



ALAMEDA NAVAL AIR STATION

Building 5/5A Demolition Scenarios and Related Estimates

October 2010



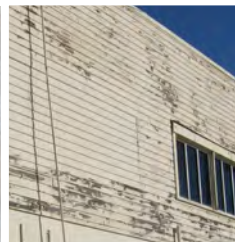
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INTRODUCTION

The revitalization of idled industrial properties is vital to the economic future of many communities in the United States. The closure of federal military facilities and automotive plants has left a physical mark upon the landscape. Communities with underutilized, idled and often contaminated properties frequently struggle to put these properties back into productive use.

Naval Air Station Alameda in Alameda, California, now commonly referred to as Alameda Point, was identified for base realignment and closure in 1993. Mission cease date and operational closure occurred in 1997. In July 1999, the former Alameda Naval Air Station was placed on the National Priorities List (Superfund List) and a Federal Facilities Agreement was signed between EPA and the Navy in 2001 which contained an enforceable investigation and cleanup schedule as well as guaranteed funding mechanisms to implement the cleanup. To date, several property parcels within the former air station have been transferred and many more leased to the Alameda Reuse and Redevelopment Authority. Operable Unit 2C of the former air station was divided into three property parcels: Site 5 (Building 5/5A - Aircraft Rework Facility), Site 10 (Building 400 – Missile Rework Operations) and Site 12 (Building 10 – Power Plant). Building 5/5A is the focus of this report. It is anticipated that when environmental work at Building 5/5A is completed, the property will be transferred to the Alameda Reuse and Redevelopment Authority.

A multi-stage ground water Removal Action to remediate a large dense non-aqueous phase liquid plume in ground water beneath Site 5 was completed in December 2008. A Time-Critical Removal Action to remove the remaining accessible radiologically-impacted storm drains and sewer lines has recently been completed.

In preparation for eventual transfer for redevelopment, this report considers Building 5/5A's reuse. Current discussions are focused on the possibility of demolishing all or portions of the building and this report provides an initial look at some of the economic and environmental considerations involved in the demolition. In light of the challenges associated with a complete analysis of the materials in the building, the U.S. Environmental Protection Agency (EPA) Region 9 requested a cursory look at some of the known issues surrounding the possible demolition of Building 5/5A as well as some "back of the envelope" cost and greenhouse gas emission estimates associated with the demolition. The calculations are based on assumptions about the type and amount of materials at the Site. Information was gathered during a site tour, and from EPA and Department of the Navy documents. Although the calculations are approximate, they provide order of magnitude estimates that will facilitate future discussions regarding reuse of the site.

This report first provides an overview of Building 5/5A. Next, the report offers a short list of precedents for redeveloping Building 5/5A. The report then provides estimates for demolition costs and associated greenhouse gas emissions under four different demolition scenarios. A few considerations apply to demolition activities regardless of the scenario ultimately carried out; these considerations are discussed accordingly.

DETAILED OVERVIEW OF BUILDING 5/5A

Building 5/5A is centrally located in the main industrial complex of the historic Alameda Naval Air Station in Alameda, California (Figure 1). The building lies between First and Second Streets and Avenue C and Avenue F (Figure 2). Building 5 was constructed in 1940 and was an aircraft overhaul and rework facility. It is a 63 foot tall one-story building with six mezzanines. Adjacent to and north of Building 5 is Building 5A. Building 5A was built between 1943 and 1946 and functioned as an airplane hangar facility. Building 5A is also a 63 foot tall one-story building with three mezzanines. Although both Building 5 and 5A are extremely large scale buildings designed to house and work on military aircrafts, they are aesthetically different. Both the aircraft hangar doors and the walls in Building 5 contain large amounts of glass windows that provide much more natural lighting than the dark atmosphere of Building 5A.



Abundant natural lighting in Building 5



Darker atmosphere in Building 5A

Building 5/5A has concrete floors throughout, steel-frames with concrete and pre-fabricated paneling, and built-up roofs. Building 5/5A covers 910,382 square feet (sq ft) distributed as follows:

- Industrial space – 528,770 sq ft.
- Hangar space – 263,391 sq ft.
- Office space – 118,221 sq ft.¹

Building 5/5A has three distinct sections, the characteristics of which are described in Table 1:

- **Building 5:** the original structure on the southern portion of the property.
- **Breezeway:** the walkway in the center of the building that connects the southern and northern sections.
- **Building 5A:** the newer structure on the northern portion of the property.

Table 1: Building Details for the Three Sections of Building 5/5A

	Dimensions	Footprint area (sq ft)	Concrete thickness (inches) ^a
Building 5	403' X 930'	374,790	6
Breezeway	16' X 824'	13,184	6
Building 5A	404' X 824'	332,896	8

a. Thickness is based on measurements taken in concrete bores during a site visit on 11/18/2009 and confirmed by historical floorplan drawings.

¹ Department of the Navy "Base Realignment and Closure Facility Layaway and Caretaker Maintenance Plan Naval Aviation Depot, Alameda Building 5/5A," September 1995.



Figure 1
Site Vicinity Map

Alameda Naval Air Station
Alameda, Alameda County, CA



POTENTIAL REDEVELOPMENT SCENARIOS

The challenges posed by previously contaminated industrial sites can offer opportunities for communities, local governments, industry and other stakeholders to work together to redevelop the properties and revive local economies. Through partnerships among all levels of government and the private sector this revitalization can lead to improvements in public health and environmental protection.

Redevelopment projects at closed federal facilities and automotive plants across the country provide examples of such partnerships. When successful, these redevelopments give new life to idled industrial spaces and help to revitalize communities. Examples of successful industrial property redevelopment projects that offer relevant precedents for Building 5/5A include:



Corporate office campus: Urban Outfitters Headquarters, Philadelphia Navy Yard, Pennsylvania.



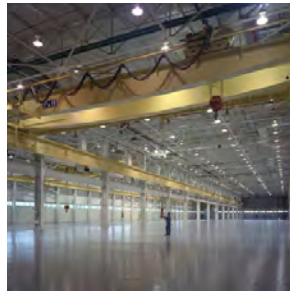
Mixed-use business park: Centerpoint Business Campus, Pontiac, Michigan.



Environmentally innovative business and industry: Eco-Industrial Park, Londonderry, New Hampshire.



Renewable energy park: Ford Assembly Plant, Wixom, Michigan.



Tax-free business park: Midlink Business Park, Comstock, Michigan.



Industrial ecology partnership: Waste = Revenue Roundtable, Cleveland, Ohio.

Appendix B presents case studies of these redevelopment projects. The case studies provide background, ideas and lessons learned for municipalities dealing with similar properties.

REDEVELOPMENT CONSIDERATIONS

If any portion of Building 5/5A is considered for redevelopment, there are several issues that would need further investigation and management including:

- Determining whether the building needs seismic retrofitting.
- Managing issues related to the peeling lead paint in portions of the building.
- Removing asbestos tiles.
- Planning the reuse of the building to reduce the long-term greenhouse gas emissions related to operation of the structure.
- Potential for the building to qualify as a historic structure.

