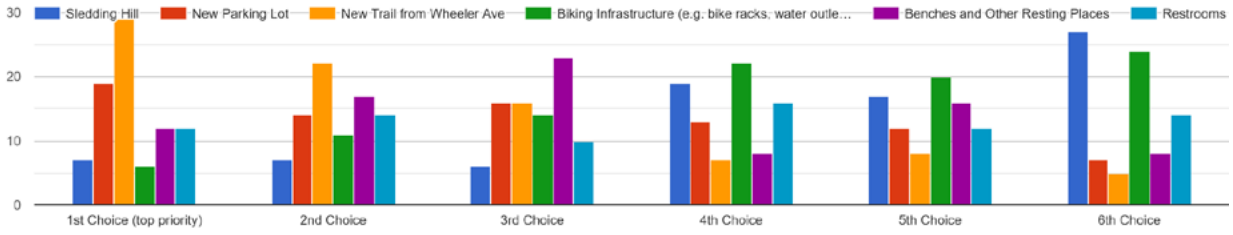


If you have visited the Stone Quarry before, what modes of transport did you use?

85 responses

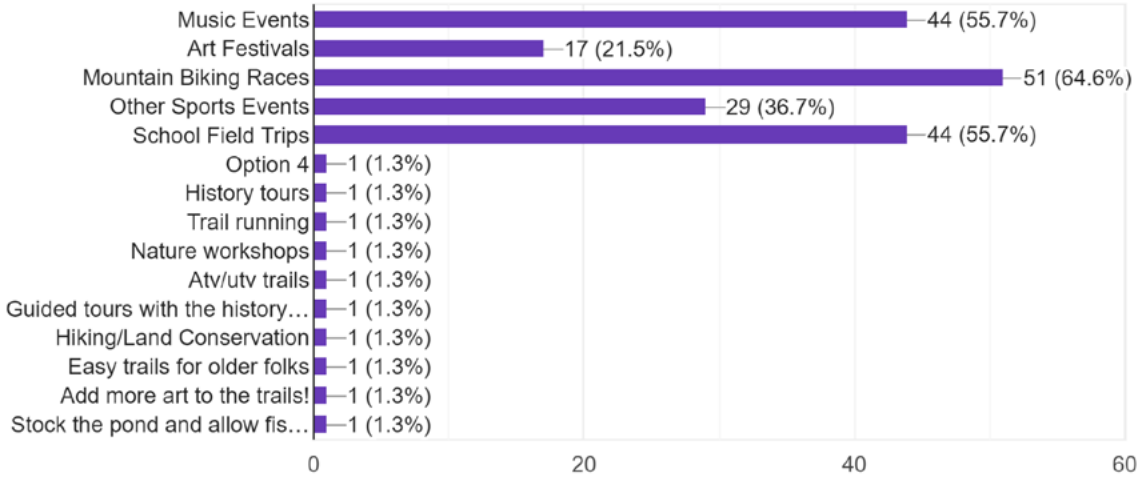


We are planning to add new facilities to the Stone Quarry. Please rank the following facilities in the order that will be most helpful to you.



What event(s) would you like to see at the Stone Quarry?

79 responses



ENTRANCE DESIGN

RESEARCH PROCESS

We started our design process by identifying the distinct features of a typical trail system entrance, which usually include a vehicle entrance, an internal circulation system, and a trailhead entry area (Shapins Associates & OZ Architecture, n.d.). Combining this knowledge with our understanding of the Stone Quarry site, we determined that the entrance area will consist of a entrance from Wheeler Ave (hereafter "street entrance"), a pedestrian plaza connected to the trailhead ("entrance plaza"), and a main parking lot, all connected by a paved driveway.

We next considered the most important functions of the entrance area. We reasoned that the entrance should be identifiable to effectively guide visitors to the park area, accessible in providing facilities for people traveling on foot, by bike, and by car, and sustainable by mitigating stormwater runoff on the steep slopes close to the entrance. These three functions guided our research as we continued to study existing best practices to inform our design of the entrance.

For identifiability, we discovered that the most appropriate and critical infrastructure are entrance portal features, signage, and barriers. First, entrance portals or gateways are often placed at trailheads to give a visual signal to visitors that they are entering the trail area. It is best if these features are made of local materials and include branding of the trail area to make it look intentional (Shapins Associates & OZ Architecture, n.d.). In the case of the Stone Quarry, these requirements reminded us of the possibility to use bluestones that were historically mined on-site and to attach the logo of the Greenway Conservancy to the portal. For signage, we reasoned it would be appropriate to install trail maps, visitor rules, and necessary interpretive signs at the entrance to provide trail users a general understanding of the site as they start their visit. We also researched options for barriers separating the Stone Quarry property from nearby private land parcels, especially as the lower part of the driveway is directly bordered by single-family houses. We found that rock walls and wooden fences, or a combination of the two, are often used for trails (Beers et al., 2019).

For accessibility, we mainly considered circulation, vehicle parking, and amenities for pedestrians and cyclists. We found that the optimal lane width for minor streets like the driveway is 10 feet as this discourages speeding while maintaining necessary right-of-way (NACTO report). Based on two vehicle lanes, we decided to layout the driveway with one sidewalk, one uphill bike lane, and a bioswale. We also considered that the proposed driveway's average slope of 14% may be challenging for vehicles in winter times, so we also planned to install four parallel parking spaces close to the start of the driveway (Shapins Associates & OZ Architecture, n.d.). On the other hand, we decided to design our main parking lot with back-in, angled spaces and a one-way circulation system, which is used in cities like Vancouver, WA to improve safety and ease of use (Nelson\Nygaard Consulting Associates, 2005). As a third part of accessibility features, we researched potential amenities for the entrance plaza. We first reviewed survey results to discover that walking and biking are travel options frequently used by 70% and 25% of respondents to reach the Stone Quarry, respectively. This informed us the importance of accommodating these users by providing dedicated amenities. In addition to planning for bike lanes and sidewalks along the entrance drive, we researched bike rack design guidelines developed by the City of Toronto to explore the correct type of racks and appropriate spacing (City of Toronto, 2008). We also recognized the importance of designing a waiting area with wooden or stone benches, preferably made of local materials, to allow people to relax or wait for others within their group (Shapins Associates & OZ Architecture, n.d.).

Last but not least, the entrance area includes the largest area of impervious surfaces in the entire site, consisting of a driveway with bike lane and sidewalk, an entrance plaza, and a 30-space surface parking lot. Therefore, an important focus of our research was stormwater management planning to reduce the impact of our design to existing hydrology and mitigate runoff problems caused by recent logging activities.

We first considered available options of stormwater management for our site and discovered that green infrastructure such as bioswale and rain gardens can be effective at mitigating runoff without requiring major engineering interventions. Compared to traditional stormwater management practices, green infrastructures intercept water on-site to reduce the volume and flow rate of runoff, thus requiring less dedicated facilities for stormwater storage and treatment (Center for Watershed Protection & New York State Department of Environmental Conservation, 2015).

To further guide our design of bioswales and rain gardens, we reviewed two green infrastructure case studies. First, the Nevin Welcome Center at the Cornell Botanic Gardens provided a good example of using bioswales to treat runoff from vehicle parking lots. The bioswale is a V-shaped channel lined by a mixed layer of loam, compost, and sand to facilitate sedimentation of pollutants and organic matter while allowing for water to infiltrate into the soil (See figure 1) (Botanic Gardens Bioswale, n.d.). Mostly local plants that can tolerate both wet and dry conditions are grown in the bioswale to slow water flow and further decompose organic matter in the water (Botanic Gardens Bioswale, n.d.). Performance evaluation shows that the bioswale is able to capture 90% of the stormwater runoff, reduce peak flow of a 100-year storm event by 58%, and significantly decrease concentrations of heavy metals between the inflow and outflow points (Palmer & Powell, 2014).

