Problem Statement

Stormwater runoff has become an important issue on our College campus. Across its sprawling 175 acres, the College generates a large amount of runoff during storm events due to impervious surfaces: flat-roofed academic buildings, residence halls, parking lots and other paved structures. Runoff has led to documented flooding, erosion, and nutrient loading of an adjacent wetland and a stream originating on campus. A recent campus-wide stormwater study recommended that any new development project should consider stormwater management in the early stages of planning, specifically incorporating green infrastructure (GI) (Foit-Albert, 2012). This report generated interest in GI, leading to construction of a stormwater retention pond behind a new residence hall and a student-built rain garden that incorporates native plants. However, the issue of runoff from impervious surfaces on campus remains. Roof surfaces account for a large portion of impervious surfaces in urban areas (VanWoert et al., 2005). In addition to incorporating GI into new development, we have proposed and begun to implement a novel approach to retrofit existing construction in order to divert runoff from flat roofs. The purpose of our project is to demonstrate successful irrigation of a small, urban garden plot on an elevated plaza with collected rainwater. Our project’s goal is to demonstrate that a simple gutter system retrofit for flat-roofed buildings on college campuses and other urban institutions can reduce stormwater runoff by diverting the flow to an urban garden.

We have defined stormwater runoff as having a significant environmental footprint on our campus. Our project’s runoff mitigation approach can address chronic issues of water quantity and quality while simultaneously bringing attention to the issue of local food accessibility. Our school’s dining services purchases nearly all of its food from national vendors, but has
committed to shifting $1 billion nationwide to “real food” -- food defined as being grown locally and in an ecologically responsible manner (Barlett, 2011). We would like to see campus dining services not only achieve its goal of serving 20% real food by 2020 but to surpass it. Our project has the long-term potential to increase the amount of food grown locally while in the short-term developing sustainable gardening skills of students. We also plan to work with local urban gardening groups to spread knowledge about the merits of urban gardening, specifically increasing local knowledge of both roof-top and small-space urban gardening potential.

**Project Summary/Background**

We plan to demonstrate that a small-space urban garden can be an important tool in mitigating runoff from existing construction while yielding the sustainable benefit of edible plants. Our project will be particularly *greenovative* as we intend to integrate an emerging stormwater mitigation GI strategy with the growing demand for local, sustainable agriculture. The initial phase of the project involved establishing a demo garden on an existing, elevated-plaza or “pocket park” on our campus while the team continues to scope out potential buildings for feasibility analysis for future roof-top garden cultivation. During this time we will continue to work closely with facilities and administrators to be sure all safety and building codes are met before a potential roof-top site is identified. Once a site has been selected and agreed upon by all parties, a roof-top application can be considered for a feasibility study. The strategic advantage of our pilot elevated-plaza garden is its ability to demonstrate the feasibility of a working campus garden to the administration and larger campus community. Even at ground-level we can test relative efficiencies of drainage systems and liner materials in raised garden beds.
We fully intend to demonstrate the value of urban gardens: they decrease stormwater runoff that would otherwise pollute local watersheds; they can serve as an educational tool for students within multiple disciplines and grade levels; and they can provide locally grown foodstuffs while enhancing the natural beauty of an area. In our garden layout, water that drains from a flat roof is collected by a gutter and diverted into a series of 55-gallon rainwater collection barrels. Under normal precipitation patterns, no additional water source for our urban garden plants should be necessary. The garden will decrease the school’s carbon footprint while saving money by reducing the amount of produce trucked in for a weekly student-initiated local food luncheon. In short, there are numerous advantages to small space, urban gardens and our project will demonstrate these substantial environmental, social and economic benefits in an innovative, educational setting over time.

The environmental benefit of this project will have broad applicability as it will add to the environmental legitimacy of our College and also encourage other institutions in the Albany capital region to follow suit. We intend to disseminate findings from our demo garden and feasibility studies of other sites, designs and materials to the larger community through a website that will be linked to our department’s homepage.

*Literature Review.* There is a growing body of literature on the benefits of green or living roofs (VanWoert et al., 2005). A recent report on projects from New York City (Melching, Resnick, & Carleo, 2012) emphasized the multiple benefits of retrofitting existing buildings with green roofs: stormwater capture, urban heat island reduction, and increasing habitat and species diversity. The stormwater retention capability of green roofs is significant. VanWoert et al.
(2005) found that vegetated roofs have a mean stormwater retention rate of 82.8%, which can help mitigate the stress put on urban watersheds by impervious surfaces. In fact, Liptan (2003) concluded that stormwater runoff mitigation was the primary benefit of green roofs due to the prevalence of impervious surfaces in urban and commercial areas and a failing stormwater management infrastructure. A recent review of the literature on green roofs and their role in pollution abatement (Rowe, 2011) concluded that they provide a unique opportunity to utilize typically unused spaces to address pollution concerns while also protecting the environment. This review pointed out that while the stormwater retention benefits of green roofs were well-documented, more research was needed on the role green roofs could play in sustainable local production of food in urban areas. The questions raised led to the approach chosen by our team.