Seismic retrofitting

Since Building 5/5A is located in the San Francisco Bay Area of California, retaining any portion of the building for reuse and redevelopment raises issues related to current earthquake preparedness standards for buildings. Multiple standards could potentially apply to Building 5/5A. The 2007 California Code of Regulations, Title 24, Part 1 provides information on structural safety based on the end use of the building.² Alameda City's Seismic Retrofitting documents focus on residential wood frame construction.³ The Uniform Building Code (UBC) is generally adopted by cities, counties and states with only minor changes. Members of the Structural Engineers Association of California wrote and maintain the seismic portion of the UBC.

The UBC does not specify when a structure must be retrofitted. Chapter 34 of the UBC requires that all alterations, additions or repairs comply with UBC requirements for new construction. When a building is retrofitted, the entire structure does not have to comply with the requirements for new construction. Sometimes the building may need to be retrofitted if the use or occupancy changes. Ultimately, it is up to the building owner, architect, structural engineer and the building official to determine if the building should be retrofitted. Due to the steel beam construction of Building 5/5A and its one-story construction, it is possible that the building would not need to be seismically retrofitted if redeveloped. However, an engineer would be needed to make the determination.



2 http://www.documents.dgs.ca.gov/bsc/Title_24/documents/2007/2007%20Part%201/Part1_AdministrativeCode_supp.pdf

3 http://www.ci.alameda.ca.us/planning/seismic_retrofit.html

Balancing the impacts of new construction

In making decisions regarding the potential reuse or demolition of Building 5/5A, it is important to understand that a building's "useful life" spans its planning, design, construction, operation and ultimate reuse or demolition. As much as 80 to over 95 percent of the greenhouse gases and environmental impacts over the life span of a building are related to the operational phase of the building while the remaining impact comes from the construction and demolition of the building.⁴ This information can help in balancing decisions about the design of a building being reused or a new building being constructed in order to reduce greenhouse gases over the life of the structure.

Often, the entity responsible for design, construction and initial financing of a building is different from those operating the building, meeting its operational expenses, and paying employees' salaries and benefits. However, the decisions made at the first phase of building design and construction, whether for new construction or reuse, significantly affect costs in later phases. High performance buildings use resources such as water, energy, materials and land more efficiently than conventional buildings. Recent studies have shown that green building tools and approaches taken during construction or renovation can result in significant operational savings over the life span of the building as well as increased employee productivity. Therefore, building-related costs and greenhouse gas/environmental impacts are best understood when analyzed over the life span of a building.



⁴ Scheuar and Keoleian, "Evaluation of LEED Using Life cycle Assessment Methods" National Institute of Standards and Technology, Technology Administration, U.S. Department of Commerce. September 2002 (NIST GCR 02-836). UNEP SBCI.

COST ESTIMATES OF DEMOLITION

Overview

This report provides an order of magnitude estimate for the financial costs of demolishing Building 5/5A. Because demolition costs will vary substantially depending on the portions of Building 5/5A structure that are demolished, this report analyzes four demolition and partial demolition scenarios and the costs associated with each. In considering the potential costs of demolition of all or part of Building 5/5A, greenhouse gas release is a negative impact, or a non-financial, environmental cost that can also be considered. Therefore, the total cost for each scenario also includes greenhouse gas emissions. The four scenarios involve varying degrees of demolition of Building 5/5A, as follows:

- **SCENARIO 1:** Demolition of all building sections (Building 5, Building 5A and the breezeway), including all concrete foundations.
- **SCENARIO 2:** Demolition of all building sections (Building 5, Building 5A and the breezeway) and demolition of the concrete foundation of Building 5A.
- **SCENARIO 3:** Demolition Building 5A and the breezeway, including the concrete foundations of both.
- **SCENARIO 4:** Demolition of Building 5A (including its concrete foundation) and the breezeway (not including its concrete foundation).

These scenarios are described below. Each description includes potential demolition costs and the costs associated with greenhouse gas emissions related to demolition activities and transportation of concrete foundation materials.⁵

Estimate calculation methodology

In order to estimate the total demolition costs for each scenario, this analysis uses three points of reference: 1) demolition estimates for the former Naval Air Station at Moffett Field, California; 2) a 1995 Department of Navy cost estimate for Building 5/5A and 3) cost estimates related to lead paint abatement and encapsulation. All three are summarized below, followed by a description of the calculation for greenhouse gas emissions estimates.

Details of Moffett Field comparable demolition cost estimates

This analysis compares the size and structure type of Building 5/5A to that of the former Naval Air Station at Moffett Field, California. Moffett's Hangar One is approximately 350,000 sq ft and comparable in size and construction to each of the two major sections of Building 5/5A. Because of these similarities, it is possible to extrapolate cost estimates for Building 5/5A demolition from those developed by the Department of the Navy for Moffett Field using simple calculations. Of the multiple demolition alternatives for Moffett Field, two are particularly applicable here: Alternatives 10 and 11.

⁵ Although there are greenhouse gas emissions related to every part of demolition and possible reconstruction, data constraints and factors in material transport result in this report's focus on the demolition and transportation of the concrete foundation.

Alternative 10 involves the complete removal of siding, demolition and disposal of all interior structures and the removal of the resulting contaminated and non-contaminated debris to appropriate off-site disposal or recycling facilities. Alternative 10 coats the exposed structural steel surface to encapsulate the PCBs in paint remaining on the structural steel and leaves the concrete pad and steel frame in place for future redevelopment. The Department of the Navy estimated Alternative 10 to cost \$25.8 million (Table 2). Note, however, that a purchase request was recently awarded to complete the work for \$22.4 million. Alternative 11 included the complete demolition of Hangar One, leaving in place the concrete pad. The Department of the Navy estimated Alternative 11 to cost \$26.3 million (Table 2). None of the alternatives considered at Moffett field included removal of the concrete pad.

Due to the large amount of open space in the structures, scaling demolition costs based on the cost per square foot is likely to result in inaccuracies. Therefore, this demolition estimate for Building 5/5A is calculated based on both Building 5 and Building 5A each being roughly equivalent in exterior size and construction as Hangar One, although not equivalent in square footage. As a result, Building 5/5A is assumed to be approximately twice the cost of Hangar One (Table 2). A calculation based on the cost per square foot is also shown for informational purposes (Table 2). Please note that the cost per square foot in each Alternative covers different things. One gives a cost of removing siding, roofing and interior structures, and the other gives the cost for wholesale demolition excluding the concrete pad. The two alternatives are not really comparable to each other although they can be useful for comparison to the four scenarios at Building 5/5A.

Table 2: Building 5/5A Demolition Estimates Based on Hangar One Costs

	Moffett Hangar One (total cost) ^a	Moffett Hangar One (cost per sq ft)	Building 5/5A (total cost of Hangar One, doubled)	Building 5/5A (total cost based on cost per sq ft Hangar One)
Alternative 10: Leave steel frame and concrete pad in place	\$22.4 million	\$64	\$45 million	\$58 million
Alternative 11: Demolition of Hangar 1 and leave concrete pad in place	\$26.3 million	\$75	\$53 million	\$68 million

a. Department of the Navy “Engineering Evaluation/Cost Analysis Revision 1” (July 30, 2008) for Hangar One (Moffett Field).

