Grey Scars of the Past: Case-Study-Based Green Principles of Historic Mill Redevelopment with a Sustainable Future

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A Master's Project Presented

By

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ABSTRACT

Historic mill buildings are vast structures that tend to have a negative connotation associated with them. They are usually looked at as eyesores or symbols of a historic, working past that should be demolished. However, due to a variety of reasons, and the array of benefits that can be created if preserved, these mill buildings should be redeveloped and in a green, sustainable way. This Master's of Regional Planning Project examines the concept of sustainable mill revitalization, and various case study examples in the state of Massachusetts that demonstrate this. Various patterns of the concepts and elements were evident amongst the case studies. Through research and these case studies, a set of case-study-based green principles for sustainable historic mill redevelopment are proposed. These principles can serve as a basis for future development of similar sets of values.

Additionally, various planning concepts and initiatives were applied in the case studies and worth being noted in this project. Historic mills are large structures that tend to be located in downtown areas, which makes it a main task for regional planners to determine what next steps should be taken to handle these buildings. If redeveloped, the mills offer an array of benefits associated with planning goals and theories of today.

INTRODUCTION

A city's landscape changes ever so slightly each and every day, with the transitions being evident to the human eye over the course of decades. What is left behind from years and years of past industrial urban life may leave scars on the landscape, remnants of what used to be. A majority of these scars are in the form of structures; buildings that once thrived in the community where they now stand, vacant and crumbling. What these buildings offer us today are enormous opportunities in the cities and towns where they once dominated.

This Master's Project examines four case studies in Massachusetts that demonstrate sustainable redevelopment of historic mill buildings. From these case studies and additional historic mill redevelopment research, ten case-study-based green principles are proposed for sustainable mill redevelopment. These principles can serve as a basis for the creation of future guiding principles.

Implications of Regional Planning/Contributions to the Field

This research is important to regional planning, landscape architecture, green and urban design, environmental, architecture and an array of other fields because sustainable development is becoming exponentially prominent in today's society. We are recognizing the importance of conserving our resources, especially as the population is growing significantly, and there is a higher need for more closed loop, sustainable, resilient systems. Mill buildings take up vast areas of land, and existing dilapidated mills are reaching the end of their lives. Before they fall to the ground, are determined a public health concern, or are demolished because of their state of disrepair, there needs to be a recognition of their importance to society as a whole and the

advantages they can bring to a community. Once the environmental benefits are determined, there will be a higher concern for turning mills into efficient elements of our city.

Specifically, the sustainable redevelopment of mills is important to the planning field, mainly because mill buildings tend to be vacant and a safety hazard. Figuring out how to handle these buildings and deciding whether to demolish them or encourage their redevelopment is a common planning activity in communities that contain mills. Since they tend to be located alongside water bodies, such as rivers and canals, the handling of them becomes more important because waterfront access can either be created or further restricted depending on the actions taken on the mill.

If redeveloped, especially as a mixed use development, the mill can help foster and support planning initiatives and programs such as green communities, smart growth, walkable environments, handling of vacant buildings, prevention of urban sprawl, conservation of open space, transit oriented development, urban agriculture, etc. On the other side, various planning tools and techniques can help foster and support the redevelopment of mills. Such tools and techniques include those related to zoning (overlays, inventories), building code, master planning, and tax incentives or funding options.

LITERATURE REVIEW

Industrial communities may be a thing of the past, representing a form of urban decay and an obstacle to city officials (De Sousa, 2006). More importantly, though, these communities are a basis for the future and can serve as valuable assets to a community. The world is entering a new age of living with a higher need and want for energy efficiency. In the United States alone, the president has committed the country to 83% carbon dioxide reductions by 2050 (Kats, 2010). What better way to foster this new sustainability desire but in large underutilized structures that have potential for important future uses.

The reasons for sustainable redevelopment of mill buildings are enormous and include such things as: serving as an example for future sustainable projects; helping in lowering CO_2 emissions and other pollutants; lowering the urban heat island effect; creating a healthier environment; providing jobs; preventing urban sprawl (the spaces where industrial mills are located are considered drosscapes and are encouraged to be utilized instead of developing on untouched, greenfields (Waldheim, 2006)); creating a more positive aesthetic appearance; improving environmental quality overall; gaining recognition for being environmentally innovative; enhancing recreational opportunities; and of course saving money by adding value to the buildings through the sustainable improvements. In addition, it has also been found that the well-being of nearby residents can be improved through reduction of crime (since blighted areas tend to have higher crime rates), reducing stress levels (De Sousa, 2006), and an overall better quality of life. “People who live in green communities stay longer, are more involved in community life, and are generally more likely to create a rich, vibrant community” (Kats, 2010).

Enhancing recreational opportunities and contributing overall to a community is a major motivator to redevelop mills sustainably, especially since most mills are located in close proximity to waterways. The historical developments of many mills, such as the ones located in Holyoke, Massachusetts are directly contributable to waterways such as man-made canals, so that the mills could easily harness water power. After all, the luxury of electricity was not offered during this time. Mills had to be developed where energy could be harnessed (Boston Affiliates, 1981). Weaving redeveloped mill structures into overall master plans can be beneficial. For example, for communities with riverwalks or canalwalks and mill buildings located along these waterways, the mills can be adaptively reused for storefront shops, restaurants, office space, etc (Fig. 1).

Fig. 1 The above image is prior to the city of Holyoke, Massachusetts' Canalwalk construction, while the below image shows a rendition of what the area would look like after construction. Note the storefronts located in the mill buildings along the Canal. *(Source: Holyoke Office of Planning)*

Industrial mill buildings have a higher chance of being contaminated brownfield sites due to their past uses, which is very important when discussing how these structures can be more environmentally friendly and sustainable. Many of these industrial wastelands, as one could call them, are located in inner-city cores since they were historically developed in the urban center for convenience of workers to work and live in the same area (De Sousa, 2006). This is another reason why mills should be sustainably redeveloped and it presents a greater motivation to apply

sustainable principles and methods to these sites. They can be cleaned up and redeveloped into clean and green pieces of the urban community.

History & Characteristics

Before turning to how industrial mills can be redeveloped sustainably and the methods that can be harnessed, it is important to take a look at the history and structure of these mills. Industrial mill buildings were originally constructed beginning in the early 1700's (specifically the first large scale textile mill was built in 1717 in England) (Pearson, 2009). Some mill buildings can have the same design features and characteristics, due to the fact that they had the same functions and purpose. "Uniformity of character is a striking quality of American factories" (Munce, 41). Some such features include: rectangular in shape; several stories high; containing large and expansive rooms with tall ceilings; open layout; many small windows on each floor; wooden floors; brick structure with not much insulation; attached, vertical towers; 100-200 foot chimneys or smokestacks (Bradley, 1999); flat, toothed, gable, mansard or hip roofs; and overall "functional simplicity". The buildings are quite large and were developed in this way so that the manufactured product would not cross the same path more than once, but instead would travel throughout the entire building once. This was done to increase efficiency and production (Boston Affiliates, 1981).

Another feature of historical industrial mills is that they tended to be constructed along waterways to harness energy and take advantage of hydro electricity. In *The Works: The Industrial Architecture of the United States*, E. I. Du Pont points out, "The most essential consideration in choosing a location is that there shall be a sufficient stream of water, not only to prevent the necessity of closing the works in the summer, but also that that plant may be

increased in proportion to its success" (Bradley, 57). This is a sustainable method that was historically used and demonstrates a way that mills have always had some type of efficient measure in their design. This historical harnessing of hydro power serves as a connection to sustainable mill redevelopment today.

Sustainable Concepts

As mentioned earlier, more sustainable methods exist today than when historical mills were constucted in the 1700s and 1800s. Some of these methods include: green roofs (Fig. 2); greenwalls; pervious paving; solar panels; wind turbines; geothermal; better insulation; higher energy efficient windows and window treatments; increased vegetation on site; passive solar techniques such as daylighting, increased reflective surfaces, heated water systems/pipes, skylights, natural lighting; glazing techniques; the use of recycled materials; on site recycled wastewater; other closed loop systems; use of lighter colors and reflective exterior materials; use of VOC (volatile organic compounds) free materials; development into a mixed used structure (which opens the

Fig. 2 Though this green roof is located on the U.S. Postal Service's distribution facility in New York City, the size and shape are very similar to most mill buildings: massive and rectangular. This green roof decreased runoff by 75% during summer, saves $30,00 a year on energy costs and has a life span of about 50 years. Similar green roofs can be designed on mill structures. *(Source: electrictreehouse.com)*

door to an array of other benefits); etc. As an example, greenroofs themselves can provide a 10% increase in insulation for a building which will increase overall energy efficiency, not to mention they have a longer life span of a typical roof (Beatley, 2000). They also provide a place for recreational space in certain cases and on buildings where they are visible, they serve aesthetic qualities. Fortunately, greenroofs also work better on older structures (specifically those greater than 30 years old) due to structural differences (Castleton, Stoven, Beck, Davison, 2010). These methods and more are seen in the case studies, and will be discussed in more detail later in this report.

Economics

Why are not more of these historic industrial mills being sustainably redeveloped? One of the main factors can be attributable to the cost of such techniques. The upfront cost of implementing some of these techniques could be what is worrisome to developers of mill structures. “The fear that green building increases construction costs makes it hard to sell to private developers and or government agencies despite its advantages for the environment and public health” (Hecht, 2003). What is not realized is the long term cost benefit. Initial investments in green building techniques can be paid off in as little as 3 years (Chandler Green Building, 2008). According to Greg Kats in his book, *Greening Our Built World,* turnaround rates can be calculated by dividing the initial cost by the expected annual benefits, without applying a discount rate. He determined that green buildings on average have a payback or turnaround rate of 6 years (Kats 86). Although industrial mill buildings will have a longer payback rate than this, it gives us some idea of the expected payback time period for a large scale structure. Also, costs for sustainable technologies have been decreasing in recent years, making it

more affordable to implement into building reuse projects. For example, “PV (photovoltaic) prices fell 40% between early 2008 and mid-2009” (Kats, 2010).

Cost savings are witnessed overall, due to energy savings from a more efficient building, the increased productivity of employees working in these buildings, the increased health and safety benefits associated with these buildings and overall maintenance savings (Ries, Bilec, Gokhan, Needy, 2006). To be specific, it has been determined that a 1% increase in employee productivity was equal to a 15% decrease in property costs (Kats, 2003). A savings of $1-4 billion can be witnessed from an 8-25% decrease in allergy and asthma symptoms in 53 million allergy sufferers and 16 million asthma sufferers (Fisk, 2002). This is an important consideration since many mill buildings today are actually being used by small manufacturing and office companies, but the buildings themselves have not been completely redeveloped into an overall improved work environment.

