Nantucket Building Material Salvage Study

Phase 1 Interim Report

ReMain Nantucket & Nantucket Preservation Trust

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EBP

Contents

Executive Summary

The Island of Nantucket has a long and proud history of repurposing buildings and building components, dating back to the 17th and 18th century, when reuse was common and disposing of building materials as 'waste' was unthinkable. Only in the 20th century did construction waste disposal become an economic option. Now, every year on Nantucket more than 17,000 tons of construction and demolition (C&D) waste is transported off-Island, much of which is eventually disposed of in landfills in Ohio and Maine. Much of this 'waste' is a result of the demolition of houses on Nantucket, and a significant portion of these discarded materials has the potential to be salvaged and reused through deconstruction. As we face a changing climate and increasing pressure on finite natural resources, it is more important than ever that we use our existing resources thoughtfully and sustainably.

ReMain Nantucket and Nantucket Preservation Trust have teamed up on a study to address this important challenge. This Market, Impact, and Feasibility analysis study is intended to explore and report out on the various issues and considerations surrounding building deconstruction and building material reuse on Nantucket. The study is composed of nine (9) discrete explorations, including:

1. Identifying business that would benefit from deconstruction
2. Estimating existing and potential supply of reusable materials
3. Assessing attitudes around deconstruction
4. Estimating direct economic value of reusable materials
5. Estimating the impact on housing costs of using reusable materials
6. Estimating avoided carbon emissions based on embodied energy of materials
7. Estimating impacts to businesses that would benefit from deconstruction
8. Estimating workforce needs, and
9. Researching the feasibility and costs of opening a salvage facility on Nantucket.

The goal of this study is to provide actionable insights into how to better use Nantucket's building and construction resources while having a positive impact on the Island's long-term sustainability. The primary findings of the study include:

- Recent trends in building demolition and renovation indicate that at least 4,500 tons of building materials on Nantucket could be salvaged for reuse per year.
- Interviews with builders, members of neighborhood associations, and other related stakeholders on Nantucket revealed generally positive opinions surrounding deconstruction practices and the creation of a salvage facility within the community.
- Salvaged building materials have a market value of about $100 per ton. If 25 percent of C&D waste on Nantucket was reused, this would amount to $457,000 worth of material.

- Though deconstruction incurs a higher out of pocket cost to consumers and builders than demolition, the additional cost is not significant relative to the median and average home prices on Nantucket.
- Salvaging the 4,500 tons of reusable building materials disposed of annually will result in significant greenhouse gas (GHG) emission reductions and reduction of other pollutants associated with transporting C&D waste off-Island, decomposition of organic materials at the landfill, and the embodied carbon emissions of producing new materials to replace materials disposed of as C&D waste. The estimated 3,988 MtCO2e in emissions reduction potential is equivalent to taking 869 cars off the road.
- Several industries on Nantucket are impacted by deconstruction. At their current size, they contribute about 1,300 jobs to the Island. This contribution could grow if deconstruction was widespread since it is typically more labor and time-intensive than demolition.
- Deconstruction requires workers with specific skills, knowledge and experience, both for safety and for efficiency. The Nantucket workforce is limited by the high cost of living on Nantucket and the long commute by ferry to reach the Island.
- Regions with deconstruction ordinances or building materials salvage and reuse programs and facilities, address workforce training needs by partnering with local agencies to develop and operate training and certification programs.
- The feasibility of a salvage facility will be explored in more depth during Phase 2 of the study. What our initial research shows is that there are several potential operators and locations for a facility, but property costs could be prohibitive, and workers might require subsidization in order to pay them living wages given high housing costs on the Island.

The study results suggest further investigation into potential deconstruction policy options and opportunities for deconstruction training to increase deconstruction-over-demolition as a standard building industry practice on Nantucket, with all of the multiple benefits that will accrue to the Island and its residents.

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1. Introduction

ReMain Nantucket and Nantucket Preservation Trust have teamed up on this Market, Impact and Feasibility analysis study to address the key issues and considerations regarding building deconstruction and building material reuse on Nantucket. The ultimate goal of the study is to provide actionable insights into how to better use Nantucket's building and construction resources while having a positive impact on the Island's long-term sustainability.

For the best presentation of study information and ease of reading, we have combined Task 7: Estimate impact to businesses that would benefit from deconstruction, and Task 8: Estimate workforce needs, from the original scope of work, into Section 7: Job & workforce impacts of deconstruction, and also integrated original Task 1: Identify businesses that would benefit from deconstruction, into Section 7 (see Table 1).

Table 1. Mapping original scope of work tasks to report sections

Task Number	Task Name	Report Section
1	Identify businesses that would benefit from deconstruction	7
2	Estimate existing and potential supply of reusable materials	2
3	Attitudes around deconstruction	3
4	Estimate direct economic value of reusable materials	4
5	Estimate impact on housing costs of using reusable materials	5
6	Estimate avoided carbon emissions	6
7	Estimate impact to businesses that would benefit from deconstruction	7
8	Estimate workforce needs	7
9	Salvage facility feasibility	8

In this report, the terms 'Town' and 'Island' refer to the Town of Nantucket and the Island of Nantucket respectively.

2. Estimate Existing & Potential Supply of Reusable Materials

In Section 2, we estimate the existing and potential future supply of building materials salvaged from demolition, renovation, and construction on Nantucket for reuse on the Island. To the extent possible, we estimate the weight, volume, number of common "pieces" (doors, windows, fixtures, appliances), and dollar value of salvaged/salvageable materials. The supply of building materials that are salvaged for reuse rather than disposed of off-Island has implications for avoided carbon emissions. Findings from this research allow us to estimate the amount of space that might be needed to collect, stage, store, and distribute/sell materials. The findings are also used in estimating the value of these materials (quantified in Section 5), which reduces the net cost of deconstruction.

2.1. Approach

Numerous communities in North America have studied the feasibility of building materials salvage and reuse policies and programs. The general methodology used is to survey or interview builders active in the community regarding the amount and value of salvageable materials, then develop per-building or per square foot assumptions that can be applied to demolition and renovation permits. Many of these communities also have existing formal markets for the sale of salvaged building materials from which quantity and price information can be gleaned.

Due to the unique nature of Nantucket, building, renovation, and demolition practices on the Island significantly differ from the norm. The communities that have studied building materials salvage and reuse tend to be located within metropolitan regions with significantly more population, economic activity, and building stock than Nantucket. This gives them a much larger "sample size" of building types and construction activity from which to develop assumptions about average quantities and costs. They also tend to have large-scale builders using relatively standardized designs and construction materials who can provide data or professional opinion on the volume, types, and value of salvaged materials. By design, Nantucket has no large-scale builders, and the highly custom nature of construction and renovation on the Island is more difficult to characterize in terms of averages.

Furthermore, the pace and nature of construction, renovation, and demolition on Nantucket is significantly different compared to larger regions with broader income distributions. High-end buyers in all markets build, demolish, and renovate at higher-than-average rates, which adds newer – and sometimes brand new – building materials and appliances into the salvage supply. In larger regions, however, the presence of these new materials is diluted within the larger supply of materials from buildings being renovated or demolished due to age or otherwise in a more cost-conscious fashion. These larger markets also have major building materials wholesalers and retailers who sometimes donate overstock to building materials reuse outlets. There are no major building materials wholesalers or retailers on Nantucket, therefore reclaimed materials from demolition and renovation are the main source of materials to supply a building materials salvage and reuse program or facility.

Historic buildings are important sources of salvaged building materials in other communities, but as many of those studied are in the western United States and Canada, "older" buildings tend to be concentrated in the late 1800s and early 1900s vintages, while Nantucket's building supply includes higher shares of buildings that pre-date this by 100 years or more. Older materials tend to be of greater value due to their quality and historical and architectural significance.

Fortunately, by understanding how the building stock and building practices on Nantucket differ from other communities that have studied building materials salvage and reuse, we can make reasonable adjustments to the assumptions, factors, and relationships established by empirical research in other communities. These adjustments allow us to make order-of-magnitude estimates of weight, volume, materials, and value that are grounded in the realities of Nantucket and sufficient to inform the feasibility of a building materials salvage facility or program for the Island.

2.2. Characterizing Nantucket's Current Supply of Salvaged Building Materials

Though Nantucket lacks a formal market for salvaged building materials, builders do buy and sell salvaged materials on an informal basis. Builders are motivated to salvage materials to the extent possible to avoid costly tipping fees, however, the volume of materials exchanged in this manner is significantly limited by two key factors. The first is space for materials storage. Space is at a premium on Nantucket due to high land costs and geographical realities (e.g., protected areas, flood areas, beach retreat). As a result, builders operating on the Island are unable to store a significant volume of materials. Anecdotally, some have reported storing items that they expect to be able to reuse in their own garages and basements. However, due to the highly bespoke nature of construction and renovation on the Island, it can be hard for an individual builder to predict when a piece will be needed and to keep track of pieces in a personal inventory.

The second key factor limiting the current supply of salvaged building materials is the lack of a formal way to communicate materials available and materials needed to other builders. Builders communicate informally by calling other builders they know, or by posting materials on social media buy-and-sell groups. A review of postings to numerous Island-only Facebook buy-and-sell groups over the last 12 months identified a handful of postings offering building materials or appliances for sale, primarily on a group called "Nantucket Mansignments" (which, anecdotally, was created in response to the high volume of women's clothing and children's items on other Island buy-and-sell group pages).

Most postings feature furniture, household goods, sports equipment and bicycles, older appliances and fixtures, and vehicles, leaving would-be building materials buyers to sift through a significant amount of irrelevant content with no efficient way to search for what is needed. Notable building materials nestled among these other posts included a new, unopened pack of 10 8' interior shiplap siding, 150' of antique wood trim/molding, an unused custom name-brand French door unit, baseboard radiators, an HVAC duct and accessories, and 24 used wooden

shutters in two sizes. Also buried in the list of postings were ISOs ("in search of") for garage door torsion springs, a 7'7" x 7'7" sliding door and stone countertops.

These postings reveal the limitations of social media buy-and-sell groups for exchange of building materials. One listed a full kitchen's cabinets and countertops, kitchen island, dishwasher, range and microwave (photographs suggest circa 1980s), all in working order and free but must be picked up on the day it was posted. Another ad listed over two dozen pressure-treated 12' 2x4 and 2x6 wood beams, brand new and still on the pallet, apparently delivered too late to be used for their intended project. A group member posted a comment that they would take half the wood, indicating that the offeror will need to interact with several buyers to liquidate the inventory. These examples illustrate the inefficiency of existing social media platforms for the exchange of salvaged building materials.

2.3. Data Sources and Assumptions for Estimating Nantucket's Potential Supply of Salvaged Building Materials

The potential supply of salvaged building materials can be estimated based on the following data and assumptions:

1. Data on trends in demolition and renovation permits;
2. Assumptions regarding the amount of square footage demolished and renovated based on Assessor's data including building type, age, and size (square feet);
3. Assumptions regarding the total amount of construction debris based on estimates made by the U.S. Environmental Protection Agency (EPA) and other sources;
4. Assumptions regarding the salvageable portion of construction debris (Delta Institute);
5. Assumptions regarding the composition of salvageable materials by category (Vancouver Demolition Waste Calculator);
6. Assumptions regarding weight-to-volume ratios for common salvageable materials (material wholesaler websites);
7. Assumptions regarding the number of common pieces of salvage such as interior doors, exterior doors, windows, interior trim and molding, kitchen cabinets, kitchen sinks, and bathroom fixtures.

Together, these data and assumptions allow us to approximate a likely range of materials by weight, volume, and type.

These estimates are then compared to C&D waste trends compiled from data covering C&D waste at the Island's two waste handling facilities (provided by Nantucket Department of Public Works (DPW) and Massachusetts Department of Environmental Protection (MassDEP)).

2.4. Demolition and Renovation Trends on Nantucket

The Nantucket Planning and Land Use Services provided monthly construction, renovation, and demolition permit data for fiscal years July 2017- December 2021. The municipal fiscal year runs July 1-June 30, which allowed us to analyze trends for the five-year period FY2017-FY2021. The data contained counts of permits and estimated construction value (as reported by permit applicants) for 31 categories of building type and construction activity. Categories that are not appreciable sources of salvageable building materials were removed from analysis (e.g., pool, spa or cabana; solar panel installation; tent erection; roof re-shingle; trench; HVAC; and woodstove). Additionally, four categories that could periodically yield salvageable building materials, but do not occur often enough to provide sufficient data were removed from the analysis: dorm, hospital, fire station/school, commercial utilities (i.e., power lines). Remaining categories were coded by activity – new construction, renovation, demolition – and building type – single family residential, multifamily residential, commercial, and industrial.[1]

Table 2 presents the number of permits in each of these categories from fiscal year 2017 through fiscal year 2021. As the table shows, renovation and new construction of single-family residential buildings represent the great majority of permit activity. Single family residential renovation permits ranged from 324 to 544 (average of 385) per year during the 5-year period. Single family residential construction permits ranged from 241 to 351 (average of 304) per year. Single family residential demolition (average 35 per year), commercial renovation (average 50 per year), and commercial demolition (average 25 per year) are the next greatest sources of activity. There was no renovation or demolition of multifamily or industrial/institutional buildings during the period and only a handful of permits for new construction.

[1] There were no permits for multi-family or industrial demolition or renovation during the 5-year period.

Table 2. Nantucket Building Permit Trends, FY2017-FY2021

Building Type Activity	Number of Permits FY17	FY18	FY19	FY20	FY21	2017-21 Average
Single Family Residential						
Demolition	31	27	35	30	53	35
Renovation	325	324	393	339	544	385
New Construction	341	308	278	241	351	304
Multifamily Residential						
New Construction	0	0	7	7	0	3
Commercial						
Demolition	27	63	17	14	4	25
Renovation	59	71	42	38	41	50
New Construction	3	2	0	5	4	3
Industrial/Institution						
New Construction	4	9	1	12	24	10

Source: EBP with data from Nantucket Planning and Land Use Services.

The U.S. EPA reports that approximately 90% of C&D debris - which includes waste, recyclable material and reusable material - is generated by demolition (including demolition undertaken as part of renovation) and the remaining 10% is from new construction. As a result, this analysis focuses on demolition and renovation activity. Anecdotal reports indicate that new construction in Nantucket does generate some reusable material due to change orders during the construction process after materials have already been received or even installed. However, these events are not tracked locally, and the national estimates of construction waste do not disaggregate reusable materials from unusable construction scraps, thus in the interest of being conservative, this source of supply is not captured by this analysis.

2.5. Estimating the Annual Supply of Reusable Building on Nantucket

The average annual supply of reusable building materials on Nantucket is estimated using the average number of demolition and renovation permits for single family residential and commercial buildings from Table 2 and applying a per square foot factor representing the average amount of square footage of building space affected by each permit. Per square foot factors for each activity and building type were developed as follows:

1. **Residential demolition** –We developed this factor based on the median size of existing single-family homes on Nantucket of 3,100 sq.ft., calculated from Assessor's data.
2. **Residential renovation** – Renovations can range from a 50-100 sq.ft. bathroom remodel or bedroom addition, a 500 sq.ft. kitchen remodel, a to a whole house gut renovation of several thousand square feet. Data characterizing the average size of a remodel project on Nantucket was not available. Instead, we developed an assumption of 500 sq.ft. based on published sources including Estimating 2003 Building-Related Construction and Demolition Materials Amounts (U.S. EPA), which reports empirical data on residential renovation in the U.S., and other sources.

3. **Commercial demolition** – The Assessor's database shows approximately 575 commercial buildings on the Island, with a median size of 4,700 sq.ft.. This includes retail stores, offices, municipal buildings, churches, museums and educational buildings, among other types of commercial buildings.
4. **Commercial renovation** – Renovations can range from dividing or combining offices, to a whole-building updates of several thousand square feet. Data characterizing the average size of commercial remodel projects on Nantucket was not available. Instead, we assume that each renovation affects 2,350 sq.ft. which is half the median sq.ft.

Factors for the average amount of construction waste per sq.ft. of affected building space are based on average pounds per sq.ft. generated by single-family residential and commercial demolition and renovation documented in the Estimating 2003 Building-Related Construction and Demolition Materials report. These values are consistent with averages reported by other empirical studies, such as the research undertaken by Metro Vancouver in developing the Vancouver Demolition Waste Calculator.

Applying these construction waste generation factors to their respective sq.ft. of affected building space, then converting pounds to tons, results in an estimated average of 18,260 tons C&D waste per year. As a point of reference, the Island's two waste disposal facilities, the Nantucket Department of Public Works facility and P&M Reis, collected an average of 19,600 tons of C&D waste between 2016 and 2019. 2019 is the most recent year for which data is available for both facilities; P&M Reis data are not available for 2020 or 2021. From 2016 to 2019, P&W Reis accepted a similar amount of waste as DPW. If P&W Reis also collected a similar amount as DPW in 2020 and 2021, the average would be similar at approximately 19,300 tons.

Some deconstructed materials will not be reusable either because they are contaminated with hazardous substances such as lead or asbestos, don't meet current/desired energy efficiency standards, have been damaged (e.g., water, termites, mold), or are of non-standard dimensions. An Oregon Department of Environmental Quality (DEQ) report that quantified salvageable materials recovered from 36 deconstructed homes found that on average 27% of materials were reusable, though certain contractors were able to salvage up to 37% of materials for reuse, and that salvage rates improved over time with increasing contractor experience and workforce skill.[2] Empirical research from the Delta Institute, a non-profit organization that is active in the area of deconstruction, indicates that up to 25% of deconstructed building materials can be reused, so in the interest of making a conservative estimate, this analysis uses the 25% assumption, acknowledging that the actual rate could differ depending on the condition of the structures being deconstructed or remodeled and the skill and experience of the deconstruction crew.[3]

[2] "Deconstruction vs. Demolition: City of Portland" State of Oregon Department of Environmental Quality (2019).

[3] Deconstructing Building Material Reuse: A tool for local governments and economic development practitioners, Delta Institute (May 2018).

The calculations described above are presented in Table 3. The result is an estimated 4,565 tons of reusable building materials per year. This estimate represents an average; the actual value will vary depending on the number of demolition and renovation permits in a given year, the size and composition of the structures deconstructed or renovated, and other factors discussed throughout this memo.

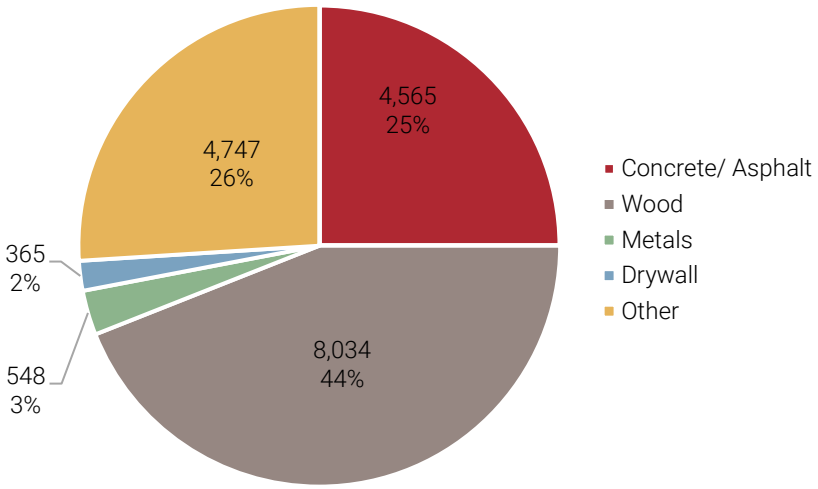
Table 3. Estimated Annual Reusable Building Materials from Residential and Commercial Demolition and Renovation (tons)

	Single Family		Commercial	
	Demolition	Renovation	Demolition	Renovation
Average Annual # of Structures (1)	35	385	25	50
Average Sq.Ft. Affected (2)	3,100	500	4,700	2,350
Total Sq.Ft. Affected	108,500	192,500	117,500	117,500
Estimated Pounds of C&D Waste per Sq.Ft. (3)	111	23.5	158	11.8
Annual Pounds of C&D Waste (÷ 2,000)	12,043,500	4,523,750	18,565,000	1,385,325
Annual Tons of C&D Waste	6,022	2,262	9,283	693
Total Annual Tons of C&D Waste from SF Residential and Commercial Buildings				18,259
% Reusable Building Materials (4)				25%
Tons of Reusable Building Materials				4,565

(1) Based on average number of residential renovation and demolition permits 2017-2021 (EBP calculations with data from the Nantucket Department of Planning and Land Use Services).
(2) Average square feet of single family residential and commercial demolition size based on their respective median building sizes (EBP calculations with data from the Nantucket Assessor); average square feet of single family renovation developed using the CR0WDsource NYS Deconstruction Resource Guide (Circular Construction Lab at Cornell University); average square feet of commercial renovation assumed to be half the median building size.
(3) "Characterization of Building-Related Construction and Demolition Debris in the United States"(U.S. Environmental Protection Agency, 1998) and the Vancouver Construction Waste Calculator.
(4) "Deconstruction & Building Material Reuse: A Tool for Local Governments and Economic Development Practitioners", Delta Institute (May 2018).

Figure 1presents the approximate distribution of C&D materials by type based on information from the Vancouver Demolition Waste Calculator. This distribution applies to total C&D waste and does not necessarily reflect the distribution of reusable materials, as different materials have different recovery rates.

Figure 1. Approximate Distribution of Total Estimated C&D Waste by Type of Material (tons, % of total)



Source: EBP with data from the Vancouver Demolition Waste Calculator.

Wood represents the largest share of total waste at over 8,000 tons and is also a significant source of reusable building materials. The "other" category includes countertops, flooring, plumbing fixtures, and built-in appliances, which is also an important source of reusable building materials. As a point of reference, 8,000 tons is more than 5.5 million board feet of framing wood (assuming an average weight of 2.9 pounds per board foot), which is the equivalent of more than 930,000 12' x 6" x 1" boards. Of course, not all wood in the building is framing wood, and as discussed further below, not all wood will be salvageable for reuse.

2.5.1. Estimated Quantity of Reusable Building Materials by Piece

The Oregon DEQ report referenced above found that the vast majority of salvaged material – 85%, by weight - was softwood lumber, including framing lumber, structural beams, and sheathing (shiplap on walls and plank subfloor). The remaining 15% can include anything from doorknobs and hinges to appliances and bathroom vanities.