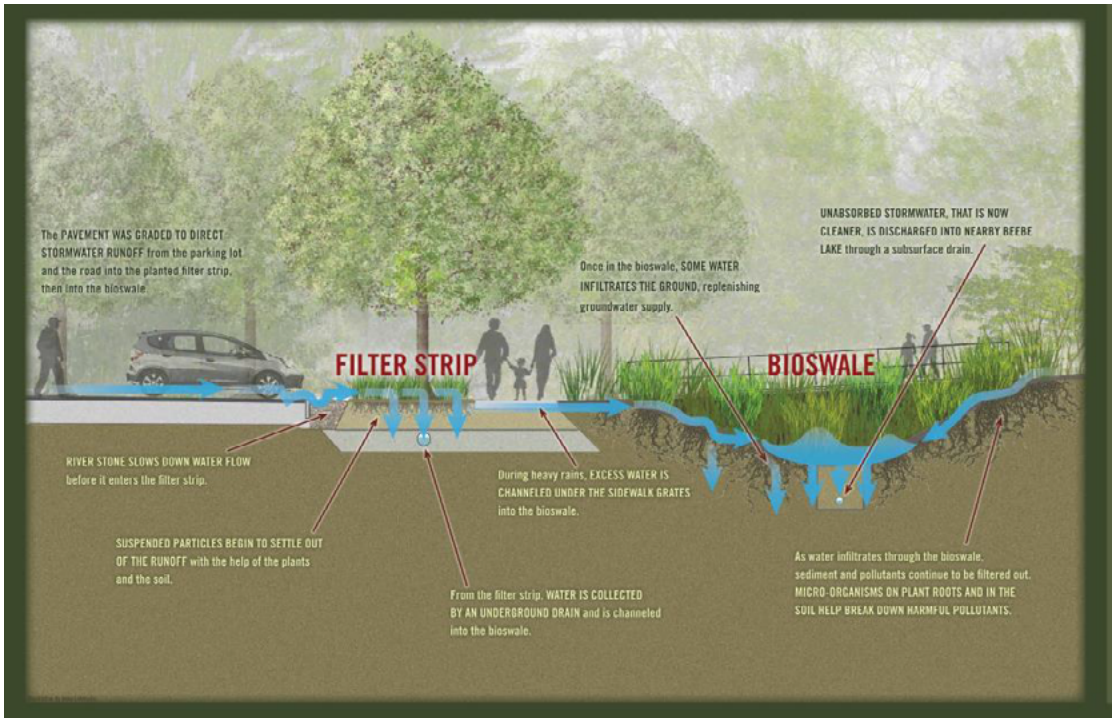


Figure 1. Cross-Sectional Rendering for the Nevin Welcome Center Bioswale (Source: Palmer and Powell, 2014)

We also researched two more case studies for bioswales located alongside roadways. The Cornell Tower Road Bioswale has similar structures and functions to those at the Nevin Welcome Center, but they are much narrower at 5 feet due to space restrictions and only feature lower shrubs instead of a variety of plants (Tower Road Bioswale, n.d.). Still, the bioswale is effective at reducing stormwater volumes and filtering pollutants from road runoff (Tower Road Bioswale, n.d.).

The other roadside bioswale we researched is located in Brampton, Ontario, Canada, which is twice as wide as the Tower Road swales and are able to reduce peak flow rates during major storm events in the one-year evaluation period by 50-70% (Toronto and Region Conservation Authority, 2018). Even so, because the bioswale is lined using impervious material, its functionality to reduce runoff is limited to evapotranspiration (Toronto and Region Conservation Authority, 2018).

The CNT Green Values Stormwater Management Calculator aided us in sizing and pricing the stormwater management solutions. The calculator sets a volume capacity capture goal which is based on a common metric that municipalities suggest, which is to capture a volume equal to ½ inch of rain falling on the impervious elements of the site (Green Values, 2020). In this case, that area would be the driveway, bikelane, sidewalk, and entrance plaza which encompass 25,063 square feet. Our design captures 249.7% of that desired goal, allowing it to process excess water and making it resilient to intense storm events.

DESIGN PROGRESSION

We can break down our design progression into five stages: brainstorming, initial sketch, feedback, improvement, final conceptual design & rendering. During the brainstorming sessions, we combined our initial research and site visit experience to outline three major challenges we need to mitigate in our design. These challenges each correspond to one of the three initial design goals: identification and visual guidance, accessibility and circulation, and environmental sustainability.

Our first concern is encroachment onto private property, as the current driveway leading to the stone quarry is partially on private land. In our efforts to preserve the residential serenity of the street, how do we make clear the entrance to the quarry while ensuring that visitors do not trespass on private land? Second of all, how do we access the main parking lot in the winter, given the steepness of the slope near the entrance? Finally, what green infrastructure can we implement to treat the runoff from the hills due to recent logging operations?

Bearing these challenges in mind, there were three key design principles that guided our design thinking. The first principle is making the stone quarry identifiable, which entails signage and major wayfinding features to direct visitors to the parking lot and installing fencing and trees to serve as privacy for private property and designation of Stone Quarry boundaries. The second principle is accessibility: we considered all modes of transportation taken by visitors and suggested installing paved roads for seamless travel between the start of the hiking trails, Wheeler Ave entrance, and the main parking lot. The third principle is sustainability: planting native species to preserve biodiversity and proposing green infrastructure solutions to enhance the site's sustainability and stormwater management capabilities.

These solutions include bioswales, rain gardens, and a gravel parking lot for increased permeability. With these criteria guiding our brainstorming process, it ensured we considered all major facilities: the parking lots, a pedestrian plaza at the trailhead, and an entrance on Wheeler Ave leading up into the stone quarry.

Following our planning stage, we came up with two initial site plans. The first design plan was a rudimentary conceptualization of a new entranceway leading to the stone quarry, outlined by the wooden fence and trees. The present driveway is disregarded for legality issues as it partially sits on private land. The parking lot has two bioswales on each end and one rain garden in the center to efficiently process rainwater at peak levels. In addition, there is a general site plan at the trailhead that illustrates the trails and overlooks.

The second design takes on a similar plan, though it takes into account a more comprehensive range of facilities and features. In this design iteration, the entrance plaza would be a dedicated pedestrian space connecting the entrance path, parking lot, and trail entrances. At the entrance plaza, portable toilets would be installed, and the waiting area would use a mix of city benches and bluestone seats to create an informal seating area. The construction of the main entrance portal would be a 6 feet wide distinctive bluestone word sculpture that spells out "Stone Quarry" and displays the Chenango Greenway Conservancy's logo to make it look grand and offer photo opportunities. The inclusion of a bike rack with a capacity of 10 - 20 spaces is due to nearly 1/4 of visitors surveyed utilizing bikes to get to the Stone Quarry.

In addition to the site plan, we used Streetmix to visualize the layout of Wheeler Avenue and the new entrance driveway. To accommodate all modes of transportation, we ensured there were bicycle lanes, pedestrian walkways, and two-way motor vehicle lanes.

Figure 2. Initial Design #1

(Call-Out Image Credit: Palmer and Powell, 2014; Townsend Collective et al., 2022; https://fcs.cornell.edu/projects/peterson-green-parking-lot; Satellite Imagery Credit: Google Earth, same for figures 3, 6. 7, 10, 11)