There are also grants, loans, incentives and other types of funding available for redevelopment of mills and the specific sustainable techniques that can be utilized for these mills. For example, there are various federal brownfield grants that assist mill owners with cleanup of hazardous materials, if there is a presence of such materials. In Saco, Maine a long-term TIF (tax increment financing) agreement was enacted which helped the developer with private financing while the land was dedicated for the use in the riverwalk and other public space uses (Versel, 2009). Utility companies, along with local, state and federal governments offer various incentives for the use of sustainable methods such as solar photovoltaic panels. With this availability of funding assistance, in addition to the above mentioned overall cost savings associated with green buildings, redevelopment of mills in a sustainable manner doesn’t seem as expensive after all.

Planning Related Tools

There are various planning tools that have been created to support the preservation and use of mill structures and mill districts. Historic mill districts whether recognized at the local, state or federal level, aid in the preservation of mills through various restrictions and incentives on the buildings included in the district. Renovations or demolition would have to be approved by historic district committees who have historic preservation as their primary goal. This discourages demolition, but also encourages redevelopment through various incentives, such as tax credits on the rehabilitation costs.

Having a listing or inventory of mill buildings in a community is another good planning tool, such as the City of New Bedford's Historic Mill Inventory created in 2008. Historic mill inventories help a community determine the existing mill structures and their conditions, and help in targeting which of these properties should be given higher priority of redevelopment over others. They provide a snapshot of what the current mill scene looks like and can offer additional recommendations for the buildings. The New Bedford inventory report examined 101 mill buildings in the City and their various characteristics such as current use, condition, redevelopment potential, and historical significance. In the end, the City discovered that "there is significant sustainable development potential for many historic mill structures with existing infrastructure in place" and that "one third of the mills surveyed have high economic development potential and it is recommended that these mills be specifically targeted for redevelopment" (City of New Bedford, 2008).

Building codes and permitting tend to be obstacles in development and redevelopment projects today. Taking a historic mill building and redeveloping it into a community's current building code standards is difficult and acts as a barrier to development. Establishing building

codes that are adaptable to mill buildings is a positive element and not only encourages, but also expedites the redevelopment of mills. Expedited permitting, an economic development tool used to encourage business development that helps to speed up the permit process associated with a project, can also be established to serve as encouragement for the redevelopment of mill buildings.

LEED and Green Communities Checklist

As mentioned earlier, one of the reasons to sustainably redevelopment historic mill buildings, different from the standard advantages, is the recognition of being environmentally innovative. Various successful sustainable mill redevelopment projects are awarded for their work and become a leader and prime example for other similar projects. A specific way this is done is through the growing Leadership in Energy and Environmental Design, or LEED, program.

Historic mill buildings can become LEED certified when they demonstrate "practicable and measureable green building design, construction, operations and maintenance solutions" (U.S. Green Building Council). To become LEED certified, points are awarded in five sustainability categories: Sustainable Sites, Water Efficiency, Energy & Atmosphere, Materials & Resources, and Indoor Environmental Quality; and two bonus categories: Innovation in Design, and Regional Priority. Though LEED certified historic mill buildings are not as common as LEED certified new development buildings, there does exist examples of the former. In fact, one of the case studies examined, is an example of this type of building which makes it a unique and important case study to consider.

Not as site-specific, the Green Communities Checklist is a list of criteria for a city/town to become a designated Green Community (see *Appendix* for Green Communities criteria). One of the criteria, "Minimize Life-Cycle Costs", requires a municipality to minimize the life-cycle costs of new commercial and industrial construction by making the structure energy efficient, incorporating water conservation measures, and implementing other renewable energy sources. This criterion contains some overlap with the LEED criteria and can be applied to redevelopment and reconstruction of mill buildings. This shows that these types of redevelopment projects support planning initiatives.

Conclusion

Historical, industrial mill buildings have great potential to be redeveloped in a sustainable manner. They are expansive in size, take up a large amount of area, have many windows, can be located in central urban areas and are usually located along waterways. These are only a few mill features that make them good candidates for green redevelopment, contributing to the quality of life for residents and the overall quality of the community itself. An array of methods can be implemented into mill redevelopment including pervious paving, solar panels, green roofs, vegetation, stormwater swales and use of recycled materials. Though the process of sustainable mill redevelopment can run costly, there exists funding options, and the turn around rates for a green building are significant. With underutilized mills reaching the end of their lives, and a greater need for sustainable living, sustainable mill redevelopment is the solution for both of these issues.

RESEARCH QUESTIONS

In this project and research, I wish to propose a set of ten case-study-based green principles for historic mill redevelopment taken directly from the case studies that will be examined. These principles can be used to serve as a basis for the creation of future developments of guiding principles.

a. Goals & Objectives

My main goal in this research is to understand the concept of sustainable mill redevelopment, and examine various case studies that represent these types of projects well in the state of Massachusetts. From these case studies, overarching elements and patterns of the concepts used in the redevelopment will become evident. These patterns can serve as a basis towards the development of a set of principles for general mill redevelopment.

The objectives are as follows:

- Understand examples of adaptive reuse and sustainable design of mill buildings;
- Determine overarching elements and concepts from the examples; and,
- Propose a set of guiding principles taken from the case studies.

b. Methodology

To achieve the overall goal and objectives, general research methods were used in addition to the examination of case studies. Case studies were collected from the Massachusetts state level. The case studies were not restricted to a specific after use (industrial, retail, residential, mixed), since certain types of after uses can be considered more sustainable than

others. Five to ten case studies were initially collected, but due to difficulties in getting in contact with those knowledgeable about the project (i.e. mill owners) and other issues, four case studies were analyzed for the purposes of this project.

Site visits were conducted for all of the case studies analyzed. The site visits and tours were given by sometimes the mill owner, developer, or employee of the end use. Interviews with these individuals served as supplementary information; sometimes, for which sustainable methods work(ed) the most ideally and other additional information.

CASE STUDIES

Four case studies were chosen in Massachusetts that represent examples of sustainable mill redevelopment. These included: Davis Square Lofts in Somerville; Forbes Park in Chelsea; Monarch Lofts in Lawrence; and Nobis Engineering, Inc. in Lowell. Some involved more thorough interviews and tours than others due to difficulty of getting in direct contact with the mill owners and developers. In some cases, leasing officers or other employees of the building's end use were interviewed over the mill owner and developer. The interviews and tours ranged from 15 minutes to 3 hours long and took place directly at the site locations. The interviews and tours were recorded with a recording device for better transcribing accuracy.

From these case studies, overarching goals and ideas appeared that were either evident in multiple or individual case studies. These goals and ideas were used to formulate the set of case-study-based green principles for mill redevelopment. Each case study has one main green method in common that encompasses the entire concept of mill redevelopment: the adaptive reuse of an existing building. Historic mill buildings are large unyielding structures that can be utilized for an array and mix of uses, without developing prime undeveloped spaces needed crucially in communities. The following is the analysis and stories of the four mill redevelopment projects examined.

Davis Square Lofts – Somerville, Massachusetts

Davis Square Lofts located in Somerville, Massachusetts is a smart growth and sustainable loft community with practical green design ideas at its core. Originally, the buildings at Davis Square Lofts were home to the M.W. Carr Company from 1894 until 1998; the country's leading manufacturer of metal goods producing such items as picture frames, silverware and fine jewelry. When the company went out of business in 1998, due to difficulties in competing with competitors whose production costs aimed to be much lower than Carrs', the final asset to be sold were the buildings themselves. The current owner and developer purchased the buildings and deconstructed them, harvesting key materials from the original building structures in the process. The five 4-story buildings are currently loft style residences with community green space on site, and an underground parking garage.

M.W. Carr Company in 1916.
Source: Davis Square Lofts

Site plan of the Lofts site. Note the skywalk areas extending off the building facades. (above)
The skywalk concept (below)
Source: M. Iarossi

The Italianate style red brick buildings are characterized by their original rhythmic design, traditional of historic industrial mill buildings of its time. “It’s sixteen bays are marked by sculptural pilasters and are further detailed by segmental brick arches framing tall windows. On the interior, the heavy timber construction for the building is made transparent with its exposed chamfered square wood columns and wood beams” (Davis Square Lofts). Each loft unit represents a simple, yet modern urban standard of living with its concrete floors, exposed brick, vast steel windows, wooden beams, and exposed columns and features. The lofts can be described as indestructible, and extremely durable due to its features.

The entire Davis Square Lofts project is uniquely characterized by its skywalk concept, a trademark of the Lofts' developer. The skywalk concept is associated with bringing natural daylighting and air circulation into the loft units in a practical way, without fancy (and costly) mechanical features developed into the building structure. Each building was hypothetically "sliced like a loaf of bread", with each unit acting as the "slices". With windows on opposite ends of the building and units, air circulation could flow uniformly and naturally. Instead of creating interior hallway space, which is expensive, ugly and creates drab space, the skywalk concept was implemented. Using old steel beams from the original factory floors, a unique intertwined walkway was designed on the outside of the building to provide entrances to each unit. This not only frees up space to allow the interior of the units to be larger and create better ventilation and lighting, it also provides outdoor community space. Each unit has its own small area on the skywalk where they keep grills, or tables and chairs. Social interactions are increased, in addition to an increased sense of community.

Brick walls, concrete floors and large steel windows makes this design concept simple, yet efficient and sustainable.
Source: M. Iarossi

As mentioned earlier, the Davis Square Lofts are a simple and extremely durable type of living. Instead of complex chassis closed drywall spaces with hidden utilities running throughout, the walls are simply made of brick, with utilities conveniently and modernly exposed throughout. Instead of complicated and costly hardwood floors, the Lofts include concrete floors. Instead of small

windows that only allow a suttle amount of natural light in, the Lofts are designed with massive ceiling-to-floor steel windows or glass garage doors that open to allow light and ventilation in. Skylights atop the buildings and units also act as solar traps, heating the living spaces comfortably. These elements (brick walls, concrete floors, large steel windows) create a heavy thermal mass, trapping heat or cool air and in turn minimizing the need for conventional heating and cooling methods.