Details of Department of the Navy demolition estimate

A November 1995 Navy Memorandum reported demolition estimates for Building 5/5A to be \$20 million (1995 dollars). Using the Consumer Price Index, this would be \$28 million in 2010 dollars (approximately \$31 per sq ft). The Branch specified that this estimate was dependent on the cost of debris disposal and proceeds from steel recycling from the buildings. At the time, the U.S. Navy did not recommend demolition. However, it did recommend dismantling the wooden portions of Building 5. These recommendations were based on the following determinations:

- The costs for cleaning Building 5/5A are lower than the costs of demolition.
- Building 5A is a well-constructed building.
- The steel framed portion of Building 5 is as strong as Building 5A.

The memorandum does not clarify whether or not the cost of Building 5/5A includes removal of the concrete pad. For the purposes of comparison, it is assumed that costs are specific to the structure and do not include the concrete pad.

Details of lead paint abatement and encapsulation

Many components of the Building 5/5A structures are likely covered in lead-based paint. The lead-based paint must be addressed whether these components are removed from the building or retained for reuse. Therefore, costs associated with addressing the lead based paint will not vary by scenario. There are two possible methods of addressing lead paint on the building materials: abatement and encapsulation. The encasement and encapsulation process starts once demolition of the necessary interior and exterior features of the building are removed, characterized, segregated and properly disposed of at an approved off-site facility. Encapsulation coats the remaining surfaces of the structural steel infrastructure and wood with an approved primer and finish coat of weather-resistant liquid coating that dries to form a water-tight jacket over the lead paint. For reused materials, the coating would be subject to inspections and touch-ups every 5 years and recoating every 10 years.

Lead paint abatement involves physically stripping the paint off all involved surfaces. Potential environmental impacts during the removal action include air and surface water concerns involving the release of polychlorinated biphenyls (PCBs) and other hazardous materials during paint removal.⁶ Lead-based paint removal projects may generate wastewater from cleaning painted surfaces, wet abrasive blasting, contaminated blasting media or decontamination of personnel or equipment. Additionally routes of entry into surface waters during paint removal can occur through falling paint particles and fine dust. Other routes of entry include surface erosion of lead contaminated soils, airborne drift of fine dust, and contamination of other sources of discharge into surface waters such as cooling water streams or wastewater treatment plant effluents. The work area would need to be properly secured and controlled to protect the public and the environment during paint removal. Tables 3 and 4 present the average costs of both methods of lead mitigation for each section of building. Since the Breezeway was constructed to connect Building 5 and 5A it contains no steel beams of its own.

Table 3: Estimates of Lead Abatement Costs for Wood Roof/Ceiling

	Area (sq ft)	Encapsulation cost estimate at \$.50 per sq ft	Abatement cost estimate at \$11.50 per sq ft
Building 5	374,790	\$187,395	\$4,310,085
Building 5A	332,896	\$166,448	\$3,828,304
Breezeway	13,184	\$6,592	\$151,616

a. Estimates made on midpoint of \$8.00-\$15.00 range for lead abatement based on particular process.

Table 4: Estimated Costs of Lead Paint Abatement for Steel Beams in Walls & Doors

	Estimated number	Total amount of steel to be abated (sq ft)	Encapsulation cost estimate at \$.50 per sq ft	Abatement cost estimate at \$11.50 per sq ft
Building 5 Steel Beams	48	3,024	\$1,512	\$34,776
Building 5A Steel Beams	46	2,898	\$1,449	\$33,327
Steel Doors	11	24,948	\$12,474	\$286,902

a. Estimates made on midpoint of \$8.00-\$15.00 range for lead abatement based on particular process.

b. The number of steel beams was estimated from blueprints. Details of greenhouse gas emission estimates

⁶ PCBs were historically used in paint formulations as drying oils (resins) and plasticizers or softening agents (liquids).

Details of greenhouse gas emission estimates

The largest source of greenhouse gas emissions during demolition is likely to be the removal and transport of concrete. Current estimates indicate that the concrete pads in all three sections of the building total approximately 30,000 tons of concrete and 1,039 tons of steel rebar (Table 1).

Table 5 shows estimates for the amounts of foundation concrete and steel for each of the scenarios. Removing the concrete in Scenario 1 (all foundation concrete) and transporting it to a recycling center would require approximately 1,560 truck trips (Table 6). Assuming that the recycling center is approximately 10 miles away and that trucks return to the site empty, the number of gallons of fuel used to remove the concrete from the Site was estimated (Table 6). Combination tractor-trailer trucks averaged 5.1 miles per gallon (mpg) in 2007.⁷ Without specific information on the fleet of trucks that would be used, an assumption of 8 mpg is used for fuel efficiency of empty trucks returning to the Site. The greenhouse gas emissions are a low-end, baseline estimate since only the greenhouse gas emissions of transporting the concrete foundation and associated steel to a recycling center are considered. The greenhouse gas emissions are expected to be higher when the equipment used to perform the demolition, and the transportation of the building frame are also considered.

Table 5: Concrete and Steel Estimates, by Scenario

Scenario	Building space to be demolished (sq ft)	Concrete pad to be demolished (sq ft)	Concrete in pad (cubic yards)	Concrete in pad (tons)	Steel in concrete pad (tons) ^a
1	720,870	720,870	15,404	30,154	1,040
2	332,896	332,896	8,220	16,090	555
3	346,080	346,080	8,464	16,568	571
4	346,080	332,896	8,220	16,090	555

a. This order of magnitude estimate assumes that there are 5 pounds of steel per cubic foot of reinforced concrete slab. The true estimate depends on the diameter, the type and the amount of rebar used.

Table 6: Greenhouse Gas Emissions from Transporting Recycled Materials after Demolition

Scenario	Truckloads of concrete	Truckloads of steel	Total truckloads to recycling center	Fuel useage for full trucks (gallons)	Fuel usage for empty trucks (gallons)	Total fuels (gallons)	Total emissions from transport of concrete and steel to recycling (kg CO ₂) ^a
1	1,508	52	1,560	3,058	1,950	5,008	55,687
2	804	28	832	1,632	1,040	2,672	29,714
3	828	29	857	1,680	1,071	2,752	30,597
4	804	28	832	1,632	1,040	2,672	29,714

a. kg CO₂ = kilograms of carbon dioxide. Emissions for the total quantity of diesel used can be estimated with emission factors from the National Renewable Energy Laboratory Life-Cycle Inventory Database (<http://www.nrel.gov/lci/database/default.asp>). The emission factor used is 11.12 kg CO₂/gallon of diesel, resulting in 55,687 kg CO₂ released in the transport of concrete from the Site. 56,000 kg CO₂ is about the same as taking 21 west coast to east coast roundtrips (3,000 miles) in an average passenger car.

⁷ Table 5-2 Transportation Energy Data Book, edition 28.

The Building for Environmental and Economic Sustainability version 4.0 (BEES 4.0) software, used by designers, builders and product manufacturers, includes actual environmental and economic performance data for over 230 building products across a range of functional applications. BEES 4.0 measures the environmental performance of building products using the environmental life-cycle assessment approach specified in International Organization for Standardization (ISO) 14040 standards.⁸ Utilizing BEES 4.0, the life cycle green house gas emissions for the manufacture of cement from raw materials through the cement product is 12.9 kilograms of carbon dioxide (kg CO₂) per cubic foot of cement. Using this value, Table 7 shows the estimates for the greenhouse gas impacts for each scenario if the concrete in any of the three building sections is replaced with new concrete during new construction.