Figure 3. Initial Design #2

Figure 4. Initial Idea for Wheeler Ave Redesign

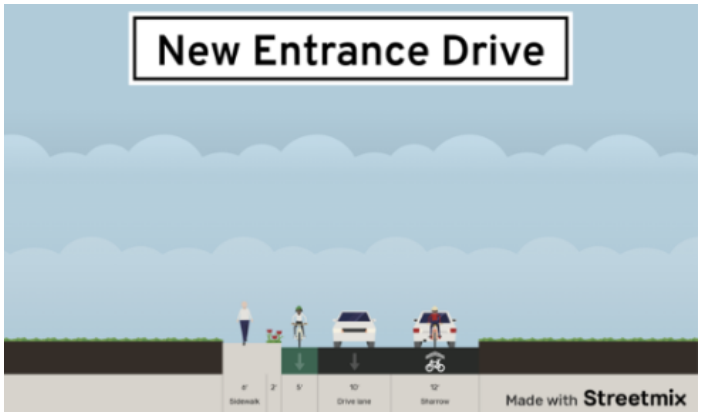


Figure 5. Initial Idea for New Entrance Drive

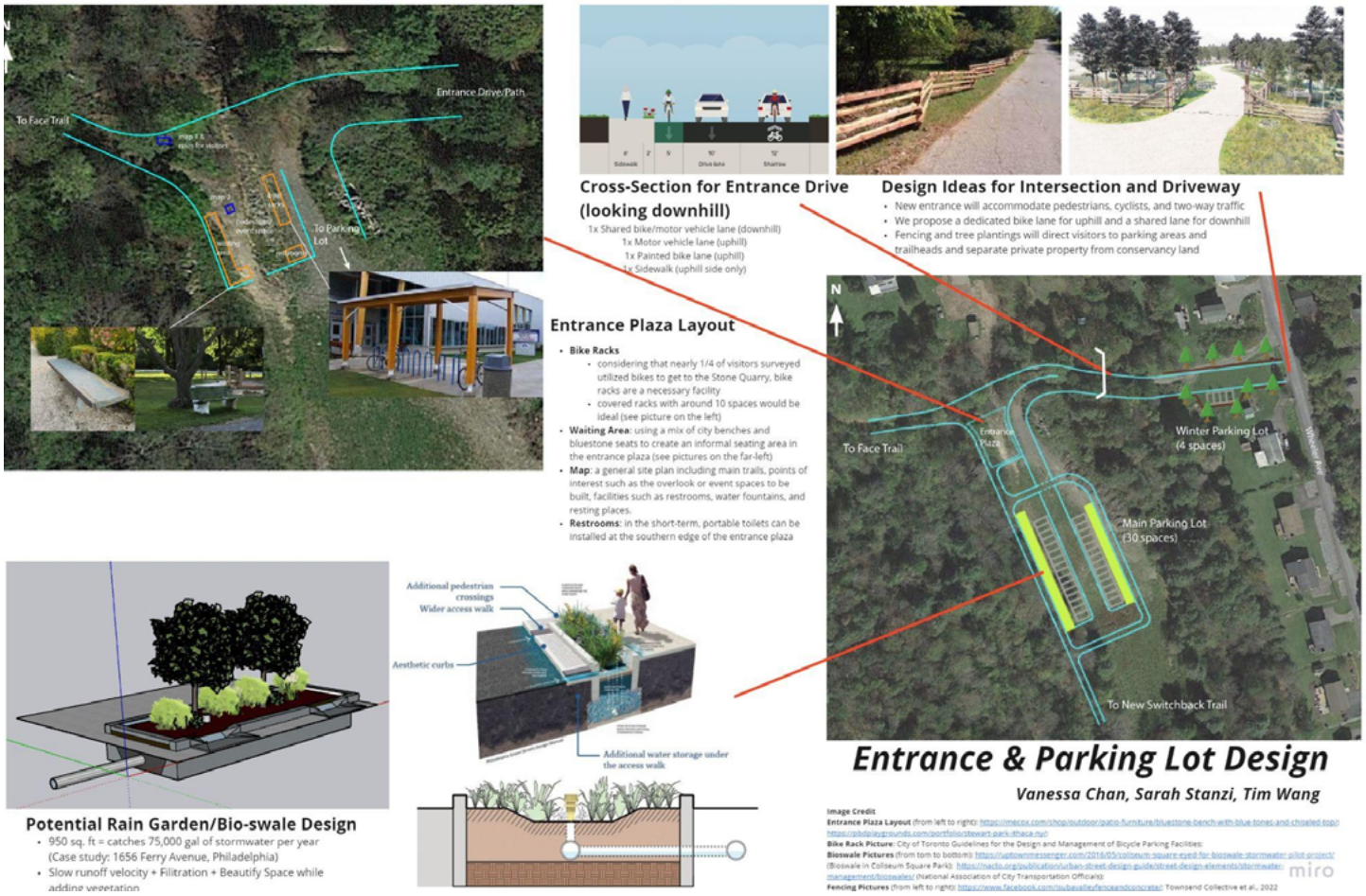


Figure 6. Midterm Review Poster Board

Having consulted our team members, we have combined the two initial sketches to produce our first formal entrance and parking lot design. It was presented at our mid-term review to receive critical feedback from our advisors. First, the reviewers reminded us to define the borders accurately between the conservancy property and the two neighboring houses. If the lines between public and private property are blurred, it may create liability issues if an accident happens on private property. Another suggestion was to get input from the local school to see whether they would hold field trips to the Stone Quarry.

If so, what kind of trail features or facilities would they be particularly interested in? In addition, we were advised to install more elaborate trail signs at essential nodes. After taking these suggestions into account and rethinking the entirety of our site plan, we have made significant adjustments, mostly reworking and repositioning major features of the site plan. We have modified the layout of the entrance driveway, optimized the location for our rain gardens, installed biking and waiting facilities in the entrance plaza, and introduced angled parking for better safety and ease of vehicle access. Ultimately, we have updated the site plan on Adobe InDesign and included callouts to illustrate what the various facilities would look like.

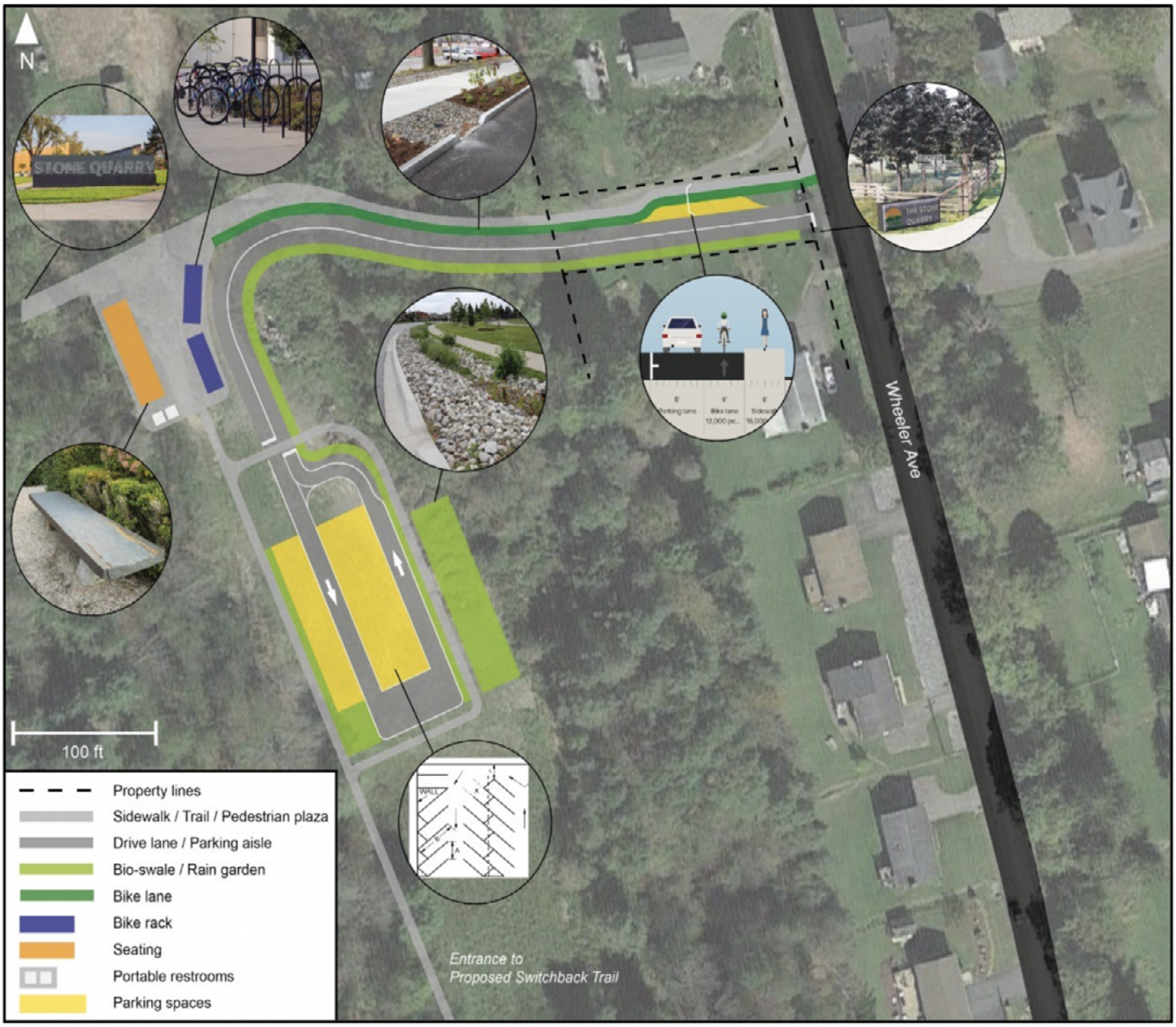


*Figure 7. Entrance and Parking Lot Site Plan #2**

(Call-out image credit: Toronto and Region Conservation Authority, 2018; Tower Road Bioswale, n.d; Townsend Collective et al., 2022; https://mecox.com/shop/outdoor/patio-furniture/bluestone-bench-with-blue-tones-and-chiseled-top/; https://www.in.gov/dot/div/contracts/standards/dm/2011/Part5/Ch51/figures/Fig51-4A.pdf; https://www.treetopproducts.com/park-it-2-bike-racks)

Our next round of feedback was during our community meeting, listening to the concerns and suggestions of Norwich residents and the Chenango Greenway Conservancy members. At the lower entrance driveway, Norwich residents wanted to leave additional space between the lower intersection and the winter parking free of trees to ensure good visibility of the driveway from neighboring properties and Wheeler Avenue for visitors. In addition, the neighbors wanted the fencing to be made out of wiring and wood. For the upper driveway, they wanted to use trees and signs to delineate the property line. Bearing the issues of deer eating and leaf littering, they have suggested eastern red cedars as an appropriate tree choice for this portion of the site. In addition, they asked many technical questions about the bioswale, specifically how the retention capacity, pipelines, and slope will affect the efficiency of the bioswale. In response to these concerns we conducted further research about the impact of slope and how much water will be discharged during intense storm events. In addition, they recommended that we add pipelines to direct water from the bioswale into the culvert downhill. Also, a community member suggested a bike maintenance station at the entrance plaza which we incorporated into our latest design. As such, we have made our final adjustments: implemented an additional bioswale, switched to check dams for the 11% driveway as the appropriate maximum slope for bioswales are 4-5%, finalized the parking lot material after conducting a cost-benefit analysis, reshaped the rain garden to increase the overall bioretention capacity, and settled on Eastern Red Cedar trees along the entrance drive.