Additionally, located throughout the site and growing up between the walkways of the steel skywalk are matured deciduous trees. Placing deciduous trees near residential buildings helps with heating and cooling of these structures. For example, during the winter months when the trees lose their leaves, more natural light can enter the units' massive windows, heating the living space. In the summer months when the trees have leave coverage, they serve to block out excess sunlight, keeping the units cool during hot times. Residents are encouraged to open their curtains during the mornings of winter months and close them at night, to trap sunlight and heat (the opposite holds true for summer months). None of the units at Davis Square Lofts are equipped with air conditioning units due to their negative environmental effects. Backup radiant heating floors heat the units when additional heat is needed. According to the

Rainwater harvesting pond.
Source: M. Iarossi

developer, radiant heating floors are the safest and cleanest way to distribute heat, and they are also soundproof and fireproof.

Every drop of rain that falls on-site at Davis Square Lofts is harvested and used for the toilet systems and landscaping. The site is not connected to the City of Somerville stormwater system. On-site stormwater is piped to a rainfall harvesting pond, located in the center of the Lofts community, where it recharges the groundwater aquifer, and recirculates the water to be used for toilet flushing and watering plants. The recycled rainwater in this pond is so clean that fish thrive in the habitat, and it serves as an aesthetically appealing community asset. Water used for all other purposes (other than for the toilet systems and landscaping) is solar heated on the building roofs, and then stored in super insulated tanks underground. If water is needed that is warmer than the solar heated water, natural gas is used to supplement the heat. This water is used for activities that require cleaner water such as showering, and washing laundry and dishes.

The Davis Square Lofts, aimed to have a non-automobile centered style of living, as any sustainable project should. With an underground parking garage, most residents' vehicles are kept out of site away from daily life. The entire site itself is located in close proximity to the Davis Square T stop. The site is also located directly on the Minuteman bike trail, an 11 mile pedestrian walkway running from Bedford to Lexington, Arlington and Cambridge. Residents can easily live without a vehicle due to these great transit oriented development amenities. In addition, there are six zip cars located on-site for resident use. More zip cars are planned on being added due to their heavy use. Car incentives are given to the Davis Square Lofts community also. Residents who own more than one car, are charged extra money. Prime parking spaces are offered to those who own less cars or more efficient vehicles.

In terms of green space, elements are implemented throughout the site design. Originally, when the site was home to the M.W. Carr factory, only one piece of triangular green space existed. In the redevelopment of the buildings, more green and community space was created, since this project had a sustainable and residential focus. Ground level green space exists, along with the community rainwater harvesting pond mentioned earlier. Additionally, the underground garage contains a green roof (which ends up being at ground level). Along the skywalk and atop the building roofs', community space dominates. Some residents have even installed their own green roofs' atop their units, which contributes to heating and cooling insulation, community space and a place to grow fresh fruits and vegetables.

Davis Square Lofts with skywalk concept.
Source: M. Iarossi

In today's society, new construction is done in a conventional manner by creating super insulated thermoses with small windows and fancy materials. This is more expensive in the long run and requires more maintenance. Walls need to be repainted; floors re-sanded; expensive equipment upgraded; insulation replaced. In designing structures as heavy thermal masses with simple ideas, such as the Davis Square Lofts, less maintenance is required and the construction

becomes more sustainably focused. Implementing small scale, smart growth solutions into the design of the Lofts creates an overall large scale impression of environmentally sensitive living.

Forbes Park – Chelsea, Massachusetts

The Forbes Park site in Chelsea, Massachusetts is a project that had larger scale green ideas, with some of the same concepts as the Davis Square Lofts. Developed and owned by the same person and company, Forbes Park had high hopes of becoming a poster child for sustainable development in a community that needed it most. Due to financial circumstances that will not be discussed due to the purposes of this project, Forbes Park is now an abandoned construction site that was not completed as hoped. The construction was ongoing for roughly three years before it halted in March of 2009. This case study was chosen, however, to be included because of the unique concepts and gestures that had been and were to be applied if the project had gone through to completion. This is not to say, that the project will never be completed. There is still a chance this could be the green staple that it was originally intended to become.

Forbes Park looking out on the Chelsea River towards Boston.
Source: M. Iarossi

The site and buildings themselves were historically Forbes Lithographic Company, operating from 1886 to 1968. Forbes was a graphic printing company, printing a wide variety of

materials from money to war bonds to cigarette packages. The site was contaminated with a variety of different metals from ink waste used in the printing operations, including lead, zinc and chromium. Ink clump remnants were discovered on the soil and banks of the Chelsea River, which spurred state and federal environmental agency involvement. The contaminated area was last encapsulated during the Forbes Park construction period, but still remains on the Department of Environmental Protection's Chapter 21E site list. The end use of the redevelopment was similar to the Davis Square Lofts, but on a larger scale, in that they were going to be 400 residential loft units.

This project had community features weaved into its design. Pictured here is stone seating to be used for events. The area behind the seating is part of the converted salt marsh and wetland area.
Source: M. Iarossi

The guiding element and vast concept of Forbes Park had to do a lot with its waterfront access and location along the Chelsea River. The site is located along an industrial waterfront in one of the most densely populated cities in the country with limited green space. With a median household income of $40,487 and 21% of families falling below the poverty level, according to 2010 Census data, the City of Chelsea is an urban environment in need of more innovative models. The Forbes Park site was going to be a "green emerald" and "urban oasis" bringing the public and residents to the working waterfront edge and educating them at the same time of sustainable concepts and green building. An ecological-trail was to be designed in order to experience the entire site on foot. The

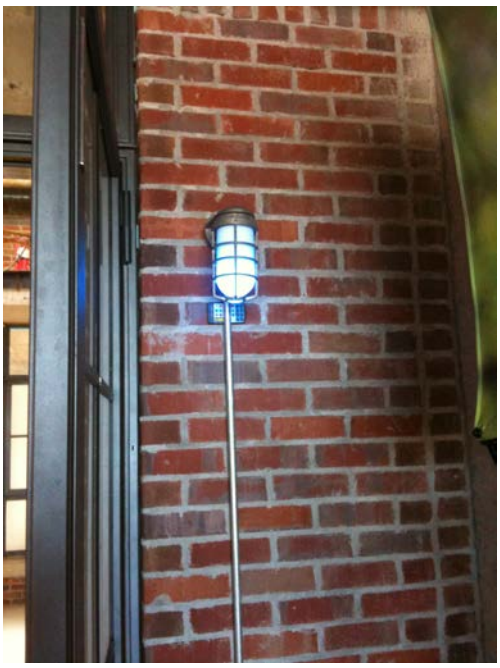
eco-trail was going to be equipped with educational storyboards spanning from the public entryway, and running along the water's edge. Students from the one and only nearby middle school in Chelsea were going to be encouraged to come to the site to learn about the environment. Certain points along the eco-trail were also equipped with electrical setups in order to conduct outdoor environmental classes, in addition to picnic areas and bathrooms.

Manmade, natural and lush landscaping elements were designed throughout the site and along the eco-trail including wetlands, salt marshes, vernal ponds, and brackish ponds. This gave the site a more natural feel and tied the adjacent Chelsea River into the whole project. It served as another set of educational elements, provided wildlife habitat and incubator space for certain aquatic and non-aquatic species, and helped with stormwater runoff. This project was also not connected to the City's stormwater system. One of the areas of salt marsh used to be a paved parking lot. Converting an impervious surface such as a parking lot into a natural and healthy salt marsh is an environmental restoration technique that reaps many benefits already mentioned.

Canal system. Note the concrete bottom that was to be used in the skywalk development. (above) Area where canal water and river water would mix and overflow into the brackish pond. (below) Source: M. Iarossi

A large scale piece of work that was completed and exists at the site is a million gallon canal system created for rainwater harvesting and aesthetic appeal. Every drop of rain that fell on-site would eventually end up in this canal system, where the recycled water would be used for the toilet systems and landscaping irrigation. The intricate canal system was connected to the Chelsea River and the brackish water pond, which during rain events and high tide would overflow to mix the fresh rainwater with salty river water. This created a unique wildlife habitat and yet another educational element. The canal system was to be stocked with herring fish and the skywalk concept (as in the Davis Square Lofts project) was to be extended from the buildings to over the canals, offering an aesthetic pleasing community walkway.

Another large scale piece of work that was finished before the project stopped and an element that still exists and stands out today is a massive wind turbine; originally capable of generating enough electricity to power 300 houses. Located right along the waterfront, the turbine is the first and last thing you see when entering the site. Equipped in the current and future units were Forbes Orbs; lights that glowed different colors based on the on-site electric usage at that moment. This served as suggestive behavior for conservation by informing residents of surge usage times. The lights would glow red when there was a surge of electricity usage, so that residents could help minimize overall site usage which would lower the cost of electricity for everyone.



Forbes Orb was a form of suggestive behavior that changed color based on amount of electricity usage on-site. Source: M. Iarossi

Also related to sustainable electricity concepts, the developer suggests developing an on-site cogeneration power plant. If a cogeneration plan existed, waste excess heat generated from this plant can be utilized on-site for heating purposes. With your own cogeneration plant, it is possible to charge residents lower utility rates for hot water and heat, than conventional utility companies charge. Another benefit of this method is sub-metering. Private sub-metering allows residents to go online and check their electricity usage in real time. With this, programs of conservation competitions can be created to encourage efficient electric usage. Whoever uses the least electric in a given month, receives a Whole Foods gift card.

Similar to the Davis Square Lofts, Forbes Park was going to encourage non-automobile use activities. A parking garage was going to be developed underground, with minimal surface parking, in order to give the impression of a non-automobile centered style of living. Electric vehicle charging stations would be installed and the best parking spots would be offered first to electric vehicles and hybrids. Larger vehicles such as pick-up trucks and vans would have to park in surface lots farther away to discourage use of these types of automobiles. These types of incentives and competitive conservation techniques encourage more sustainable automobile usage. Additionally, the Forbes Park site is located in close proximity to the commuter rail going

Sustainably harvested wood pallets with "peek-a-boo slats", allow better air flow and light throughout the unit.
Source: M. Iarossi

straight into North Station in Boston. The site would act as a transportation hub with innovative ideas for traveling such as shuttles and water taxis.

One of the buildings on the Forbes Park site had a significant amount of work done to it, including a number of finished living units. The units were to have similar concepts as the Davis Square Lofts with extremely durable and indestructible but simple spaces made up of concrete floors, brick walls and large steel windows. The units were designed to be very open and not have many doors and walls. In order to create "suggestive living spaces", sustainably harvested wood pallets were constructed off-site, and then bolted into place in certain areas. These wood pallets served as dividers and had "peek-a-boo slats" to better allow air flow and light through the pallets and various sections of the unit.