Table 7: Greenhouse Gas Emissions of Replacing Concrete

	Concrete (Cubic Yards)	Greenhouse gas emissions if replaced (kg CO ₂)
Scenario 1	15,446	199,253
Scenario 2	8,261	106,567
Scenario 3	8,505	109,715
Scenario 4	8,261	106,567

Demolition scenarios

Scenario 1

Scenario 1 would involve demolishing all three building sections (Building 5, Building 5A and the breezeway) and concrete foundations. Under this scenario, activities would demolish the most concrete and steel of all four of the scenarios. Since demolition cost estimates ignore the cost of concrete removal, demolition cost estimates for Scenario 2 are equivalent to Scenario 1. However, as the most intensive demolition option, Scenario 1 is the most expensive scenario, when concrete removal costs are considered, and also involves the largest amount of greenhouse gas emissions. Table 8 below summarizes the relevant cost and greenhouse gas estimates associated with Scenario 1.

Table 8: Scenario 1 Cost and Emissions Estimates

Total cost estimates based on comparables	Cost estimates
Hangar One Alternative 10	\$46 million
Hangar One Alternative 11	\$54 million
Department of the Navy	\$22 million
Estimates of demolition considerations	Cost and emissions estimates
Greenhouse gas emissions (CO ₂ emissions from transport of concrete and steel to recycling)	56 thousand kg CO ₂

Scenario 2

Scenario 2 would involve demolishing all three building sections (Building 5, Building 5A and the breezeway) and the concrete foundation of Building 5A, but leaving intact the foundations of Building 5 and the breezeway for future use. Since demolition cost estimates ignore the cost of concrete removal, demolition cost estimates for Scenario 2 are equivalent to Scenario 1. However when concrete removal costs are added Scenario 2 would conceivably be less than Scenario 1 since less concrete would be removed. Table 9 summarizes the relevant cost and greenhouse gas estimates associated with Scenario 2.

⁸ BEES 4.0 user manual <http://nepis.epa.gov/EPA/html/DLwait.htm?url=/Adobe/PDF/60000EQ6.PDF>.

Table 9: Scenario 2 Cost and Emissions Estimates

Total cost estimates based on comparables	Cost estimates
Hangar One Alternative 10	\$46 million
Hangar One Alternative 11	\$54 million
Department of Navy	\$22 million
Estimates of demolition considerations	Cost and emissions estimates
Greenhouse gas emissions (CO ₂ emissions from transport of concrete and steel to recycling)	30 thousand kg CO ₂

Scenario 3

Scenario 3 would involve demolishing Building 5A and the breezeway as well as their concrete foundations, but keeping Building 5 intact for future use. Scenarios 3 and 4 are equally cost-effective (less costly than Scenarios 1 and 2). Leaving Building 5 intact would provide innovative reuse options; however, this analysis does not address the details or costs associated with ensuring that Building 5 would be ready for future use. Table 10 summarizes the relevant cost and greenhouse gas estimates associated with Scenario 3.

Table 10: Scenario 3 Cost and Emissions Estimates

Total cost estimates based on comparables	Cost estimates
Hangar One Alternative 10	\$22 million
Hangar One Alternative 11	\$26 million
Department of Navy	\$11 million
Estimates of demolition considerations	Cost and emissions estimates
Greenhouse gas emissions (CO ₂ emissions from transport of concrete and steel to recycling)	31 thousand kg CO ₂

Scenario 4

Scenario 4 would involve demolishing Building 5A and its concrete foundation as well as the breezeway, but leaving intact the breezeway's concrete foundation and Building 5 for future use. Scenarios 3 and 4 are equally cost-effective. Leaving Building 5 and the breezeway foundation intact would provide innovative reuse options; however, this analysis does not address the details or costs associated with ensuring that Building 5 and the breezeway foundation would be ready for future use. Table 11 summarizes the relevant cost and greenhouse gas estimates associated with Scenario 4.

Table 11: Scenario 4 Estimates

Total cost estimates based on comparables	Cost Estimates
Hangar One Alternative 10	\$22 million
Hangar One Alternative 11	\$26 million
Department of Navy	\$11 million
Estimates of demolition considerations	Cost and emissions estimates
Greenhouse gas emissions (CO ₂ emissions from transport of concrete and steel to recycling)	30 thousand kg CO ₂

DEMOLITION CONSIDERATIONS

There are a number of issues to consider when deciding the appropriate demolition scenario for Building 5/5A. Specifically, there are recycling requirements related to demolition, requirements related to the disposal of hazardous waste, and economic considerations regarding the sale and recycling of steel. The following subsections highlight these issues.

Recycling requirements

California adopted new technical building and fire regulations, known as the California Green Building Standards Code, on August 1, 2009. Section 708.1 of the Code states that all California construction and demolition (C&D) sites must “establish a construction waste management plan for the diverted materials, or meet local construction and demolition waste management ordinance, whichever is more stringent.” Accordingly, demolition plans for Building 5/5A are required to follow the more-stringent Alameda County C&D ordinances. Section 470.4 of the Alameda County Code details minimum requirements for the diversion or salvage of waste generated by a covered construction and demolition project:

- Seventy-five percent of inert solids (such as rock, concrete, brick, sand, soil, asphalt and unsorted construction) must be diverted or salvaged.
- Fifty percent of all remaining, designated, project-related construction and demolition waste (such as steel, wood and roofing shingles) must be diverted or salvaged.
- A Debris Management Plan, as specified in Section 470.6 of the Code, must be submitted prior to issuance of a demolition or building permit.⁹

Therefore, Alameda C&D ordinances require at least 75 percent of all C&D steel and concrete from the demolition of Building 5/5A to be reused or recycled rather than disposed of in a landfill.

Steel reuse

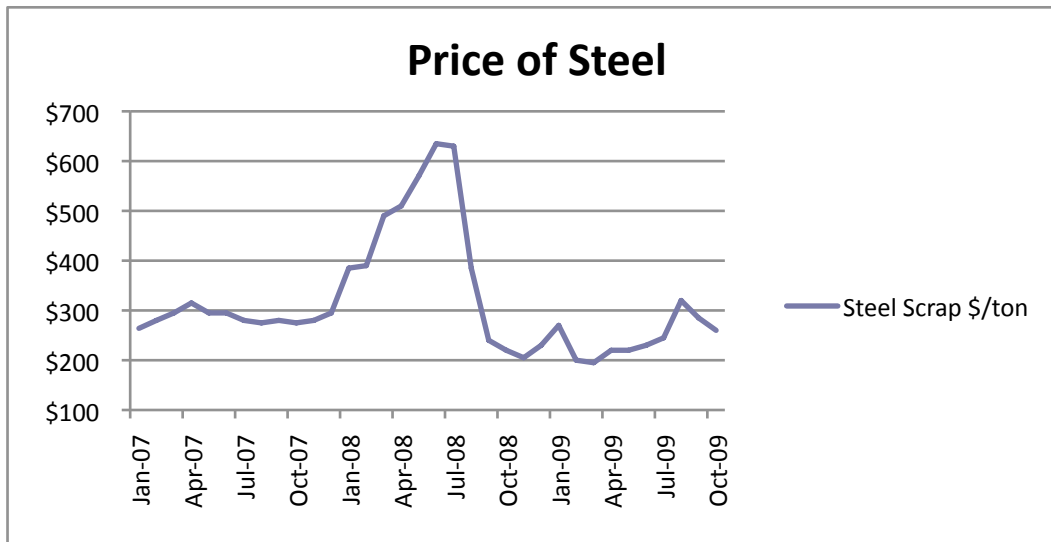
Building 5/5A contains a large amount of steel. The concrete foundation contains an estimated 1,039 tons of steel (Table 1). In addition, the building frame contains an estimated 5,922 square feet of steel beams in the walls and ceilings (Table 2) (see Appendix A for photographs). Each building contains approximately half the steel. Demolition of the structure, concrete pad or both will result in a large amount of steel that could be sold in the steel recycling market.