Research indicates the materials in highest demand among buyers are appliances, bathroom vanities, and sets of matching windows or doors.[4] In this analysis we estimate the composition of salvageable building materials from single family residential deconstruction and renovation in terms of pieces that are popular among buyers of salvaged materials.[5]

[4] See: Christiana, Asa, "A Better Way to Demo: Portland, Ore., provides a model for deconstructing houses that is better for people, the planet, and profit", Fine Homebuilding Magazine, June 2021.

[5] This analysis was not performed on commercial deconstruction and renovation due to the difficulty of identifying reasonable average unit per square foot/permit factors.

Table 4 shows estimated quantities of these common reusable materials calculated by applying per unit average factors (per square foot or per deconstruction/renovation permit) to the average annual square footage affected or number of permits. These factors were developed based on rules of thumb gleaned from the RSMeans Square Foot Costs handbook (2022 edition), Zillow, and our own observations and professional judgment. As the table shows, the number and square footage of deconstruction and renovations estimated above in Table 4 could generate 390 exterior doors and nearly 1,400 interior doors, nearly 3,300 windows per year, and 180,600 board feet of wood flooring. This is the equivalent of 78 tons of wood doors, 17 to 40 tons of windows (depending on the mix of vinyl which are relatively light and wood which are much heavier), and 32 tons of wood flooring.[6]

[6] Weight per piece assumptions: Door weights from Architectural Builder's Supply, Inc.; window weights from Windows & Doors Statements; flooring weight from La Choob Flooring.

Table 4. Estimated Quantities of Popular Building Materials Salvaged for Reuse

Deconstruction & Renovation Characteristics	Deconstruction	Renovation	
Average # of permits per year	35	385	permits
Average sq.ft. affected	3,100	500	sq.ft.
Total sq.ft. affected	108,500	192,500	sq.ft.
	Unit of measurement	**Quantity per Unit**	**Total Pieces Deconstructed**
Exterior doors (wood)	Per Sq.Ft.	1.29	390
Interior doors (swing)	Per Sq.Ft.	4.62	1,390
Interior doors (sliding, folding)	Per Sq.Ft.	1.13	340
Garage door	Per building	0.10	40
Windows	Per Sq.Ft.	10.9	3,290
Board Feet of wood flooring	% of floor area	60%	180,600
Bathroom vanities	Per building	0.75	100
Doorknobs/hinges (sets)	Per door	0.5	1,780
Door hinges (sets)	Per door	0.5	1,780
Refrigerators	Per building	0.05	20
Ranges	Per building	0.05	20
Stovetops	Per building	0.05	20
Ovens	Per building	0.05	20
Dishwashers	Per building	0.05	20
Washing machines	Per building	0.05	20
Dryers	Per building	0.05	20

Note: Numbers are rounded to avoid false precision.
Source: EBP calculations and experience using data from RSMeans Square Foot Costs handbook (2022 Edition) and Zillow.

Table 4 also shows estimates of popular appliances, but the estimate of 0.05 of each type of appliance per deconstruction/renovation lacks documentation. As a point of reference, data from DPW (Table 5) indicates that an average of 1,855 appliances with refrigerant (includes refrigerators, dehumidifiers, and other appliances with freon) and 1,222 other appliances per year. It is not known how many appliances are disposed of at the Island's private waste handling facility. If 10% of discarded appliances are in good working order and could be sold or donated for reuse, the estimate for appliances with refrigerant looks low (20 vs 185), while the estimate of all other appliances would be about right (120 vs 122). Because of the popularity of used appliances among buyers, and the desirability of keeping these complicated machines out of the waste stream, further research to more accurately determine salvage rates for appliances could be warranted.

Table 5. Appliances Disposed of at the Town Transfer Center

Year	Appliances with Refrigerants	All Other Appliances
2016	1,833	1,277
2017	1,784	1,358
2018	1,926	1,310
2019	1,795	1,397
2020	1,757	977
2021	2,034	1,012
Average (2016-2021)	**1,855**	**1,222**

Source: EBP calculations with data from the Nantucket Department of Public Works.

3. Attitudes Toward Deconstruction

We spoke with several Nantucketers to better understand their attitudes and opinions regarding deconstruction and reuse of salvaged building materials. Those interviewed include builders, neighborhood association members, and a furniture restoration expert. The people we interviewed gave valuable insights; many have direct experience with deconstruction or know someone who does. In general, the people we interviewed are supportive of more deconstruction on Nantucket but have various concerns that are important to consider before moving forward.

3.1. Interview Approach

In December 2021, students from Worcester Polytechnic Institute (WPI) wrote a report evaluating deconstruction practices on Nantucket that included 15 interviews. We built on WPI's findings by conducting nine additional interviews with different people and organizations. In identifying interviewees for the purposes of our study, we aimed to fill certain gaps in WPI's research. ReMain Nantucket and the Nantucket Historical Commission helped us identify some interviewees; we identified others through internet searches and word-of-mouth.

We included a list of interviewees at the end of this memo. To protect confidentiality, we did not associate statements or opinions with individuals.

3.2. Key Findings

The following sections explore key findings from our interviews. They are organized around perceived benefits of deconstruction, demand for salvaged materials, barriers to deconstruction and reuse, salvage facility feasibility and location, the Town's 60-day demolition moratorium, and recommendations interviewees shared with us.

3.2.1. Benefits of Deconstruction

Interviewees identified several benefits of deconstruction. By reusing more materials, Nantucket would produce less waste both on-Island and off. Greater waste diversion would generate local and even global environmental benefits. At a local level, the landfill would not expand as fast, lessening both the need for capacity expansions and the amount of methane emitted from decomposing waste. At a global level, more reuse would lessen the demand for new materials, some of which require resource-intensive manufacturing like forest clearance and mining for lumber and sheetrock production, respectively.

Deconstruction would also benefit historic preservation efforts on the Island. Nantucket is fortunate to have many homes with architecturally significant materials and fixtures that could be preserved through reuse.

Material reuse could potentially generate cost savings for homeowners, builders, and the Town. Although deconstruction is typically more expensive than demolition—often significantly so—homeowners could save if salvaged materials are less expensive than new materials. By generating less waste, builders and the Town could also potentially save on waste disposal. We explore these issues in greater detail in a later task.

3.2.2. Demand for Salvaged Materials

Interviewees generally agree that there is relatively little demand for salvaged building materials on Nantucket. Construction and renovation projects rarely incorporate salvaged materials, and when they do, it is typically decorative items that are reused, not structural or general construction materials. And in many cases, reused materials are unique items requested by homeowners from off-Island restoration companies. The most commonly cited reasons for not doing more deconstruction are increased costs and time, both of which we discuss in detail in the next section.

The most popular salvaged materials are historically significant doors, windows, fixtures, moldings, flooring, and specialty timbers. Unique hardware like sinks or faucets are also popular as long as homebuilders can accommodate them in their designs. Most homeowners and builders are uninterested in reusing building materials unless they are particularly unique, vintage, or "catchy." Interior designers have very specific requirements for the types of materials they purchase for their clients, so they rarely use salvaged materials.

Several builders we spoke with described an informal market for salvaged goods within their industry. Contractors often store valuable materials in their basements or garages until they find a way to reuse them or a willing buyer. In many cases, end users of reused materials are other contractors, not the general public. Doors, windows, appliances, cabinetry, and countertops are the most commonly held materials, yet it is often difficult to find a second use for them.

Demand for salvaged materials also varies by neighborhood. In Sconset, where there is a concentration of historic homes, people seem more interested in preservation than in newer or less historically significant neighborhoods. However, in younger neighborhoods like Surfside, there is little desire for salvaged materials because homes are not as historic, and demolitions and renovations are less frequent.

3.2.3. Barriers to Deconstruction & Reuse

The most cited barriers to deconstruction relate to cost, time, regulations, and practical and logistical challenges. We heard repeatedly that deconstruction is considerably more expensive than demolition, and, as a result, it is often less expensive to purchase new materials for projects than to recover and reuse salvaged materials. This is partly because fewer salvageable materials are recovered through demolition, but also because the salvage process itself can be prohibitively expensive. For example, one interviewee was told by a contractor that reglazing an old window would be significantly more expensive than purchasing a new window.

Logistical Challenges

The builders we interviewed expressed a strong desire to reuse construction materials but cited several practical reasons for not doing so. Builders rarely reuse structural components like walls, columns, and beams because of building code regulations and liability concerns. (This includes using old supplies that could fail or having the public access their worksites to collect materials, where they could injure themselves.) Salvaged materials are typically not under warranty because of their age. Meanwhile, clients, insurers, and building codes require that certain materials be under warranty when used in new construction or renovations. This significantly limits the amount of salvageable construction and demolition (C&D) waste. Exterior materials are also difficult to reuse, particularly when they have been damaged by sea water. The most reusable items are interior doors, window frames, and flooring. Even when a property owner wants to deconstruct a house rather than demolish it, it can be difficult finding contractors who are qualified (or available) to determine which materials can be reused.

Transporting salvaged materials can also be difficult. In one example, someone was interested in purchasing cabinetry removed during a renovation but had no way of picking it up from the construction site. Relatedly, if construction workers are spending their off hours picking up salvageable materials, that time is typically not billable to a project, which cuts into companies' profitability. (This problem has been compounded by recent increases in labor costs.)

Storage and "Market Making"

Nantucket's salvaged materials market also suffers from a basic supply and demand problem. Aside from websites like Facebook Marketplace and Craigslist, there is no formal "market maker" who matches buyers and sellers. There is also time lag at play; because people doing deconstruction often lack storage space, they are forced to discard materials when they are unable to find a buyer at the right moment. In the words of one interviewee, the supply of salvaged building materials is not "packaged the right way" where buyers can easily access it.

Storage space is particularly hard to acquire on Nantucket because of what most interviewees see as exorbitantly high property values. This prevents many members of the construction and restoration industries from holding more salvageable materials that could eventually be reused. Material exchange opportunities like Habitat for Humanity's sale apparently occur just once a year. Another challenge is that Habitat for Humanity can only accept a certain volume of materials each year, and they are limited in what they can accept if materials are no longer under warranty, for instance

Time Sensitivity

For the wealthiest Nantucketers, time is often more important than cost when making decisions about construction and reuse. Interviewees believe these individuals will pay a premium for new building materials if it allows builders to complete their project more quickly. Similarly, when individuals purchase a house with the intention of replacing it with new construction, they often want to clear the property as soon as possible, making deconstruction even less desirable than demolition.

Nantucket's relative affluence has also lessened the impact of rising lumber prices since 2020 when pandemic-related supply chain bottlenecks limited supply. In more price-sensitive markets, the increased cost of virgin lumber has likely made salvaged lumber more appealing.

Barriers to Deconstruction & Salvaged Material Reuse

- Deconstruction generally costs more than demolition
- Deconstruction takes more time than demolition
- Deconstruction presents unique logistical challenges
- Salvaged materials can be more expensive than new materials when time for retrieval and restoration is considered
- Town has limited storage space for salvaged materials
- Nantucket does not host an effective "market maker" for salvaged materials that matches supply and demand in real time
- Local and state building codes limit contractors' ability to reuse materials
- Salvaged materials are typically not under warranty

Cost & Regulatory Burdens

One builder we interviewed sees regulations as the most significant barrier to reusing salvaged building materials. Building codes have become more restrictive regarding structural requirements and the materials contractors can use in new construction or renovations. This creates a disincentive for reuse, especially among homeowners who are interested in saving costs. At the same time, Nantucket clientele have become much wealthier and therefore less concerned about finding savings.

The ability to relocate houses makes reuse more feasible. Although Nantucket has the unique advantage of having several companies trained in building relocation, the same builder mentioned above provided an example that illustrates how significant the cost difference can be between demolition and relocation. Demolition would cost approximately $15,000 plus an additional $10,000-15,000 in landfill fees. In contrast, relocation could cost as much as $500,000. While increasing landfill fees could incentivize some builders to reuse more materials, this same interviewee felt that doing so would cause people to dump waste in the moors, thereby creating a serious environmental problem.

When considering building relocation, another builder raised the burden of pausing or adjusting utility services as a potential barrier to this option. The interviewee noted that utility companies have limits to the amount of service that can be cut or adjusted to accommodate such relocations. Sometimes, the required level of service adjustment or pause can be too costly or excessive for the utilities to even consider. The interviewee stated that this was a barrier to them personally when they were considering the reuse of a structure; to maintain the integrity of certain

elements, they would have had to move large pieces requiring excessive service adjustments that the utilities were ultimately unable to accommodate.

3.2.4. Salvage Facility Feasibility

Interviewees generally had a positive reaction to the idea of creating a facility for the exchange of salvaged construction materials. Most think it would be very popular among homeowners and builders. However, they did express several concerns that should be considered before moving forward with an actual concept.

Operations

Our interviews did not reveal a strong preference for who should operate a salvage facility, but there was more discussion around private operators rather than the Town. This could include construction companies or even lumberyards since they have expertise and are in places where builders already go.

Operating a salvage facility would require significant staff time because materials would unlikely sell "as is." Employees would need to clean and even refurbish some materials to make them appealing to homeowners and builders, especially in comparison to new materials. Example tasks include pulling nails from wood, fixing windows, doors, and fixtures, and sawing off rough edges from plywood. Employees would also need to organize materials as they come in to prevent the facility from becoming a dumping ground. In some cases, the volume of materials could easily overwhelm staff if entire homes are deconstructed and transferred to the facility.

To have enough storage, the facility would need to be at least 1,500-2,000 square feet with 20-foot ceilings so it can fit racks. (A standard 40 x 80-foot warehouse facility was one suggested option.) This means that employees would need a forklift to transport and store materials. It would also help if the facility operator owned a truck that employees could use to pick up items from around the Island. One builder noted that the facility picking up materials themselves with a truck is the only way that some contractors will participate.

Financial Success

Interviewees believe a salvage facility will require financial subsidies to be successful. One reason is because the cost of land is so high on Nantucket—about $2 million per acre according to one interviewee. Operating without assistance, a facility will also have difficulty generating a financial return because the operating costs would exceed revenue generated from selling materials. (One builder thinks overhead costs could reach six figures even without paid staff.)

Cost recovery will be especially difficult in the early years before the facility attracts a steady stream of materials. The operator will need to ensure that only quality materials are accepted. This includes filtering out low-value materials that people bring to the facility instead of dropping

them at the landfill. One interviewee's opinion is that starting small and growing incrementally will be most successful.

Another reason subsidies will likely be necessary is so the operator can keep prices down. Pricing materials too high will cause potential customers to purchase new materials. Another reason is that labor costs have increased in recent years, especially on Nantucket where wages must be high enough for workers to afford increasingly expensive housing.

3.2.5. Salvage Facility Location

Interviewees had differing ideas on the potential location for a salvage facility. Residents noted that some neighborhoods will likely express that they do not want the facility to be located in their area. Some interviewees expressed that a facility would likely be most successful if located along a route that builders travel along. Some interviewees said an area at or near the dump would be an ideal location, while other interviewees explicitly said the dump should not be a consideration. In addition to discussions on specific locations, some interviewees noted that commercial space is limited and often difficult to come by on the Island. And for the few undeveloped commercial lots, regulations may limit the total square footage that can be developed. Below are options for salvage facility locations that were discussed in multiple interviews.

Airport or Nearby Town-Owned Land

Multiple interviewees raised the idea of locating the salvage facility on land owned by the Town at or near the airport. Some interviewees noted that the Town owns a large amount of land around the airport, including an industrial subdivision east of the airport. One interviewee noted that the Town has actually set aside some acreage in that area to relocate small contractors who previously operated on land off of Old South Road but have been displaced due to a change of ownership and development of the land. An additional benefit to locating the salvage facility in this area is that leaving salvaged items or materials outside would have less of an aesthetic impact on neighbors than other potential locations.

Potential barriers to using this land for the location of the salvage facility were also addressed. One interviewee noted that operations at the airport are required to turn a profit, but if the Town worked with the airport to remove the profit requirement, then the location could be feasible. Some interviewees also noted that land around the airport still available for lease is shrinking every day, implying that this land may not always be available as an option for the salvage facility. Some interviewees added that though the facility could be located on Town-owned land, the Town should not run this sort of facility.

Land Owned by Private Businesses

Some interviewees raised the possibility of working with private businesses to use some of their land to locate salvaged materials. An interviewee noted that some companies involved in construction and demolition already own property for materials storage. Additionally, some

lumberyards or home furnishing centers may have additional land that could be used for storing and selling salvaged materials. According to one interviewee, working with a business involved in the construction or building materials space has the benefit of locating salvaged materials at a place that builders already frequent.

One builder recommended collaborating with lumberyards to establish covered yards on their property where second-generation wood could be set aside. This non-virgin wood would potentially be priced less due to having nails, holes, polyurethane foam, or other remnants of prior use. The builder noted that it's possible that lumberyards would be unwilling to be involved in such an initiative due to it potentially competing with their business model. This builder then noted that positive publicity for businesses willing to partake in such initiatives could incentivize them to get involved.

Online Marketplace

Several interviewees raised the idea of an online website marketplace for salvageable materials. They noted that establishing a website marketplace with a few box trucks could be a successful operation and eliminate the need for a physical space.

One builder discussed the website Nantucket Reuse Exchange, which serves as an online marketplace for salvaged materials. The website was successful for many years but is used less frequently now. Facebook marketplace and other social media sites are more commonly used for the buying and selling of salvaged materials, however, social media platforms may require frequent re-posting of items for them to remain visible.

3.2.6. Demolition Moratorium

When asked about the Town of Nantucket's 60-day demolition moratorium when a demolition permit application is filed, interviewees expressed mixed opinions on the rule. One builder expressed that they were uncertain as to how often somebody actually saves a piece of or all of the structure; they do not view the moratorium as being very effective in terms of salvaging materials. In general, builders shared that they found the rule to be reasonable or possibly too long, whereas residents and members of neighborhood associations tended to express that they found the moratorium to be too short.

Among interviewees who expressed that the 60-day rule is long enough, some noted that the 60-day period is already too long for some construction schedules. Any extension of the rule would likely be met by pushback for the building community. One builder shared that they believe the current rule to be reasonable as it is in between creating an unnecessary delay for a person wishing to get a permit and giving enough time for the public to respond or come up with ideas should they wish to reuse some of the building materials.

Interviewees who find the 60-day period to be too short stated that the timeframe doesn't allow the neighbors enough time to publicly comment on demolitions. Additionally, if someone takes

interest in a part of the structure that is up for demolition, it often takes time to organize the logistics for moving it. The current 60-day period may not allow enough time for this. Suggestions for a longer moratorium ranged from 6 to 12 months. One interviewee noted that lengthening the moratorium could incentivize property owners to consider moving their structures or reusing their materials, as it would save on time. Another interviewee suggested creating an exception to the current rule that would allow a party interested in reusing the structure or materials to extend the time period to coordinate relocation.

Several interviewees addressed the topic of advertising structures intended for demolition. One interviewee noted that broader advertising of these structures could be beneficial in connecting interested parties and coordinating logistics for relocation within the 60-day time frame. Advertising a structure online was seen as the most effective method, with one interviewee noting that advertising in the newspaper is too slow. This interviewee floated the idea of posting a property to Facebook marketplace or a similar website to find a party that is interested in the structure or its materials prior to applying for a demolition permit. This person noted that if an interested party can be found, then the owner need not apply for a demolition permit.

3.2.7. Recommendations Received

Interviewees shared the following recommendations with us. They range from ways to educate residents and builders about deconstruction to incentives and regulatory changes for encouraging new practices on the Island.

Education and Outreach

One builder we interviewed thinks the average Nantucketer is in favor of preserving historic buildings and reusing more materials, including those salvaged through deconstruction. The problem is lack of education; by informing the public, there will likely be more explicit support for a deconstruction model on the Island. Several interviewees feel Nantucket has particularly talented carpenters, including many who care greatly about quality construction. In their opinion, this talent pool represents a significant untapped opportunity for building a deconstruction and reuse culture on the Island.

Educating residents about what is salvageable will likely increase the supply of reusable C&D materials, thereby making a salvage facility more feasible. Increased education and outreach will also generate additional demand for salvaged materials and interest in postings on Facebook Marketplace and other sites.

Deconstruction Incentives

Interviewees offered several ideas for incentivizing deconstruction. One person shared an example from Lexington, Massachusetts, where the government places a surcharge on demolition. The ostensible objective of their policy is not to stop demolition, but to slow the

removal of affordable homes that are replaced by more expensive homes. Surcharge revenue is then used to build new affordable housing.

This interviewee feels that, by comparison, permit fees on Nantucket are "way too low." The Town should also make it easier for homeowners to recycle building materials, potentially through financial incentives similar to reimbursements people receive for recycling aluminum cans. In general, the "externalities" or invisible costs of demolition are not apparent to people, similar to how installing a third electrical cable connecting Nantucket to the mainland would likely raise electricity prices for everyone.

Regulatory Reform

One builder recommended potential regulatory reforms that would incentivize deconstruction. Whether the reforms are under the Town's jurisdiction is unclear, but they provide a sense of the barriers to deconstruction. Nantucket and most other jurisdictions in the U.S. follow the International Building Code (IBC). While states apparently have the authority to amend the IBC, the builder we interviewed said that the code's application on Nantucket severely restricts the ability to deconstruct homes and reuse many materials, especially those required for structural support.

In some cases, deconstruction practices are allowed by the Town's codes departments, but are effectively banned because insurance companies will not cover homes that fail to meet certain codes or use salvaged materials that are no longer under warranty. This challenge is magnified by the fact that lenders do not issue mortgages for uninsured homes.

New Models

Interviewees suggested creative models and ideas that could stimulate more deconstruction and material reuse. One person suggested that some materials could be salvaged and reused off-Island. While this would not add to the supply of salvaged materials on Nantucket, it would benefit the environment by diverting C&D waste that would otherwise end up in the landfill. (One idea this interviewee does not support is creating a staging area for homes slated for demolition, which was mentioned in the WPI report. While this would give people more time to consider alternatives to demolition, moving a house twice is inefficient and disruptive to the community.)

Another person said it would help if the Town had dumpsters for different C&D materials (e.g., lumber, bricks). This way, builders looking for salvageable materials could more easily find and retrieve them, saving time and resources.

As mentioned in the discussion of a salvage facility, another recommendation we heard is to create a consignment model for lightly used furniture and construction materials. If successful, a consignment model could generate revenue and become self-sustaining with little to no subsidization.

3.3. Interviewees

We interviewed the following individuals for this memo. We truly appreciate their input and contributions to this study.