This building was cut in half, with the roof removed in the middle to allow more daylighting and better airflow.
Source: M. Iarossi

The building containing the finished units was cut in half, with the middle portion of the roof removed completely to allow more natural daylighting, air circulation and passive cooling for the living spaces. The skywalk concept was designed as the exterior walkways for the building, and was planned on being implemented throughout the entire project site

including the canal system, as mentioned earlier. The roof of the building was to be used for growing fresh fruits and vegetables in raised garden beds and hydroponic farming systems. Edible architecture concepts were to be implemented throughout, including growing fresh food on the walls of the building units. The roof space would also serve as another common area for residents to socialize and cook meals.

The Forbes Park project included large scale and generous sustainable methods with a focus on water features, educational elements and competitive conservation. Utilization of the industrial waterfront in a community that needs it would have been a positive ending to this project alone; but adding an enormous amount of environmentally sensitive techniques and innovative concepts makes this project one of a kind, and a poster child for green development projects in the world today.

Monarch Lofts – Lawrence, Massachusetts

Exterior of Monarch Lofts.
Source: M. Iarossi

Lawrence, Massachusetts is another community with demographics somewhat similar to that of Chelsea, Massachusetts. According to Census data, Lawrence has a median household income of about $31,459 and a high percentage of the population falling below the poverty line, at 27%. These demographics serve as a reason to

further convert abandoned, vacant mills into new uses.

Opened in 1906 as a part of the American Woolen Company, the Monarch Lofts building was said to be one of the biggest mill buildings in the world during its time, having the length of approximately 25 football fields and a total square footage of about 1.3 million. When the textile industry left the area in the 1950's, the building became the location of a computer manufacturing company until 1996. The current owner purchased the building in 2003 and redeveloped it into 204 "eco-luxury" rental units using environmentally responsible building materials such as reclaimed wood, flooring with recycled content, and low volatile organic compound (VOC) paints. The building itself is located in a prime spot in Lawrence, situated along the Merrimack River and Interstate 495, and directly adjacent to the fairly new constructed $25 million Senator Patricia McGovern Intermodal Transportation Center.

Open layouts, tall ceilings, and floor to ceiling windows allow these units to have better air flow and natural daylighting. Source: Monarch Lofts

As seen in the previous mill redevelopment projects, the Monarch Lofts have a focus on open and spacious layouts with 16 foot original timber ceilings, and 12 foot windows. Spacious and open layouts allow better air circulation and flow through the spaces. With large, energy efficient windows equipped with UV glass located in the units, more natural light is allowed in to

passively heat the units, reducing reliance on electrical lights and heating systems. The units themselves are installed with a minimal amount of energy efficient light structures to discourage overall electrical light use. Residents may install their own additional lighting if necessary, but by not being initially equipped with excess lighting structures, their use can be minimized overall in the building.

Although the units in Monarch Lofts contain large ceiling to floor windows to help heat the building during the cooler months in a natural way, a geothermal heating and cooling system has been developed for the building. This fossil fuel free method involves liquid filled pipes that run through the ground and get naturally heated or cooled from the steady temperatures of the earth. These pipes then run through the living units to heat or cool the indoor spaces. This geothermal system not only is a form of clean energy, but the residents have reduced utility bills to heat or cool their homes.

Underground parking is available for residents which creates a non-automobile centered environment at Monarch Lofts. With the newly constructed (2005) Intermodal Transportation Center located directly across the street from Monarch Lofts, residents have quick and convenient access to commuter rail and bus service to Boston and other destinations. Additionally, 430 parking spots at the transportation center are set aside for Monarch Lofts residents. Originally, the designers of the transportation center wanted a similar skywalk concept running directly from the Monarch Lofts building to the parking lot at the transportation center, essentially removing the street experience that residents would normally have walking to the rail or bus stop. But the Lofts owner and developer declined because of future plans and possibilities of retail development on the street. He wants the street to become “activated” with things to do

for both residents and visitors. The Monarch Lofts building also has bike storage available to encourage bike use by the residents.

The roof of the building contains a rooftop deck including a green roof planted with native vegetation that allows resident access. This allows more green community areas for residents to enjoy without using up valuable surface, ground-level space. Additionally, the green roof offers more heating and cooling benefits for the building since it helps to insulate the structure further, and increases the albedo effect that it would normally have. The Monarch Lofts site also includes a waterfront park to take advantage of the great waterfront access to the Merrimack River.

Rooftop deck with green roof.
Source: Monarch Lofts

The redevelopment project of the building also included some smaller scale green building methods, such as installation of Energy Star appliances in all the units, installation of programmable thermostats to better maintain control over the temperature within the units, and installation of low-flow shower heads and toilets to help in conserving water on-site. There is also a recycling center inside the building, so that residents can recycle their glass, plastics and paper waste products right in their building.

Monarch Lofts may be located in a community with a negative reputation attached to it, but with green redevelopment and eco-conscious adaptive reuse projects that catch the eye of

residents, investors, and entrepreneurs, the community is well on its way to witnessing a change; one that is larger in scale than the smaller (if you can call it that) green mill redevelopment projects that are occurring now. Monarch Lofts is a great example of sustainable design and restored architecture at an incredible scale in an underprivileged area, and it is a model for future redevelopment plans in the City.

Nobis Engineering, Inc. – Lowell, Massachusetts

Exterior of Nobis Engineering, Inc.
Source: M. Iarossi

Davis and Sargent Lumber Mill, 19th century.
Source: M. Iarossi

Nobis Engineering, Inc. is a LEED Gold certified mill building with an after use different from the other case studies examined. While a majority of the mill buildings are redeveloped into residential and mixed uses, the Nobis Engineering building is used as a commercial environmental and civil engineering consulting firm in Lowell, Massachusetts. The building itself contains many different green methods in its redevelopment, including some methods that were not utilized in other case studies, such as tables

recycled from flower seeds, pervious paving, solar panels, etc.

The 20,000 square foot building was originally the site of the Davis and Sargent Lumber Mill, wood factory in the mid 19th century. Nobis Engineering purchased the property, redeveloped it sustainably, and opened for business in December of 2009. The building itself was the first LEED Gold certified structure in the entire City of Lowell, boasting bold green methods that scored high points in various LEED categories (see *Appendix* for specific LEED points awarded). Since Nobis is an environmental services consulting company, they wanted to "practice what they preach" by incorporating the various initiatives they stand by in their building and site design. This not only teaches the company and its workers hands on about the products they support, but also shows clients the positive reality of the various initiatives.

While walking through the Nobis building, one can notice the mix of old and new; historic materials versus new development. Old wooden beams that could be salvaged from the original building were cleaned and used for interior support. Occasionally, adjacent to these historic beams, are new metal beams that had to be brought in for places that original beams could not be used or were not strong enough to support the structure of the building on its own. Wooden ceiling beams from the original building were abundantly reclaimed. Original brick and stone walls are also located throughout the building. It is evident in areas where building

An original wooden structural beam that was preserved in redevelopment.
Source: M. Iarossi

additions were added on during the redevelopment. Overall, 75% of the original building structure was reused in the redevelopment.

Similar to the Lofts at Davis Square project, Nobis contains design elements that give the building an indestructible character and nature. Nobis was designed with exposed utilities, clearly visible across the ceiling as you walk throughout the inside. This is cheaper during the construction phase and whenever maintenance is needed. It's a new way of designing urban structures, as opposed to the traditional way of hiding utilities behind drop ceilings and dry wall. This helps in breaking the technophobic nature of society today; the fact that society loves nature, but also loves technology and therefore we are left with hiding the infrastructure that makes this technology work. To be expected, the building also has exposed brick as previously mentioned. Additionally, certain rooms contain concrete flooring which is a good design element for retaining heat in the building. These features are characteristics of most historic mill redevelopment projects; indestructible, simple, and sustainable.

Exposed utilities are a trait that seems to be common in most historic mill redevelopment projects. This lowers construction and maintenance costs. Source: M. Iarossi

During the building's historic operations, the site became a contaminated brownfield with various contaminants such as volatile organic compounds and heavy metals. During the redevelopment process, Nobis cleaned up the site. Today, the site is not considered to be a brownfield or contaminated with pollutants. Another sustainable method to consider was that an

astonishing 90% of the construction waste during the redevelopment process was recycled, and 10% of recycled content was incorporated back into the building.

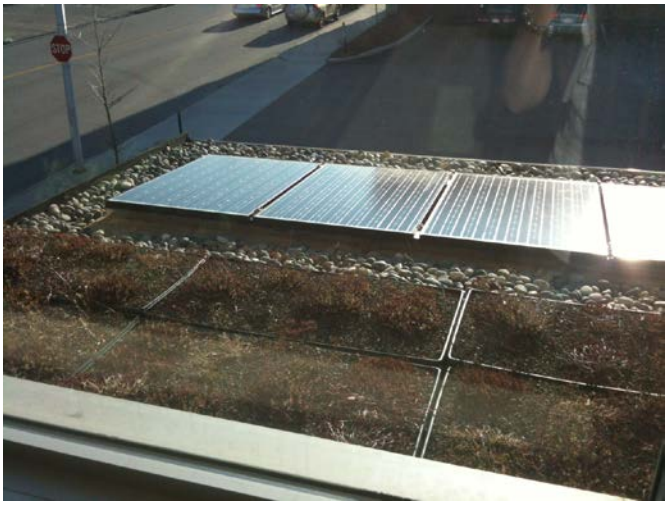
The Nobis parking lot and certain exterior employee areas use different pervious paving materials to infiltrate water on site, as opposed to directing stormwater completely off site to the City's combined sewer systems. A filter layer in the parking lot helps to remove any contaminants from the parking lot before the water is combined with groundwater. Thusfar, there has been positive feedback on the implementation of the pervious paving. Installed in 2009, the parking lot has not needed to be maintained or vacuumed. A common argument against pervious paving is that it requires more maintenance than the average, impervious parking lot. Salt is used on the pavement instead of sand during the winter time, because this clogs the pavement less. Though this is more expensive by minor amounts, Nobis feels the pervious parking lot was worth it because of the environmental benefits and display to clients associated with it. Also created on-site and located outside at Nobis along the parking lot is a bio-swale, designed to further flush out any pollutants and contaminants from parking lot surface water before it enters the water table.