The price of steel can have a significant impact on the costs of demolishing a large building such as Building 5/5A. Therefore, the timing of the building demolition is important to the overall financial costs of the endeavor. Figure 3 charts changes in steel prices on a monthly basis from January 2007 through October 2009 and illustrates that there can be a two or threefold increase or decrease in price over just a few months. When separated, heavy gauge (1/4 inch or thicker) steel, particularly steel beams, may have a much higher salvage value (two to three times more) than light-gauge, cold-rolled or mixed steel.

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<http://www.stopwaste.org/docs/c-d-model.pdf>

Figure 3: Price of Steel¹⁰



Handling and disposal of hazardous waste

Much of the existing timber used in Building 5/5A is covered in lead-based paint. Most of the paint is peeling, i.e., not intact. The California Department of Toxic Substance Control (DTSC) states that demolition debris painted with lead-based paint that is intact may or may not be considered hazardous waste. In order for the entire item to be hazardous, the lead concentration in the paint and the painted item (e.g., door or beam) must exceed hazardous levels. In most cases, the lead concentration from the intact paint alone will not exceed hazardous lead levels for both the item and the intact paint. Lead painted items become more dangerous when the paint is peeling or is in some manner compromised and more likely to have a completed exposure pathway such as inhalation of dust. While it is still a hazard, intact lead paint poses less of an immediate threat because it does not easily create falling paint particles or fine dust containing PCBs and other hazardous materials. Furthermore, over 50 municipal landfills in California are authorized to accept lead-based paint-covered wood waste, but the decision to accept the material is left to the individual landfill and approval by the applicable Regional Water Quality Control Board.

Lead-based paint is an issue that will need to be managed carefully. If the timber is reused it will need to be mitigated. If the wood is disposed of, the concentration of lead in the paint will need to be determined. If the content is high enough to be considered hazardous waste, this will require that an appropriate landfill be located for disposal of the wood. According to the California State Water Resources Control Board, the closest open public disposal facility to Building 5/5A is the Republic/Vasco Road Landfill, located approximately 40 miles away.¹¹

If entire structures or building materials, such as steel beams and doors, are to be reused or recycled, lead paint issues will affect the feasibility and legal requirements of the process. The steel in Building 5/5A appears to be coated with lead-based paint; however, testing is required to confirm this. Steel recycling at Building 5/5A is subject to the federal Residential Lead-Based Paint Hazard Reduction Act of 1992 (Act). The Act addresses private, public, commercial, and industrial buildings and tanks, bridges, and superstructures as well as demolition and dismantling projects. The Act outlines an acceptable disposal method using encapsulation for lead-based paint-coated steel.¹² Encapsulation is an alternative to lead paint abatement of the steel structure and increases the ease of reusing the steel beams.

¹⁰ http://www.steelonthenet.com/commodity_prices.html

¹¹ <http://www.ci.livermore.ca.us/SWR/landfill.html>

¹² Deleading Journal, Technology Review, Encasement and Innovative Solutions for Lead-based Paint Management: <http://www.stayflex.com/pdf/Stayflex%20Systems%20%20Innovative%20Solutions%20for%20Asbestos%20&%20Lead%20Paint%20Management.pdf>

CONCLUSIONS

The cost estimate and greenhouse gas emission information related to the possible scenarios for demolition considered in this report are summarized in Table 12. The following are the limitations on the data presented:

- The cost estimates are approximate order of magnitude values.
- There are multiple factors that will affect the true financial cost of demolition.
- The greenhouse gas emissions are a low-end, baseline estimate since only the greenhouse gas emissions of transporting the concrete foundation and associated steel to a recycling center are considered. The greenhouse gas emissions are expected to be higher when the equipment used to perform the demolition, and the transportation of the building frame are also considered.
- The analysis ignores the internal structures of the office and work spaces contained in the building mezzanines. It's probable that the mezzanines include asbestos, lead, and PCBs. Those structures are likely to add complication, expense and greenhouse gas emissions to a demolition project.

Table 12: Summary of Cost and Greenhouse Gas Estimates by Scenario^a

Scenario	Cost based on Hangar One Alternative 10	Cost based on Hangar One Alternative 11	U.S. Navy estimate	Total emissions from transport of concrete and steel to recycling ^b
1	\$46 million	\$54 million	\$22 million	56 thousand kg CO ₂
2	\$46 million	\$54 million	\$22 million	30 thousand kg CO ₂
3	\$22 million	\$26 million	\$11 million	31 thousand kg CO ₂
4	\$22 million	\$26 million	\$11 million	30 thousand kg CO ₂

a. None of the comparative cost estimates consider removal of the concrete pad under the building. Alternative 10 leaves the steel frame in place, Alternative 11 demolishes Hangar 1, and the U.S. navy estimate considers removal of Building 5/5A.

b. For comparison purposes, 56,000 kg CO₂ is equivalent to driving 21 west coast to east coast roundtrips (3,000 miles) in an average passenger car, driving 11 passenger cars for a year or burning 6,300 gallons of gasoline (EPA Clean Energy Calculations and References <http://www.epa.gov/cleanrgy/energy-resources/refs.html> and Greenhouse Gas Equivalencies Calculator <http://www.epa.gov/cleanrgy/energy-resources/calculator.html#results>).

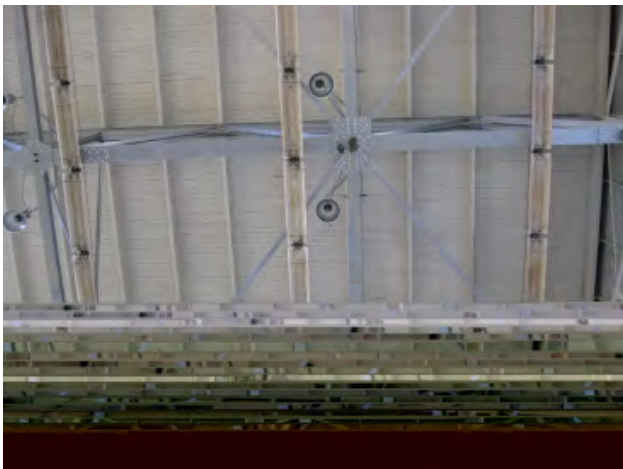
APPENDIX A: SITE PHOTOGRAPHS



1. Interior of Building 5, facing southwest.



2. Interior of Building 5, facing west.



3. Wood beam ceilings in a portion of Building 5.



4. Peeling paint on ceiling of building 5.



5. Eastern side of Building 5/5A where the breezeway connects Building 5 (on left) to Building 5A (on right).



6. View of a mezzanine in Building 5.



7. South side of Building 5.



8. View to the south from Building 5.



9. View to the west from Building 5.



10. Exterior door on Building 5A.



11. Interior of Building 5A with a hangar door partially open.



12. View of the exterior wall structure on Building 5A. Note the concrete and painted steel beams within the wall.

APPENDIX B: PRECEDENTS REDEVELOPMENT

Case Study: Adaptive Reuse

Urban Outfitters Headquarters, Philadelphia Navy Yard, PA



The Philadelphia Navy Yard, which encompasses more than 1,000 acres, 2,000 buildings, and 2.5 miles of riverfront, was decommissioned in 1996. Today, under the guidance of the Philadelphia Industrial Development Corporation, the Philadelphia Navy Yard is rapidly becoming a dynamic and viable new business location, as evidenced by the Urban Outfitters corporate office campus, which was completed and opened in October 2006.