Table 6. List of Interviewees

Name	Affiliation	Date Interviewed
Lynn Filipski	Sconset Civic Association	February 9, 2022
Billy Cassidy	Homebuilder	February 11, 2022
Tom Szydlowski	Nantucket Surfside Association	February 15, 2022
Hillary Hedges Rayport	Nantucket Historical Commission	February 16, 2022
Will Stephens & Andy Buccino	Stephens & Company (homebuilders)	February 23, 2022
LeeAnn Maitland	Furniture restorer	February 23, 2022
Bill Grieder	Madaket Conservation Association	February 23, 2022
Dave Armanetti	The Richland Company (real estate developer)	February 23, 2022
Brook Meergerben	Homebuilder	March 1, 2022
Chris Carey	Homebuilder	March 7, 2022

3.4. Interview Questions

We conducted semi-structured interviews using the following questions. The interviews were semi-structured in the sense that we sometimes asked different questions based on new topics the interviewees raised.

1. Could you please tell us about yourself, your organization/ business, your relationship to Nantucket, and your relationship (if any) to deconstruction?
2. What do you think the main benefits of deconstruction on Nantucket are? What do you think the main challenges are?
3. What do you think the main reasons are that homeowners would choose deconstruction over demolition?
4. What are your impressions of salvaged materials, especially their cost, quality, aesthetics, durability, and availability?
5. If Nantucket was to establish an official salvage facility for construction and demolition waste, how successful do you think it would be? How much do you think residents would utilize or patron the facility?
6. Where do you think it should be located? Who do you think should operate it?
7. Are you familiar with the Town of Nantucket's rule that requires applicants seeking a demolition permit to wait 60 days prior to a public hearing to give residents time to consider alternatives? If so, what are your opinions of the 60-day timeline?
8. Is there anything else you'd like to share about your thoughts around deconstruction?
9. Is there anyone else you think we should speak with?

4. Estimate Direct Economic Value of Reusable Materials

This chapter covers the economics of deconstruction on Nantucket. Specifically, we discuss (a) the estimated value of salvageable materials and (b) the financial impact of greater reuse.

4.1. Salvaged Material Value

Salvaged building materials are inherently valuable, but this value goes to waste when builders purchase new materials instead of reusing materials recovered from deconstruction. Our Task 3 interviews revealed several reasons for the waste that occurs on Nantucket, including a lack of "market makers" that prevent salvaged materials from trading hands.

Sales data from Chicago and San Antonio suggests that, on average, salvaged building materials have a market value of about $100 per ton.[7] Our Task 2 analysis found that about 4,570 tons of Nantucket's C&D waste could be diverted from the landfill each year through widespread deconstruction and reuse (Table 7), assuming 25 percent of all construction and demolition (C&D) waste—about 18,260 tons—is salvaged.[8] Valued at $100 per ton, salvaged materials would be worth $457,000 annually.

Table 7. Amount and Value of Potentially Reusable Materials

Annual Tons of C&D Materials	Reusable Share of C&D Materials	Annual Tons of Reusable Materials	Value per Ton	Annual Value
18,260	multiplied by 25%	= 4,570	multiplied by $100	= $457,000

Our Task 2 analysis also estimated the amount of potentially reusable material by type (Table 8). Wood is the most likely to be reused, followed by concrete, asphalt, and brick. Metal and drywall are least likely to be reused. About 2,010 tons of wood and 1,140 tons of concrete, asphalt, and brick could be reused each year if there was widespread deconstruction on Nantucket.

[7] *Treasure in the Walls, Reclaiming Value Through Material Reuse in San Antonio,* prepared by PlaceEconomics for the City of San Antonio Office of Historic Preservation, February 2021. Cook County Deconstruction Strategy Report, prepared by the Delta Institute for Cook County, Illinois, July 2011.

[8] Deconstructing Building Material Reuse: A tool for local governments and economic development practitioners, Delta Institute (May 2018).

Table 8. Reusable Material by Type

Reusable Material Type	Percent of Total Tonnage	Annual Tons
Wood	44%	2,010
Concrete, asphalt, brick	25%	1,140
Metal	3%	140
Drywall	2%	90
Other	26%	1,190
Total, all salvageable materials	100%	4,570

Though salvaged materials are worth about $100 per ton when averaged across all material types, this amount varies widely based on individual material types. The value of salvaged wood can range from $350 per ton for firewood that sawmills can convert into lumber, to over $1,500 per ton for slabs that can be turned into flooring, cabinetry, furniture, or architectural fixtures.[9]

According to various estimates, the value of recycled concreate ranges from $15-55 per ton, the value of recycled asphalt ranges from $10-20 per ton, and the value of recycled bricks ranges from $300-700 per ton (assuming a pallet weights about one ton).[10]

4.2. Financial Impacts of Deconstruction

More deconstruction on Nantucket would impact municipal finances in two primary ways: (1) reduced waste management and disposal fees; and (2) reduced fees paid to Waste Options Nantucket for C&D collection, handling, and disposal. While the Town would collect fewer tip fees under a deconstruction model, homeowners and builders would realize savings by not having to pay those fees. Below, we review the current C&D disposal cost structure and the potential financial impacts of deconstruction.

4.2.1. Current Cost Structure

The cost structure for C&D disposal on Nantucket includes several fees that can be categorized into Town revenues and expenses. Revenues include tip fees for commercial C&D waste and certain residential C&D waste. Expenses include fees paid to Waste Options Nantucket, LLC (WON), the Town's waste collection contractor. Table 9 details these various fees.

[9] The Urban Wood Workbook: A Framework for the Baltimore Wood Project, U.S. Department of Agriculture, April 2020 (Figure 3). U.S. Forest Service: Urban Wood Disposition Pay-for-Success Feasibility Report, Quantified Ventures, April 2018 (pages 17-18).

[10] Civiconcepts.com (concrete), homeguide.com (asphalt), homeadvisor.com (bricks)

Table 9. Fees for C&D Waste Disposal

Fee	Description	Amount per Ton
Town Revenues		
Tip fee (residential)	Fee collected for residential C&D waste <40lbs	$0
Tip fee (commercial)	Standard fee collected for commercial C&D waste and residential C&D waste >40lbs. There are discounted rates for nine high-tonnage customers.	$372 $252 for 8 high-tonnage customers $200 for 1 one high-tonnage customer
Town Expenses		
Handling fee (residential)	Fee paid to WON for handling residential C&D waste <40lbs.	$212
Handling fee (commercial)	Fee paid to WON for handling commercial C&D waste and residential C&D waste >40lbs.	$95
Transfer, haul, ferry, and disposal fee (residential & commercial)	Fee paid to WON, who pays Hughes News & Transport for transporting residential and commercial C&D waste off-Island.	$224
Monthly lump sum fee (residential & commercial)	Paid to WON monthly regardless of tonnage.	$114 implied rate based on 298 tons of C&D waste in November 2021
Diversion fee (residential & commercial)	Paid to WON for residential and commercial C&D waste they are able to recycle through mulching. Would otherwise pay transfer fee for this diverted waste.	$100

4.2.2. Cost Analysis

Table 10 presents a cost analysis for C&D waste disposal on Nantucket. For residential C&D waste weighing under 40 pounds, the Town's combined expense paid to WON is $436.66 per ton. Since there is no tip fee for this waste, the Town does not recover this expense.

For commercial C&D waste and residential C&D waste weighing over 40 pounds, the standard expense paid to WON is about $319 per ton. The tip fee for this waste is $372 per ton, meaning the Town has a net revenue of $53 per ton before factoring in lump sum fees, which we discuss below. For eight commercial customers that receive a discount, the Town has a net expense of about $7 per ton. For a ninth customer that receives a different discount, the Town has a net expense of $33 per ton.

In November 2021, the Town paid a lump sum fee of $33,835 for about 298 tons of C&D waste.[11] This implies a fee of $114 per ton in addition to the fees discussed above. If we include this fee in

[11] 52.11 tons of residential C&D waste (code 1827) and 245.4 tons of commercial C&D waste (1927).

the cost analysis, it has a net expense of $550 for residential waste, $61 for commercial waste, and between $121 and $147 for discounted commercial waste.

Table 10. Cost Analysis for C&D Waste Disposal

Town Revenue or Expense	Rate per Ton Residential C&D Waste <40lbs	Commercial C&D Waste and Residential C&D Waste >40lbs	Commercial C&D Waste (Discounted Rates)
Town Revenue			
Revenue: Tip fee	$0	$372	$200 - 252
Total Revenue	**$0**	**$372**	**$200 - 252**
Town Expenses			
Expense: Handling fee	$212	$95	$9 - 35
Expense: Transfer, haul, ferry, and disposal fee	$224	$224	$224
Total Expense	**$437**	**$319**	**$233 to 259**
Net Revenue	**-$437**	**$53**	**-$33 to -$7**
Total Expense with lump sum fee ($114)	$550	$433	$347 – 373
Net Revenue with lump sum fee ($114)	-$550	-$61	-$147 to -$121

Source: Town of Nantucket.
Note: Rows may not sum to totals due to rounding.

4.2.3. Potential Savings

Our Chapter 2 analysis found that approximately 4,600 tons of Nantucket's C&D waste could be diverted from the landfill each year through widespread deconstruction and reuse. If this amount was diverted from the waste stream, residents and businesses would collectively save $1.70 million in tip fees each year (Table 11). However, this is the high end of a likely range because it assumes that most C&D waste is commercial and is assessed a standard tip fee, not a discounted fee. If most commercial C&D waste was assessed a discounted tip fee of $252 per ton, annual savings would equal $1.15 million.

Table 11. Change in Tip Fee Revenue under Widespread Deconstruction

Scenario	C&D Waste Diversion	Tip Fee	Change in Tip Fee Revenue
Standard Fee Scenario	-4,600 tons	multiplied by $372	= -$1.70 million
Discounted Fee Scenario	-4,600 tons	multiplied by $252	= -$1.15 million

To put these figures in context, in 2022, the Town expects to collect about $3.1 million in tip fees plus $400,000 in other landfill fees. The estimates also assume that 25 percent of C&D waste is reused—a level of diversion that could take years to achieve.

Under the 4,600-ton diversion scenario, the Town would likely pay less in WON fees, although it is difficult to determine how much savings there would be. This is partially because it is unclear how WON's lump sum fee would change if there were 4,600 fewer tons of C&D material in the waste stream.

5. Estimate Impact on Housing Costs of Using Reusable Materials

The up-front cost of deconstruction is generally acknowledged to be more costly than the upfront cost of demolition. Organizations and research groups involved in deconstruction estimate that the gross cost of deconstruction – that is, not including the value of salvaged materials or the economic value of social and economic costs and benefits - typically exceeds the cost of demolition by between 40% and 80%, but the difference can exceed 120%. The purpose of this analysis is to determine the potential impact of the cost difference on Nantucket housing costs, and on the cost of affordable housing in particular.

Estimates of the Cost Premium for Deconstruction over Demolition

- Northwest Economic Research Center at Portland State University: 36-84% greater
- Delta Institute: 67% greater
- PlaceEconomics national survey: 68% greater
- ReUse People: 124% greater

5.1. The Cost of Housing on Nantucket

As in any other real estate market, the cost of housing on Nantucket is determined by supply and demand. **Demand** for Nantucket housing is created by the local population of year-round residents who live and work on the Island, the seasonal workforce that rent accommodations on the Island during the high tourism months, and seasonal home buyers who buy properties they intend to occupy or rent to tourists only part of the year. These two seasonal populations are drawn from throughout southeastern Massachusetts, the Boston metropolitan region, other regions across the nation, and even internationally.

As an island 30 miles out to sea, Nantucket's real estate **supply** is uniquely constrained. Environmental conditions on the Island including wetlands, flood areas, soil erosion and beach sand retreat limit the amount of land that can be developed for housing. Furthermore, approximately 55% of Nantucket's land is held by conservation organizations and permanently protected as open space.[12] This preserves the natural beauty of the Island which is central to its tourism-based economy, but further constricts the supply of land available for housing. The 2020 Nantucket Long Range Transportation plan reports that only 5.9% of the Islands total land area is vacant and available for development. While only a small fraction of developed land is developed for non-residential uses, some fraction of the remaining 5.9% will likely be developed for commercial, employment, or government use. Some increase in supply could be achieved by redeveloping existing properties at higher densities, but under current development patterns, the

[12] Nantucket Housing Production Plan.

majority of existing housing stock is single-family detached, with small concentrations of multi-family housing in the center of the Island.

This relatively unbound demand coupled with tightly bound supply of land is a significant contributor to high housing costs on Nantucket. Construction costs are also a significant contributor. Construction costs are high due to the high cost of labor (because workers face high housing costs or high transportation costs to reach Island worksites) as well as high cost of materials (because all materials must travel to the Island by ferry). According to the 2020 real estate market summary published by Fisher Real Estate, a real estate group active on Nantucket, construction costs range from between $450 per square foot for modular construction (framed off-site and brought to the Island) to more than $700 per square foot for traditional construction framed on-site. Anecdotal reports indicate that it is not unusual for construction costs to exceed $1,000 per square foot. (For reference, construction costs in the Boston metropolitan area range from $250 to $500 per square foot according to area developers).

The median price of a single-family home on Nantucket was $2.78 million, and the average was $3.62 million. The large difference between median price and mean price is due to some very high-priced properties that are much greater than the median. Rents are also high relative to the rest of the state and the nation as a whole. As of the U.S. Census Bureau's 2020 5-Year American Community Survey, the median rent for a 2-bedroom housing unit on Nantucket was $1,808 per month, 27% higher than the Massachusetts statewide median ($1,428) and 67% higher than the nationwide median ($1,080).[13] Note that because the Census surveys residents, it does not capture rents for short-term rentals, which can be many times higher than the average for year-round residents.

The high cost of housing on Nantucket presents a challenge for year-round residents who make their living on the Island (e.g., town government workers, tradespeople, and for resident-serving business owners and staff), as well as for seasonal workers needed to support the visitor industry.

Many of the costs of demolition are borne by entities other than the individual making the decision to demolish while the benefits of deconstruction are unfamiliar to most builders and homeowners. As a result, from the point of view of the person making a deconstruction versus demolition decision, the upfront costs for the former typically well exceeds upfront costs for the latter. This difference in cost would contribute only a small fraction of the total cost of a median-priced home and is unlikely to deter buyers or affect market prices at that price-point. However, it is important to determine whether the additional costs associated with deconstruction would affect the cost and availability of affordable housing.

[13] American Community Survey Table B25031 for Nantucket County, Massachusetts, and the United States (U.S. Census Bureau).

5.2. Comparison of Demolition versus Deconstruction Costs

As noted above, from the point of view of contractors and homeowners making a decision about how to remove a structure or portion of a structure, the cost of deconstruction typically well exceeds the cost of demolition. This is because many of the costs associated with demolition are externalities that are borne by society as a whole rather than the person incurring the cost. These costs include the cost of hazardous pollutants (asbestos, lead) and other particulates released into the air by machine demolition and into the ground when they are placed in landfills, and by the avoidable resource and energy consumption needed to deliver debris to landfills and to produce new materials and deliver them to job sites (as calculated below in Section 6).[14] As a result, the upfront cost of demolition to builders and homeowners is artificially low.

Conversely, the upfront cost of deconstruction is artificially high. The value of salvaged building materials isn't widely recognized, and certain infrastructure is necessary to create efficiency and achieve economies of scale to tap into that value. This infrastructure includes trained deconstruction crews, materials for staging, storage, and display space, and a system for collection and distribution or sale of reused materials. Furthermore, even for materials that cannot be reused, deconstruction creates a "cleaner" waste stream, as materials are source-separated. These source-separated materials are much more easily (and cheaply) recycled, which increases waste diversion rates and can lower municipal waste disposal costs (cost savings that can be passed on to consumers and taxpayers).

The Delta Institute, the ReUse People, and researchers at the Northwest Economic Research Center at Portland State University have collected data comparing the cost of demolition versus deconstruction from the point of view of the person making the decision to deconstruct versus demolish, typically the builder or homeowner. Many of these estimates are based directly on case studies of actual demolition and deconstruction projects. Table 12 presents a synthesis of these estimates, tailored to reflect current C&D waste disposal fees on Nantucket. Low and high estimates for both demolition and deconstruction were established based on the relevance of case study examples to Nantucket in terms of labor costs.

[14] Paruszkiewicz M, "The Economics of Residential Building Deconstruction in Portland, OR".

Table 12. Gross Cost of Demolition versus Deconstruction

	Demolition		Deconstruction	
	Low	High	Low	High
Cost to lower home	$10,000	$15,000	$14,000	$35,000
Tons of Debris (1)	50	50	50	50
% not Salvaged for Reuse (2)	100%	100%	75%	75%
Tons to Dispose (assumes 2,000 sq.ft. home)	50	50	37.5	37.5
Tipping Fees (per ton) (3)	$372	$372	$372	$372
Disposal Cost	$18,600	$18,600	$13,950	$13,950
Total Cost	**$28,600**	**$33,600**	**$27,950**	**$48,950**

(1) "Characterization of Building-Related Construction and Demolition Debris in the United States"(U.S. Environmental Protection Agency, 1998).
(2) Delta Institute.
(3) Nantucket Department of Public Works (a limited number of high-use customers pay reduced tipping fees lower than the schedule fee of $372 per ton).
Sources: EBP with information from U.S. EPA, Delta Institute, the ReUse People, the Northwest Economic Research Center at Portland State University, and the Nantucket Department of Public Works.

Among the case studies analyzed, actual costs to remove a home by demolition ranged from about $5,725[15] to $15,700[16], and costs to remove by deconstruction ranged from $7,825[17] to $37,700[18]. Based on the relevance of the case study examples to the particular characteristics of Nantucket, an appropriate range for whole house demolition was assumed to fall between $10,000 and $15,000. Similarly, the range for deconstruction was determined to be $14,000 to $35,000. The cost of deconstruction is more variable due to the complexity of the job as well as the skill and experience of the deconstruction crew. These costs represent out-of-pocket costs before disposal fees, and without any resale or tax benefits from donation of reusable salvaged materials.

Both processes start with the same amount of material. For a demolition project, the entire amount will become debris that incur disposal costs, while for a deconstruction project, approximately 25% of this debris (by weight) will be salvaged for reuse, avoiding disposal fees. As a result, the total cost of demolition is assumed to range from $28,600 to $33,600, versus $27,950 to $48,950 for deconstruction. Under these assumptions, the low range for deconstruction is actually less costly than the low range estimate for demolition due to disposal fee savings. Note that this is before accounting for revenue that could be generated by the sale of salvaged materials or tax benefits generated by donation of salvaged materials to a designated non-profit organization.

[15] RS Means, 2014.
[16] The ReUse people composite estimate.
[17] City of Portland Bureau of Planning and Sustainability Deconstruction Grant Program case studies.
[18] The ReUse people composite estimate.

5.3. Impacts and Opportunities for Affordable Housing

While a comparison of the low range of both scenarios favors deconstruction, most builders and homeowners will encounter higher costs for deconstruction. Note that the high estimate for deconstruction is $20,000 greater than the high estimate for demolition and $25,000 greater than the low estimate for demolition.

An additional cost of $20,000 to $25,000 would comprise only a small fraction (less than 1.0% of the cost of a median or average priced home. This difference is not significant enough to have an appreciable impact on the price or availability of housing, in general, on Nantucket.

For affordable housing, a $20,000 to $25,000 cost to deconstruct an existing structure to make way for a new affordable unit could present an additional hurdle in a process with numerous existing challenges. Assuming a hypothetical 1,000 square foot unit built at $450 per square foot, deconstruction of an existing structure to make way for an affordable unit could add 5 to 6 percent to the total project cost. Fortunately, a review of characteristics of current and recently completed and affordable housing projects on Nantucket indicate that this is not likely to present a significant issue.

Among current and recently completed affordable housing developments, the majority were already free of structures. Projects built on parcels with existing structures typically integrate those structures into the final project design, creating little need for demolition and indicating that the convention of reuse already exists in the industry.

Furthermore, an on-Island salvaged building materials reuse program or facility could become an important source of lower-cost building materials for affordable housing builders, particularly for smaller-scale projects. The rising cost of building materials on Nantucket is already affecting affordable housing development. For example, in 2017, the Town approved and permitted Halcyon Gardens, a 64-unit workforce housing development on a Town-owned parcel at 6 Fairgrounds Road. The project was delayed by project opponents, but ultimately prevailed and recently secured the necessary tax credits to move forward with construction. Unfortunately, during the intervening 5-years, the original project budget of $20 million ballooned to more than $31 million due to increases in building material costs. This created a significant budget gap, and it is unclear whether the project can move forward.

Larger-scale builders are likely to continue to purchase new materials such as appliances, doors and windows for purposes of uniformity. Sources report that some builders are reluctant to use salvaged appliances because they may not be covered by warranty. These builders could still benefit from salvaged, re-graded wood which is functionally equivalent to new wood and in many cases, of a higher quality.

Much of the affordable housing construction on the Island is done at a smaller scale. For example, Housing Nantucket, a 501c3 operates a housing recycling program to add to the portfolio of affordable units they own and manage. This program buys buildings slated for

demolition, or receives them as donations, sometimes accompanied by a cash donation, then works with the Town or private landowners to identify an appropriate site to relocate the structure to. This organization is already accustomed to using salvaged building materials and appliances, providing a model for salvage and reuse of building materials that can be extended to the broader community.

6. Avoided Carbon Emissions

In Chapter Task 6, we estimate the avoided carbon emissions associated with reusable C&D materials that are currently put into the Nantucket waste stream, and the embodied energy of new materials required to replace these discarded materials. Nantucket's unique geography makes shipping materials to and from the Island more cost- and energy- intensive than for most municipalities. Cost savings associated with deconstruction and materials reuse was addressed in Chapter 4. This section is concerned with quantifying the potential for greenhouse gas emissions and other pollutant reductions in three distinct areas:

1. Transport
2. New Materials
3. Decomposition of Materials

Currently, approximately 17,822 tons of C&D waste are shipped off Nantucket annually.[19] Of the 18,259 tons of C&D waste that arrive on average at the Nantucket DPW/Waste Options and Reis Trucking facilities, approximately 437 tons (2.4%) are diverted from the waste stream at the two facilities. The majority of this is attributed to non-pressure treated wood that is chipped for mulch and used on-site for road base and other uses, and asphalt, brick, and concrete that is ground up and used for road re-surfacing on-Island. Our findings documented in Chapter 2 show an estimated 25% of the total C&D waste is potentially reusable. This means that on average, 4,456 tons of potentially reusable C&D waste materials are shipped off-Island annually. It is this total tonnage that we based our emissions calculations on, with adjustments made for waste diversion rates at each of the two first off-Island facilities,[20] and the resulting weight reduction in waste transported on subsequent legs of the journey to the landfill.