A plan table made from recycled and crushed sunflower seeds.
Source: M. Iarossi

Recycling receptacles are located throughout the building for use by employees. Janitorial services only use green cleaning products. As mentioned earlier, a small but interesting

and unique green method Nobis has implemented in its building design is the use of recycled and crushed sunflower seeds to create two new plan tables used in the office. Why did they use sunflower seeds? Sunflower seeds are a resource that can be completely renewed in less than 10 years. Appliances used throughout the building are Energy Star Appliances. Carpeting used in the building, is made from 100% recycled materials. Though these are more quiet (but more cost effective) green methods, the combination of all of the methods adds up to a loud and bold statement.

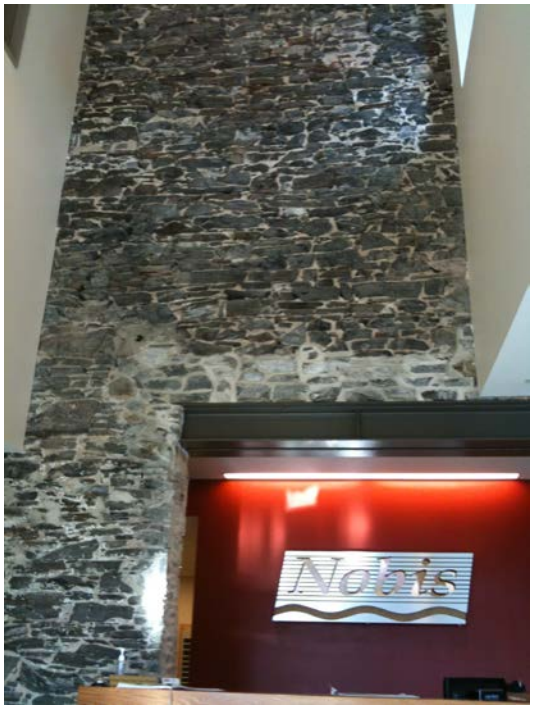
The building is equipped with energy efficient and motion detecting lights in all the rooms. This helps to conserve energy, so when a room is unoccupied for a certain period of time, the lights automatically shut off. Also, sensors in the lighting system automatically adjust the interior lighting based on the amount of sunshine inside. If it is a bright day, and a lot of sunshine lights up the interior of the building, the electric lights within do not shine as brightly.



A roof equipped with solar panel arrays and vegetated areas, helps to reduce the building's heat island effect, keeps the building cool during the summer, and reduces roof runoff through evapotranspiration.
Source: M. Iarossi

The Nobis Engineering roof is one of the most impressive pieces of the redevelopment project. To start with, the Nobis roof is a white color, having a high albedo effect and high reflectivity. This reduces the building's heat island effect and therefore keeps the building cooler. Equipped with solar panels on the roof,

Nobis receives a portion of its building energy from this renewable resource. Additionally, portions of the roof that are not covered with solar panels are vegetated with various plantings. This reduces the building's heat island effect further while also reducing roof runoff through evapotranspiration. Rainwater that normally would fall on the 100% impervious rooftop would immediately fall to the impervious ground below and get piped into the city's combined sewer system. At Nobis, however, some of the rainwater falls onto the roof gardens where it is stored by the plants and evaporated back to the atmosphere. Rainwater that did not reach the roof gardens would fall to the pervious Nobis parking lot below where it can infiltrate into the immediate area directly into the groundwater.



The Nobis front desk area shows the beautiful original stone walls that were part of the historic building.
Source: M. Iarossi

Overall, through different water efficiency measures, Nobis has reduced their water use by an amazing 43%. One of these measures already mentioned is the green roof. In the Nobis restrooms, waterless urinals, dual-flush toilets, and low-flow fixtures contribute a large portion of water reduction. The dual-flush toilets have two different flush options based upon the type of flush needed. For example, liquid waste flushes use less water than a solid waste flush would. Appropriate signage informs restroom users how to use each type of flush. Additionally, outside and on-site, drought tolerant landscaping was used that can sustain and thrive even in drought like conditions.

Nobis Engineering, Inc. displays various similarities seen in the other case studies examined, which proves that historic sustainable mill redevelopment have commonalities and patterns to their design.

SUMMARY OF CASE STUDIES

After examining the four case studies, similarities and differences were noticed for each one (see *Table 1* in the *Appendix* for a comparison table). The main differences were that each project used a different variety of green and sustainable methods. While one project prided itself on wind energy (Forbes Park), another boasted geothermal (Monarch Lofts), and yet another implemented solar panels (Nobis Engineering). The reasons for the different methods used are obvious. All the projects had different financial backing, availability of space, and additional constraints that prevented or allowed them from being able to utilize various measures. The limited surface lot space of the Nobis site, made solar panels a more plausible and realistic example, then a wind turbine which takes up more space. In comparison, the Forbes Park site was larger and located in a prime spot along a body of water without much building interference. This made it more reasonable for a wind turbine, than a more space constrained feature such as solar panels.

While each example had differences in the green methods used, all of them had similarities that started to appear more after each tour. Redeveloped mill buildings have the characteristic of being simple and practical, yet indestructible. Original brick or stone walls were exposed, windows were large and made of steel, utilities were exposed to a large extent, along with original (and sometimes new) wooden ceiling or structural beams. Industrial mill buildings today stand as impressive and vast structures with an indestructible and mighty feeling. The concepts seen in this project's case studies reinforce the original image of mills. They are heavy thermal masses with durable materials and elements.

A majority of the case studies were located in historically industrial communities along water bodies. These locations make it more of a reason to have them redeveloped. For example, Forbes Park in Chelsea (though it has not reached completion), is located in a community right along the Chelsea River in an area with limited public waterfront access. The benefits that this project was to bring to Chelsea residents were vast. Not only was the project going to allow the general public to the water's edge, but also was going to involve the design of an ecological-trail to educate visitors of ecological and sustainable processes. Monarch Lofts in Lawrence is located right along the Merrimack River, providing green space and waterfront areas for residents directly. Many mills today across the world are located in historic industrial cities along canals or rivers. Historic industrial cities tend to experience a greater hardship than non-historic industrial communities, because of the large decline in industrial and manufacturing jobs and businesses in recent years. This gives a better reason to redevelop old mill buildings, since they are in areas that need it most. Additionally, the advantage of being located along waterways makes the site more appealing and increases waterfront access, which we see is diminishing today.

Another element noticed in all the case studies was that they each contained their own small statements. While bold statements such as the Forbes Park wind turbine were extremely sustainable in and of themselves, the smaller statements add up to create a large end result. In the Nobis Engineering building, they implemented a green roof of vegetation. They installed waterless urinals, dual flush toilet systems, and low-flow fixtures. Drought tolerant landscaping is used outside around the parking area. Though these are all individually small methods, they combine to have a large effect. Through these water saving measures, Nobis has reduced their water usage by 43%; that's almost cutting their usage in half.

A possible reason for these case studies to be more successful than others (with the exception of the Forbes Park example), is the relationships that the mill owner/developer had with the community that the mill was located in. For example, in the Nobis Engineering, Inc. case study, the Lowell location was chosen because of the strong support and resource availability of the City. This office could have been located elsewhere in another mill structure, but Lowell is more advanced in mill redevelopment and the support of the community overall for mill redevelopment helped in deciding to choose this location. One of the resources that the City of Lowell can offer for such redevelopment projects is assistance from the Lowell Green Building Commission.

Trade-offs and Complexities

Though all of the above mentioned green methods that were utilized in the various case studies are in fact beneficial in certain ways, they do have important aspects to consider that are worth mentioning in this report. As with anything, there are drawbacks and negative points to make about the green methods.

Open and spacious layouts are beneficial in creating more natural and uniform air flow and lighting, but this means there are fewer walls present. With fewer solid interior walls, there is less insulation capability of the building. Impervious areas are more environmentally friendly than pervious cover, but impervious areas do require more maintenance since they tend to be landscaping elements or pervious paving. The roof can be utilized for an array of uses and offer benefits, but this requires a mill roof that can structurally support these uses. Mill buildings are historically old structures, and in order to turn the roof into a green roof or place solar panels on it, it must be structurally sound to support such uses which can run costly. The large windows

concept may let in an abundant amount of natural light and help with heating a building, but the size of these windows also make it a difficult redevelopment piece. Since standard sized single pane windows do not have good thermal insulation to begin with, mill building windows must be either partially boxed in to make the size of the windows essentially smaller or installed with triple pane glass in order to retain heat. Triple pane glass for the large windows can run more costly than single or even double paned glass windows.

An obvious drawback to the green methods involved in the case studies, and one that is the main reason why more mills are not sustainably redeveloped is the cost. While reports and evidence show us that green buildings end up being cheaper in the long run, the upfront costs weigh much heavier than traditional development projects. These upfront costs are what make sustainable mill redevelopment not look very appealing.

With this being said, there are some trade-offs and complexities to the green methods seen in the case studies, and these are definitely factors that need to be considered when redeveloping a mill building in a sustainable manner. Each green method will have its positive and negative aspects, and these need to be weighed and looked at carefully in order to determine the best approach to redeveloping a mill as a green building.

CASE-STUDY-BASED GREEN PRINCIPLES OF MILL REVITALIZATION

A set of case-study-based green principles are proposed to guide sustainable mill revitalization currently and into the future. These principles are based directly on the case studies examined, and any feedback from mill owners and developers that were interviewed. The following are case-study-based green principles of Massachusetts mill revitalization (they are not listed in any particular order):

- **Sustainable roofs should be heavily explored;**

  Large expansive mill roofs offer great potential for use. As seen in the case studies, they can be utilized for solar panels, vegetation, green roofs, community space, urban agriculture, and skylighting. They do increase redevelopment costs, and require a building that can structurally support these uses, but the fact that they are large and flat makes them ideal to use as for solar panels or vegetated cover.

- **Open layouts are an opportunity for increased natural air flow and circulation;**

  With tall ceilings, windows that span from the ceiling to floor, open and spacious layouts, and suggestive living spaces designed with slatted wooden pallets, air flow throughout the space is more natural and efficient.

- **Space constraints give precedence to zip cars;**

  If parking space is limited, and zip cars are provided, then their use is encouraged. Instead of all the users of the building having individual personal vehicles, they can utilize shared vehicles. As we saw in one of the case studies, zip cars were so heavily used, that implementation of additional zip cars is in the works at this location.

- **Mills foster areas for urban agriculture methods;**

  Due to space availability, and sustainable use urban agriculture in and on mill buildings is beneficial. Raised garden beds, hydroponic systems, on-site community gardens, edible architecture, cooking and food programs available for residents/users of the building, community farmers markets, building

integrated aquaculture; these are all urban agriculture methods that can be implemented in the sustainable mill redevelopment. These were seen in the case studies and research in different aspects.