A Philadelphia-born-and-based business, Urban Outfitters Inc. saw great potential in consolidating its operations—which had been scattered throughout Center City—into a

single, 11-acre, five-building campus. Urban Outfitters' decided to rehabilitate five turn-of-the-century, low-rise industrial buildings (250,000 square feet) formerly used for shipbuilding and maintenance. Their efforts received extensive support from municipal, state, and federal governments. The buildings were sold for \$1 per building and qualified for a 20 percent historic-preservation federal tax credit. Costing \$4 million in public infrastructure improvements and \$95 million in private investment, the project has spurred further interest in redevelopment at the Navy Yard.



Other enterprises at the Naval Yard include Penn State University's master's program in Systems Engineering, a data and operations center for the Philadelphia Stock Exchange, a pharmaceutical lab and manufacturer, and a private shipbuilding yard. Future plans call for development of a forty-acre industrial park, a 600,000 square foot produce and seafood distribution center and a highly automated bakery as big as six football fields.

The Urban Outfitters site takes advantage of unused rail lines for pedestrian paths between the corporate headquarters, the three retail brands (Urban Outfitters, Free People and Anthropologie), and the common spaces and support services (cafeteria, coffee bar, library, employee fitness center, and dog park). The project incorporates bioswales that collect and filter stormwater runoff and also mitigate solar heat gain. Concrete and asphalt from old parking lots was broken up and reused as landscaping fill.



The company chose an unusual renovation strategy, preserving much of the industrial character and history. Surfaces were cleaned rather than sandblasted, so layers of paint, grease stains and miscellaneous worker's markings are retained. Many remnants of the past coexist with the new infrastructure in an industrial aesthetic, for example former pipe-bending pits now serve as ponds where water lilies grow and koi swim. In all five buildings, employees work in light-filled interiors with open layouts that encourage collaboration and creativity.

Saffron, Inga. "A Stitch in Time." *Metropolis Magazine* May 2007

McKnight, Jenna and Sebastian Howard. "Urban Outfitters' Edgy Adventure." *HQ Magazine*:

http://hq.construction.com/case_studies/0912_Urban_Outfitters.asp

Meyer Scherer & Rockcastle, LTD. Urban Outfitters Corporate Campus: http://architecture.uark.edu/uark_urban.pdf

ULI Development Case Study. Urban Outfitters Corporate Campus: <http://casestudies.uli.org/Profile.aspx?j=8096&p=5&c=94>

Lara Swimmer Photography

Case Study: Adaptive Reuse

Ford Assembly Plant, Wixom, Michigan



The GM Assembly Plant in Wixom, Michigan opened in 1957 and was a reliable employer in the town of 12,000 people for more than 50 years. The 320-acre site, 4.7 million square foot facility employed 5,000 people and produced Lincoln Town Cars and Continentals. The last car rolled off the assembly line in 2007. The Wixom plant is now hoping to become the largest renewable energy park in the United States.



Several newspapers report that two companies are planning to invest \$725 million into renovating the former Ford factory, with construction starting in fall 2011. Clairvoyant Energy, a Spanish company, will relocate its operating office from Santa Barbara, California and produce solar panels in Wixom. Xtreme Power of Austin, Texas plans to build large scale batteries to store power from solar panels and wind farms for the electric grid. A third

operator will be Oerlikon Solar USA, a branch of a Swiss company which works closely with Clairvoyant on thin-film solar technology. The renewable energy park will also host a training center for individuals interested in working in the renewable energy sector.

The renewable energy park is hoping to bring some much needed employment opportunity back to the state. Michigan has offered a series of large tax breaks and the federal government is providing substantial grants to support the promise of 2000 - 4000 new jobs in the state. Clairvoyant Energy and Xtreme Power still need to find additional partners to fill the space, and they need a federal loan guarantee from the Department of Energy to get the project going. Aside from these uncertainties, the project plans are moving forward, and environmental remediation is in its second phase.

In addition to significant state and federal incentives, the plant has several assets that make it a desirable site for renewable energy manufacturing. Xtreme and Clairvoyant officials said they selected the Wixom factory because it has a rail line, a big electricity grid, large buildings and is close to a major interstate, making it easier to bring in supplies and ship out products.



Eggert, David. "Alternative Energy Companies Want to Convert Shuttered Ford Plant." *The Huffington Post* 26, August 2009.

Morrison, Chris. "Renewable Energy Firms May Buy Old Ford Plant." [Webblog entry.] BNET Energy Blog 26 August 2009. (<http://industry.bnet.com/energy/>).

Graddon-Hodgson, Beth. "Wixom, MI Begins Conversion of Ford Plant to Renewable Energy Resource." *Clean Energy* 16 September 2009.

Korzeniewski, Jeremy. "Ford Finds Buyer for Wixom Plant, Will Be Used as Renewable Energy Park." *Detroit Free Press* 13 September 2009.

Case Study: Adaptive Reuse

Midlink Business Park, Comstock Township, Michigan



The former 2.2 million square foot GM Stamping Plant in Comstock Township, Michigan has been renovated and rebranded as a world-class, tax-free business park. Hackman Capital Partners of Los Angeles acquired the site and its buildings and equipment in 1999 and launched a plan to redevelop the 340-acre property. After buying the building, the new owners spent several years cleaning

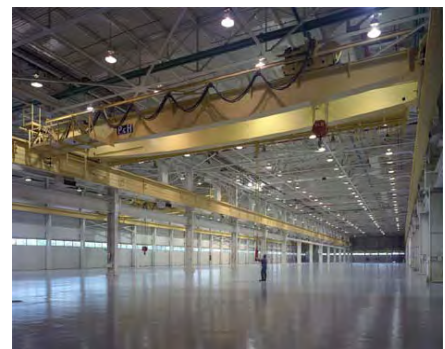
up the site, removing massive metal-stamping machinery and remodeling the facility for multitenant use. The focus was on putting the facility to use as a warehousing and logistics center, capitalizing on a location that has Chicago to the west, Detroit to the east, Grand Rapids to the north and South Bend, Indiana, to the south. The facility takes its new name – the Midlink Business Park – from being a midpoint in that region.

Remodeling the former 2.2 million square foot facility involved removing the middle section of the mammoth building to create an area large enough for tractor-semitrailers to turn around. The plan created two separate buildings: Midlink East, an 854,526-square-foot structure available for manufacturing, and Midlink West, an 811,927-square-foot building available for warehousing and light industrial uses.

The Midlink Business Park is ready to handle requests for space between 25,000 – 850,000 square feet. They left the heavy-duty bridge cranes, some with 50-ton capacity, and kept the CN and Norfolk Southern rail lines in place. The site also offers truck bays, 20-foot to 42-foot ceiling heights and high-capacity electrical.