6.1. Approach

Our approach involved researching and determining the best data sources for avoided carbon emission and other pollutant calculation methodologies, interviews with key stakeholders involved in the Nantucket C&D waste stream, detailing the journey from the Nantucket C&D facilities to the respective landfills, and application presented in Section 2 data and calculation of avoided carbon emissions and four (4) other harmful pollutants, sulfur dioxide (SOx), nitrous oxides (NOx), volatile organic compounds (VOCs), and particulate matter (PM). The data types, key variables, and sources accessed are detailed in Table 13.

We applied emissions factors from the U.S. Environmental Protection Agency and U.S. Department of Transportation data. In addition, our interviews included Steven Arceneaux and

[19] Based on a 2016-2019 average of annual data from Nantucket Department of Public Works and Massachusetts Department of Environmental Protection (MassDEP).

[20] Stoughton Recycling Technologies (Nantucket DPW/Waste Options) and J.R. Vinagro Recycling (Reis Trucking).

Paul Berard (Nantucket DPW) who provided overall guidance and a connection to Waste Options; Nathan Widdell (Waste Options) who provided detailed information on the Nantucket DPW C&D waste journey, modes of transportation, and waste diversion rates at Stoughton Recycling Technologies; Steve Pietrantozzi (J.R. Vinagro Recycling) who shared information on the Reis Trucking waste journey, modes of transportation, and waste diversion rates at Vinagro's Johnston, RI facility. We also spoke with Mark Dakers at MassDEP who alerted us to the newly published Massachusetts 2030 Solid Waste Master Plan which establishes goals to reduce disposal statewide by 30 percent (from 5.7 million tons in 2018 to 4 million tons in 2030) over the next decade, and sets a long-term goal of a 90 percent reduction in disposal to 570,000 tons by 2050.

Table 13. Data types, key variables, and sources accessed to estimate avoided carbon emissions.

Data Type	Key Variables	Source
Emission factors	Pollutants: Metric tons[21] CO2e, SOx, NOx, VOCs, PM per mile Modes: ferry, truck, train	U.S. DOT 2022 BCA Guidance; U.S. EPA 2020 Ports Emissions Inventory Guidance
Historic C&D waste shipped off Island	Metric tons of waste, waste composition	Nantucket DPW; MassDEP
Embodied carbon of building materials	Metric tons CO2e (MtCO2e)[22]	U.S. EPA Waste Reduction Model (WARM)
Landfill emissions	Material type, metric tons CO2e (MtCO2e)	U.S. EPA Waste Reduction Model (WARM)
Journey from Nantucket DPW to landfill	Mode & distance traveled; % of materials diverted	Waste Options
Journey from Nantucket (Reis) to landfill	Mode & distance traveled; % of materials diverted	J.R. Vinagro Recycling

6.2. Journey from Nantucket to Landfill

We pieced together the specifics of the detailed journey from each of the C&D waste facilities on Nantucket, Nantucket DPW and Reis Trucking, to the final landfill destinations, and calculated the resulting carbon and pollutant emissions associated with each journey.

6.2.1. Nantucket DPW/Waste Options

Waste Options, a private waste hauling contractor, transports off-Island, from the Nantucket DPW C&D facility at 188 Madaket Road, Nantucket, an average of 2,192 tons of potentially reusable C&D waste per year[23], based on 2016-2019 data and results reported in Chapter 2. Waste Options

[21] Note that carbon emissions are measured in metric tons (MT) while the C&D waste is measured in U.S. or 'short' tons. The conversion factor from metric tons to U.S. tons is 1.10231

[22] Metric tons of carbon dioxide equivalent

[23] Waste category 017: Outbound C&D

transports C&D material using either 80-yard trailers or 100-yard walking floor trailers. Waste Options trucks travel 4.1 miles to 1 Steamboat Wharf, where they leave the truck and trailer in the parking lot and the Steamship Authority does a 'drive on' for the 29.1-mile, 2 hour and 15-minute trip to Ocean Street Dock in Hyannis. The Steamship Authority then does a 'drive off' into the parking lot and a driver retrieves the truck for the 99.9 mile trip to Stoughton Recycling Technologies facility[24] at 100 Page Street, Stoughton, MA.[25] At the facility approximately 15% of the C&D materials are diverted from the waste stream for reuse or recycling.[26] The remaining 85% of the waste is shipped by train 775 miles northwest to its final destination at the Sunny Farms Landfill at 12500 West County Road 18, Fostoria, OH. The entire journey comprises a total of 908 miles as shown in Table 14.

Table 14. Emissions associated with transporting C&D waste from the Waste Options facility to the Sunny Farms Landfill in Fostoria, Ohio.

Transport Mode	Origination	Destination	Miles	% C&D Materials Diverted	Average Annual Reusable C&D Waste (Tons)
Truck	188 Madaket Rd., Nantucket	1 Steamboat Wharf, Nantucket	4.1	0%	2,192
Ferry	1 Steamboat Wharf, Nantucket	Ocean Street Dock, Hyannis	29.1	0%	2,192
Truck	Ocean Street Dock, Hyannis	100 Page Street, Stoughton, MA	99.9	0%	2,192
Train	100 Page Street, Stoughton, MA	12500 West County Road 18, Fostoria, OH	775.0	15%	1,863
Total			**908**		
Total (RT)			**1,816**		

Note that the full round-trip (RT) accounts for the transport vehicle returning trip to its starting point to transport the next load of C&D waste.

6.2.2. Reis Trucking

Reis' facility at 10 Industry Road, Nantucket, transports off-Island an average of 2,264 tons of potentially reusable C&D waste per year, based on 2016-2019 data and results from Task 2. Reis' waste hauling trucks travel 4.1 miles to 1 Steamboat Wharf, where they board the Steamship Authority ferry for the 29.1-mile journey to Ocean Street Dock in Hyannis. The trucks disembark in Hyannis and drive 95.9 miles to the J.R. Vinagro recycling facility at 116 Shun Pike, Johnston, RI, where approximately 48% of materials are removed from the waste stream and reused or

[24] Owned by Tunnel Hill Partners

[25] Currently a small percentage of non-recyclable waste is trucked to the Zero Waste facility in Rochester, MA, however this began in 2020 and was not part of the 2016-2019 data. This new waste category is 020: Outbound non-recyclable/non-reusable

[26] Based on information from Nathan Widdell of Waste Options

recycled.[27] The remaining 52% of the waste is trucked 261 miles north to its final destination at the Crossroads Landfill at 357 Mercer Road, Norridgewock, ME. The entire journey comprises a total of 390 miles as shown in Table 15.

Table 15. Emissions associated with transporting C&D waste from the Reis Trucking facility to the Crossroads Landfill in Norridgewock, Maine.

Transport Mode	Origination	Destination	Miles	% C&D Materials Diverted	Average Annual Reusable C&D Waste (Tons)
Truck	10 Industry Road, Nantucket	1 Steamboat Wharf, Nantucket	4.1	0%	2,264
Ferry	1 Steamboat Wharf, Nantucket	Ocean Street Dock, Hyannis	29.1	0%	2,264
Truck	Ocean Street Dock, Hyannis	116 Shun Pike, Johnston, RI	95.9	0%	2,264
Truck	116 Shun Pike, Johnston, RI	357 Mercer Road, Norridgewock, ME	261.0	48%	1,177
Total			**390**		
Total (RT)			**780**		

Note that the full round-trip (RT) accounts for the transport vehicle returning trip to its starting point to transport the next load of C&D waste.

6.2.3. Pollutant Emissions

We quantified the estimated pollutant emissions associated with transporting C&D waste for the following substances:

1. **Carbon Dioxide (CO2)** enters the atmosphere through the burning of fossil fuels (coal, natural gas, and oil) and the decomposition of organic matter, including wood and other materials. CO2 is a heat-trapping greenhouse gas which is measured in MtCO2e, metric tons of carbon dioxide equivalent.
2. **Nitrous Oxides (NOx)** is emitted through industrial activities, treatment of wastewater, and the combustion of fossil fuels and solid waste. NOx is a heat-trapping greenhouse gas with a global warming potential (GWP) 265-298 times that of CO2 for a 100-year timescale. NOx emissions are measured in grams (g) or kilograms (kg).
3. **Sulfur Dioxide (SO2)** is produced through the combustion of sulfur-containing fuels, including coal, oil, and gasoline. SO2 is a colorless gas with a pungent odor and its emissions are measured in grams (g) or kilograms (kg).
4. **Volatile Organic Compounds (VOCs)** are reactive organic gases found in many consumer products, such as paints and solvents, and are produced by the combustion of fossil fuels. VOC emissions are measured in grams (g) or kilograms (kg).

[27] Based on information from Steve Pietrantozzi, J.R. Vinagro

5. **Particulate Matter (PM)** is a complex mixture of extremely small particles and liquid droplets. PM pollution contains a number of components, including acids, such as nitrates and sulfates, organic chemicals, metals, and dust particles. PM is produced through the burning of fossil fuels and is harmful to human respiratory health. PM is measured in grams (g) or kilograms (kg).

Table 16 details the avoided emissions associated with not transporting potentially reusable C&D waste materials off-island to the landfill.

Table 16. Emissions associated with journey from Nantucket to landfill.[28]

Origination	Destination	CO2 (MtCO2e)	NOx (kg)	SO2 (kg)	VOC (kg)	PM (kg)
DPW/Waste Options	Sunny Farms Landfill	164	3.9	177	7.3	56
Reis Trucking	Crossroads Landfill	230	5.4	156	3.7	48
Total		**394**	**9.3**	**333**	**11.0**	**104**

Note that these pollutant emissions are based on the full round-trip (RT) of the transport vehicles, which accounts for the vehicles returning to their starting point to transport the next load of C&D waste.

These avoided CO2 emissions are the pollution equivalent of taking 86 cars off the road, based on U.S. EPA figures[29]. These avoided emissions of NOx, SO2, VOCs, and PMs reduce the health risks associated with breathing these pollutants. NOx emissions are associated with an increase in the incidence of asthma, respiratory illness, vegetation damage, and reduced crop yields. In the presence of heat and light, NOx also combines with VOCs to form ground-level ozone (smog), a respiratory irritant that can damage lung tissue and reduce lung function. Exposure to VOCs themselves can cause a variety of healthy effects, including irritation to the eyes, nose, and throat, headaches, loss of coordination, nausea, and damage to the liver, kidneys, or central nervous system. SO2 can cause a range of harmful effects on the lungs, including wheezing, shortness of breath, chest tightness, and reduced lung function. The health effects of breathing PM, particularly fine particles ($PM_{2.5}$) that can get deep into the lungs, may include cardiovascular effects such as cardiac arrhythmias and heart attacks, and respiratory effects such as asthma attacks and bronchitis, especially for those with pre-existing heart or lung disease, older people, and children.

[28] Emission factor data sources: GHG Emission Factors Hub | US EPA and 2018 SmartWay Shipper Partner Tool: Technical Documentation, U.S. Version 2.0.17 (Data Year 2017) (EPA-420-B-18-046, October 2018)

[29] A typical passenger vehicle emits about 4.6 metric tons of CO2 per year. Greenhouse Gas Emissions from a Typical Passenger Vehicle | US EPA

6.3. Embodied Carbon

All new material goods have an associated carbon emissions figure, often referred to as the product's embodied carbon or carbon footprint. The Carbon Leadership Forum defines embodied carbon as the "greenhouse gas emissions arising from the manufacturing, transportation, installation, maintenance, and disposal of building materials."[30] Any carbon emissions resulting from use of the product - such as running a home dishwasher or driving a car - are known as the operational carbon. As seen in Figure 2, construction materials are associated with carbon emissions across their lifecycle, from raw material production through construction, useful life, deconstruction or demolition, and disposal.

Figure 2. Embodied and operational carbon across the lifecycle of a building.

Source: Carbon Leadership Forum.

6.3.1. Embodied Carbon of New Materials

Salvaging and reusing building materials on the Island will reduce the demand for new building materials, resulting in a carbon savings from the embodied carbon of avoided new products. Our analysis determined potential avoided new materials and applied the associated greenhouse gas emissions factors published by the Environmental Protection Agency (EPA) in their Waste Reduction Model (WARM) to reach an estimated 4,928 MtCO2e potential savings annually, as shown in Table 17.

[30] "Embodied Carbon 101," Carbon Leadership Forum, https://carbonleadershipforum.org/embodied-carbon-101/.

Table 17. Estimated Potential Avoided Embodied Carbon of New Materials.

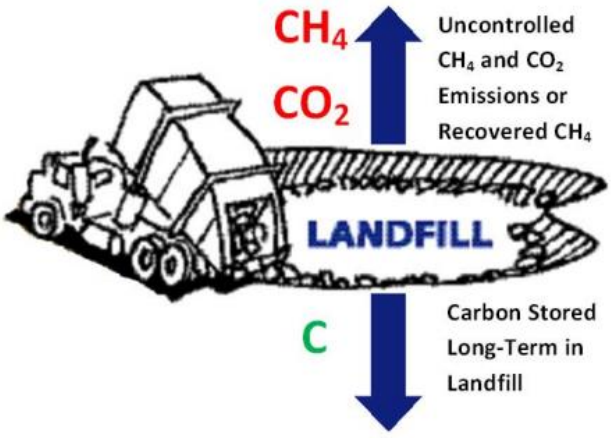
Material type	Avg. Annual Avoided C&D waste (tons)	GHG emissions per ton of new material (MtCO2e)	Avoided GHG emissions total (MtCO2Ee)
Concrete & Asphalt	1,114	0.11	124
Wood	1,961	2.13	4,181
Metals	134	3.65	488
Drywall	89	0.22	19
Other	1,159	0.10	116
Total	**4,456**		**4,928**

Source: GHG factors from EPA WARM.

6.3.2. Carbon Emissions and Landfill Decomposition

Landfilled materials store and release greenhouse gases such as carbon dioxide and methane gas while decomposing to varying extents. The EPA Waste Reduction Model provides helpful context on the carbon accounting of landfilled materials: "In landfills, anaerobic bacteria digest organic materials… to produce methane (CH4) and CO2. Although the CO2 emissions would naturally occur from these materials due to natural degradation, the CH4 emissions would not, and are therefore considered anthropogenic GHGs and accounted for in WARM. The landfilled materials that are not fully decomposed by anaerobic bacteria are stored in the landfill." Critically, methane (CH4) is a 84-87 times more potent greenhouse gas than carbon dioxide (CO2) over a 20-year timeframe, thus landfill methane emissions have an outsize effect. As illustrated in Figure 3, carbon emissions and storage happen simultaneously.

Figure 3. Carbon Flows in a Landfill.



Source: EPA Waste Reduction Model (WARM), 2010.

It is important to remember that landfilling materials must be compared to an alternative end-of-life disposal method. For instance, landfilling wood sequesters far more carbon than incinerating it as firewood. Table 18 shows an overall negative avoided GHG emissions of 1,335 MtCO2e associated with the potential decreased landfilling.

Table 18. Estimated Change in Landfill GHG Emissions.

Material type	Avg. Annual Avoided C&D waste (tons)	GHG emissions per ton of landfilled material (MtCO2e)	Avoided GHG emissions total (MtCO2e)
Concrete & Asphalt	729	0.02	15
Wood	1,816	(0.92)	(1,677)
Metals	40	0.02	1
Drywall	83	(0.06)	(5)
Other	1,073	0.31	332
Total	**3,740**		**(1,335)**

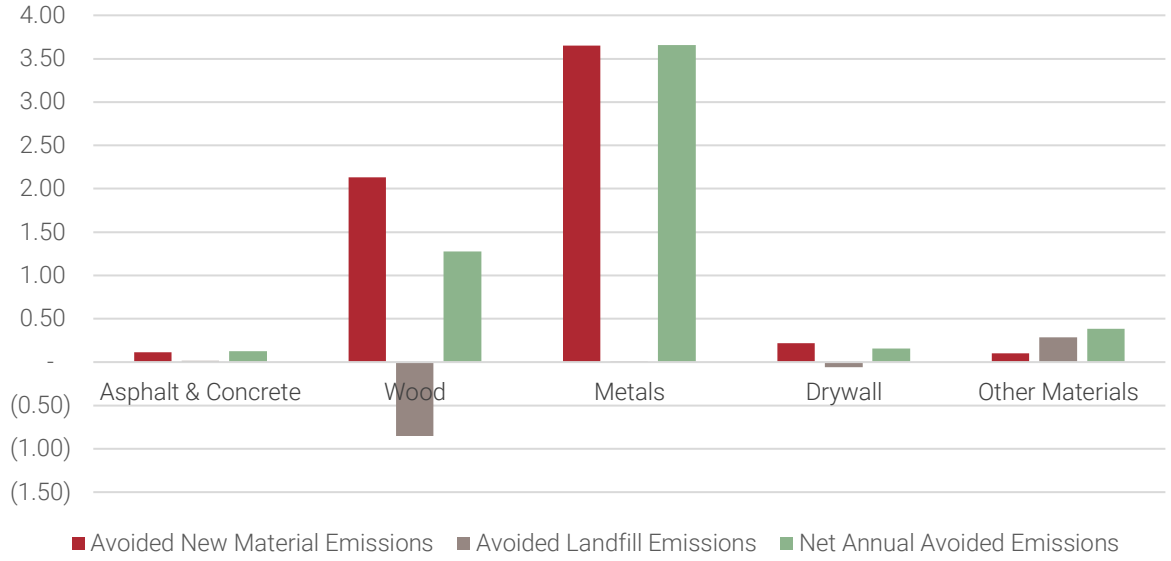
Source: GHG factors from EPA WARM.

This finding may be counterintuitive, as it seems to suggest that sending scrap materials to the landfill is an environmental good. However, the emissions associated with sourcing new materials to replace the landfilled materials are significantly higher, and our analysis shows that the net effect would be a carbon emission savings of 3,593 MtCO2e annually.

6.3.3. Net Emissions from Embodied Carbon

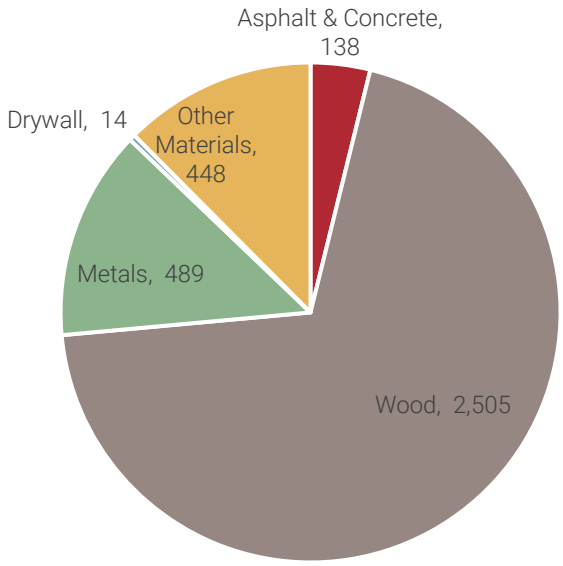
Since salvaging materials on Nantucket would both avoid the necessity for creating some new materials and lessen the volume of materials sent to the landfill, we can consider the net effect on embodied emissions by material type. Figure 4 shows the net embodied carbon savings per ton of salvaged material.

Figure 4. Net Embodied Carbon Emissions Savings per Ton Salvaged Material (MtCO2e).



Finally, Figure 5 shows the overall annual volume of potential embodied carbon emissions savings by material type - the majority of embodied emissions savings coming from wood (70%) and metals (14%).

Figure 5. Total Annual Avoided Embodied Carbon Emissions (MtCO2e).



Embodied carbon emissions of salvaged materials have the potential to avert up to 3,593 MtCO2e annually.

6.4. Key Findings

Our analysis finds that total emissions of 3,988 tons of carbon dioxide equivalent (CO2e), 333 Kilograms (Kg) of sulfur dioxide (SO2), 9.3 Kg of nitrous oxides (NOx), 11 Kg of Volatile Organic Compounds (VOCs), and 104 Kg of fine particulate matter (PM) could be avoided with the on-Island reuse of the 4,456 tons[31] of potential reusable C&D waste that is currently shipped off-Island to the landfill each year. Strategic reuse of building materials on Nantucket could significantly reduce the pollutant emissions associated with the C&D waste stream as shown in Table 19.

Table 19. Estimated Potential Avoided Emissions from Decreased Transport and Landfilling of C&D waste and Decreased Need for New Materials.

Pollutant Emissions Source	CO2 (MtCO2e)	NOx (kg)	SO2 (kg)	VOC (kg)	PM (kg)
Off-Island C&D waste transportation	394	9.3	333	11.0	104
Embodied Carbon in New Replacement Materials	4,928	n/a	n/a	n/a	n/a
Landfill Decomposition	(1,335)	n/a	n/a	n/a	n/a
Total	**3,988**	**9.3**	**333**	**11.0**	**104**

These avoided CO2 emissions are the pollution equivalent of taking 869 cars off the road, based on U.S. EPA figures.

[31] 25% of 17,822 tons

7. Job & Workforce Impacts of Deconstruction

This chapter summarizes the potential job creation and associated workforce training needs that would result from more deconstruction on Nantucket.[32] In the next section, we present a description of businesses and industries that will be most impacted by increased deconstruction and material reuse. Then, we estimate potential job creation within deconstruction-related industries and unrelated industries that could also benefit from new transactions. Lastly, in section 7.2, we discuss workforce training needs associated with increased deconstruction.

7.1. Businesses & Industries Impacted

In Chapter 1, we identified existing industries on Nantucket that are most directly impacted by deconstruction (Table 20). Industries like construction, remediation, and architectural design services are directly involved in deconstruction. Others, like wood products and furniture manufacturing, might use salvaged products from deconstructed buildings. Relatedly, building material dealers and wholesalers might sell salvaged products.

According to Data Axle, a third-party database of business establishments, there are an estimated 184 businesses in these industries doing $356.8 million in annual sales. These values are purely estimates; they could be higher or lower given recent economic changes resulting from pandemic-related business closures, unemployment, and inflation.