- **Highly visible green methods serve as bold statements;**

  When sustainable methods are implemented, they should be shown off. They need to be evident to not only residents and users of the structure, but also by the general public. Bold statements educate people and make them more aware of the green initiatives involved with a site or project. For example, in the Forbes Park case study in Chelsea we saw implementation of a large wind turbine right along on the Chelsea River. This turbine can be seen from the public roadway and homes around the area. Though it is currently inoperable, the owner/developer said he likes that it is still standing because of the "in-your-face" effect it has, and the sustainable symbol it represents.

- **Revitalization of mills can lead to a more simple quality of life;**

  We have seen that mill redevelopment brings a new perspective to conventional building design. Conventional design creates super insulated thermoses with small windows and fancy materials, which is more expensive in the long run and requires more maintenance. Walls need to be repainted; floors re-sanded; expensive equipment upgraded; insulation replaced. In designing structures as heavy thermal masses with simple ideas less maintenance is required and the construction becomes more sustainably focused. Simple yet highly durable buildings contain brick walls, steel windows, and concrete floors. Exposed building elements, such as exposed brick, beams and utilities were common amongst the examples.

- **Solar efficiency implemented at the start yields a large result;**

  In all of the examples, large windows and skylights were implemented into the building design. In the Lofts at Davis Square and Monarch Lofts, residents are encouraged to open their shades during the day to bring in solar heat and then close them when they get home in the evening, locking in that heat. The Nobis Engineering building implemented motion detecting lights, and a sensored lighting system, helping to maximize the use of natural light during the daytime.

- **A variety of transportation choices should be provided;**

  A variety of transportation choices discourages automobile use. We saw various transit amenities in the case studies such as: close location to public transportation such as commuter rail, the T, and bus services; zip cars located

on-site; bicycle racks located on-site; close proximity to pedestrian trails. We also saw various incentives to use more efficient transportation choices, such as prime parking spots and cheaper car related services given to those who use more sustainable options.

- **Best management practices help prevent pollution from on-site activities; and,**

  Best management practices utilized in the case studies included pervious paving, vegetated swales, ground level yet green roofs, native vegetation plantings, and other man-made landscaping elements such as the wetlands and salt marshes at Forbes Park, in which some of that area was originally impervious parking lots.

- **Historic mills can be LEED certified too.**

  When you think about a LEED certified building, you probably don't automatically think of a 150 year old historic industrial mill building. And these are not common. But all the LEED categories that points are gained under can be applied to mill buildings. This recognition increases awareness of the building while also setting the stage for other similar projects.

FUTURE RESEARCH

The case-study-based green principles that are proposed are based upon a select few case studies examined and the researcher's beliefs on what should be used as guiding principles in the revitalization of mill buildings; therefore they are to be used as a starting point. Future studies and research on developing a more concrete set of green principles may include further examination of sustainably revitalized mill building case studies, a survey for mill developers and owners to express what they feel are key guiding principles, and more examination and research of green mill redevelopment in other states and parts of the world.

Additionally, other factors can be further examined that would be helpful in the development of green mill principles. As an example, some funding sources and tax incentives were examined in this research, but these and other new concepts can be further explored. Tax increment financing, investment tax credits, other grants available to help fund projects like this, and historic tax credits are some economic and funding concepts that can be further explored in future research. It would also be beneficial in future research to have cost benefit analyses done on the various green methods that can utilized in mill redevelopment. This could include the current costs of the methods, the turn-around rates (or payback period), and alternatives to making the method cheaper or more affordable. This analysis could also take into consideration the tax incentives that are available in order to create a cumulative idea of approximately how much a traditional mill redevelopment would range in cost.

Similar to funding sources and tax incentives available, general planning tools and techniques can be further looked at in order to develop a better understanding of options

available to assist in mill redevelopment. Mill overlay districts, adaptable building codes, expedited permitting, and historic mill inventories were mentioned in this project as planning tools used in mill redevelopment. If more heavily researched, the logistics of these tools can provide a better idea in terms of the process and how it can be directly related to the sustainable redevelopment of mills.

CONCLUSIONS

The sustainable redevelopment of historic mill buildings can reap many benefits ranging from improving overall environmental quality and quality of life to reducing crime rates, and increasing public waterfront access. By reviewing the research and case studies, there is a huge variety of green methods that can be implemented into this sustainable redevelopment. Large concepts such as implementation of renewable resources and converting impervious parking lot areas to pervious natural landscape elements are available; and smaller concepts such as installing energy star appliances and native plantings can be utilized as well. While mostly all examples of sustainable mill redevelopment contain different methods that were utilized, they all have the same over arching and general concept, which is the adaptive reuse of an existing building. It is important to consider the drawbacks and trade-offs of these concepts when mills are sustainably redeveloped.

The case studies demonstrated that sustainable mill redevelopment supports various planning initiatives and concepts. Adaptively reused mills are designed at a high density and support walkable communities and smart growth principles. The criteria to become designated as a Green Community contain many concepts that involve mill redevelopment. Most historic mills are considered brownfield sites and vacant buildings, both which planners strive to eliminate in their communities. Redeveloped mills can increase community spaces and recreational opportunities. Open space is conserved and urban sprawl is minimized when mills are redeveloped as opposed to constructing new development elsewhere. The mills can play a part in transit oriented development, with a lot of these mills being located in close proximity to public transit options. Additionally, alternative modes of transportation are supported through mill

redevelopment. These redevelopment projects can be weaved into existing or future master plans, or other community plans. Inventories can be created of the number, condition and potential for reuse of mill buildings. The buildings themselves or cluster of buildings can be designated on the National Register of Historic Places. All of these planning concepts and initiatives point to the importance of planners to be involved with sustainable mill redevelopment in today's communities.

The case studies also demonstrated that there exist similarities and patterns amongst these redevelopment projects. Case-study-based green principles were proposed to serve as a basis for future developments of sustainable mill revitalization principles, from these patterns or elements witnessed in the case studies. Possibly, if the sustainable redevelopment of mills becomes even more common than it is today, this Master's of Regional Planning Project's principles can be used as a starting point or guiding element.

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APPENDIX

Table 1: The matrix on the following page displays the four case studies and their associated green methods utilized in order to compare and contrast the different examples.

	Lofts at Davis Square: Somerville	Forbes Park: Chelsea	Monarch Lofts: Lawrence	Nobis Engineering, Inc.: Lowell
Bicycle amenities			x	
Brownfield site	x	x		x
Community space	x	x	x	
Commuter rail	x	x	x	
Eco-trail		x		
Efficient car incentives	x	x		
Energy efficient lights	x	x	x	x
Energy star appliances	x		x	x
Green roof			x	x
Indestructible features	x	x	x	x
Landscaping elements		x		x
Large windows	x	x	x	x
LEED certified				x
Light colored roof				x
Motion detecting/sensored lights				x
Pedestrian trails	x			
Pervious paving				x
Programmable thermostats			x	
Rainwater harvesting	x	x		
Recycled materials	x	x	x	x
Recycling center			x	x
Renewable resource		x	x	x
Reuse of materials	x	x	x	x
Skywalk concept	x	x		
Urban agriculture		x		
Water reduction measures			x	x
Zip cars	x			

LEED criteria and points: The following displays the LEED points awarded and under which category for the Nobis Engineering, Inc. case study.

LEED-NC

Nobis Engineering, Inc.

LEED-NC Version 2.2 Certified Project Checklist

Nobis Engineering - Lowell, MA

Yes	?	No			
10		**4**	**Sustainable Sites**		**14** Points
Y			Prereq 1	**Construction Activity Pollution Prevention**	Required
1			Credit 1	**Site Selection**	1
1			Credit 2	**Development Density & Community Connectivity**	1
		1	Credit 3	**Brownfield Redevelopment**	1
1			Credit 4.1	**Alternative Transportation**, Public Transportation Access	1
1			Credit 4.2	**Alternative Transportation**, Bicycle Storage & Changing Rooms	1
1			Credit 4.3	**Alternative Transportation**, Low-Emitting and Fuel-Efficient Vehicles	1
1			Credit 4.4	**Alternative Transportation**, Parking Capacity	1
		1	Credit 5.1	**Site Development,** Protect of Restore Habitat	1
1			Credit 5.2	**Site Development,** Maximize Open Space	1
1			Credit 6.1	**Stormwater Design,** Quantity Control	1
1			Credit 6.2	**Stormwater Design,** Quality Control	1
		1	Credit 7.1	**Heat Island Effect,** Non-Roof	1
1			Credit 7.2	**Heat Island Effect,** Roof	1
		1	Credit 8	**Light Pollution Reduction**	1

Yes	?	No			
4		**1**	**Water Efficiency**		**5** Points
1			Credit 1.1	**Water Efficient Landscaping**, Reduce by 50%	1
1			Credit 1.2	**Water Efficient Landscaping**, No Potable Use or No Irrigation	1
		1	Credit 2	**Innovative Wastewater Technologies**	1
1			Credit 3.1	**Water Use Reduction**, 20% Reduction	1
1			Credit 3.2	**Water Use Reduction**, 30% Reduction	1

Yes	?	No			
10		**1**	**Energy & Atmosphere**		**17** Points
Y			Prereq 1	**Fundamental Commissioning of the Building Energy Systems**	Required
Y			Prereq 2	**Minimum Energy Performance**	Required
Y			Prereq 3	**Fundamental Refrigerant Management**	Required
6			Credit 1	**Optimize Energy Performance - Model = 22.4% savings**	1 to 10
1			Credit 2	**On-Site Renewable Energy - 4.09% from PV**	1 to 3
		1	Credit 3	**Enhanced Commissioning**	1
1			Credit 4	**Enhanced Refrigerant Management**	1
1			Credit 5	**Measurement & Verification**	1
1			Credit 6	**Green Power**	1

continued...