The two buildings, totaling 1.6 million square feet, are in a State of Michigan Renaissance Zone, thereby offering substantial tax abatements and incentives through 2017. Midlink also received \$3 million grant from Michigan Economic Development Corporation for road and utility construction.

As of the end of 2009, Midlink has about 425,000 square feet of space available in the existing buildings and about 230 acres available for new office and commercial use, retail and industry and distribution development.



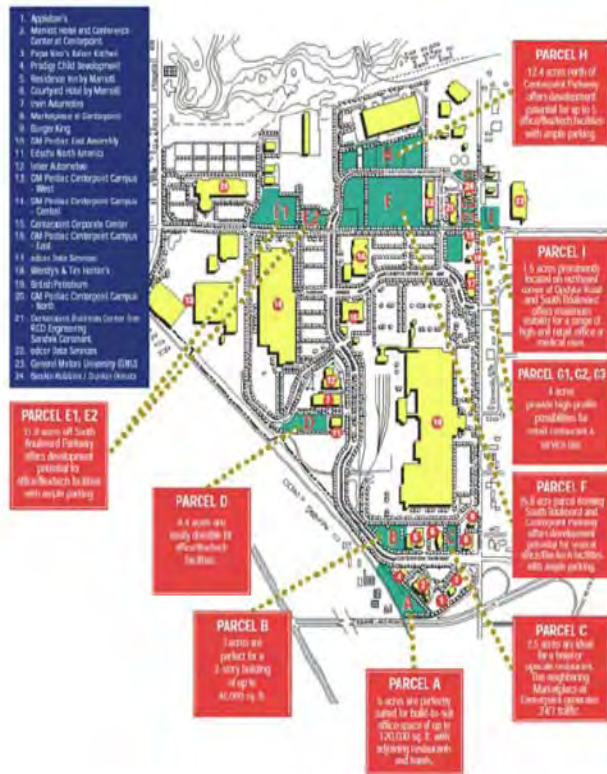
Midlink Business Park: <http://www.midlinkbusinesspark.com/>

Hoekenga, Bryce. "Industrial Park at Former GM Plant Celebrates First Decade." *Kalamazoo Gazette* 29, November 2009.

Pulsinelli, Olivia. "Midlink Business Park Continues Redevelopment Plans in Kalamazoo, Adds Hotel." *Business Review West* 2, March 2009.

Case Study: Adaptive Reuse

Centerpoint Business Campus, Pontiac, Michigan



Pontiac, Michigan is the birthplace of GM's Truck and Bus and Pontiac Motors Divisions. The GM former 4.4 million square foot Central Manufacturing and Assembly Facility was situated on an approximately 650-acre site. Prior to 1987, more than 60 buildings were located on the site. In the early 1990s, GM, Etkin Equities and the city of Pontiac transformed a to-be-abandoned assembly plant into the anchor of a 350-acre mixed-use business park called the Centerpoint Business Campus, while helping to keep as many as 10,000 GM employees contributing to the Pontiac economy.

The goals of the project were to maintain the strong industrial base of Pontiac, but to diversify site redevelopment to leverage non-industrial market demands. The project capitalized on existing site amenities, such as

the existing access by road and rail, utilities and surrounding skilled work force.

The redevelopment effort involved demolishing approximately 75 percent of the existing assembly plants and converting 1.1 million square feet to office and laboratory space for the GM Truck worldwide engineering center. The real key to the project's success was not renovating the assembly plant, but creating the campus and developing property peripheral to the core of the facility to create additional value. Additional development beyond the GM redevelopment phase includes other corporate headquarters, a multi-tenant office building, a daycare center, multiple restaurants, a retail shopping center and multiple hotels.

The construction of a movie training and production facility is also currently underway. Raleigh Studios of Hollywood will operate the 600,000 square feet movie studio at the Pontiac Centerpoint Business Campus which will produce movies for a film industry and is expected to employ over 4,000 people in the metro area.



GM – Environment – Case Study Web site: http://www.gm.com/corporate/responsibility/environment/plants/brownfield_redev/study_pontiac.jsp
Michigan Economic Development Corporation site portfolio: <http://ref.michigan.org/cm/attach/166EE88B-F270-4D36-9C91-8BCFADF0082C/CenterpointBusinessCampusdetailinfo.pdf>

Stein, David. "Detroit." *National Real Estate Investor* 1 June 1997.

Duggan, Daniel. "Pontiac Film Studio Investor Nelson Used to Complex Deals." *Crain's Detroit Business* 7 March 2010.

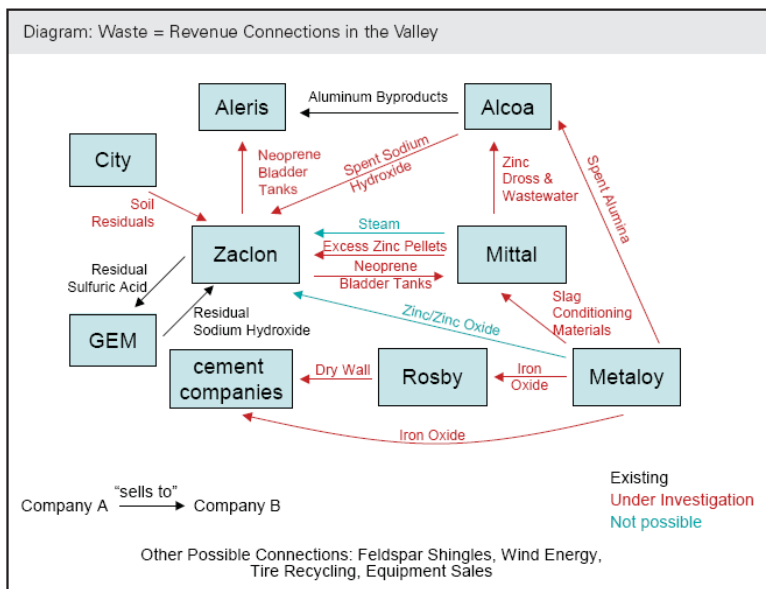
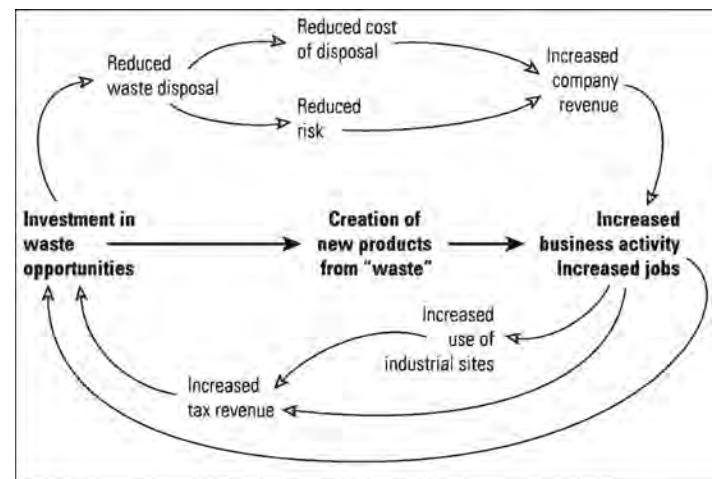
Case Study: Eco-Industrial Initiatives

Waste = Revenue Roundtable, Cleveland, OH

The Cuyahoga River, which runs through Cleveland, Ohio, is a heavily industrialized and polluted waterway. Today, a public-private partnership known as the Cuyahoga Valley Initiative (CVI) is underway to revitalize the Cuyahoga Valley. One of the primary components of the initiative is the private sector-driven Waste=Revenue Roundtable, which is helping to reduce the valley's waste streams and create a competitive advantage for the region based on resource sharing. Since 2006, eight Cuyahoga Valley companies have worked with industrial ecology specialists to create a network of business opportunities from waste or by-products.