**Relationship to Sustainability**

Another major benefit of urban gardening is localization of food sources. Some large cities, like Detroit, have seen the benefits of localizing food sources and have begun to reclaim unused land (Timm, 2014). Other cities that do not have as much unused land as Detroit are looking up to their roofs as untapped, potential growing space. More recently, other major cities, like Cleveland and Chicago, have begun implementing urban gardening systems with the intention of reducing long-distance transportation of foods. McCormick Place in Chicago has implemented the largest green roof in the Midwest at 20,000 square feet. This roof is able to produce approximately 8,000-12,000 pounds of food per year, drastically reducing food transportation distance (Barclay, 2013). Although our pilot elevated-plaza garden plan is an order of magnitude
scaled down from McCormick Place, we intend to influence the local food supply, especially on our campus.

Urban populations often lack adequate access to locally grown food and thus often fail to understand the workings of the food system. The disconnect between urban people and their food must be remedied if we wish to promote sustainable agricultural practices. Increasing opportunities for urban gardening is both an ends and a means to reduce the impact of nutrition acquisition and help people understand the process of food production. While food production in cities can be a challenge due to the limited real estate, implementation of small space, “pocket park”, and roof-top gardens can help employ underutilized space with great potential. Every aspect of our project is planned to be environmentally beneficial, from retaining stormwater to providing local produce for the students’ local food initiative. The only tradeoff we have identified was transporting the necessary building materials to campus, thereby using fossil fuels and emitting greenhouse gases. However, because this is a small pilot project, we estimated negligible initial construction impact.

**Materials and Methods**

Key milestones and project tasks began in November 2014 with submission of our proposal to NYSP2I and our College’s Administration. In December, we met with representatives of facilities and a commercial roofing company to discuss construction on the plaza site and materials needed. In January 2015, we met with our sustainable urban gardening consultant to finalize garden layout and plant selection; water collection and monitoring design; and develop plan to order plants and seedlings. In March, we recruited volunteers for the construction/tilling
event to be scheduled after thaw. April 2015 was the end of the first phase of our project with bed construction and tilling; planting seedlings (weather dependent); and preparing the final report and presentation for NYSP2I Exhibition.

Our design involves installing a garden on a raised elevated plaza area on our campus. Many years ago, this area was a flower garden that was planted over with grass, so the location and exposure is suitable for growing plants. A gutter will be installed to collect the runoff from the overhanging roof surface and move it to the collection barrels. For the first phase of our pilot site, we constructed framed, raised planting beds, over a base of rooftop garden liner material as a test. These base layers aid in root stability and drainage from the soil on rooftop gardens. Plant varieties will be determined in consultation with our urban gardening expert as we get closer to planting time. Construction and summer maintenance will be accomplished with volunteer labor from the student Environmental Club and other interested students.

**Team Member Roles:** The team leader’s assigned tasks included recruitment of volunteer workers; acting as liaison with the urban gardening consultant; keeping team members on task; and assisting in all aspects of garden set-up and maintenance. Team member one designed the rainwater collection system; team member two was responsible for composing press releases and website text; team member three acted as liaison with roofing company representative; all team members assisted in all aspects of garden set-up and maintenance. The team adviser acted as liaison between students and administration; she will help us develop an interpretive sign.

**Partnerships.** Roots Café is a student-run local food initiative that has been identified as a partner for our project. Roots Café provides a luncheon of locally-sourced, organic food every
week with the support of our partners in dining services. Program organizers are eager to identify local food sources and are interested in any produce from our garden. In addition, the owner and manager of a private, sustainable urban farm in Albany, NY, has agreed to advise us in the building and maintenance of our garden and plant selection. He has extensive experience in edible plant cultivation in small spaces. Along with running his urban farm center, he partners with a Community Supported Agriculture program in Albany that provides produce for a local community on a weekly basis. And last, a local roofing contracting company that has experience with green roof projects will be a source of materials and professional expertise for constructing our water diversion system and testing roof-top garden liner material. We have an established relationship with this company as team members worked on one of their projects near campus earlier last summer.