Yes	?	No			
4		9	**Materials & Resources**		13 Points
Y			Prereq 1	**Storage & Collection of Recyclables**	Required
1			Credit 1.1	**Building Reuse**, Maintain 75% of Existing Walls, Floors & Roof	1
		1	Credit 1.2	**Building Reuse**, Maintain 100% of Existing Walls, Floors & Roof	1
		1	Credit 1.3	**Building Reuse**, Maintain 50% of Interior Non-Structural Elements	1
1			Credit 2.1	**Construction Waste Management**, Divert 50% from Disposal	1
1			Credit 2.2	**Construction Waste Management**, Divert 75% from Disposal	1
		1	Credit 3.1	**Materials Reuse**, 5%	1
		1	Credit 3.2	**Materials Reuse**,10%	1
1			Credit 4.1	**Recycled Content**, 10% (post-consumer + ½ pre-consumer)	1
		1	Credit 4.2	**Recycled Content**, 20% (post-consumer + ½ pre-consumer)	1
		1	Credit 5.1	**Regional Materials**, 10% Extracted, Processed & Manufactured Regio	1
		1	Credit 5.2	**Regional Materials**, 20% Extracted, Processed & Manufactured Regio	1
		1	Credit 6	**Rapidly Renewable Materials**	1
		1	Credit 7	**Certified Wood**	1
Yes	?	No			
12		3	**Indoor Environmental Quality**		15 Points
Y			Prereq 1	**Minimum IAQ Performance**	Required
Y			Prereq 2	**Environmental Tobacco Smoke** (ETS) **Control**	Required
1			Credit 1	**Outdoor Air Delivery Monitoring**	1
1			Credit 2	**Increased Ventilation**	1
		1	Credit 3.1	**Construction IAQ Management Plan**, During Construction	1
1			Credit 3.2	**Construction IAQ Management Plan**, Before Occupancy	1
1			Credit 4.1	**Low-Emitting Materials**, Adhesives & Sealants	1
1			Credit 4.2	**Low-Emitting Materials**, Paints & Coatings	1
1			Credit 4.3	**Low-Emitting Materials**, Carpet Systems	1
1			Credit 4.4	**Low-Emitting Materials**, Composite Wood & Agrifiber Products	1
		1	Credit 5	**Indoor Chemical & Pollutant Source Control**	1
1			Credit 6.1	**Controllability of Systems**, Lighting	1
1			Credit 6.2	**Controllability of Systems**, Thermal Comfort	1
1			Credit 7.1	**Thermal Comfort**, Design	1
1			Credit 7.2	**Thermal Comfort**, Verification	1
		1	Credit 8.1	**Daylight & Views**, Daylight 75% of Spaces	1
1			Credit 8.2	**Daylight & Views**, Views for 90% of Spaces	1
Yes	?	No			
5			**Innovation & Design Process**		5 Points
1			Credit 1.1	**Innovation in Design: Green Housekeeping**	1
1			Credit 1.2	**Innovation in Design: Exemplary Performance WEc3**	1
1			Credit 1.3	**Innovation in Design:Exemplary Green Power**	1
1			Credit 1.4	**Innovation in Design:Sustainability Education**	1
1			Credit 2	**LEED® Accredited Professional**	1
Yes	?	No			
45		18	**Project Totals (pre-certification estimates)**		69 Points

Certified 26-32 points **Silver** 33-38 points **Gold** 39-51 points **Platinum** 52-69 points

Green Communities Checklist: This checklist displays the criteria required to become designated as a Green Community.

September 26, 2011

FY 2012 GREEN COMMUNITY DESIGNATION AND GRANT PROGRAM

PROGRAM GUIDANCE

INTRODUCTION

The following guidance describes the Green Community Designation and Grant Program process (pursuant to M.G.L. Ch. 25A §10).

Becoming designated as a Green Community provides grant funding to a municipality to support all, or a portion, of the cost of the following:

- studying, designing, constructing and implementing energy efficiency activities including, but not limited to, energy efficiency measures and projects;
- procuring energy management services;
- adopting energy efficiency policies; and,
- siting activities and construction of a renewable energy generating facility on municipally-owned land.

The Green Community Designation and Grant process requires a sequence of steps:

1) A municipality applies to DOER's Green Communities Division (the Division) for designation to demonstrate that it meets the five specific designation criteria. These criteria are outlined in this document and detailed in the toolkit available at http://tinyurl.com/GCToolkit. To fully understand all of the criteria, it is important to review all of the detailed guidance available at the toolkit link, some of which is provided as important links in this document. **Prior to applying for designation, it is important for a municipality to review the toolkit to make sure that it is complying with the most recent guidance available.** Designation guidance begins on page 3 of this guidance document.
2) The Division reviews the application and determines whether a municipality meets the five criteria. The Division then informs the municipality of its decision of whether or not it meets the criteria to become designated as a Green Community. If designated a Green Community, the municipality will also be informed of the amount of its grant award.
3) The designated municipality applies for grant funding.
4) The Division evaluates the designated municipality's grant application and determines if the proposed projects are eligible for funding and provide the best overall beneficial impact for the municipality.

INSTRUCTIONS

Designation Application (Required)

To receive grant funding, the applicant must first be designated as a Green Community. To receive official designation as a Green Community, the applicant must complete the "Designation Application" and submit it to the Division for review. Once the Division has completed its review, it will notify the applicant whether or not it has been designated a Green Community.

Preliminary Consultation (Optional)
Those municipalities that wish to have their designation criteria reviewed prior to formally submitting a Designation Application to the Division may request a preliminary consultation with the Division. In order to receive a preliminary consultation you must submit an electronic request via email to your Regional Coordinator (find your Regional Coordinator). The request must specify which of the five criteria the applicant is seeking consultation for and include draft supporting documents. Preliminary consultation requests may be submitted between September 28, 2011 and November 4, 2011 and will be reviewed in the order in which they are received. Requests received after November 4, 2011 at 5:00 p.m. will not be considered. It is suggested that requests for preliminary consultation be made to allow time for review and consultation by the Division and potential revision by the municipality before documents are to be voted upon at a Town Meeting.

Please note that a preliminary consultation does not represent designation approval.

Deadline for Designation
Municipalities may apply for designation at any time. However, in order for a municipality to be eligible to submit a grant application, it must submit a designation application prior to the grant application deadline. The next designation application deadline is:

Designation Application Deadline: Friday, November 18, 2011, 5:00pm

To apply: This Designation Application Instructions document, is available at **http://tinyurl.com/GCToolkit** and at www.comm-pass.com, PON-ENE-2010-039.

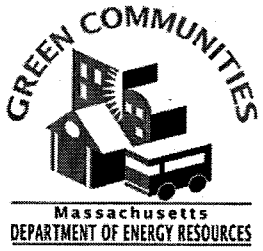
Grant Application (Required for funding)
Once designated, the Green Community is eligible to apply for grant funds. Designated Green Communities must fill out a grant application and submit it by the deadline of January 20, 2012 at 5:00 PM. Amount of awards will be based on available funds, the number of applicants and a predetermined grant allocation formula.

Please note: This is the last time the Division will offer a grant round for newly designation communities in the Fall/Winter season. Beginning in Spring 2012, the Division will move to a single annual announcement for newly designated municipalities and grant application deadline in the late Spring and early Summer, respectively.

FALL FY 2012 DESIGNATION AND GRANT APPLICATION TIMELINE

DATE	EVENT
Wednesday, September 28, 2011 through Friday, November 4, 2011	Accepting requests for designation application preliminary consultations
Friday, November 18, 2011, by 5pm	Deadline for designation applications
Friday, December 16, 2011	Begin accepting grant applications
Friday - January 20, 2012, by 5pm	Deadline for grant applications

September 26, 2011



GUIDANCE FOR BECOMING DESIGNATED AS A GREEN COMMUNITY

REQUIREMENTS FOR MEETING THE CRITERIA TO BE DESIGNATED AS A GREEN COMMUNITY
As outlined in MGL c. 25A §10(c), a municipality must do ALL of the following:

NOTE: One or more municipalities may submit an application together to qualify as a regional Green Community. Each municipality in a regional application must meet each of the requirements with one exception: the 20% reduction from the energy baseline can be applied in the aggregate across all of the municipalities.

CRITERION 1: AS-OF-RIGHT SITING – RENEWABLE ENERGY / ALTERNATIVE ENERGY

A municipality must provide zoning for the as-of-right siting of:

1. renewable or alternative energy generating facilities,
   OR
2. renewable or alternative energy research and development (R&D) facilities,
   OR
3. renewable or alternative energy manufacturing facilities in designated locations.

- "As-of-Right Siting" is defined as siting that provides for the allowed use and that does not unreasonably regulate nor require a special permit.
- An applicant can meet this requirement by providing as-of-right siting for any one of the three types of facilities listed above.
- If a community has as-of-right siting in place for R&D and/or manufacturing facilities in general, this can meet this requirement. The community must demonstrate that the zoning bylaw applies to renewable and alternative energy R&D or manufacturing.
- Communities can select the specific locations for the as-of-right siting, for example, where these facilities are to be located. These locations must be feasible and practical. For example, locations for wind are required to have adequate wind resources (6m/s at 70 meters) and biomass Combined Heat and Power (CHP) locations are required to have a sufficient thermal load.
- If providing as-of-right siting for a renewable or alternative energy generation facility, the community must select technology that is practically available and provides a realistic opportunity for generation. It is expected that a community will appropriately utilize its available

renewable resources, and this will be taken into consideration in the review of an application meeting this requirement.

- As-of-right zoning bylaws can apply appropriate standards that protect public health and safety and provide for non-discretionary site plan review. Reasonable environmental performance standards per the developed bylaw may be incorporated into the Site Plan Review (SPR) process (e.g. height, setback, etc...), but cannot be so stringent as to make the use infeasible. The key is that SPR must be truly non-discretionary: if the standards and zoning requirements are met, the project can be built. This is distinct from the Special Permit (SP), in that the SP may be denied if the Planning Board or other permit granting authority is not satisfied with the project.

- An applicant can meet this requirement with as-of-right siting for renewable or alternative energy generation with any ***one*** of the following project requirements:
  - On-shore Wind – a turbine of a minimum 600 kW in size or above
  - Off-shore Wind – a turbine of a minimum 2.5 MW or above
  - Solar Photovoltaic – a single ground-mounted system of a minimum of 250 kW or above
  - Biomass CHP – a minimum of 5MW in a stand-alone building
  - Ocean, wave or tidal – no minimum threshold

- If providing as-of-right siting for R&D or Manufacturing facilities, a municipality's zoning must specify as an allowed use construction of one of the following facilities:

  - **Research and Development Facilities** are those used primarily for research, development and/or testing of innovative information, concepts, methods, processes, materials, or products. This can include the design, development, and testing of biological, chemical, electrical, magnetic, mechanical, and/or optical components in advance of product manufacturing. The accessory development, fabrication, and light manufacturing of prototypes, or specialized machinery and devices integral to research or testing may be associated with these uses.

  - **Manufacturing Facilities** are those used primarily for heavy or light industry or the manufacture or assembly of a product including processing, blending, fabrication, assembly, treatment and packaging.