The Waste=Revenue Forum is based on a simple concept: wastes from one industrial process could become food for another industry. The flow diagram to the right highlights the ways in which realizing the value of waste can help to create multiple benefits. (Source: Rocky Mountain Institute, *Whole System Design and Natural Capitalism*).

While many of the business leaders involved in the roundtable were aware of the benefits of reusing waste materials, few were aware of the processes and materials that were generated at neighboring industries. Roundtable discussions provided a venue for business leaders to share what waste products they could sell and what materials they needed. To date, more than twenty waste reuse projects have been discussed.



The diagram on the left, one of the key outcomes of the roundtable, highlights revenue-generating waste reuse partnerships that were developed through the roundtable. (Source: Rocky Mountain Institute)

While the Cuyahoga Valley Initiative's Waste=Revenue Roundtable is still in the early stages, this initiative shows how large, complex manufacturing businesses can work together to share resources. The roundtable discussions have helped regional businesses to build trust, and to generate new partnerships for economic growth, and environmental sustainability.

Case Study: Eco-Industrial Initiatives

Eco-Industrial Park, Londonderry, New Hampshire



The town of Londonderry, New Hampshire is using the principles of industrial ecology to orchestrate economic development, improve environmental performance, and limit commercial sprawl in the southern part of the state. The idea for the Londonderry Eco-Industrial Park (EIP) was formed when a plastic recycling company approached organic yogurt producer Stonyfield Farms about locating a facility on property adjacent to an its Londonderry plant and reusing Stonyfield Farm's grey water for rinsing plastic. Encouraged by the burgeoning partnership, the Town of

Londonderry initiated a larger effort to establish an EIP on 100-acres of publicly-owned land adjacent to Stonyfield Farms.

In order to establish the EIP, the Town of Londonderry took the following actions:

- Established the following vision statement; "The Eco-Park recognizes as its primary function developing systems and processes which minimize the impact of industry and business on the environment, improve the economic performance of the member companies and strengthen the local economy. Through modeling the Park's industrial systems on natural ecosystems, decreased environmental impact will be realized."
- Developed a set of key principles to guide the parks development, which include: sharing a common mission through long-term partnerships, accountability, striving for continuous improvement and innovation, land stewardship, serving the local community, and serving one another.
- Created a set of covenants and a governance structure for the EIP. Covenants require that all tenants of the EIP develop an environmental management system, track resource use, set environmental performance goals, and perform third-party ecological audits.



Since the Londonderry EIP was established in 1996, a 720-megawatt natural gas-powered generating plant has located in the EIP, providing power to Stonyfield Farms and the plastic recycling facility. A medical supply company, software development company, and car rental facilities have also located in the EIP. Londonderry's efforts illustrate how industrial ecology's principles can be applied to help cooperating industries develop improve environmental performance, and create a competitive advantage.

APPENDIX C: COSTS ESTIMATES

APPENDIX C
ALTERNATIVE II
DEMOLISH AND REMOVE HANGAR

Item Description	Qty	Unit	Total Labor	Total Equipment	Total Subcontractor	Total Other (supplies/tax)	Total Cost
Construction Directs							
Mobilization							
Procurement	1	ls	\$ 55,783	\$ -	\$ -	\$ 1,917	\$ 57,700
Personnel Training	1	ls	\$ 34,779	\$ -	\$ 9,612	\$ 2,909	\$ 47,300
Site Mobilization and Preparation	1	ls	\$ -	\$ -	\$ 84,769	\$ 21,631	\$ 106,400
Utility Disconnect	1	ls	\$ -	\$ -	\$ 780,000	\$ -	\$ 780,000
Interior Building Demolition							
Asbestos Abatement ^a	1	ls	\$ -	\$ -	\$ 776,000	\$ -	\$ 776,000
Interior Building Demolition ^d	1	ls	\$ -	\$ -	\$ 252,000	\$ -	\$ 252,000
Environmental Cleanup/Removal	1	ls	\$ -	\$ -	\$ 44,100	\$ -	\$ 44,100
Equipment Removal (Man-Cranes)	8	ea	\$ -	\$ -	\$ 240,000	\$ -	\$ 240,000
Facility Cleanup/Washing ^e	1	ls	\$ -	\$ -	\$ 662,000	\$ -	\$ 662,000
Waste Management/Transport and Disposal							
Steel Handling, Transport and Disposal	1	ls	\$ -	\$ -	\$ 3,187,800	\$ -	\$ 3,187,800
Asbestos Containing Material Transport and Disposal	1	ls	\$ -	\$ -	\$ 1,659,433	\$ -	\$ 1,659,433
Miscellaneous Debris and Material Handling	1	ls	\$ 114,597	\$ -	\$ 126,170	\$ -	\$ 240,767
Environmental Sampling and Monitoring							
Analytical Sampling	1	ls	\$ -	\$ -	\$ 88,800	\$ -	\$ 88,800
Air/Personnel Monitoring	19.5	mon	\$ -	\$ -	\$ 1,632,150	\$ -	\$ 1,632,150
Structure Demolition							
RPM Siding / Roof Demolition ^f	1	ls	\$ -	\$ -	\$ 3,736,000	\$ -	\$ 3,736,000
Structural Steel Demolition	170	days	\$ 1,065,072	\$ 814,601	\$ 1,736,178	\$ 49,150	\$ 3,665,000
Waste Debris Handling/Sizing	170	days	\$ 323,445	\$ 736,779	\$ -	\$ 44,776	\$ 1,105,000
Demolition							
Site Cleanup	1	ls	\$ 61,033	\$ 7,047	\$ -	\$ 11,920	\$ 80,000
Demolitionization	1	ls	\$ -	\$ -	\$ 8,727	\$ 5,973	\$ 14,700
Subtotal							\$ 18,375,150
Construction Indirects							
Meetings							
Pre-mobilization meetings	1	ls	\$ 26,909	\$ 334	\$ -	\$ 6,258	\$ 33,500
Public and agency meetings	1	ls	\$ 54,564	\$ 799	\$ -	\$ 9,837	\$ 65,200
Community Relations	1	ls	\$ -	\$ -	\$ 369,000	\$ -	\$ 369,000
Project Documents							
Comprehensive Work Plan	1	ea	\$ 360,000	\$ 2,000	\$ -	\$ 38,000	\$ 400,000
General Site Requirements							
Construction Management	19.5	mon	\$ 4,635,405	\$ 395,848	\$ -	\$ 1,391,381	\$ 6,422,634
Project Management	25.5	mon	\$ 480,936	\$ 41,070	\$ -	\$ 144,360	\$ 666,366
Subtotal							\$ 7,956,700
Total							\$ 26,331,850

a) Based on past pricing received from Bayview Environmental during summer of 2006. Scope includes abatement, interior demolition, and siding removal.