INSPIRATION

Figure 8. Check Dam Inspiration
(Image Credit: https://wiki.sustainabletechnologies.ca/wiki/Check_dams:_Gallery)

Figure 9. Entrance Drive Fencing Inspiration
(Image Credit: Pasillas, 2022)

FINAL DESIGN

Through five rounds of brainstorming, design, and feedback, we finalized our conceptual diagram and overview map, as shown in figure 10 and figure 11, respectively. Our design incorporates the identifiable, accessible, and sustainable goals into three spatial components and six main design elements, which we discuss in detail below.

Component 1 is the lower entrance and driveway located on a narrow land parcel that is 50 feet wide. At the lower intersection (labeled A in figures 10 and 11), we recommend starting the fencing at the corner with Wheeler Ave, but leaving the initial 50 feet of driveway length free of trees. A modest sign, made of the existing stone found on-site and bearing the Greenway Conservancy logo, should also be placed at the southern corner of the intersection (see call-out in figure 11). Considering the space constraints for the lower part of the driveway, we include two vehicle lanes, one bike lane, one sidewalk, and a linear bioswale, which take up a 37-feet right-of-way. In addition to these features, we propose four parallel winter parking spaces (labeled B) between the uphill bike lane and sidewalk at the lower part of the driveway, bringing the right-of-way to 45 feet (see figure 12). The remaining space will be used for two wooden fences with metal wires as well as two lines of trees on each side of the driveway.

Figure 10. Final Conceptual Plan
(Call-out image credit: https://www.wildflower.org/gallery/species.php?id_plant=JUVI)

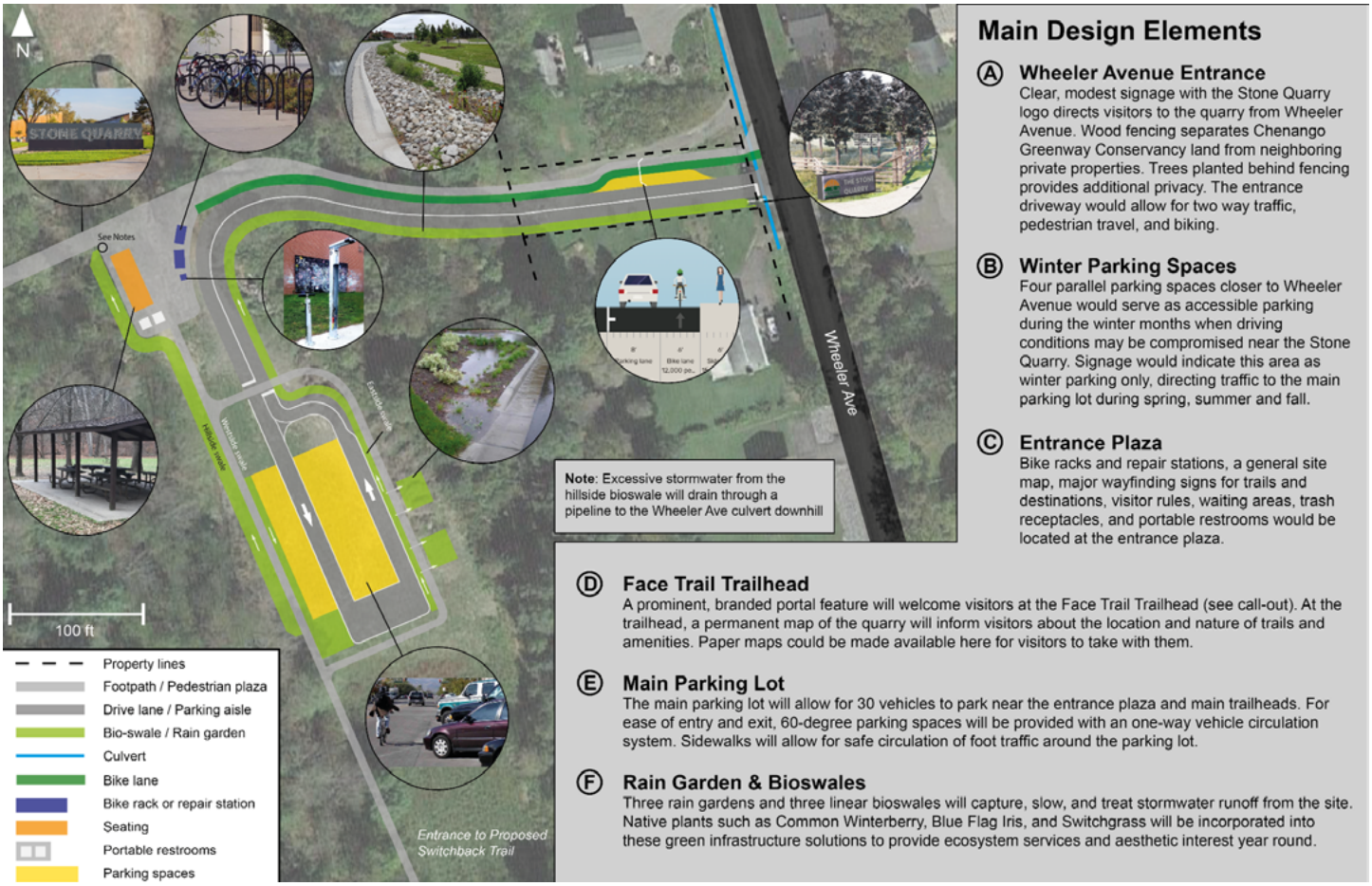


Figure 11. Final Overview Map

(Call-out image credits: Nelson\Nygaard Consulting Associates, 2005; Toronto and Region Conservation Authority, 2018; Townsend Collective et al., 2022; https://www.downtownithaca.com/bikerepairstation/; https://shophu.shtshg.ru/category?name=park%20with%20table; https://tikbow.com/life/environmentally-friendly/earth-day-2022-what-can-you-do-to-take-action-for-the-well-being-of-our-planet/; https://www.treetopproducts.com/park-it-2-bike-racks)

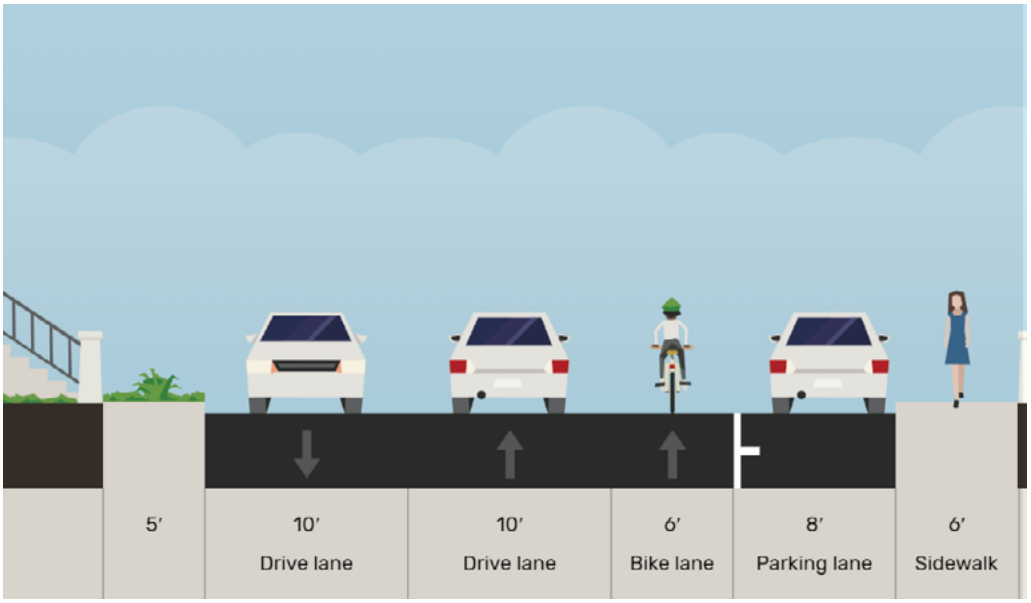


Figure 12. Final Entrance Drive Layout

The driveway bioswale will be a 5-feet wide, 430-feet long vegetated swale that mainly treats runoff from the driveway and entrance plaza. The initial 385 feet of the bioswale from the lower intersection to the entrance plaza will be equipped with check dams at regular intervals to accommodate the steep slope, while the remaining part will be set up with continuous soil mix and vegetation. One additional modification at the lower entrance is the extension of the existing culvert along Wheeler Ave 50 feet to the south to enable it to cross under the driveway (see figure 14). The driveway bioswale should be connected to the culvert through a PVC pipe to enable the drainage of excess stormwater.