Table 20. Industries Impacted by Deconstruction

Industry	Approx. Number of Businesses	Approx. Annual Sales
Construction	160	$305,230,000
Building Architectural Design Services	1	$2,130,000
Remediation Services	1	$1,070,000
Building Material and Supplies Dealers	11	$22,180,000
Lumber and Other Construction Materials Wholesalers	3	$9,860,000
Wood Product Manufacturing	3	$11,930,000
Furniture Manufacturing	5	$4,360,000
Total	**184**	**$356,760,000**

[32] We used IMPLAN to estimate the economic contribution of deconstruction-related industries. IMPLAN is a leading economic impact model that uses data from the U.S. Bureau of Economic Analysis and other publicly available sources. For this study, we used a 2019 model of Nantucket County's economy. The latest available model year is 2020; however, IMPLAN recommends using the 2019 model because of the significant economic changes that occurred during 2020.

Source: Data Axle

7.1.1. Industry Contribution Analysis

At their current size, the industries in Table 20 contribute about 1,300 jobs to Nantucket's economy (Table 21). Of those, 160 jobs are with suppliers to the industries listed; an additional 220 jobs are supported by worker spending. This could include jobs at cafes, restaurants, and retail shops at which construction workers and their suppliers spend their wages.

Deconstruction-related industries contribute more than jobs to Nantucket's economy. At their current size, they also contribute about $266 million in labor income, $320 million in value added, and $505 million in output. (Value added and output are equivalent to gross domestic product and business sales, respectively.)

Table 21. Economic Contribution of Deconstruction-Related Industries (millions of of 2021 dollars)

Impact	Employment	Labor Income	Value Added	Output
Direct	920	$210.4	$229.6	$356.8
Indirect (Suppliers)	160	$25.2	$35.0	$59.6
Induced (Worker Spending)	220	$30.8	$55.1	$88.9
Total	1,300	$266.4	$319.7	$505.3

Source: EBP analysis of IMPLAN data

7.1.2. Potential Job Creation

The analysis described above summarizes how deconstruction-related industries contribute to Nantucket's economy *today*. If deconstruction became widespread, their contribution could potentially expand. Construction and remediation companies could see increased revenue if hired to do more deconstruction, particularly because it requires more time and labor. Building and renovating homes using salvaged materials would also increase the demand for specialized construction and design services. Similarly, a larger marketplace for salvaged materials would likely generate additional revenue for dealers, wholesalers, and manufacturers.

Other research shows that deconstruction creates significantly more jobs relative to demolition and even building material recycling. The San Antonio Study referenced earlier provides a comparison of the number of post-deconstruction jobs created relative to the amount of waste generated, shown in Table 22.

Table 22. Downstream Jobs per 10,000 Tons of Waste

Waste Stream Process	Jobs per 10,000 Tons of Waste
Landfilling/Incineration (Linear)	1-6 jobs
Recycling (Partial Circular)	36 jobs
Reuse/Refurbishment (Circular)	300 jobs

Source: City of Antonio Office of Historic Preservation, "Treasure in the Walls", February 2021, p. 37. https://www.sanantonio.gov/Portals/0/Files/HistoricPreservation/Deconstruction/Treasure%20in%20the%20Walls.pdf?ver=2021-04-25-115830-417

7.2. Workforce Training Needs

Workforce training needs are important to the success of deconstruction everywhere it takes place and are particularly salient for Nantucket. Deconstruction crews are larger than demolition crews and the deconstruction process takes longer, resulting in greater labor needs.

7.2.1. Workforce Availability

The labor force on Nantucket is limited by the high cost of living and long commute by ferry to reach the Island, and it can be challenging to recruit workers with specialized skills within a small labor market. During the peak season on Nantucket, the island's unemployment rate typically drops below 4 percent, implying a very tight labor market with few available workers.[33] Even during summer 2020, when the national economy was emerging from a recession, Nantucket's unemployment rate was just 4.9 percent.

During the off-peak, unemployment is significantly higher, exceeding 10 or even 15 percent in recent years. However, worker demand is likely lower during the colder months when there is less construction and demolition activity happening (relative to summer months).

7.2.2. Deconstruction Occupational Skills & Experience

Deconstruction requires workers with certain skills, knowledge and experience, both for safety and for efficiency. Contractors and their crews must be trained in hazardous materials handling and safe dismantling of structural building components, among other important topics. A Delta Institute handbook on deconstruction and building material reuse reports that successful building materials salvage requires contractors to have the following specialized competencies:

- Evaluating a building site
- Assuring job site safety
- Knowledge of and management of hazardous materials
- Knowledge of and ability to use tools for building material salvage and deconstruction
- Creating a site plan, schedule, and work plan
- Non-structural and structural deconstruction[34]

[33] U.S. Bureau of Labor Statistics, Unemployment Rate in Nantucket County/town, MA [MANANT9URN], retrieved from FRED, Federal Reserve Bank of St. Louis; https://fred.stlouisfed.org/series/MANANT9URN, April 9, 2022.

[34] Delta Institute, "Deconstruction & Building Material Reuse: A Tool for Local Governments & Economic Development Practitioners", May 2018, p. 23., https://delta-institute.org/wp-content/uploads/2018/05/Deconstruction-Go-Guide-6-13-18-.pdf.

Furthermore, a Portland, Oregon study found that the amount of reusable building materials obtained from a deconstruction effort was highly correlated with the contractor performing the work, much more so than the age or size of building being dismantled. [35] The researchers speculated that this increased efficiency among some contractors was due to greater deconstruction skill and experience.

Demolition contractors and traditional contractors don't necessarily possess the necessary skills and experience. A Delta Institute report observes that though demolition contractors often report having experience with materials salvage, they cannot efficiently salvage structural wood or unique items without specialized training. [36] A study by Cook County, Illinois, found a need for traditional contractors to expand their understanding of valuable salvage materials to enable them to recognize reusable materials and salvage and transport them without damaging them.[37]

7.2.3. Workforce Development Opportunities

Deconstruction and operation of a building materials salvage program or facility creates a range of workforce development opportunities and a shift toward higher value-added, living-wage jobs. The process provides opportunities for entry level deconstruction apprentices, who are lower cost and help minimize the overall cost of deconstruction, as well as experienced craftspeople for finish carpentry and historic restoration.

Operation of a facility can provide valuable work experience in warehousing and logistics, materials appraisal and valuation, and retail sales. Deconstruction and building materials salvage and reuse occupations can provide career-path employment opportunities for individuals with barriers to employment such as at-risk youth and English-language learners. Deconstruction training programs may need to incorporate more general employment skills. For example, the Vancouver (BC) Deconstruction Training for At-Risk Youth curriculum includes "employability, life skills, environmental responsibility and stewardship." [38]

Because deconstruction is not an official occupation recognized by the U.S. Department of Labor, and the skills differ somewhat from recognized construction occupations, employers may have difficulty identifying employees with the appropriate skills and may also have difficulty determining an appropriate wage. [39] The Building Material Reuse Association (BMRA) has developed a deconstruction training program and credential, which is helping establish

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[35] Nunes, A., Palmeri, J., and Love, S., City of Portland Bureau of Planning and Sustainability (BPS), "Deconstruction vs. Demolition: An evaluation of carbon and energy impacts from deconstructed homes in the City of Portland", March 2019, p. 31, https://www.oregon.gov/deq/FilterDocs/DeconstructionReport.pdf.

[36] Delta Institute, "Deconstruction & Building Material Reuse: A Tool for Local Governments & Economic Development Practitioners", May 2018, p. 23., https://delta-institute.org/wp-content/uploads/2018/05/Deconstruction-Go-Guide-6-13-18-.pdf.

[37] Cook County, "Deconstruction Strategy Report", July 2011, p. 23, https://www.cookcountyil.gov/sites/g/files/ywwepo161/files/service/cook-county-deconstruction-strategy-report-draft-2011.pdf.

[38] City of Antonio Office of Historic Preservation, "Treasure in the Walls", February 2021, p. 41.

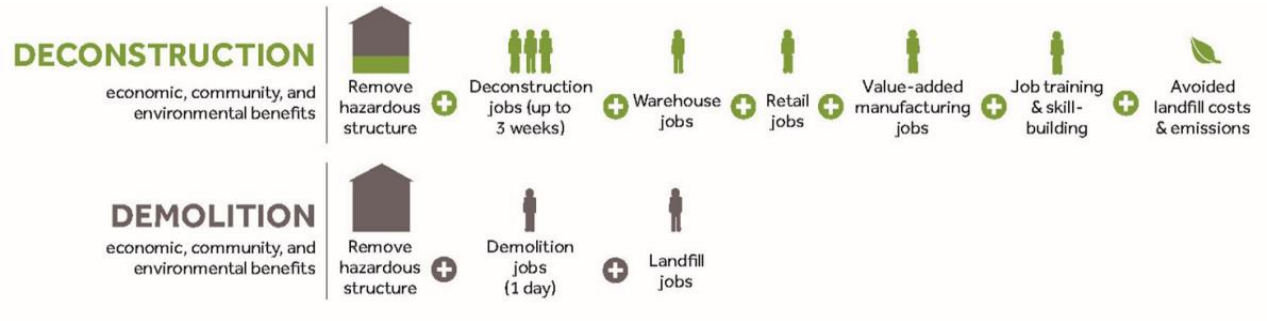
[39] Cook County, "Deconstruction Strategy Report", July 2011, p. 23, https://www.cookcountyil.gov/sites/g/files/ywwepo161/files/service/cook-county-deconstruction-strategy-report-draft-2011.pdf.

deconstruction as a distinct occupation and helping employers identify trained workers and determine appropriate wage rates.

For example, the North Fork Community Development Council Deconstruction Project workforce development program in California, certified participants in safety training, tool handling, scaffold erection, forklift operation, welding, lead abatement, large equipment rigging and hazardous materials handling.

The Delta Institute provides an insightful illustration of the nature of these jobs, shown below in Figure 6.

Figure 6. Jobs and Community Benefits of Deconstruction vs. Demolition



Source: Delta Institute, "Deconstruction & Building Material Reuse: A Tool for Local Governments & Economic Development Practitioners," May 2018, p. 8. https://delta-institute.org/wp-content/uploads/2018/05/Deconstruction-Go-Guide-6-13-18-.pdf.

8. Salvage Facility Feasibility

In Chapter 3 of this study, we summarized interviews with builders and other stakeholders on Nantucket in which we discussed demand for, opinions of, and suggestions for a building materials salvage facility. Interviewees stated that in general there is likely not much demand for the use of salvaged building materials in construction or renovation projects on Nantucket. Salvaged materials that are popular include historically significant doors, windows, moldings, fixtures, flooring, specialty timbers, and unique hardware.

When asked about the feasibility of a salvage facility on Nantucket, interviewees generally believe that it could be successful and that it would be popular among homeowners and builders. Interviewees shared suggestions and concerns related to the operations, financial success, and location of a salvage facility. One builder stressed that education and outreach are key to informing the public on what types of materials are salvageable, that salvaged materials can be high in quality, and on the widespread societal benefits of the reuse of salvaged materials.

In this section we further explore ideas presented by interviewees on salvage facility location and feasibility, discussing facility requirements, potential locations for the facility, potential owners and operators, and estimated construction and operation costs.

8.1. Facility Requirements

To determine facility requirements of a building material salvage facility on Nantucket, we evaluated the available characteristics of comparable facilities in other locations around the U.S. and revisited suggestions for facility requirements expressed by builders and other stakeholders.

From an evaluation of existing salvage facilities around the U.S., smaller facilities appear to typically be between 5,000-6,000 square feet in size.[40,41] Larger facilities can range between 10,000-25,000 square feet or larger. Though these are the sizes of facilities whose operations are comparable to what is envisioned for the Nantucket building materials salvage facility, it is unlikely that a facility of these sizes could be established on the Island due to typical building size and availability constraints. However, builders on Nantucket expressed that they thought a salvage facility could successfully operate in a smaller building. One builder expressed that a facility as small as 1,500 square feet could be sufficient for salvage facility operations, while

[40] Houston-Galveston Area Council, "Guide to Developing Building Material Reuse Centers", https://www.h-gac.com/getmedia/1c66a57e-48c5-4e7b-a07f-c0ef1ae00a1c/guide_to_developing_building_material_reuse_centers.pdf.

[41] These comparable facilities are classified as reuse centers. According to the Building Materials Reuse Association, there is a distinction between reuse centers and reuse stores. Reuse centers handle large volumes of salvaged building materials, including lower value materials such as dimensional lumber, flooring, bricks, and fencing. Reuse stores are more loosely defined but tend to be smaller facilities that handle higher-value architectural salvage materials and fewer C&D materials. For more information, see the U.S. Environmental Protection Agency's "Construction and Demolition (C&D) Materials Scoping Study: Building Materials Reuse Centers", https://www.epa.gov/sites/default/files/2016-01/documents/reuse_centers_scoping_memo_508-fnl.pdf.

others expressed that at least 2,000-3,000 square feet for the facility would be preferable. One interviewee suggested that a standard 40 x 80-foot warehouse would be a reasonable option.

Ceiling height is an important consideration for the salvage facility to ensure that there is enough space for display racks or industrial shelving. Shelves used in warehouses can range in height, with the standard maximum freestanding shelf height set at 15 feet by OSHA.[42] One Nantucket builder suggested that ceiling height for a facility should probably be around 20 feet, however, buildings with ceiling heights as low as 14 feet could be appropriate for the salvage facility if shorter shelving units are used.

In addition to display racks or industrial shelving units, the salvage facility will require a few other baseline needs for its operations. The salvage facility will need a forklift to move heavier items around the facility grounds. The facility will also need a truck or a van that employees could use to pick up items from around the Island. Utilities such as a gas line and electric will need to be accessible to the facility. Other items to consider for the facility include an electronic floor scale and a computer with inventory software.

8.2. Potential Locations

We employed three steps to evaluate potential locations for the establishment of a building materials salvage facility. First, we evaluated the Town of Nantucket's Code, Zoning and Land Use Bylaw to determine which zoning districts may permit the operations that a salvage facility would perform. Second, we revisited the suggested locations heard from builders and other stakeholders and evaluated their zoning. Third, we researched real estate listings current as of March 2022 to evaluate the availability of properties and developable land.

8.2.1. Zoning and Land Use Considerations

To determine available locations on Nantucket for the establishment of a salvage facility, it is important to consider zoning and land use requirements. The intent of the salvage facility will be to store and sell salvaged building materials, including wood, doors, windows, fixtures, hardware, appliances, and furniture. A facility that conducts such an operation will only be permissible in select zoning districts.

According to the Town of Nantucket's Code, "lumberyard" and "bulk merchandise retail", land uses that fall within the commercial industrial category appear to best represent the operations that will be carried out at the salvage facility.[43] "Lumberyard" is defined in the Code as "a facility where building materials such as lumber, plywood, drywall, cement blocks, roofing materials, insulation, and the like, including related products such as wallpaper, plumbing and electrical supplies, paint,

[42] Shelving + Rack Systems, Inc., "10 Shelving Safety Tips to Keep Your Warehouse OSHA Approved", https://www.srs-i.com/blogs/10-shelving-safety-tips-to-keep-your-warehouse-osha-approved/.

[43] We considered other land uses including "contractor shop" but ultimately excluded them due to the use definition being inconsistent with the needs of the envisioned building materials salvage facility.

glass, and hardware, are stored and sold."[44] Whereas, "bulk merchandise retail" is defined as, "the sale of goods that require a large amount of floor space and which involves goods both warehoused and retailed at the same location". The Code also specifies that "Items for sale include large, categorized products such as household appliances, furniture, construction and lawn equipment, electrical and heating fixtures and supplies, plumbing fixtures and supplies."[45]

The commercial zoning districts in which lumberyard and bulk merchandise land uses are permissible are shown in Table 23. A building materials salvage facility falling under one of these two potentially applicable land uses would be permissible on land zoned as commercial industrial (CI), commercial neighborhood (CN), commercial downtown (CDT), commercial mid-Island (CMI), and possibly commercial trade entrepreneurial craft (CTEC) if issued a special permit by the Zoning Board of Appeals.

Table 23. Permissible Zones for a Materials Salvage Facility

Land Use	Commercial Zoning Districts				
	CDT	CMI	CN	CTEC	CI
Lumberyard	N	N	SP	SP	Y
Bulk Merchandise Retail	Y	Y	Y	SP	Y

Note: Y=Yes, this use is permissible. N=No, this use is not permissible. SP=Special Permit issued by the Zoning Board of Appeals.
Source: Town of Nantucket Code, Zoning, Article III, 139 Attachment 2.

Land zoned on Nantucket for these commercial zoning districts is depicted in Figure 7 below.

[44] Town of Nantucket Code, Zoning, Article III, § 139-2, https://ecode360.com/11471477.
[45] Ibid.

Figure 7. Location of Commercial Zones on Nantucket

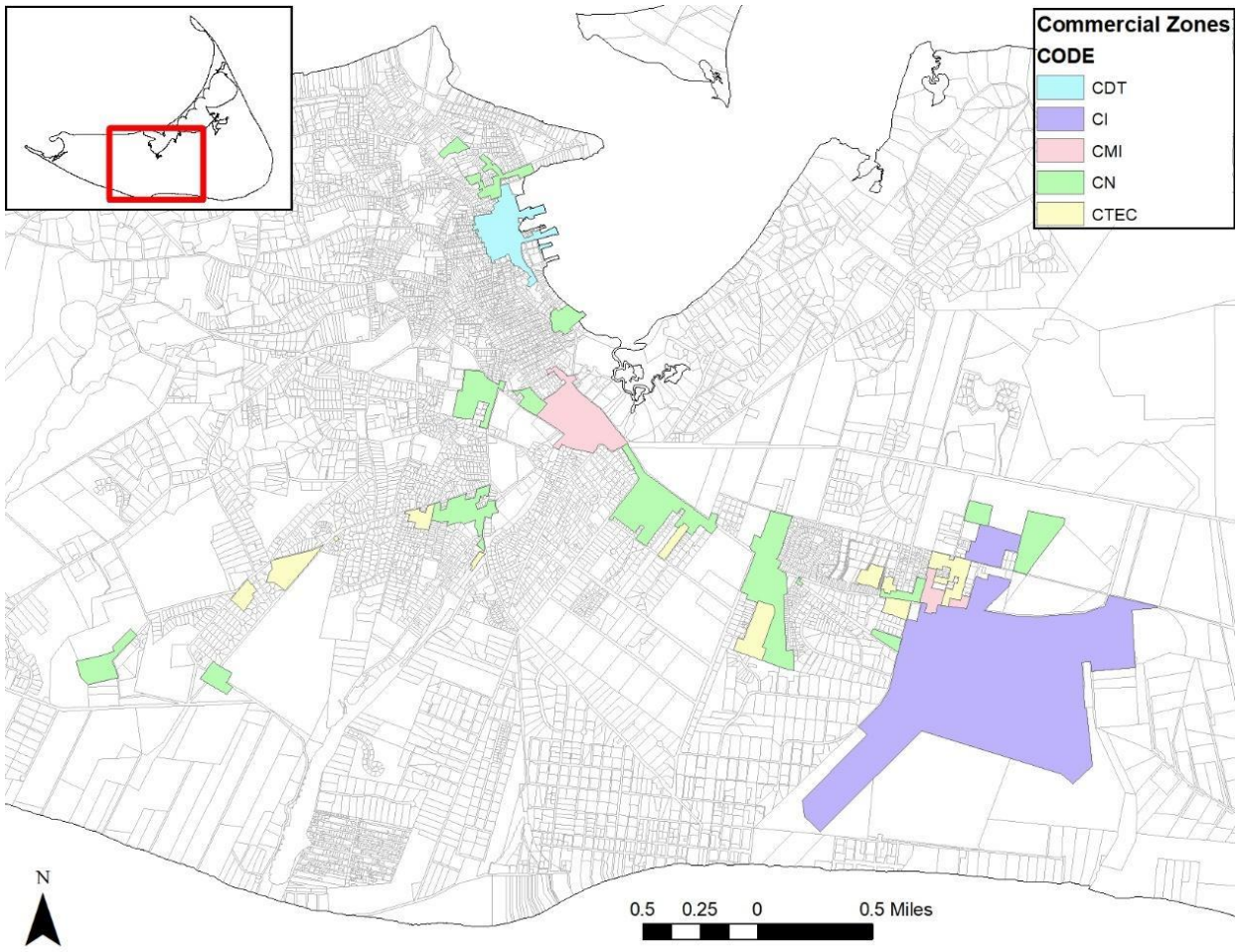


Figure 7 shows that there is a large concentration in the select commercial zoning districts at and around the airport, which is located within the large purple CI district. Note that the only CI zones are located at and across from the airport. The only area where there is CDT zoning is downtown, while the largest district of CMI zoning is located just south of Town. CN and CTEC zoning districts are more spread out. Table 24 below lists the acreage, number of parcels, and average assessed value of parcels in each select commercial zoning district.

Table 24. Acreage and Number of Parcels by Commercial Zone

Zone	Acreage	Number of Parcels	Average Assessed Value
CDT	38	201	$4,100,400
CI	455	135	$3,542,500
CMI	54	141	$1,592,000
CN	214	231	$2,547,500
CTEC	69	152	$1,052,300
Total	**830**	**860**	**$2,645,700**

Since a building materials salvage facility would likely be established within one of these commercial zoning districts, it is important to understand land use requirements in these zones. Table 25 below shows intensity regulations for buildings constructed or used in the commercial zoning districts that permit the use of lumberyards or bulk merchandise retail. Depending on the commercial district, the Zoning Bylaw requires differing minimum lot sizes, front and side/rear yard setbacks, frontage, and ground cover ratio.

Table 25. Intensity Regulations for CI, CN, CDT, CMI, and CTEC Commercial Zoning Districts

Commercial District	Minimum Lot Size (square feet)	Yard Setback		Frontage (feet)	Ground Cover Ratio
		Front (feet)	Side/Rear (feet)		
CI	15,000	20	Side: none Rear: 10	75	50%
CN	7,500	10	Side: 5 Rear: 10	50	40%
CDT	3,750	None	Side: none Rear:5	35	75%
CMI	5,000	None	None	50	50%
CTEC	10,000	10	Side: 5 Rear: 10	50	40%

Source: Town of Nantucket Code, Zoning, Article III, § 139-16 Intensity Regulations.
Note: Exceptions for frontage requirements in commercial districts can be found in § 139-16 part B of the Zoning Bylaw.