- Additionally, in order to qualify, the as-of-right zoning for R&D or manufacturing must clearly allow renewable or alternative energy activities defined as follows. The expectation is that the municipality will allow for all of the technology areas listed below. Given adequate justification, the Division may permit exclusion of a particular technology.

  Renewable Energy:
  - Solar – photovoltaic (PV) and thermal
  - Wind
  - Biomass power conversion or thermal technologies, including R&D related to, or the manufacture of, wood pellets
  - Ultra low emissions high efficiency wood pellet boilers and furnaces
  - Low Impact Hydro – electric and kinetic
  - Ocean thermal, wave or tidal
  - Geothermal
  - Landfill Gas
  - Fuels Cells that use Renewable Energy
  - Advanced biofuels

Alternative Energy:
- Combined Heat and Power
- Electric and hydrogen powered vehicles and associated technologies including advanced batteries and recharging stations

Documentation Required to Meet Criterion 1

The following documentation must be provided as evidence that the municipality has met this criterion.

- Brief description of the qualifying section of the bylaw or ordinance that identifies designated locations
- Color copy of the zoning map that shows area zoned
- Applicable sections of the zoning bylaw or ordinance
- Important zoning definitions
- Relevant section of the use table and any key that will help DOER interpret the use table
- Any related local regulations applicable to facilities sited under the bylaw/ordinance—such as site plan review regulations—so that DOER can confirm that the related local regulations are non-discretionary; and
- For *RE/AE R&D and/or Manufacturing Facilities only* yield calculations, either in the text of the letter provided by municipal legal counsel or attached.

In addition to the above, for those applicants that meet the criterion for either RE/AE R&D and/or Manufacturing through *existing* bylaws or ordinances, applicants must provide a letter from municipal legal counsel certifying that the existing zoning complies with the RE/AE Facilities criterion. In terms of specific contents, the letter must cite and summarize the pertinent section of the zoning ordinance/bylaw.

NOTE: When grant awards are made to those applicants who have been designated as a Green Community, dependant upon the funds available, a bonus amount **may** be provided to those who have met the as-of-right siting requirement through renewable and alternative energy generation.

IMPORTANT LINKS:

- Model As-of-Right Wind Bylaw
- Model As-of-Right Large Scale Solar PV Bylaw
- Guidance for As-of-Right R&D or Manufacturing Bylaw

CRITERION 2: EXPEDITED PERMITTING

A municipality must adopt an expedited application and permitting process under which these Criterion 1 facilities may be sited within the municipality and the permitting process shall not exceed one (1) year from the date of initial application to the date of final approval.

- The expedited application and permitting process applies only to the proposed facilities which are subject to the as-of-right siting provision.

- An applicant can meet this requirement by applying the expedited permitting process of MGL c 43D to these zoning districts.

Documentation Required to Meet Criterion 2

The following documentation must be provided as evidence that an expedited application and permitting process has been fully adopted for the as-of-right zoned parcels.

Local Expedited Permitting Process

- Municipalities must provide DOER a letter from municipal legal counsel affirming that nothing within the municipality's rules and regulations precludes issuance of a permitting decision within one year along with the language addressing approval procedures and associated timing from any applicable bylaws/ordinances or regulations.

- The applicant should also include a color copy of the applicable map(s) showing that the areas where the expedited permitting applies coincides with the as-of-right zoned areas for Criterion 1. If appropriate, this map may be the same as the map provided for Criterion 1.

MGL c43D

- Municipalities must provide DOER with a certified copy of their City Council or Town Meeting vote designating the as-of-right zoned parcel(s) as a Priority Development Site.

- The applicant should also include a color copy of the applicable map(s) showing the areas where the expedited permitting applies.

IMPORTANT LINKS:

Guidance on Expedited Permitting

CRITERION 3: ENERGY BASELINE / 20% ENERGY REDUCTION PLAN

A municipality must establish an energy use baseline inventory for all municipal buildings, school buildings, municipal and school vehicles, street and traffic lighting, drinking water and wastewater treatment plants, pumping stations and open spaces owned by the municipality prior to submitting a designation application, and put in place a comprehensive program designed to reduce this baseline by 20 percent within 5 years of the baseline year.

- The 20% reduction goal should be applied in the aggregate across buildings, vehicles, water/sewer, street and traffic lights on an MMBtu (million British Thermal Units) basis.

- To receive credit for energy efficiency measures that have been recently implemented, applicants can establish a baseline no earlier than FY 2009 (or CY2009), with a reduction plan commencing the following year.

- For applications consisting of more than one community, each community must complete an inventory and all of the individual inventories together will serve as the total baseline for the

regional application. The comprehensive program to reduce the baseline by 20% will then be applied across all communities.

- Perform the inventory using one of these acceptable tools:
  - DOER's MassEnergyInsight tool
  - EnergyStar Portfolio Manager
  - ICLEI software
  - Other tools proposed by the community and deemed acceptable by DOER

Documentation Required to Meet Criterion 3

A copy of the Energy Reduction Plan for reducing energy consumption by 20% in 5 years across all municipal buildings, school buildings, municipal and school vehicles, street and traffic lighting, drinking water and wastewater treatment plants, pumping stations and open spaces owned by the municipality must be provided. At a minimum, the Plan must include the following information:

- Identification of the inventory tool used
- Identification of the baseline year used
- The energy baseline, including the local school district, and associated documentation Specific energy conservation measures to be implemented, the reductions to be achieved, and a timeline with milestones to implement measures and achieve required energy reductions
- Documentation that both the general government and local school district have adopted the energy reduction plan. If a regional school district is included as part of the designation, documentation that the regional school district has adopted the plan must be included. See Criterion 3 Guidance, "Energy Reduction Plan Guidance", for more details.

IMPORTANT LINKS:
Energy Reduction Plan Guidance (Word 97/2003)

Excel Tables for Energy Reduction Plan

(Guidance in Word 2007 and later with embedded excel tables can be found at the toolkit)

CRITERION 4: PURCHASE ONLY FUEL-EFFICIENT VEHICLES

A municipality must purchase only fuel-efficient vehicles for municipal use whenever such vehicles are commercially available and practicable.

To meet this criterion, an applicant must provide a vehicle inventory for all vehicles and a plan for replacing non-exempt vehicles with vehicles that meet the fuel efficiency ratings below. These fuel efficiency ratings are set to ensure that at least 5 or more automatic transmission models of mass production are available for sale in Massachusetts. Based on 2010 EPA data, vehicles are to have a combined city and highway MPG no less than the following:

- 2 wheel drive car: 29 MPG
- 4 wheel drive car: 24 MPG
- 2 wheel drive small pick-up truck: 21 MPG
- 4 wheel drive small pick-up truck: 19 MPG
- 2 wheel drive standard pick-up truck: 17 MPG

- 4 wheel drive standard pick-up truck: 16 MPG
- 2 wheel drive sport utility vehicle: 21 MPG
- 4 wheel drive sport utility vehicle: 18 MPG

Hybrid or electric vehicles in these vehicle classes will meet these criteria

- Recycling of vehicles is only allowed if the replacement vehicle meets the fuel efficiency ratings prescribed above. Please be advised that recycled Ford Crown Victoria vehicles do not meet the MPG rating and therefore would not meet the fuel-efficient vehicle requirement.

- Heavy-duty vehicles such as firetrucks, ambulances, and public works trucks are exempt from this criterion. Heavy-duty vehicles are defined as those vehicles that have a gross vehicle weight rating of 8,500 pounds or more.

- Police cruisers, passenger vans, and cargo vans are exempt from this criterion. However, municipalities must commit to purchasing fuel-efficient cruisers, passenger vans, and cargo vans when they become commercially available. Police department administrative vehicles must meet the fuel-efficient ratings above.

- If an applicant does not have a vehicle fleet other than exempt vehicles, it must propose alternative means for meeting this requirement. For example, a municipality may put in place policies and procedures that promote reduced fuel usage for the municipality; carpooling incentives for municipal employees; preferred parking for employees with hybrid vehicles; bike racks at municipal buildings and incentives for employees to bike to work.

Documentation Required to Meet Criterion 4:

The following documentation must be provided as evidence that the municipality has met this criterion:

- Copy of the policy or other mechanism adopted for purchasing only fuel efficient vehicles
- Inventory of all vehicles (model, year, estimated MPG) including local school district vehicles, with exempt/non-exempt status indicated.
- Replacement plan for non-exempt vehicles with fuel efficient vehicles
- Documentation that both the municipality and the local school district have adopted the fuel efficient vehicle policy. If a regional school district is included as part of the designation, documentation that the regional school district has adopted the fuel efficient vehicle policy must be included. See Criterion 4 Guidance, "Guidance and Model Policy for Purchasing Fuel Efficient Vehicles", for more details.

IMPORTANT LINKS

Guidance and Model Policy for Purchasing Fuel Efficient Vehicles

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CRITERION 5: MINIMIZE LIFE-CYCLE COSTS

A municipality must require all new residential construction over 3,000 square feet and all new commercial and industrial real estate construction to minimize, to the extent feasible, the life-cycle cost of the facility by utilizing energy efficiency, water conservation and other renewable or alternative energy technologies.

The recommended way for cities and towns to meet this requirement is by adopting the Board of Building Regulations and Standards (BBRS) Stretch Code (780 CMR 115.AA), an appendix to the MA State Building Code. Should a community chose to not adopt the Stretch Code and choose to use another standard, the community must provide evidence that this alternative standard minimizes the life cycle energy costs for all new construction and is enforceable by the community.

Towns are advised to adopt the Stretch Code as a general bylaw by its Town Meeting. Cities are advised to adopt the Stretch Code by general ordinance via the City Council.

Documentation Required to Meet Criterion 5

The following documentation must be provided as evidence to verify that the municipality has met this criterion:

Stretch Energy Code

The municipality must provide documentation of the city council or town meeting vote adopting 780 CMR 115.AA, the MA Board of Building Regulations and Standards (BBRS) Stretch Energy Code.

PLEASE NOTE: 780 CMR 120.AA is no longer in effect. **The municipality MUST adopt 780 CMR 115.AA.**

Local Process

The municipality must provide documentation of the standard adopted, the mechanism in place for requiring this criterion for new construction and documentation of how this standard provides reduced life-cycle energy costs.

NOTE: If a municipality plans to meet this criterion through a local process, they are encouraged to submit a description of how it plans to do so with supporting documentation in advance of applying for designation. In this way, the Green Communities Division can provide feedback on the acceptability of the identified process for meeting this criterion.

IMPORTANT LINKS

Stretch code

Stretch code questions and answers

Stretch Code Adoption Process