Component 2 of our entrance design is the entrance plaza and trailhead (labeled C and D in figures 10 and 11) that welcome cyclists and pedestrians to the existing face trail. The entrance plaza connects to the sidewalk and bike lane to the east to provide direct access for people walking and biking, while the south side connects to the walkway system in the main parking lot to allow people driving to access the plaza. The entrance plaza is set up with two bike racks each able to accommodate 9 bikes and a bike repair station (shown as blue rectangles on figure 11). To the hillside, we recommend setting up a waiting area consisting of both city park benches and seating made of bluestone. Two portable restrooms should be placed next to the waiting area, close to the southern edge of the entrance plaza.

Component 3 of our final design is the main parking lot and its supporting green infrastructure. The 30-space parking lot is laid out using a one-way circulation system with 60-degree, back-in parking to enable easier entry and exit and improve safety (see schematics in figure 13). Instead of parking perpendicular to the street, these angled spaces require drivers to first drive past, then back into the space. This design allows for easier existing and a better view of cyclists and pedestrians who might be on the parking aisle. We recommend maintaining the existing gravel material but leveling the surface to improve user experience. The parking lot should also have painted lines indicating circulation lanes, individual parking spaces, and the direction of traffic flow.

In addition to providing vehicle parking, the parking lot includes three bioswales and three rain gardens to process stormwater runoff from both the impervious parking lot and uphill area. The bioswales and rain gardens have a similar vertical structure with vegetation adapted to wet conditions planted in a soil mix consisting of sand, gravel, and fine soil. The soil mix ratio should be determined upon further evaluation of local runoff and climate conditions to balance structural stability and infiltration rates. The key difference between bioswales and rain gardens is that the linear swales are designed to mainly slow down stormwater flow and direct excess runoff to the drainage system, while the rain gardens function to contain stormwater and enable soil infiltration and plant evapotranspiration, eventually reducing flooding on-site and in downhill areas. Therefore, the bioswales have an extra stone bed in the bottom, where a PVC pipe is installed to discharge excess water.

Among the three bioswales, the hillside swale (west of the entrance plaza and parking lot walkway, see figure 11) is the widest at 10 feet to accommodate large volumes of stormwater runoff from the uphill area. The hillside swale has a gradient that directs water flow from the south to the north with an outlet discharging excess water to the Wheeler Ave culvert using a PVC pipe. The other two bioswales are located to the west and east of the impervious parking areas (labeled westside and eastside swale on figure 11) and mainly function to capture runoff from the gravel surface. Due to the smaller drainage area, these bioswales are narrower at 5 feet. The westside swale flows from north to south and discharges into one of the rain gardens. The east side swale flows from south to north and eventually connects to the driveway bioswale, bringing excess water to the Wheeler Ave culvert. The three rain gardens are connected to the bioswales to the west and east of the parking lot to receive excess stormwater and reduce the amount discharged to the drainage system. The rain gardens also act as a barrier to runoff that is not captured by the bioswales and reduce the amount of flooding downhill. The rain garden to the west is 600 sq. feet in size, while the two rain gardens on the east side are each 470 sq. feet.

Figure 13. A Signage Explaining Back-In Angle Parking
(Image Credit: Nelson\Nygaard Consulting Associates, 2005)

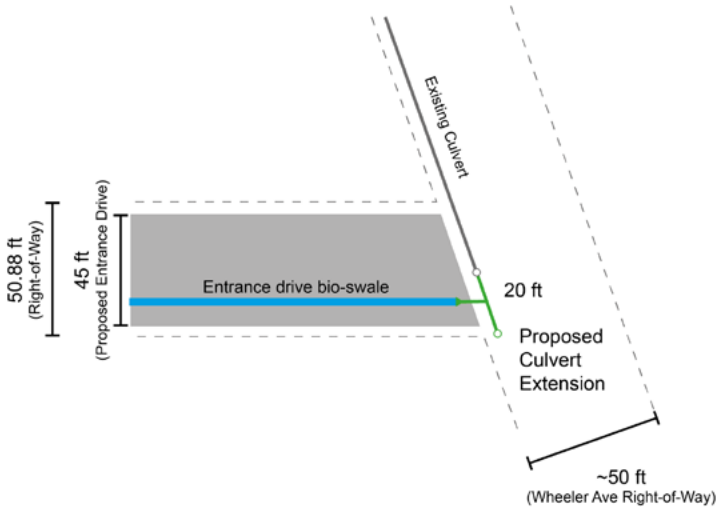


Figure 14. Schematic Diagram of Wheeler Ave Culvert Extension

MAINTENANCE

The green infrastructure solutions proposed in this design require minimal maintenance. Plant species were meticulously chosen based on maintenance requirements. Woody plants, perennial and annual herbaceous plants, and native grasses incorporated into the design are all considered low maintenance species. In the rain gardens, perennials and woody shrubs are easily maintained throughout the year, with minimal herbicides and pruning necessary. Tall grasses in the open areas only require annual mowing. Mulching should occur in the fall before extensive winter frost. Biannual weeding, herbicide application, and debris removal should occur. The bioswales should be mowed during the spring and summer months. Perennial flowers will minimize maintenance and replanting. Snow can be placed into low bioswale areas on the edges of walkways during winter. The bioswales and rain gardens at Cornell Botanical Gardens' Nevin Welcome Center provide a maintenance model for these interventions.

SUGGESTED PLANTS

Table 1. Plant List

Plant Type	Common Name	Scientific Name	Potential Size
Trees	Blue Point Juniper	Juniperus chinensis	3-gallon container
	Eastern Red Cedar	Juniperus virginiana	3-gallon container
	Greenleaf American Holly	Ilex opaca	3-gallon container
	Japanese Cedar	Cryptomeria japonica	3-gallon container
	Norway Spruce	Picea abies	3-gallon container
Shrubs	Black & Red Chokeberry	Aronia melanocarpa	18 to 24"
	Buttonbush	Cephalanthus occidentalis	3-gallon container
	Spicebush	Lindera benzoin	18 to 24"
	Virginia Sweetspire	Itea virginica	18 to 24"
	Northern Bayberry	Morella pensylvanica	2-gallon container
	Common Winterberry	Ilex verticillata	2-gallon container
Forbs	White Turtlehead	Chelone glabra	2-gallon container
	Woodland Sunflower	Helianthus divaricatus	2-gallon container
	Shrubby St. John's wort	Hypericum prolificum	2-gallon container
	Blue Flag Iris	Iris versicolor	2-gallon container
	Cardinal Flower	Lobelia cardinalis	6 inch pot
	Common Monkey Flower	Mimulus ringens	2-gallon container
	Lizard's tail	Saururus cernuus	6 inch pot
	Spotted Joe-Pye Weed	Eutrochium maculatum	6 inch pot
Gramminoids	Soft Rush	Juncus effusus	2-gallon container
	Green Bulrush	Scirpus atrovirens	6 inch pot
	Big Bluestem	Andropogon gerardii	6 inch pot
	Switchgrass	Panicum virgatum	6 inch pot

FUNDING

The New York State Green Innovation Grant Program and New York State Water Quality Improvement Project (WQIP) Program are possible state funding sources for this design. The Green Innovation Grant Program supports projects across New York State that employ EPA-designated green stormwater infrastructure designs and create cutting-edge green technologies.The WQIP Program funds projects that address documented water quality impairments or protect a drinking water source. Information about these funding sources and others can be found on the New York State Department of Environmental Conservation website.

Table 2. Entrance Plaza Amenities Cost Estimation

Entrance Plaza Amenities	Number of Items	Cost (per item)
Bike Racks	2	$300.00
Portable Restrooms	2	$800.00
Park Benches	3	$600.00
Bike Repair Station	1	$1,000.00
	Total Cost:	$2,700.00

Table 3. Roadwork Cost Estimation

Asphalt/Concrete Work	Size (sq ft)	Cost (per sq ft)	Cost
Entrance Driveway	10,460	10	$104,600.00
Entrance Plaza	5,370	10	$53,700.00
Parking Lot	12,866	10	$128,660.00
Bike Lane	2,538	10	$25,380.00
Sidewalks	6,695	10	$66,950.00
		Total Cost:	$379,290.00

Table 4. Stormwater Management Cost Estimation

Stormwater Management Solutions	Size/ Amount	Capacity (gal)	Initial Costs	Annual Maintenance Cost	Life Cycle Cost
Raingarden (sq ft)	1,560	9,856	$9,469.00	$639.60	$21,845.00
Bioswale (sq ft)	7,440	4,978	$20,638.92	$305.24	$37,587.00
Trees (per item)	15	4,667	$3,750.00	$2,700.00	$55,994.00
TOTAL COSTS			$33,587.92	$3,644.84	$115,426.00

TRAIL DESIGN

OBJECTIVES

Our sub-team was assigned the task of developing programming for the summit site and second switchback trail connecting to the parking lot. With such a large subject area, in-person and academic research was essential to develop a greater understanding of the site and an effective plan for its development.