In addition to the intensity regulations by commercial district, Article IV of the Zoning Bylaw outlines miscellaneous regulations that may affect land use in the select commercial districts. The Zoning Bylaw outlines off-street parking requirements, stating that for commercial industrial uses such as lumberyard and bulk merchandise retail, there must be one off-street parking space for each 900 square feet of gross floor area that is developed. The Zoning Bylaw also notes that Site Plan Review (SPR) is required before the issuance of any building or use permit, with a few exceptions, including a construction or alteration that does not change the footprint of any buildings on the lot and that does not add parking. Height limitations are also in place for commercial zoning districts; except for CDT and CMI Districts, the maximum height for buildings is 32 feet. For CDT, CN, CTEC, or CI zoned land within the Town Overlay District, buildings may not exceed 30 feet, while CMI zoned land may receive a special permit allowance to 38 feet. [46]

Depending on the location of the commercial zoning district, it may be affected by an overlay district, such as the Town Overlay District. The intent of the Town Overlay District is to ensure that development within the district is consistent with traditional settlement patterns, encouraging the

[46] Additional off-street parking requirements, SPR requirements, height limitations, and exceptions to these requirements can be found in Article IV Miscellaneous Regulations of the Town of Nantucket's Zoning Bylaw, https://ecode360.com/11472207.

use of existing infrastructure and utilities.[47] Lumberyard and bulk merchandise retail land uses are permissible in the Town Overlay District, just as they are in the underlying commercial zoning districts.

8.2.2. Suggested Locations

During the interviews with builders and other stakeholders to better understand public perceptions of salvaged building material reuse, several interviewees made suggestions for a potential salvage facility location. Commonly suggested was land owned by the Town at or near the airport. As shown in Figure 7, there is a large CI district which includes the airport and nearby land to the east. North and west of the airport are various residential and commercial districts including some CN and CMI zoned land, on which a salvage facility could be permissible. Some of the benefits to this option that interviewees noted were that some acreage had already been set aside for use by small contractors, and that salvaged items left outside would have a low aesthetic impact on neighbors. One disadvantage to this option is that available land in the area is quickly shrinking and that there may be requirements for operations on the land near the airport to turn a profit.

Another option expressed in interviews for a potential salvage facility location is on land owned by private businesses such as lumberyards or home furnishing centers. Interviewees mentioned that some private businesses may already own property designed for materials storage, or that they may have land that could be used for storing and selling salvaged materials. Since this land is already being used for lumberyard or bulk merchandise retail purposes, zoning would likely not be a hurdle for this location option. A potential barrier to this option is that private businesses may be unwilling to get involved in such an initiative due to possible competition with their business model.

8.3. Potential Owners and Operators

Various interviewees suggested that the Town of Nantucket or privately owned lumberyards might potentially own and/or operate a salvage facility on Nantucket. There are possible advantages and disadvantages to each option, as discussed below. Note that these are only suggestions; specific arrangements should be explored in more depth during Phase 2 of the study.

8.3.1. Town of Nantucket

Several interviewees suggested the airport as a potential location for a salvage facility, which is also Town-owned property. One advantage of having the Town as owner/operator is that the Department of Public Works already has the knowledge and experience required to manage the

[47] More information on the Town Zoning District is available in Article III, § 139-12 A of the Zoning Bylaw. https://ecode360.com/11472011.

storage of materials. However, operating a new facility would require additional staff and financial resources, and our understanding from interviews is that the Town is understaffed and has had trouble finding workers.

8.3.2. Lumberyards

Nantucket has three lumberyards: Island Lumber, Marine Home Center, and Shepley Wood Products. This option has at least two primary advantages. First, contractors already frequent lumberyards, so having salvaged materials available alongside new materials could possibly incentivize builders to use more salvaged materials because it removes the hassle of having to travel to a different location to obtain them. Second, lumberyards already have the equipment and knowledge needed to transport, organize, and store building materials.

This option also presents challenges. Lumberyards would need a financial incentive to offer salvaged building materials, since they derive their revenue from selling new materials. One interviewee suggested that residents could crowdfund the construction of a facility through donations, which a lumberyard would operate. The lumberyard would then receive a portion of all sales of salvaged materials.

8.4. Facility Costs

This section provides a clearer picture of how much it would cost to operate a salvage facility. It includes a discussion of land/building acquisition costs and labor costs, both of which are heavily influenced by the specific parameters of a salvage facility, including its size, ownership, location, and hours of operation.

8.4.1. Land & Building Acquisition

We evaluated current real estate listings to gain a sense of how costly existing buildings are that could accommodate a salvage facility. Our search focused on areas of the Island suggested by interviewees, and also those located in commercial zoning districts. We searched for listings on the following websites: Berkshire Hathaway Home Services Island Properties, Jordan Real Estate, Silver Realty Group, Inc., William Raveis, Lee Real Estate, Fisher Real Estate, and Killen Real Estate. In total, we found eight commercial property listings current as of March 2022, a few of which are within a zoning district that would permit the establishment of a salvage facility according to the previous section's analysis.

One of the properties we identified that could be appropriate for a salvage facility (but is pending sale as of March 2022), is located at 6 Daisy Way.[48] The property sits on a 0.46-acre lot abutting the airport on CI zoned land. While the entire building is 3,200 square feet, the listing is for half of the building (1,600 square feet) to be leased for $2.6 million until October 2026. The building has

[48] Jordan Real Estate, 6 Daisy Way, https://www.jordanre.com/listing/89126/6-daisy-way-nantucket-ma-2554/.

ceilings of 14 to 16 feet in height. According to the listing, the property is only permitted for storage, warehousing, and contractor's shops. Though this property is no longer available, a property of a similar size, also on CI zoned land near the airport and permitted for retail sales of salvaged materials, could appropriately host a building materials salvage facility.

Another potential listing that we felt could be considered for a salvage facility is a property at 8 Salros Road.[49] This property is located on a 0.12-acre lot, is 1,305 square feet of open interior space, and has 16-feet high ceilings. As of March 2022, the property is listed for $1,750,000. The small size of the building could be a barrier, as well as the fact that it is located in a RC-2 zoning district. While the uses of lumberyard and bulk merchandise retail are not permissible within an RC-2 zoning district, a property used for a contractor shop could receive a special permit within this district. The use of a contractor shop, however, may not allow for all of the operations that would be conducted at the salvage facility.

We also identified some undeveloped plots of land for sale; however, the majority are intended for residential uses. An empty lot of 0.67 acres is available at 111 Old South Road with CTEC zoning. However, the lot is likely too expensive ($4.275 million as of March 2022) to be a reasonable option for the building materials salvage facility.[50]

8.4.2. Labor Costs

The Massachusetts Department of Unemployment Assistance provides occupational wage data for the combined region of Cape Cod, Martha's Vineyard, and Nantucket. To get a sense of expected labor costs for a salvage facility, we obtained wage data for laborers who work in the transportation and warehousing industry—the closest equivalent to a salvaged building materials facility.[51]

Table 26 shows hourly wages and annual salaries for the average transportation and warehouse laborer in the Cape and Islands region. Hourly wages range from $13.23 for entry level workers to $20.18 to more experienced workers, with a median wage of $15.88 per hour. Annual salaries range from $27,500 for entry level workers to $42,000 for experienced workers, with a median salary of $33,000 per year.

According to MIT's Living Wage Calculator, only an experienced warehousing laborer would earn a living wage on Nantucket, which is $19.81 per hour for a single adult with no children.[52] A living wage is even higher for families. This suggests that wage subsidization or a housing allowance would be required to create living wage jobs at a salvage facility.

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[49] Fisher Real Estate, Mid Island – 8 Salros Road, https://fishernantucket.com/nantucket-homes-for-sale/mid-island-8-salros-road/.

[50] Jordan Real Estate, 111 Old South Road, https://www.jordanre.com/listing/89092/111-old-south-road-nantucket-ma-02554/.

[51] The specific occupation is Laborers and Freight, Stock, and Material Movers, Hand (occupational code 53-7062).

[52] MIT Living Wage Calculator, accessed April 4, 2022, https://livingwage.mit.edu/counties/25019

Table 26. Hourly Wages and Annual Salaries for Transportation and Warehousing Laborers

	Hourly Wage	Annual Salary
Entry Level	$13.23	$27,500
Experienced	$20.18	$42,000
Median	**$15.88**	**$33,000**

Source: Massachusetts Department of Unemployment Assistance

9. Conclusions & Recommendations

Moving from a paradigm of building demolition on Nantucket, to one of thoughtful and sustainable deconstruction and building material reuse, is a worthy goal that will pay multiple dividends to the Island of Nantucket and its residents. As has been shown from the Envision Resilience Nantucket Challenge 2022 Survey, Nantucket residents, in addition to their own efforts to reduce their contribution to climate change, are supportive of their fellow homeowners, businesses, government actors, and other community stakeholders in efforts to increase sustainability and resilience on the Island. The research team has identified and quantified the challenges, costs, and multiple benefits of building a culture of deconstruction and building material reuse on Nantucket. These benefits include overall financial savings, carbon and pollution emission reductions, and workforce development opportunities.

With the goal of providing actionable insights into how to better use Nantucket's building and construction resources to have a positive impact on the Island's long-term sustainability, we offer the following insights and recommendations:

- Recent trends in building demolition and renovation indicate that more than 4,500 tons of building materials on Nantucket could be salvaged for reuse per year. A large share of this material will be wood, including flooring, doors, windows, and structural wood.

- Interviews with builders, members of neighborhood associations, and other related stakeholders on Nantucket revealed generally positive opinions surrounding deconstruction practices and the creation of a salvage facility within the community. Interviewees discussed certain barriers to deconstruction related to cost, time, regulations, and logistical challenges, as well as how there is relatively little demand for salvaged materials in construction or renovation projects. Interviewees did note, however, that salvaged items that are unique or historically significant are in demand. Most interviewees believe that a salvage facility on Nantucket would be successful and particularly popular among builders and homeowners and suggested that the best locations for such a facility would be near the airport or on land owned by a private business such as a lumberyard or home furnishing center. In order to encourage more deconstruction over demolition and greater utilization of salvaged building materials, interviewees recommended public outreach to establish better understanding of the quality and uses of salvaged materials.

- Salvaged building materials have a market value of about $100 per ton. If 25 percent of C&D waste on Nantucket was reused, this would amount to $457,000 worth of material. If deconstruction on Nantucket was widespread, the Town would potentially collect between $1.15-1.7 million less in tip fees each year, however, the Town would also likely owe Waste Options Nantucket less in fees and businesses and households would save by not having to pay them.

- Though deconstruction incurs a higher out of pocket cost to consumers and builders than demolition, the additional cost is not significant relative to median and average home prices on Nantucket. The affordable housing industry on the Island avoids impacts because few projects involve removal of existing structures. Instead, structures are commonly integrated into the design of affordable housing developments, and deconstruction and reuse of building materials is already common practice for at least one Nantucket affordable housing provider.

- Reusing the 4,500 tons of reusable building materials disposed of annually will result in significant greenhouse gas (GHG) emission reductions and the reduction of other pollutants associated with transporting C&D waste off-Island, decomposition of organic materials at the landfill, and the embodied carbon emissions of producing new materials to replace materials disposed of as C&D waste. Pollution reductions include avoided emissions of almost 4,000 $MtCO_2e$, 9.3 kilograms of nitrous oxides, 333 kilograms of sulfur dioxide, 11 kilograms of volatile organic compounds, and 104 kilograms of particulate matter.

- Several industries on Nantucket are impacted by deconstruction. At their current size, they contribute about 1,300 jobs to the Island. This contribution could grow if deconstruction was widespread since it is typically more labor and time-intensive than demolition.

- Deconstruction requires workers with certain skills, knowledge, and experience, both for safety and for efficiency. Contractors and their crews must be trained in hazardous materials handling and safe dismantling of structural building components. They must also be trained in how to recognize valuable salvage materials and handle and transport them without damaging them. Deconstruction requires significantly more workers than demolition. The labor force on Nantucket is limited by the high cost of living on Nantucket and the long commute by ferry to reach the Island, and it can be challenging to recruit workers with specialized skills within a small labor market. Salvage facility operators would likely require wage stabilization or a housing allowance to afford to live on-island.

- Regions with deconstruction ordinances or building materials salvage and reuse programs and facilities address workforce training needs by partnering with local agencies to develop and operate training and certification programs. The Delta Institute and the Building Materials Reuse Association have created guides and resources for agencies interested in offering workforce training to support deconstruction and building materials reuse.

- Investigate possibilities for offering a course on deconstruction for the local building industry or potentially for high school students. If a full course is not feasible, consider bringing an expert to Nantucket to offer a series of workshops or training sessions.

- The feasibility of a salvage facility will be explored in more depth during Phase 2 of the study. What our initial research shows is that there are several potential operators and

locations for a facility, but property costs could be prohibitive, and workers might require subsidization in order to pay them living wages given high housing costs on the Island.

The study results suggest further investigation into potential deconstruction policy options and opportunities for deconstruction training to increase deconstruction-over-demolition as a standard building industry practice on Nantucket, with all the multiple benefits that will accrue to the Island and its residents.

Nantucket Building Material Salvage Study

Phase 2 Report

Nantucket Preservation Trust

AUGUST 2022

EBP

Contents

Executive Summary

The Island of Nantucket has a long and proud history of repurposing buildings and building components, dating back to the 17th and 18th century, when reuse was common and disposing of building materials as 'waste' was unthinkable. Only in the 20th century did construction waste disposal become an 'economic' option. Now, every year on Nantucket more than 17,000 tons of construction and demolition (C&D) waste is transported off-Island, much of which is eventually disposed of in landfills in Ohio and Maine. Much of this 'waste' is a result of the demolition of houses on Nantucket, and a significant portion of these discarded materials has the potential to be salvaged and reused through deconstruction. As we face a changing climate and increasing pressure on finite natural resources, it is more important than ever that we use our existing resources thoughtfully and sustainably, and that we have policies in place to support this.

Nantucket Preservation Trust is leading Phase 2 of the Nantucket Building Material Salvage study to address this important challenge. This Existing Ordinance Research and New Ordinance Development phase of the study is intended to explore and report out on the various issues and considerations surrounding potential building deconstruction and building material reuse policy on Nantucket.

The study is composed of eight (8) discrete explorations, including:

1. Research ordinances/regulations around the U.S. related to deconstruction, demolition, and C&D waste disposal.
2. Categorize the different models for salvaged materials collection and sale/distribution (e.g., non-profit, for-profit, municipal) and lessons learned.
3. Research ordinances/regulations around the U.S. related to affordable housing and identify ways to integrate deconstruction to support affordable housing.
4. Research and interview organizations in other communities that have building materials salvage and reuse programs and facilities.
5. Map existing properties and their age to determine how many properties could be impacted.
6. Speak with Nantucket residents about a possible ordinance.
7. Build strategic partnerships with key Nantucket organizations to support a possible ordinance.
8. Recommend ordinance language, incentives, grant programs, and other support mechanisms, identifying partners, options for implementation, and next steps.

Goal and Recommendations

The goal of this study is to provide actionable insights into how to encourage better use of Nantucket's building and construction resources through comprehensive deconstruction policy, while having a positive impact on the Island's long-term sustainability.

The study results indicate that there are multiple policy approaches to encourage or require deconstruction and building material reuse that have been employed by communities around the U.S. to support sustainability objectives. Beyond the clear environmental benefits, the other drivers to implementing deconstruction and reuse policy measures include, historic preservation, depletion of natural resources, declining landfill capacity, cost savings, and the affordable housing crisis.

The primary recommendations of the study include:

- Organize a meeting of Nantucket stakeholders, including key Town officials, to further build strategic support and to assist in building deconstruction and reuse ordinance design and implementation strategy.
- Propose a comprehensive deconstruction ordinance, for approval at Town Meeting, that combines waste diversion and recycling requirements, a demolition fee or refundable deposits, and restrictions related to banned materials, heavy machinery, and certified deconstruction and sustainable building practices.
- Consider baseline deconstruction or recycling minimums that apply to a broad category of structures, such as all residential buildings or all single-family residential buildings, with higher thresholds and/or additional requirements for historic structures (e.g., higher recycling minimum, requirement to salvage all wood for reuse, prohibition on machine demolition).
- Since Nantucket is only one of two towns in the Commonwealth to have a demolition delay period of less than 3 months, extend the delay period to at least 6 months, and preferably 12+ months to allow sufficient time to coordinate building reuse.
- Revise the demolition delay process so that it starts with seeking Historic District Commission approval and then proceeds to public notification (posting an ad). Ensure that the demo delay process and timeline is fixed and consistent for everyone so there will be no financial incentive to try and speed up the process.
- In addition to Massachusetts Historic Preservation Tax Credits, explore additional incentives for citizens who demonstrate a commitment to building deconstruction and material reuse, such as local tax credits or jumping to the front of the building permit, Historic District Commission, and/or Zoning board queue.
- Devote resources to training motivated trades people who want to make a business of building deconstruction.

- Establish an on-island salvaged materials facility where materials can be stored for sale and distribution. Explore the feasibility of expanding the 'Take It or Leave It' operation at the DPW to handle salvaged building materials, as well as the potential for a public-private partnership model to create and operate the facility. Also, put forward a proposal for a small public-facing space in the downtown area, showcasing high-end salvaged materials, including an online inventory of the materials available at the main facility. Develop a viable on-island distribution network of used building materials and offer deep discounts or free materials to affordable housing groups.
- As an interim approach until the ordinance and/or on-island salvaged materials facility can be established, partner with an existing building materials reuse operation off-island (e.g., EcoBuilding Bargains, Boston Building Resources) to store salvaged materials in transportation containers on island and have them periodically transported to the mainland for resale.
- Employ pilot concepts such as the Habitat Nantucket and Habitat Cape Cod proposal for a deconstruction pilot to send trained deconstruction specialists to Nantucket to perform targeted deconstruction on specific homes slated for demolition and then transport the materials back to the Cape Cod ReStores, with proceeds to be shared between the two Habitat chapters. Explore other deconstruction pilot concepts with the Nantucket Land Bank and/or Housing Nantucket as viable short-term solutions to demonstrate the viability of deconstruction practices while the ordinance is being developed and the on-island facility established.
- Use funds collected through deconstruction ordinance fees and fines, and salvaged building materials sold, to support affordable housing development on the island.
- Create and launch a public education and awareness effort to promote building reuse, deconstruction, material salvage and reuse, and historic preservation.
- Make the new deconstruction policy, process, and support mechanisms straightforward and easy to understand and navigate. As one of the interviewed stakeholders said, "People will do the right thing if it's not too difficult. You have to make it easy for them."

Acknowledgements

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Massachusetts), Matthew St. Onge (Boston Building Resources), Deb Beatty Mel (Boston Building Bargains), and all of the interviewees from Task 1.

1. Introduction

Nantucket Preservation Trust is leading this Existing Ordinance Research and New Ordinance Development phase of the Nantucket Building Material Salvage study to explore and report out on the various issues and considerations surrounding potential building deconstruction and building material reuse policy on Nantucket. Building on previous studies that explored and quantified the benefits of reducing Nantucket construction and demolition (C&D) waste, the EBP team expanded the exploration to building deconstruction and material reuse policy options and best practices in communities around the U.S.

This report presents the study findings in four sections: Existing Ordinances (Section 2), Models for Building Materials Reuse Programs and Facilities – Perspectives form Other Communities (Section 3), Nantucket Perspectives (Section 4), and New Ordinance Development (Section 5).

The ultimate goal of Phase 2 of this study is to provide actionable insights into how to encourage better use of Nantucket's building and construction resources through comprehensive deconstruction policy, while having a positive impact on the Island's long-term sustainability.

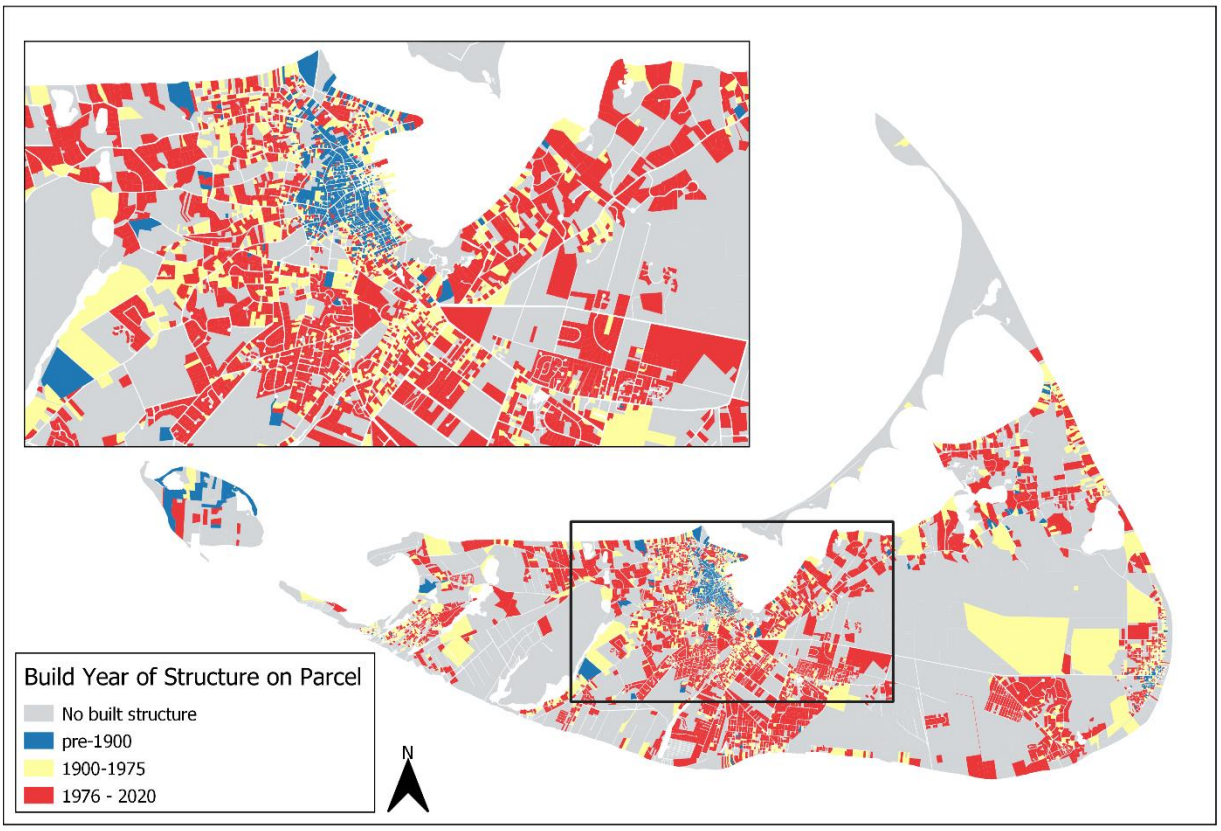
In this report, the terms 'Town' and 'Island' refer to the Town of Nantucket and the Island of Nantucket respectively.