**Results, Evaluation and Demonstration**

To assess the overall success of our project, a few quantitative measures will be recorded and analyzed for trends. Our primary evaluation metric is volume of rainwater collected in gallons, the first data that will be collected will be a quantitative measure of the volume of runoff that should come off the flat roof surface next to and above our garden. This will be accomplished by using the EPA’s water runoff formula for impervious surfaces. This formula specifies: (Feet of Rain) X (Roof Width in Feet) X (Roof Length in Feet) x (Gallons per cubic Foot) = Gallons of runoff. This calculation will give an accurate estimation of the amount of water that should be running off the roof. The rain measurement required for this calculation will be determined using a standard rain gage in the same location. Additionally, by integrating holding tanks with roof
gutters and downspouts the collected rainwater can be stored and used to water the vegetable beds in the garden as necessary. This runoff flow diversion will essentially lead to zero net runoff and potential pollution from the impervious surface of the adjacent roof. If there is surplus water, it can be distributed to landscaping plants elsewhere on campus. According to the Town of Colonie and the Latham Water District, the charge for water is approximately $2.91 per 1,000 gallons. According to the EPA, a rain barrel will save most homeowners about 1,300 gallons of water during the summer months. This estimate is for an average home, our college is a much larger institutional site so the amount of water has the potential to be much higher. If the rainwater collected was indeed used for other landscaping purposes, the amount of money saved could be estimated based on the number of gallons collected (Town of Colonie, n.d.).

The next measure of our success that can be assessed would be how much food is produced and used locally. Any edible plants grown during the harvest season will used by our partner, The Roots Café student local food initiative. Invoices from previous seasons can be used to estimate the amount of money saved by this student run initiative. In addition, the more food that can be produced and used locally will also reduce the carbon footprint of the project and the community by reducing food transportation costs. However, this kind of data will need several growing seasons to be meaningful. To calculate the actual impact on our local carbon footprint we will use an equation created by the Berkeley Institute of the Environment. This equation, CO2 emissions in pounds reduced = [ (dollars saved on produce per month × emissions factor for produce (1176) × months of production ) × gram to pound conversion (0.0022) ], can be used to directly quantify the reduction of CO2 emissions that the garden is responsible for. This number
is neglecting the carbon emissions that would be reduced due to photosynthesis and sequestration by the plants as well, so the overall impacts on the carbon footprint would be even greater than calculated (Jones, 2011).

The scalability of this project adds to its merit, as we hope to one day to expand roof-top and small-space gardens throughout campus. Applications of sustainable infrastructure should be steadily expanding if we wish to have a progressively reduced impact. The purpose of this project is to serve as a pilot that will demonstrate the transferability of roof-top and small-space gardening to the larger community. Our vision is for a future where major green roof projects are adopted routinely for new academic buildings; the ecological benefits will only increase as chronic issues of water quality and quantity are addressed.

At the exhibition we plan to represent our project with a poster. We will present our project/research plan, demo photos, while providing sketches of feasibility models. For comparative purposes the poster will also include photographs of potential rooftop sites alongside an artist’s rendition of what they might look like as working gardens.

**Conclusion**

Urbanization and the rapid expansion of the human population has many effects on the natural world around us. We have identified some of the largest local impacts (i.e., stormwater runoff from impervious surfaces and a lack of locally-sourced food) and are now attempting to mitigate these effects in a *greenovative* way. We intend to establish a demo garden on an existing, elevated-plaza on our campus to demonstrate the feasibility of a working campus garden built below an impervious surface. To reduce the runoff from impervious surfaces, water that drains
from an adjacent flat roof is collected by a gutter and diverted into a series of 55-gallon rainwater collection barrels. This project aims to: decrease stormwater runoff that would otherwise pollute local watersheds; be utilized as an educational tool for students; and provide locally grown foodstuffs while enhancing the aesthetic beauty of campus. Once feasibility has been demonstrated potential locations for future roof-top garden cultivation will be assessed. The benefits of this project will have many positive impacts on the local community that will be both environmental benefits and socioeconomic benefits. The garden will decrease the school’s carbon footprint while saving money by reducing the amount of produce purchased. It will also add to the environmental legitimacy of our College and also encourage other institutions in the Albany capital region to follow suit. The final findings from our demo garden and feasibility studies of other sites, designs and materials will be presented to the larger community through a website that will be linked to our department’s homepage as well as presented various campus symposia and community engagement events.

Figure 1. Site of Elevated Plaza Garden
References