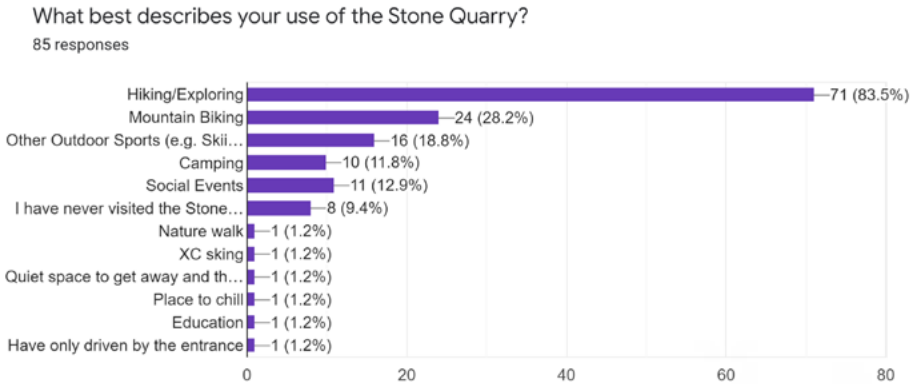
SITE VISIT

On the preliminary site visit, we focused on gaining context for the site and understanding of how it could be reorganized for greater usage by the community. We started by traversing the current trail that travels up to the main overlook. Doing so under winter conditions helped us to appreciate the community's desire for a more gently-sloped and protected alternative.

At the site, the overlook locations were stand-out features that held significant potential for tourism and sight-seeing. At the site visit, the mayor and a number of community members were present who gave feedback on desired improvements to the site. A consensus of excitement was shared between the community members about new amenities and access to the Stone Quarry Site. Local residents responded positively to ideas about installing benches, campfires, and an amphitheater on the top of the site.

COMMUNITY SURVEY

The results of our team's community survey further informed what uses and characteristics Norwichers were most concerned with supporting at the site.



The vast majority of respondents indicated they primarily used the site for hiking, biking or other outdoor sports. Only about 25% said they visited the quarry primarily for camping or socializing. This multiple-choice question clearly communicates that even if residents do use the quarry for a variety of purposes, hiking is by far the most popular. This may be a function of the site's extensive, apparently well-known network of trails, which could encourage exploration and attract returning patrons. By contrast, other activities like camping may be disserviced by the site's relative lack of amenities or programming at its summit.

When asked another multiple-choice question about how they access the site, 68% percent of respondents indicated they have traveled by foot and 24% indicated they used bikes. 43% of those surveyed indicated that upgraded access via improved pedestrian trails was their "top priority", compared with 15.3% who prioritized amenities like benches or fire pits. A new trail from Wheeler Avenue ranked as respondents' most common first and second preference for improvements, while "benches and other resting spaces" was the most common third choice. Combined, these answers strongly emphasized the community's focus would be on improving trails and other hiking infrastructure, but that considerable interest also surrounded the improvement of the summit site.

GUIDELINES

We sought out specification guidelines published by park institutions, such as the National Parks Service (NPS), to inform the engineering considerations of our site design. From the NPS, we obtained trail specifications for different usages and levels of accessibility which served as the framework for the new trail. In addition, we also utilized NPS campground development guidelines for the campfire and other amenities that are planned to be added to the overlook areas.

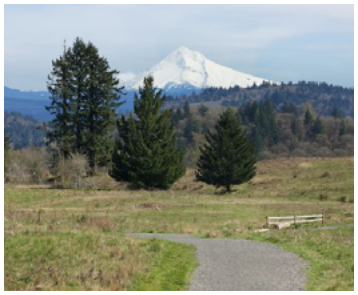
DESIGN QUESTIONS AND CASE STUDIES

Pursuant to our visit and initial stakeholder meetings, we developed a clearer understanding of our design questions based on the site's existing characteristics and the stakeholders' goals.

1. The Chenango Quarry is a disused industrial space with unique man-made features carved out over its previous lifetime. How can we best make use of and respect those features and their history?

2. The Chenango Quarry has traditionally been used informally as a recreational site by Norwich citizens and regional residents, particularly for hiking, biking and related activities. How can we formalize the site to best support that recreational use?

These central questions provided grounds for researching case studies that successfully accomplished similar missions.



Perth, Australia's Quarry Amphitheater most closely resembles the Chenango Quarry project: the Amphitheater represents the effective reuse of a formal quarry as a recreational space that hosts concerts, weddings and other activities. However, its site differs significantly from the Chenango Quarry with a significant open hollow which Chenango lacks, as well as a more constrained site inside the Perth metropolitan area. Perfectly replicating the Quarry Amphitheater is unlikely to be either economical or fitting for the Chenango Quarry site.

Portland's Mount Tabor and Powell Butte nature parks are not built on abandoned quarries, but they do offer similar examples of adapting industrial and infrastructural environments for recreational use. Both sites host Portland municipal reservoirs wrapped inside public parks, which interact with the reservoir in different ways: either by concealing it, in Powell Butte's case, or by integrating the reservoir structure into the landscape of the park at Mount Tabor. The two sites also benefit both from high vantage points on the surrounding regions and a large portfolio of different subspaces which offer visitors significant choice in their activities, advantages shared by the Chenango Quarry site.

Our mid-semester community review session helped us to identify more local case studies. Norwich residents brought examples of upstate New York trails and outdoor recreational areas they enjoyed. One particular example mentioned was Ithaca's Black Diamond Trail. Community members praised the trail's gentle slope, smooth pavement and beautiful scenery as desirable qualities for an outdoor space like the quarry. Another site neighbors referenced was the Monkey Run Trail Loop, a medium-length hiking course with similar features.

These global and local case studies each helped us to imagine how we could formalize the Chenango Quarry site to answer our design questions and create a cohesive, appealing experience for Norwich residents. Well-designed paths such as the Black Diamond Trail would be crucial for improving access to the site. Similarly to the Quarry Amphitheater, we would want to make effective use of the site's unique features. In order to weave individual spaces together, we also hope to replicate the success of Mount Tabor and Powell Butte in programming a variety of outdoor activities with the site's complex landscape.

DESIGN PROPOSALS

Based on our site visit, community feedback and case studies, we developed a site plan for the quarry that we thought could best accommodate visitors' needs with minimal change to the site's geography. Our design attempts to use the preexisting variance of spaces on the quarry site to support a variety of outdoor activities, including hiking, picnicking, camping, barbecuing and small outdoor events.

Overhead Site Rendering

This overhead site rendering illustrates the connections linking key areas of the site, as well as its position relative to the town of Norwich. The main overlook on the upper right corner serves as the site's entryway via the existing trail. It connects to the quarry's central clearing and the north overlook in the bottom and top left, respectively. More trails shown in the bottom right lead to a third overlook and camping areas relatively secluded from the rest of the site, as well as the planned upper terminus of the new switchback trail.

THE MAIN OVERLOOK

Endowed with both the greatest direct vista of downtown Norwich and the main entrance to the summit site, the main overlook is the keystone element of the summit site. Our plan is to improve its seating capacity with additional benches at its center and eastern slope to complement the existing firepit and vista, respectively. Programming signs could also be placed along the edge to simultaneously identify Norwich town landmarks and mark a spatial barrier between the overlook and the slope below.

Main Overlook Rendering

THE QUARRY CLEARING

Stemming directly from the main overlook, the quarry clearing is the site's largest open space, with clear evidence of its original purpose in the form of stone walls lining its northern edge. We want to use this circular area to program large social amenities for the site's visitors: an open picnic area where families can sit down to relax, and a small amphitheater for performing arts or events.