1.1. Property Mapping

The map below shows tax parcels on Nantucket by the year which a structure on the parcel was built. Of the approximately 13,700 tax parcels on the island, about 9,600 parcels contain a built structure. Of parcels containing a built structure, approximately 1,200 structures (13 percent) were built prior to 1900, shown below in blue. An additional 2,200 structures (23 percent) were built between 1900 and 1975, shown in yellow, and over 6,100 structures (64 percent) have been built after 1975, shown in red.

National Park Service considers 1975 to be the end of the "period of significance" for historical buildings that contribute to Nantucket's National Historic Landmark. About 3,500 parcels, or 36 percent of all parcels with a built structure, contain a structure built in or before 1975, many of which are located in Town.

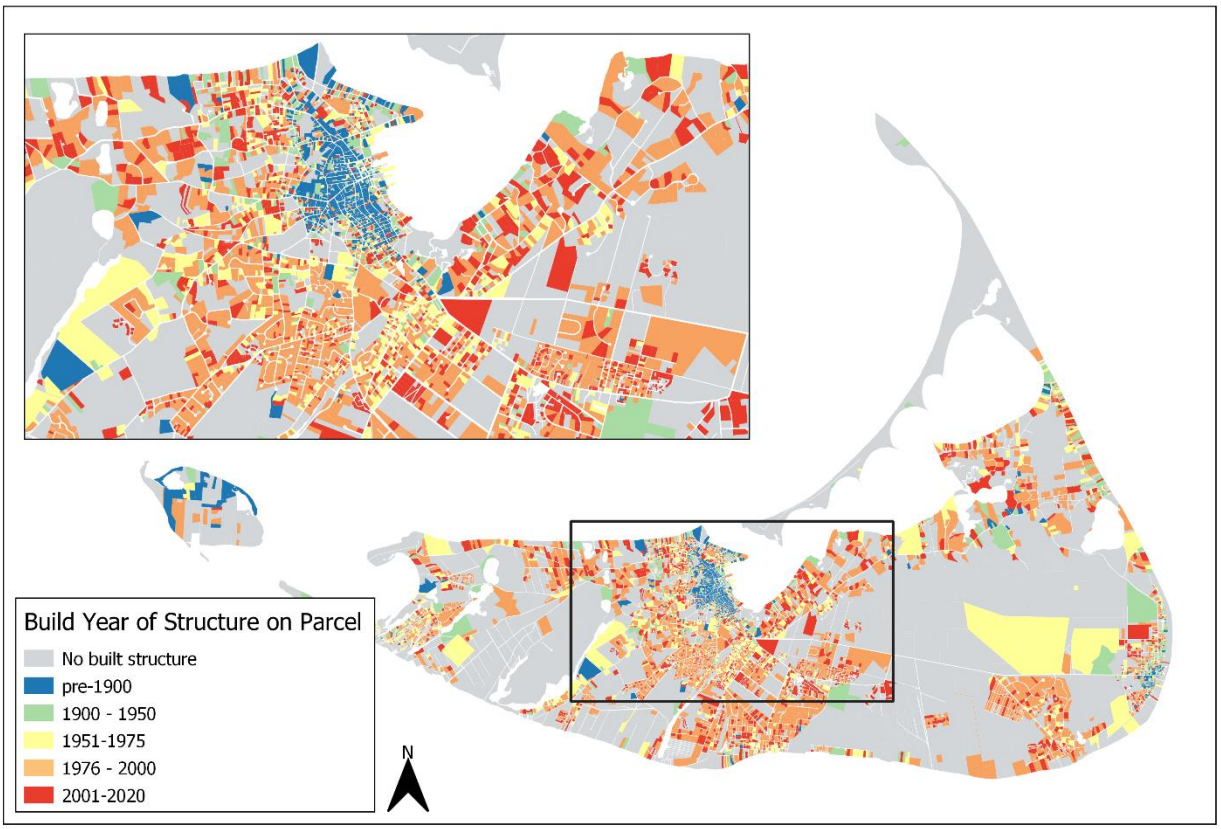
Map 1. Build Year of Structure on Parcel



Source: Town of Nantucket Assessor's Data, EBP Analysis.

Map 2 below shows in greater detail tax parcels on Nantucket by the year in which a structure on the parcel was built. Over 1,000 structures (11 percent) were built between 1900 and 1950, shown in green, and an additional 1,200 structures (12 percent) were built between 1951 and 1975, shown in yellow. In addition, between 1976 and 2000, 4,100 structures (43 percent) were built, shown in orange, and 2,000 structures (21 percent) have been built since 2001, shown in red.

Map 2. Build Year of Structure on Parcel (detailed years)



Source: Town of Nantucket Assessor's Data, EBP Analysis.

2. Existing Ordinances

2.1. Overview of Existing Ordinances that Require or Encourage Deconstruction

Over the last 20 years, municipalities across the country have adopted ordinances that either specifically require deconstruction, or encourage deconstruction through waste diversion minimums, source separation requirements, or sustainability "points" systems that reward salvage, reuse, source separation, and/or diversion of building materials. Some ordinances, such as many in California municipalities, were driven by the need to meet the standards of state-level environmental legislation. Others were established in recognition of the significant contribution construction and demolition (C&D) waste makes to landfills, and to reduce municipal waste costs and environmental burdens. Notably, the Portland, Oregon ordinance was in large part driven by citizen dissatisfaction with the amount of noise and dust being generated by the high number of demolition projects occurring in neighborhoods throughout the city.

The Appendix contains a table summarizing key characteristics of 15 ordinances including a summary of ordinance requirements, the type of buildings or demolition activity it applies to, reporting requirements, the municipal department or official responsible for program administration and enforcement, penalties for violations or non-compliance, along with links to each ordinance and relevant supporting documents and reporting forms.

2.2. Ordinances with Deconstruction & Reuse Requirements

Of the ordinances analyzed for this study, five specifically require deconstruction of applicable structures (see "Applicability" below). Two of the five (Portland, OR, and Boulder, CO) explicitly prohibit the use of heavy machinery in any way that would render salvageable materials unsalvageable.

Five additional ordinances strongly encourage deconstruction without explicitly requiring it, each in a different way. For example, Vancouver, B.C.'s Green Demolition By-Law credits re-use of materials at a rate of five times its actual weight. This encourages at least soft stripping[1] or partial deconstruction as reusable materials are difficult to obtain by machine demolition. San Mateo, CA requires site separation "to the maximum extent feasible" for certain materials, and site separation is both difficult to achieve using machine demolition and also increases the recyclability and reusability of building materials. Cook County, IL's Demolition Debris Diversion Ordinance requires that 5 percent of materials from residential demolition be reused. Evanston, IL and King County, WA both include deconstruction and materials reuse criteria as options among a broader range of sustainability measures that must be satisfied to comply with the terms of the building permit.

2.3. Ordinances with Diversion

Many ordinances, whether or not they require deconstruction, establish diversion minimums, meaning that certain percentage of total C&D waste or of certain materials must be diverted from landfill disposal through recycling or reuse (either reuse onsite or sold or donated for offsite reuse). Some ordinances mandate or require that materials be sent to waste handling facilities capable of separating materials to determine weight by type. Higher diversion rates and source separation encourage deconstruction because the machine demolition process comingles waste, making it difficult to recycle, and damages materials so they cannot be reused.

Though most ordinances state diversion as a percentage by weight (and sometimes by weight or volume), Austin Texas's Construction and Demolition Recycling Ordinance gives applicants a choice to meet diversion minimums or disposal weight-per-square foot maximums. Another unique feature of Austin's ordinance is that the statute phases-in over 14 years. Originally established in 2016, diversion minimums increase and weight maximums decrease in 2020 and

[1] Soft stripping is a selective deconstruction process to remove high-value materials that are simple to remove such as doors, lighting fixtures, cabinets and vanities.

again in 2030. In 2020 and 2030, the City Manager is required to make a report to the City Council on the economic impact of disposal and diversion rates on household affordability and assess future markets for reuse of construction and demolition materials. This stipulation integrates an element of program evaluation which can be used to revise the ordinance if necessary.

2.4. Ordinances that use a "Scorecard"

A few ordinances that are more generally concerned with sustainability rather than specifically focused on deconstruction or C&D waste reduction employ a scorecard or points system. For example, under Evanston, Illinois's Green Building Ordinance, applicants are required to meet a certain number of "sustainability measures" depending on project type. Applicants indicate which measures they intend to meet, and materials reuse, materials salvage, and use of locally sourced materials are included among the choices. However, under this system, it is possible for projects to satisfy program requirements without selecting any measures related to deconstruction or materials reuse.

King County, Washington's Green Building and Sustainable Development Ordinance uses a Sustainable Development Scorecard developed by the County. The scorecard awards points for a wide range of sustainability measures including reuse of salvaged materials, use of on-site materials for construction, use of materials obtained within 500 miles of the jobsite. An innovative feature of the scorecard is that it awards points for projects designed for future disassembly, which scorecard instructions define as "a building design process that facilitates a longer life for a building and allows for the easy recovery of products, parts, and materials when a building is disassembled or undergoes renovation. The process is intended to maximize economic value and minimize environmental impacts through reuse, repair, remanufacture and recycling." This includes using materials that can be easily reused or recycled, designing connections that are accessible, using bolted, screwed, and nailed connections, and other design measures that facilitate interchangeability and safe deconstruction. As with Evanston's ordinance, King County's scorecard can be satisfied without selecting any measures related to deconstruction or materials reuse. However, the King County ordinance also bans clean wood (untreated, unpainted), cardboard, metal, new scrap gypsum, and asphalt, bricks and concrete from the landfill. Though this doesn't specifically require deconstruction, at a minimum builders will need to employ a certain degree of source separation to meet this requirement.

2.5. Applicability

The ordinances specify what type of activity or structures they apply to, and the ordinance may establish different requirements or thresholds for different activities and structures (and combinations of structures/activities) such as:

- Specific construction activities, e.g., all demolition or all new construction
- Building types by use (residential, commercial, single family, multifamily) or construction (wood-frame, steel frame)

- Building age (e.g., built before 1940, built before 1910) or historic designation (e.g., historic structures, structures in historic districts)
- Building size (square feet)
- Projects of a certain value (e.g., renovations of $100,000 or greater).

This approach can allow a municipality to place special emphasis on salvage and preservation of historic materials. For example, Vancouver, B.C.'s Green Demolition By-Law applies only to homes built before 1950, but applies a higher recycling minimum and an additional salvage requirement on homes built before 1910, as follows:

- 75% of materials by weight must be reused or recycled for houses built before 1950;
- 90% of materials by weight must be reused or recycled for houses built before 1950 and deemed as a character house by the building department;
- Minimum wood salvage requirement of 3 metric tons for houses listed on the Vancouver Heritage Register or built before 1910.[2]

Portland, OR's Deconstruction of Buildings Law initially applied to homes built before 1910, as this was the group of homes most frequently being demolished. This limited implementation gave the market a chance to attract and train certified deconstruction contractors and develop a distribution network for used building materials. The success of the ordinance led the City to expand the ordinance to all homes built before 1940, and it may ultimately be extended to homes of all ages.

Due to the high volume of structures of all ages being demolished on Nantucket, it may be advisable to have at least a minimum regulation that applies to a large number of structures, such as all residential buildings or all single-family residential buildings. Additional regulations, such as a higher recycling minimum, requirement to salvage all wood for reuse, or prohibition on machine demolition could then be applied to historic structures if desired.

2.6. Enforcement Models

Most ordinances are primarily enforced through penalties for non-compliance/violations. Penalties can include fines, civil charges, and/or delay or withholding of final occupancy permits. Fines and penalties can range from hundreds to thousands of dollars, and they can be imposed per violation and/or per day that each violation continues.

Five of the featured ordinances are deposit-based, which means that applicants for demolition permits pay a deposit upfront which is refundable at the conclusion of the project if program

[2] City of Vancouver Demolition Permit with Recycling and Deconstruction Requirements

requirements are met. Non-compliance results in proportional or complete forfeiture of a deposit and can also result in additional fines (as in Vancouver, B.C. and Concord, CA) or denial of final permits. Concord, CA's ordinance calls it a "Performance Security Fee", and it is calculated based on project valuation. This is in addition to a non-refundable application fee that covers program administrative costs. Under Boulder, CO's ordinance, applicants pay a small administrative fee of $212 and a refundable deposit equal to $1 per square foot of demolition or renovation area, with a minimum deposit of $1,500. For this type of ordinance, it is critical to determine a dollar amount that is significant enough to motivate homeowners to comply but not cost-prohibitive to lower-income homeowners.

2.7. Use of Approved Contractors, Haulers, or Disposal Facilities

Two of the deconstruction ordinances - Portland, OR's Deconstruction of Buildings Law and the similar Milwaukee, WI Deconstruction Ordinance - require the use of deconstruction contractors who are certified by the municipality. This requires each city to establish a certification process and to maintain a current list of certified contractors. A certification requirement has the disadvantage of creating an additional administrative layer to the process. However, it has the advantage of facilitating the creation of a group of professionals who can be expected to know ordinance requirements and who can be held accountable for meeting them under penalty of fine, removal of certification, or both. Portland's ordinance also requires the use of municipally approved waste haulers or disposal facilities, as do Concord, CA and Palo Alto, CA. In addition, San Jose, CA and Austin, TX recommend, but do not require, use of certain facilities/haulers.

2.8. Reporting Requirements

All of the ordinances surveyed require some level of reporting and documentation. Typically, a demolition plan, deconstruction plan, and/or recycling plan is required in conjunction with application for a construction or demolition permit. Applicants are typically required to estimate the amount of construction waste to be generated, usually by material category such as wood, concrete, metal, and other materials. Most ordinances leave this up to contractors. The City of Vancouver, B.C. created an online Demolition Waste Generation Rate Calculator to help homeowners estimate the minimum amount of waste they will be required to recycle, in total and by material (concrete asphalt, wood, metals, drywall, and "other") to meet municipal requirements. Palo Alto's ordinance requires that a Salvage Survey be completed by an approved reuse organization or other third party to itemize and estimate by weight materials eligible for salvage.

Pre-project reports also sometimes ask applicants to document how waste will be collected and how and where it will be transported for disposal.

All of the ordinances also require some type of post-project reporting that documents how requirements were met. Required documentation typically includes all disposal weight tickets, receipts for materials donated or sold, and photos of materials reused onsite or for which otherwise no receipt or ticket is available.

Some municipalities provide pre- and post-project reporting forms that can be submitted in hard copy or sometimes by email. Madison, WI gives applicants the option to use their online WasteCapTrace reporting system, as well as the ability to file hard copies or submit reports by email. Concord, CA and Cook County, IL both use online waste management reporting systems hosted by Green Halo.

3. Models for Building Materials Reuse Programs and Facilities – Perspectives from Other Communities

EBP researched building materials salvage and reuse programs and facilities across the country to determine the different operational models. Through our research, we identified examples operated by (1) non-profit organizations, (2) municipalities, (3) for-profit model, and (4) non-warehouse-based programs.

3.1. Non-Profit Model

The most common model for materials reuse distribution is the non-profit warehouse/store model. We analyzed the following non-profit building reuse programs to identify key operational details:

- Reuse Center at Boston Building Resources, Boston, MA
- EcoBuilding Bargains, Springfield, MA
- ReBuilding Center, Portland, OR
- Building Resources, San Francisco, CA
- The Great Exchange, Devens, MA
- The ReUse People (nationwide)

Reuse Center at Boston Building Resources (BBR), Boston, MA. The Boston Building Materials Co-op Charitable and Educational Fund operates a 9,000 square foot warehouse for collection and retail sale of used building materials. They primarily receive used building materials from homeowners and contractors, but also periodically receive batches of new materials from retail home improvement stores (e.g., surplus unsold merchandise) and wholesale distributors (e.g., discontinued products).

The BBR's primary goal is to sell materials to low-income buyers and non-profit organizations. These customers receive materials at a 50% discount from retail price paid by the general public. Most materials are sold to walk-in buyers, but materials are also sold over the phone or through the website. BBR advertises materials on Craigslist, which helps increase visibility of available items. Smaller, unique items are sometimes offered for sale on eBay.

To price materials, the BBR purchased a custom-designed pricing database. The database indicates the approximate value of an item, then experienced retail sales staff adjust the price up or down depending on age, appearance, and demand.

In 2020, the facility did $353,000 in sales on donated materials valued at $1.15 million. In 2019 and 2020, BBR had operating budgets of $1.3 million and $1.0 million, respectively. In 2020, grants, contributions, and membership dues comprised approximately 27% of operating budget, however in a typical year without an unexpected drop in sales due to COVID-19 lockdowns, grants and contributions comprise more like 15-20% of the budget.

BBR employs about 15 people, including executive management. Staff positions include from retail sales representatives, materials receiving and processing, a database manager, donations managers, advertising/marketing, and interior and kitchen designers. BBR has a box truck, staffed by a driver and a material handler that collects materials from jobsites and homeowners throughout the Boston metro area, on a fee for service basis.

Of the 9,000 square foot warehouse space, 2,300 square feet is dedicated to materials receiving and processing. The facility also has a gas line and 220-volt electrical service to test donated appliances, however, testing is minimal. Staff typically verify that an appliance will power on, but, for example, they do not verify that an oven reaches the temperature it is set to. In 2020, BBR remodeled its warehouse to improve operations and achieve net zero carbon through all electric systems powered by a rooftop solar array.

Figure 1. Inventory of Doors at Boston Building Resources

Photo credit: Boston Building Resources.

EcoBuilding Bargains, Springfield, MA. The Center for EcoTechnology, a non-profit environmental organization, operates a building materials reuse warehouse and retail store in Springfield, MA. The facility was created from a former furniture warehouse that CET improved through a deep energy retrofit. The ground floor houses a 30,000 square foot retail store and 20,000 square foot building materials warehouse. The basement level, which is not served by a freight elevator, is used to store smaller items being sold by ecommerce. The facility is not located in a retail area and does not receive pass-by shoppers.

The facility is operated by 14 staff, including positions for retail sales, cashiers, warehouse, e-commerce, and shipping/receiving, and management. EcoBuilding Bargains offers pick-up service, which requires drivers and dispatch/logistics staff. The store also has two donations representatives who are part of the sales department and are dedicated to developing relationships with builders, lumber yards, manufacturers, and other potential donors.

The Center for EcoTechnology (CET) is a non-profit organization based in Springfield, MA. Established in 1976, the organization's mission is "to research, develop, demonstrate and promote those technologies which have the least disruptive impact on the natural ecology of the Earth". CET pursues this goal through innovative pilot programs and production scale services. CET operates the EcoBuilding Bargains used building materials store and warehouse, administers the Massachusetts Department of Environmental Protection (MassDEP)'s RecyclingWorks Massachusetts program. CET has resources to help businesses, households, and builders reduce energy use, reduce

In general, new materials are priced at 50% of retail price and used materials are priced at 30% of retail, subject to an adjustment for quality and condition. To price specialty items, EcoBuilding Bargain does research to determine the value, or uses information from the donor such as the original receipt. The store has projected sales of $1.5 million for 2022, an increase of 15% over the previous year. EcoBuilding Bargain does not keep track of the underlying value of goods sold.

The operation receives many doors, windows, lighting fixtures, and cabinets. New doors obtained through relationships with manufacturers and distributors typically sell very quickly, while individual used doors, including historic pieces, take much longer to sell. Similarly, sets of new wood windows sell quickly, while used vinyl or fiberglass windows take longer. EcoBuilding Bargains accepts newer appliances (up to 7 years old) in working condition. The facility does not test the appliances, and appliances are the only materials eligible for a cash refund (within 7 days of purchase). However, because many appliances are sourced from donors with whom donations representatives have developed relationships, non-functional appliances are rarely an issue.

Martha's Vineyard Pilot Project. CET completed a pilot project on Martha's Vineyard to collect materials for re-use on-island. The project encountered a mismatch between available materials and users. They found, for example, that someone remodeling a 1,000 square foot Cape style

home is unable to use cabinets donated from the deconstruction of a 10,000 square foot mansion because although they are of very high quality, they are built to a much larger scale and simply don't fit in the smaller kitchen. Conversely, they found that homeowners building multi-million-dollar custom homes were uninterested in reusing materials, even high-quality materials from homes of similar value. EcoBuilding Bargains customer base is not limited to a single island and instead draws customers from a much larger trade area. As a result, the store is better able to match available materials to interested buyers.

As a result of lessons learned, CET is engaging with the Martha's Vineyard Builder's Association, the island's waste hauling service, and local contractors to determine the logistics of collecting materials on-island, determining what can be reused on-island, and transporting the rest to EcoBuilding Bargains for resale. CET currently provides a storage container on Martha's Vineyard for materials collected by Habitat for Humanity. When it is full, CET transports the container to EcoBuilding Bargains. The store values the materials and issues a check in that amount to the Martha's Vineyard Habitat for Humanity. This is currently the only materials donor that CET compensates in this way. (Typically, donors receive a donation receipt for tax purposes).

CET Technical Assistance for Deconstruction. CET administers the Massachusetts Department of Environmental Protection (MassDEP) RecyclingWorks in Massachusetts program. RecyclingWorks in Massachusetts is a state-funded recycling assistance program that helps businesses and institutions reduce waste and maximize recycling, reuse, and food recovery opportunities. Program services are provided to businesses (rather than consumers) and include virtual and in-person technical assistance to help increase recycling and reuse of a wide range of materials. The unofficial program motto is "we can help any business properly dispose of any material". The RecyclingWorks program is available state-wide, and CET holds a similar contract with Connecticut's Department of Environmental Protection and is able to provide services throughout that state as well. CET can provide more limited forms of assistance to businesses nationwide.

The program has a C&D waste specialist on staff and specific services related to building materials reuse include creating waste management plans and project-specific cost comparisons of demolition versus deconstruction. Massaro gives presentations to contractors and builder's associations to demystify deconstruction. The program approach is to encourage contractors to begin by removing easier pieces such as bathroom vanities or perform a soft strip. This familiarizes contractors with the process which often motivates them to increase the amount of deconstruction they perform.

CET is currently providing technical assistance to the South Mountain Company, a large builder on Martha's Vineyard, to support the complete deconstruction of a residential home. As part of the project, CET is making a documentary film of the effort to be used to raise awareness of deconstruction.

ReBuilding Center, Portland, OR. The non-profit Our United Villages operates this 30,000 square foot used building materials warehouse. The organization's mission to support construction materials reuse and building repair for sustainability has recently been expanded to incorporate environmental justice. The Center's activities are supported by a six-person administrative team.