Quarry Clearing Rendering

THE NORTH OVERLOOK

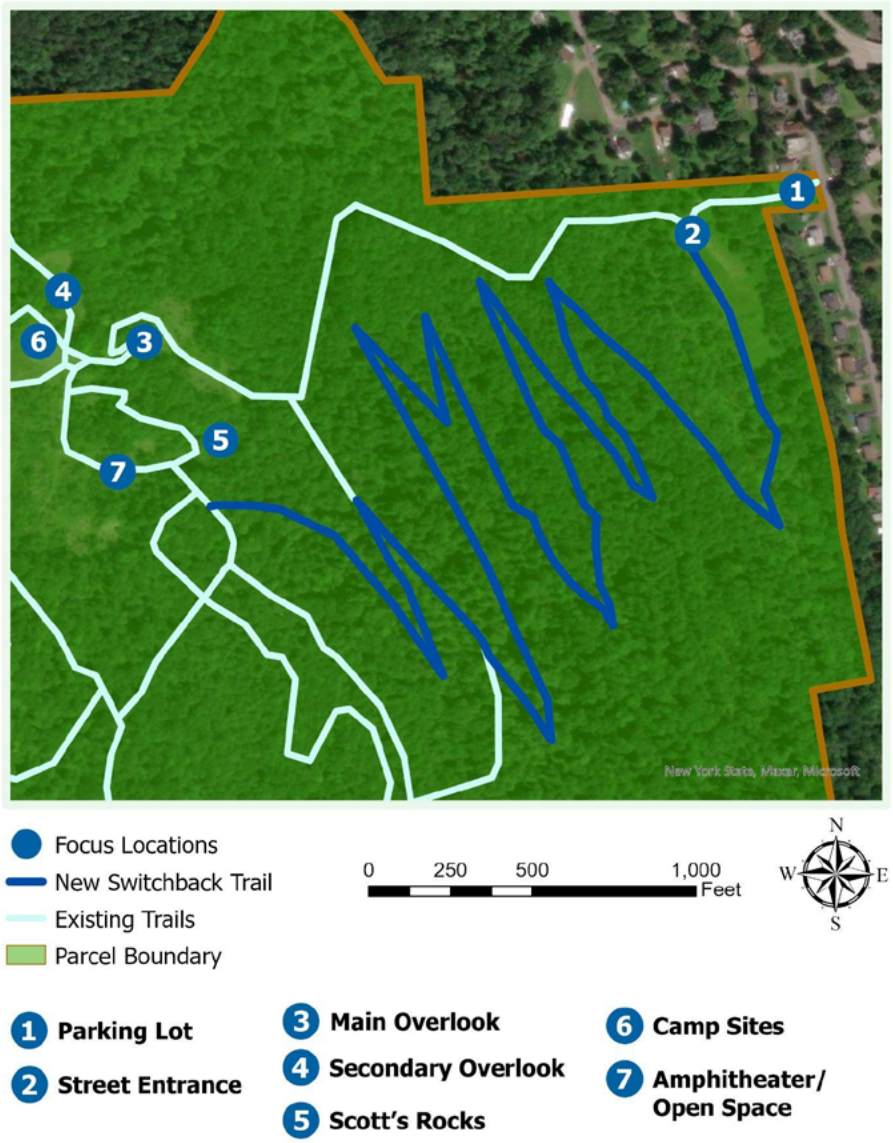
On our site visit, we identified a long section of the summit rim which we determined to have potential as a more social overlook area, geared towards visitors who want to hold events with larger groups while still enjoying excellent views. The north overlook could feature log benching along its rim and encircling a series of larger campfire pits. Its close connection to the quarry clearing could enable easy access between both sites.

North Overlook Rendering

THE CAMPING AREA

Relatively secluded from the social centerpieces of the summit, the camping area would provide visitors interested in an overnight stay a quieter environment to set up their tents, light a fire and relax, complete with a small overlook of their own, called Scott Rocks, hidden among the trees. The camping area is set in an existing clearing between two ridges that may help shield it from the wind.

Camping Area Rendering



THE NEW TRAIL

A main priority for the community was the creation of a new switchback trail to travel up the hillside to the top of the quarry at a grade more accessible than the current trail. In addition, the new trail looked to provide additional access to the nature of the quarry site. With these two goals in mind, a the new trail was mapped along the hillside. 8 main switchbacks were utilized that followed the elevation of the hillside to provide a gradual ascent on the way up and descent on the way down. The new trail is approximately 2 miles long and has an average grade of 3.25%. Following feedback from the community meeting, it was requested that the new switchback trail follow former trails on the hillside that had been in use when the stone quarry was active to limit the work that needed to be done. Based on analysis of current and historical imagery from Google Earth, these routes were roughly identified and the new trail was adjusted to take advantage of the pre-existing infrastructure.

The specifications for this trail were created with the framework of the National Park Service's park trail guidelines, specifically the level three hiking trail guidelines. This specification outlines optimal forward grade, peak forward grade, as well as cross grade and material information, which the new trail is designed within. The trail will be partially a natural surface with some leveling and gravel brought in to improve drainage along the trail. To address drainage, a priority

identified in community outreach, the new trail should havea 6 inch drainage ditch on the slope side of the path with a 2-3% inward inclide. Following the trail route, the trail should be well under the maximum slope for this type of trail (15%).

This new trail will broaden access to the new amenities at the quarry sit. A significant proportion of the respondents to the first digital survey indicated that they are over the age of 60, and the easier grade will make the top of the quarry much easier to access. Particularly in the winter, when the trail has the potential to be icy, the new trail will offer significantly safer access. Finally, mountain biking is frequently enjoyed on the quarry site and the easier grade will make the trails at the top of the quarry significantly more accessible, particularly to beginners.

MEETING COMMUNITY EXPECTATIONS

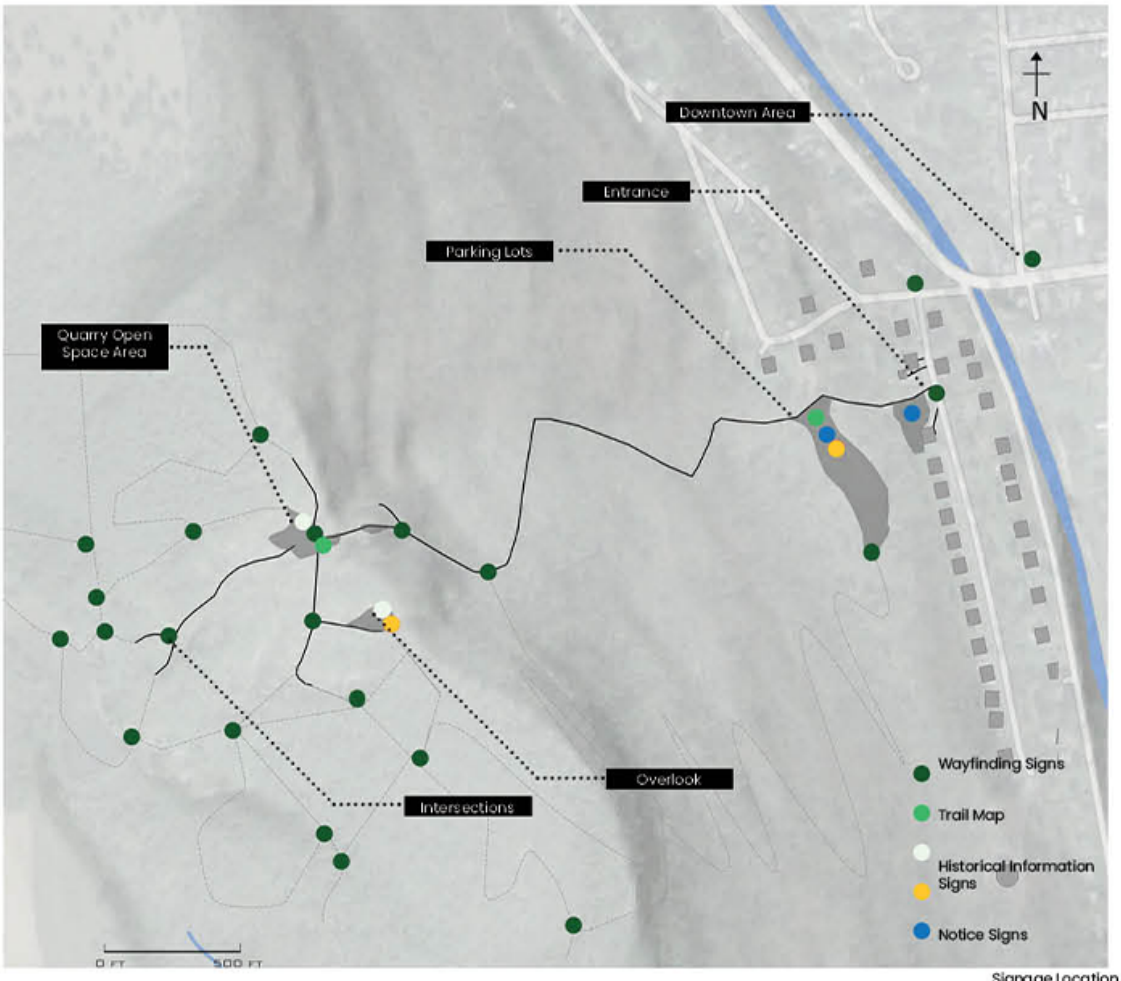
We believe that this design should satisfactorily serve visitors' needs and answer the questions we identified. It makes effective use of the Chenango Quarry site to support a wide variety of recreational activities by leaving the landscape largely unchanged, while also exploiting its natural variation. Each amenity is placed where they would best benefit from and complement the natural landscape; the overlooks that are central to the site are centered on celebrating that landscape.The variety of spaces formalizes the landscape with a set pattern of uses for different sites, which could contribute both to improved legibility and ease of maintenance. The planned switchback trail will more effectively connect the site to the community and improve accessibility so more people can make use of it.

SIGNAGE DESIGN

RESEARCH PROCESS

The research process started with exploring the history of Chenango County, Norwich, and any available information we could find on the Stone Quarry. This was to understand if there were any established signs or logos that should be included in the design, such as the City of Norwich's logo or the Chenango Greenway Conservancy's logo. We also studied signage guidelines by the New York State Office of Parks, Recreation and Historic Preservation Planning Bureau. This provided us with a general understanding of visible signage for trails. It is incredibly helpful for imagery and construction tips on placing signs along trails. It will be linked below. Next, we studied modern urban park signage designs for inspiration of high-use area signage. These parks included Burlington's Waterfront Park and Ithaca's Stewart Park. The goal was to combine high usage modern signage with the more rustic, less technical trail signage.

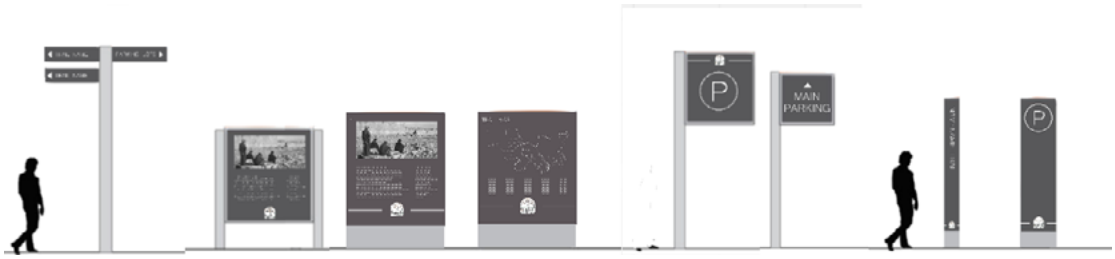
We toured the site in February 2022 to get a general understanding of the site plan and the surrounding neighborhood. This helped to capture the vibe of the Stone Quarry and allow us to start deciding on colors, shapes, and sizes for the signs in relation to areas such as the entrance-way, the parking lot area, and the overlooks.



Signage Location
Norwich, NY

DESIGN PROGRESSION

Our first step was to organize signage into a few general categories: trail signs, high-use area signs, entrance-way signs, and informational signs. The first iteration of our design was colorless and consisted of two designs for each category.



Our next step was to add color and themes to the signs. Following the Chenango Greenway Conservancy's logo colors, Texas Orange and Forest Green were chosen as the primary text colors. Navy Blue and Slate Gray were picked as the background, or secondary colors, because they complemented the brighter primary colors well and reflected the color theme of the Stone Quarry. Our Midterm presentation consisted of the colored designs and two ideas for the new category main entrance marker. The first was a large grated cube filled with pieces of stone and the words "The Stone Quarry" attached to the front. The second was a large stone with the Conservancy's logo engraved and the words "The Stone Quarry" etched on the surface. At the community meeting in Norwich, the designs received very positive feedback. One important comment we received was to make the primary colors on the signs be reflective in order to increase nighttime visibility. For the final presentation, we removed a few repetitive design ideas—such as the second parking lot sign—and put a larger emphasis on the favorable main entrance marker.

DETAILED EXPLANATION

The final design iteration contains three informational signs, a trail intersection marker, two parking-lot signs, a main navigational sign for high use areas, and a main entrance marker. All writing on the signs is purely to showcase sizing on the signs and is not an important part of the design.

The informational signs are intended to be used for trail maps and for historical information about the Stone Quarry or the City of Norwich. These signs are to be placed in the Parking Lot—by the entrance to the new switchback trail and the original trail—as well as by the overlooks to provide context for the views of Norwich and the Quarry. For the overlooks, the signs are not meant to be placed in front of the overlook spots, as they will obscure much of the view. They are intended to be placed by the bushes towards the back of the overlook, across from the entrance so they remain visible but not in the way. These signs can range from 4′ to 6′6″ in height, but they ideally should remain roughly around eye level for ease of use.

Trail Intersection Marker

The trail intersection marker is a roughly 4′ tall marker intended to be placed at the intersection of any and all trails within the Stone Quarry. Trail names will be written on each side with arrows to signify which direction that trail heads. This likely will be the most heavily used sign on the property.

Entrance-Way Signs

The entrance-way signs are roughly 8′ to 9′ tall and signify where to park. They are intended to be used by the entrance-way to point towards the winter-time parking and towards the main parking lot up the road.

Main Navigation Signs

The pole of the main navigation sign is roughly 8′ tall. The signs themselves are roughly 6″ tall per line of text. A concern emphasized in the community meeting was theft of signs, so we recommend that the signs do not extend 2′6″ in length to prevent too much leverage. These signs will be placed in the parking lot and the high-use area at the top of the Stone Quarry, pointing to trails and points of interest such as bike racks, camping areas, overlooks, and the amphitheater.

Main Entrance Marker

The main entrance marker is a large rock, ideally on a pedestal to lift it up a bit, with Stone Quarry engraved on the front. At the community meeting, we were happy to learn there was a rock that suited these conditions perfectly, roughly 30″ tall and 5′ wide, and the owners were willing to donate it for this sign.

SUGGESTIONS FOR APPROPRIATE RECOGNITION OF DONORS AND THE QUINCY FAMILY

To honor the Quincy family and the donors to the Chenango Greenway Conservancy who made this project possible, we propose a stone or metal plaque recognizing them. This plaque will be attached to a rock to keep it safe. One option is a single large plaque on a large rock honoring all of the necessary people at once, dated when the plaque was commemorated. This large plaque would be located in the parking lot by the entrance plaza. Another option is multiple smaller plaques honoring individuals or families who contributed to the project, scattered throughout the quarry.

COST ESTIMATE

There are two style options included in the final design. The first option is a stone base or stone-looking pole with a wooden sign board. The second option is a wooden base or pole with a plastic sign board. Below, examples of these solutions, in their component parts, are listed.

Item	Size	Source	Unit Price	Total Cost
Round wooden post	6.5" L x 3.75" W	Lowes	$11	$242 (x22 units)
Round wooden post	8ft L x 3.75" W	Lowes	$16	$352 (x22 units)
Wood plank	8ft L x 4.5" W x .75"	Lowes	$12	$96 (x8 units (would need to saw each unit into thirds))
Customizable aluminum trail sign	6" x 18"	CampgroundSigns	$44	$968 (x22 units)
Steel sheet	60" x 24"	Shapiro Metal Supply	$96	$192 (x2 units (would need to saw each unit into 10 pieces))
Aluminum sheet	¼ inch thick, 2ft L x 2ft W x .25" D	Shapiro Metal Supply	$104	$624 (x6 units (would need to saw each unit into fourths)
Plastic board	25" L x 52" W x .25" D	ePlastics	$191	$382 (x2 units (would need to cut each into 11 pieces)
Stone pole	7ft L x 6" W	South Shore Landscape Supply	$256	$5,632 (x22 units)
Custom metal/plastic signage		https://trailmarking.com/product/custom-trail-marking-signs/		

Maintenance costs	Unknown (only foreseeable for vandalism/theft reasons)

NEXT STEPS

If this design is considered, it's also important to identify potential next steps to improving the site, which mostly center on utilities. Lack of utility access will significantly handicap the site's ability to sustainably support large numbers of visitors. Campers and other visitors will face significant restrictions to their stay without a steady supply of water. Without electricity, there may be limited light and the amphitheater would be incapable of supporting technically complex productions. Waste management will also pose a significant issue if large crowds come to the site. However, these would all represent costly infrastructure investments which the Greenway Conservancy may have difficulty financing. They would also emerge as critical issues only if the site massively succeeds at attracting visitors, which remains to be seen.

That said, we encourage the Conservancy to consider how they would implement these systems within the quarry should they find there is adequate demand and resources to justify it. Forging connections to municipal services would be the final step in the formalizing process to make Chenango Quarry accessible to all Norwichers and sustainable for its operators. We hope our site plan provides a satisfying outline to build on the quarry's past and create a vibrant, enjoyable space for the future.

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