The store sells donated building materials at 40% to 90% off retail and offers free materials to public service organizations and projects through an application process. The store employs 11 staff, including two managers and an assistant manager, five salvage specialists, and four drivers/materials handlers that together make over 1,000 pickups per year. In 2019, the Center accepted donated materials valued at approximately $1.4 million.

The Center also offers classes in woodworking, carpentry, electrical, and plumbing, as well as a deconstruction service. The educational program is staffed by four instructors, a program manager and program coordinator and generates approximately $125,000 in annual revenue. The deconstruction service generates approximately $150,000 in annual revenue.

The store and education program have an annual budget of $2 million, [3] and receives $1.5 million in grants and donations.

Building Resources, San Francisco, CA. This non-profit store is unique among those summarized here because in addition to used building materials, they sell a wide variety of used landscaping materials. Materials are sold to the public from a 1-acre site with 3,300 square foot warehouse[4] and multiple storage outbuildings. Materials pick-up can be arranged. The organization also offers workshops and classes on repair and reusing materials for landscaping and furniture building.

The Great Exchange, Devens, MA. The Great Exchange accepts operating supplies, furniture, and small fixtures for sale to community organizations, daycare facilities, schools, libraries, municipal departments, nonprofits, and small businesses. Though this reuse store does not collect and distribute used building materials, and is not open to the public, it is an interesting model for consideration.

Items are priced at 50% of retail value. The website explains the operation as follows:

> "The Great Exchange provides establishments with an alternative solution for items that cannot be used internally with the added benefits of avoided disposal cost, community stewardship and environmental protection. Inventory is sourced from manufacturers with reusable by-products, firms with new processes and facilities that are remodeling or

[3] Revenue, budget, and donation figures are from the organization's 2019 IRS 990 form.
[4] Building size estimated based on building footprint visible from Google Maps.

> closing. Accepted items include new or like new materials that could be used in a classroom, library, town office, non-profit or business setting."[5]

In 2021, the Great Exchange collected materials from six businesses, four retailers, three schools, three non-profits, and a college. Materials were sold to 130 small businesses, municipalities, non-profits, schools and libraries from more than 50 towns. The Great Exchange also donates materials to public service programs. For example, 100 trays no longer needed by a local food manufacturer were given to a program that supports immigrant farmers and nearly 100 potable water jerry cans and several cases of writing pads were donated to a school in the Republic of Congo.

The Reuse People, multiple locations in CA, CT, ID, IL, TX, UT, WA, and WI. Established in San Diego, CA in 1993, The Reuse People now operates multiple facilities throughout California and several other states. Headquartered in Oakland, CA, they operate retail warehouses in Oakland, North Haven, CT, Maywood, IL, and Salt Lake City, UT. Other locations offer a range of deconstruction and materials reuse services including deconstruction contracting (arranging independent IRS appraisal, soliciting deconstruction bids, and collecting salvaged materials). They also operate The ReUse Institute (TRI), located in Oakland, which provides deconstruction training and certification as well as workshops on deconstruction and retail-warehouse operations.

Figure 2. The ReUse People Retail-Warehouse, Oakland, CA

[5] The Great Exchange - The alternative solution for excess resources – (tgedevens.com)

Photo credit The ReUse People website.

3.2. Municipal Model

Houston Building Materials Reuse Warehouse, Houston, TX. This facility was established through a grant from the Houston-Galveston Area Council of Governments to store salvaged building materials until they can be used by community groups. The facility is not open to the public and materials are not for sale, they are only available free to non-profit organizations. Materials are housed in a 12,000 square foot warehouse[6] and due to staff limitations, pick up service is not available and people donating materials are asked to assist with the unloading. Donors are given donation receipts for tax purposes. Non-profit shoppers select desired items, then weigh them on the facility's floor scale to help the Public Works Department keep track of the amount of material diverted from the landfill.

TIPS Warehouse, Huntsville, TX. TIPS stands for "Trash Into Plowshares". This facility was established in 2002 "to reintroduce construction and deconstruction materials into economic mainstream with a creative infrastructure[7]". As with Houston's Reuse Warehouse, this operation was established by a grant from the Houston-Galveston Area Council of Governments. The operation recruits donors and "shoppers" (explained below) through ongoing community outreach through flyers, referrals from non-profit organizations, newspaper articles and other media features, and by "word of mouth". Donors are motivated by the opportunity to avoid paying disposal fees by donating materials to the TIPS warehouse.

Useable building materials, excluding appliances, are brought to the City's transfer station, weighed, then stored in a dedicated warehouse. Similar to Houston's Reuse Warehouse, materials are not for sale but instead are offered free to low-income homeowners and non-profit organizations. Upon entering the facility, these qualified "shoppers" obtain a voucher and weigh their transport vehicle to determine its empty weight. Once they have selected desired materials and loaded them into their vehicle, the vehicle is weighed again to document the amount of material being diverted from the municipal landfill.

[6] Building size estimated from building footprint visible on GoogleMaps.
[7] City of Huntsville Solid Waste Services presentation.

Figure 3. TIPS Warehouse, Huntsville, TX

Photo credit: City of Huntsville Solid Waste Services presentation.

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3.3. For-Profit Model

Ballard Reuse, Seattle, WA. This for-profit reuse retail store was established on the site of a former Habitat for Humanity Re-Store. The business offers materials pick-up and salvage services and sells salvaged materials to the public. Ballard offers cash or store credit for materials picked up but does not pay cash for materials dropped off at the store. They also accept donations on behalf of the non-profit Seattle ReCreative who receives a percentage of the sale of those materials. Materials donated to Seattle ReCreative are eligible for tax benefits. A representative from the store indicated that they pay for the majority of their stock and that the model works well for them.

Ballard Reuse is a member of the Northwest Building Salvage Network, a collaborative effort of Puget Sound businesses committed to promoting the salvage and reuse of building materials. Two other for-profit reuse stores - Second Use and Earthwise Architectural Salvage - are also members and all three are certified by the City of Seattle to perform Salvage Assessments. While the City of Seattle does not require deconstruction, it is strongly encouraged and the City waste management website guides builders and homeowners to Network resources.

3.4. Non-Warehouse Based Deconstruction and Reuse Programs

The Deconstruction & ReUse Network (DNR), Long Beach, CA. This company, established in 2007, combines a deconstruction network with a reuse network. The organization describes itself like a bicycle. The front wheel is a deconstruction network comprised of project managers, facilities managers, deconstruction contractors, sustainability managers and other professionals who advocate for, and provide their clients with, cost effective alternatives to traditional demolition and waste disposal. The back wheel distributes salvaged items and surplus property to a network of local and international non-profit organizations for reuse.

DNR offers residential and commercial complete deconstruction and selective salvage services including on-site project review and solicitation of deconstruction bids. DNR also offers commercial surplus property waste diversion to connect donors' oversupplies with local and international non-profits in need of the items slated for disposal. DNR also coordinates delivery logistics.

Recipient organizations make use of donated materials in a range of ways. For example:

- The non-profit housing organization Corazón incorporates donated materials directly into home building;
- San Francisco Unified School District and Oakland Zoo use donated items for operations; and
- Habitat for Humanity ReStores sell discounted materials to the public and use the proceeds to fund the organization's civic mission.

3.5. Models for Integrating Materials Reuse with Affordable Housing

While none of the deconstruction and C&D ordinances reviewed for this project contained language specifically tying them to affordable housing, existing building materials reuse programs and facilities support affordable housing both directly and indirectly.

The building materials reuse facilities featured in Section 3 that re-sell materials, even for-profit operations such as Ballard Reuse, typically price them below their retail price as new materials. This practice indirectly supports affordable housing development by providing a source of lower cost materials. Moreover, many of the programs (Table 1) also provide more direct support for affordable housing through special discounts and/or free materials to non-profit community groups, including affordable housing non-profits, and sometimes to low-income homeowners.

Table 1. Building Materials Reuse Operations that Provide Discounted Pricing to Non-Profit Organizations and/or Low-income Individuals

Organization	Discount
Reuse Center at Boston Building Resources	50% discount to low-income homeowners and non-profit organizations
ReBuilding Center (Portland, OR)	Free materials to public service organizations/projects through application process
The Great Exchange (Devens, MA)	Materials not for sale, available free only to community organizations, daycare facilities, schools, libraries, municipal departments, nonprofits, and small businesses
Houston Building Materials Reuse Warehouse	Materials not for sale, available free to non-profits only
TIPS Warehouse (Huntsville, TX)	Materials not for sale, available free to non-profits only
Deconstruction & ReUse Network	Some materials are donated to domestic and international civic/relief organizations

Alternatively, some operations sell materials to the public and use the proceeds to fund affordable housing. Perhaps the most well-known organization to follow this model is Habitat for Humanity. Local Habitat for Humanity organizations operate ReStores. Each ReStore is independently owned by the operating organization. ReStores sell discounted building materials, furniture, and appliances to the public, generating revenues that support Habitat's mission of providing shelter and affordable housing. The two building materials reuse operations surveyed for this report that follow this model – The CET's Martha Vineyard partnership and the Deconstruction & ReUse Network - are both affiliated with Habitat for Humanity.

3.6. Implications for the Sale and Distribution of Nantucket's Salvaged Building Materials

The municipal models featured above do not have the staff or organizational capacity to inventory and sell materials. However, a non-profit organization that does sell materials may not be able to obtain a site on Nantucket due to cost and scarcity of space. If the Town has a suitable site, there may be an opportunity for a partnership with a non-profit operator.

Nantucket may find, as Martha's Vineyard did, that many materials cannot be re-used on-island. Instead of establishing a distribution facility on the island, Nantucket may consider pursuing a partnership with an off island building materials salvage and re-use program like CET's partnership with Habitat for Humanity on Martha's Vineyard. Though this approach would forgo some of the greenhouse gas savings, as materials would still be shipped off-island, and new materials shipped on-island for new construction, at least materials would largely stay in New England for re-use, rather than being shipped to landfills in Maine and the Midwest. This type of partnership has the advantage of not requiring costly retail warehouse space on Nantucket, but instead only requires a space to store materials until they can be transported off-island. Such an arrangement would only require enough space for one or more TEU-type containers. Moreover, the need for retail and warehousing staff on Nantucket would be avoided, which is a significant advantage in terms of operational cost savings. It limits opportunities to workforce training for retail and warehousing on Nantucket but deconstruction activities, however, would still present workforce training opportunities and support living-wage jobs.

The for-profit model is generally used by businesses that also offer deconstruction and salvage services, as the businesses are highly complementary (i.e., the business receives revenues from both deconstruction and resale of salvaged items). Instead of accepting materials donations for which the donor receives a receipt for a tax write-off, they purchase materials from deconstruction projects they perform, and sell them in their retail store. In the case of Ballard Reuse, materials brought in through the salvage business are supplemented by materials donated to the affiliated non-profit partner (for which those donors receive an IRS receipt rather than cash compensation). Nantucket does not currently support a strong enough salvage market to support this model.

However, it is possible that under a deconstruction ordinance, demand for deconstruction services would be sufficient to support a private building materials reuse store operated by a local deconstruction business. As with a non-profit, this business would face the challenge of finding a site that is not cost prohibitive. To avoid high rent for storage space on Nantucket, for-profit building materials salvage businesses may ultimately end up transporting materials off-island for resale.

4. Nantucket Perspectives

4.1. Nantucket Resident Perspectives

We expanded on our Phase 1 interviews by asking several residents what they thought specifically about a deconstruction ordinance on Nantucket. General impressions of deconstruction were again very positive. Interviewees feel that incentives could encourage deconstruction, but only if they are paired with education and engagement efforts. Some homeowners and builders are not very cost-sensitive, so financial incentives may not have a

significant effect. One interviewee suggested that homeowners might even pay builders an extra amount to compensate for having to pay the deposits.

If the Town were to implement meaningful financial incentives, the residents we interviewed would support an ordinance that collects deposits from builders that are refunded based on the amount of demolition waste diverted. At least one person would also support an ordinance that would fine builders for not diverting demolition waste. There were also no objections to ordinances that ban certain materials from the landfill or require contractors to be certified in deconstruction.

One person we interviewed felt it is imperative that builders are involved in developing new ordinances. This would first require educating builders on the benefits of deconstruction, and then working with them to devise effective strategies for encouraging it. Otherwise, there would likely be resistance to an ordinance that impacts builders.

Interviewees feel that most Nantucket residents would be receptive to ordinances that promote sustainability on the island. There is a sense that preservation is an important aspect of Nantucket's history that many residents appreciate and want to support. One person we interviewed believes now is an opportune time to encourage deconstruction and re-use because the cost of materials and transportation has increased significantly in recent months.

4.2. Building Strategic Partnerships with Key Organizations

EBP performed outreach to contacts at key stakeholder organizations on Nantucket. See Table 2 for interviewee list, developed in coordination with Nantucket Preservation Trust.

These outreach efforts were used to build support for a possible building deconstruction ordinance and to gather feedback and thoughts on the approaches to deconstruction and reuse. The discussions centered on what stakeholders think will be most effective on the island. Our outreach consisted of email invitations and 30-minute video interviews with eleven (11) key Nantucket stakeholders/organizations. The conversations consisted of input on the four general categories of deconstruction ordinances we've found among U.S. municipalities through our research, as detailed in Section 2, the ordinances' compatibility with Nantucket, and the interviewee's thoughts on how best to approach deconstruction and encourage building material reuse on the Island.

Table 2. Strategic Partnership Interviewee List

Stakeholder	Title	Organization
Holly Backus	Town Preservation Planner	Town of Nantucket
Bill Kline	Former Nantucket Town Planner	Retired
Elizabeth Blair	Marketing & Development Director	Housing Nantucket
Frank Daily	President	Nantucket Builders Association
Hillary Hedges Rayport	Former Chair	Nantucket Historical Commission

Stakeholder	Title	Organization
Gennifer Costanzo	Executive Director	Habitat Nantucket
Jesse Bell	Executive Director	Nantucket Land Bank
Lauren Sinatra	Energy Coordinator	Town of Nantucket
Paul Murphy	Building Coordinator	Town of Nantucket
Tucker Holland	Director, Affordable Housing Trust	Town of Nantucket
Abby Camp	Vice-Chair	Historic District Commission

Note: Additional interview invitations were sent to eight (8) other stakeholders, however we did not receive responses and/or were unable to schedule interviews with them.

The overall message that came through clearly in all of the interviews was that each of these stakeholders cares deeply about preserving the architectural heritage of Nantucket and they are committed to exploring pathways to increasing building reuse, deconstruction, and materials reuse. The primary question then is defining the best pathway.

4.3. Assessing the Current State

Each of the stakeholders provided an assessment of the current state of building deconstruction and material reuse from their vantage point in the Nantucket building ecosystem. Their observations and insights collectively provide an informative, composite picture of the current landscape, including challenges that could be addressed through an ordinance and/or other market interventions.

The following are specific stakeholder observations, opinions, and insights from the interviews, organized into the primary topic categories: History of Sustainability, Current Standard Practice, Financial Considerations, and Other Considerations, Thoughts, and Observations.

History of Sustainability

- Nantucket has always had to be sustainable; it came from necessity.
- For long-time Nantucket residents, sustainability is more of a standard practice.
- Islanders have been reusing and recycling structures for over 300 years.
- Nantucket has one of the busiest Historic District Commissions in the U.S. and building demolitions move-offs are often on the agenda.
- The greenest building is the building that is already built.

Current Standard Practice

- Reuse is big on the island. Entire structures are commonly moved – people want them. The timing needs to work between availability and demand.
- If a building can't be moved, for whatever reason, it is usually not deconstructed.

- Housing Nantucket has a successful house recycling program, allowing a homeowner to donate a house instead of demoing it. Housing Nantucket moves it to their land, if available, and turns it into affordable rental housing, or sells to a 3rd party.
- The Nantucket Land Bank acquires and offers structures to the town and affordable housing organizations. With a lot of structures they acquire, there is strong interest in turning the property "back to natural" so the structure must be moved or demoed/deconstructed.
- The Land Bank reaches out to Habitat Nantucket and Housing Nantucket on available appliances. Residents often reach out to the Land Bank and are allowed to "take what they need."
- Often houses can't be moved because a representative of National Grid, the electric utility, says the neighborhood would lose electricity for 2 days if power lines are temporarily removed for the house move.
- Some of the buildings being destroyed are not very old.
- A lot of historic materials with inherent value are currently ending up in the waste stream.
- The current demo delay period (60 days) is too short to be effective.
- Currently a demo can be advertised, starting the 60-day demo delay period, before the project goes before the Historic District Commission.
- There is an informal building materials reuse system on Nantucket, including the Cape Cod and Islands Craig's List and the Nantucket REuse eXchange. They have limited use for building materials, however, because there's a limit on who needs what at any given time.

Financial Considerations

- Money and easy access to everything has changed the island.
- Access to money can put sustainability on the back burner.
- People love Nantucket and want to live and work here, but many people can't find even a small, affordable place to live.
- When ranch houses built in the 1950s and 1960s are demolished, the new owner takes relatively affordable housing out of the community and reduces the supply of housing for older adults looking to downsize and live on one accessible floor.
- Making a building available for salvage could present a town liability issue.

Other Considerations, Thoughts, and Observations

- The biggest issues on the island are coastal resiliency and affordable housing.
- More people have been talking recently about how to reuse building fixtures (e.g., faucets, sinks, toilets).

- The reclaimed materials that contractors would more likely reuse are interior trim, doors, cabinets, flooring, and plumbing fixtures. Older windows often can't be reused because they don't meet current building energy code.
- It's all about education.
- Nantucket preservation classes are being offered for realtors.
- As we go into a recession people are going to want smaller houses.
- The best outcomes will come from reducing, reusing, and recycling.
- Lots of people can't afford new materials and would benefit from the availability of salvaged materials.
- Some of the new developments are so un-Nantucket and so insensitive to the character of the island.
- Our parents brought us up to be frugal. Demolition goes against everything I was taught.
- It makes me physically ill allowing demolition of perfectly good buildings.
- There's a national housing crisis – don't throw away usable materials.

4.4. Thoughts on Ordinance Types

With a few exceptions, the stakeholders feel that a town ordinance would be a positive tool to encourage building deconstruction and material reuse. Those who disagreed with this position cited their impression that Nantucket residents' dislike regulation.

Specifically, most stakeholders were in support of ordinance types 2, 3, and 4 (see below) and some were concerned that ordinance type 1 would be challenging to measure and monitor due to different age homes having different percentages of reusable materials.

1) Requirements to divert a certain amount of construction waste from landfills through reuse, recycling, and composting, or landfill maximums (Palo Alto, CA, San Mateo, CA, Los Angeles, CA, Concord, CA, Madison, WI, Boulder, CO, Cook County, IL, Austin, TX, Milwaukee, WI)
2) Deposits that are refundable based on meeting certain diversion levels (San Jose, CA, Vancouver, BC, Boulder, CO)
3) If deconstruction happens, requirement that work be performed by certified deconstruction contractors and that heavy machinery doesn't render materials unusable (Portland, OR, Milwaukee, WI)
4) A certain number of sustainable building practices must be employed, one of which is deconstruction (Evanston, IL, King County, WA).

The following are specific stakeholder thoughts on ordinances and other approaches to encourage building deconstruction and material reuse.

- Get the right mix of 'sticks and carrots' (regulations and incentives).

- Lengthen the 'demo delay' to at least 6 months, and ideally 12+ months, similar to other communities in Massachusetts.
- Make the 'demo delay' process and timeline fixed and consistent for everyone so there will be no financial incentive to try and speed up the process.
- Less bureaucracy is better; free market is better.
- Increase the percentage of Historic Tax Credits with the state.
- People have a strong feeling that things should be 'fair'. The Nantucket community values transparency and the consistent application of rules and processes to everyone.
- Institute penalties for illegal demos, such as a hefty fee, and contractor can't apply for another building permit for X months.
- Institute a system of rewards for citizens who do the right thing, such as a local tax credit or jumping to the front of the building permit queue.
- Devote some resources to helping/training (incentivize) motivated trades people who want to make a business of deconstruction.
- Involve the realtor community in the development of solutions.
- Having a 'home base' to bring salvaged materials is important.
- Place a fee on house demos, since they contribute to the waste stream problem and disposal costs, and often take an 'affordable' home out of the Nantucket housing market. Charge 1% of sales price if the home is to be demolished, to go into an affordable housing account, with a fee waiver or partial refund if the home is repurposed or substantially deconstructed.
- Encourage the town to purchase chunks of land near town water/sewer and utilities. Once procured, make small developments with the houses that are saved, providing places to live for people who can't afford to live on-island anymore.
- An incremental approach could first address the low-hanging fruit and then be expanded.
- It's tricky politically. Town meeting can be quite a challenge. If you do your homework and build support you can usually win the day, but not always.
- People will do the right thing if it's not too difficult. You have to make it easy for them.

Most stakeholders agreed that passing a deconstruction ordinance would effectively decrease the problem of demolition of perfectly habitable buildings and building materials going into the waste stream.

4.5. Other Ideas and Takeaways

The overall takeaway from the stakeholder interviews is that this is a multi-faceted problem requiring a holistic integrated multi-faceted solution. A successful strategy that will garner enough support from town residents and stakeholders will likely require:

- Passing an ordinance, with a lengthened demo delay period (6-12+ months like other Massachusetts communities), a demolition fee or deposit program, a revised process starting with the Historic District Commission and then advertising, and including incentives and other support
- Linking solutions to support of affordable housing
- Establishing an on-island salvaged materials facility
- Providing deconstruction training
- Town and stakeholder involvement in designing and implementing the strategy.

Almost all the stakeholders interviewed suggested finding a way to expand the 'Take It or Leave It' operation at DPW as an on-island salvaged building materials facility. Considering that land and retail space is "prohibitively expensive," and given that the town already owns the property, costs for a salvage facility would be reduced and help ensure that the operation generates positive cash flow. In addition, some stakeholders suggested a public-private partnership to fund the creation and operation of the facility to mitigate DPW's staffing and budget constraints. A further reason for locating at the DPW site is that DPW has a vested interest in limiting the waste stream to help extend the life of the landfill, reduce costs, and comply with the Massachusetts Department of Environmental Protection's new 2030 Solid Waste Master plan[8]. Some stakeholders suggested that the proceeds from salvaged material sales could go towards affordable housing. A further suggestion was to have a small public-facing space in the downtown area, showcasing high-end salvaged materials, with a binder showing the inventory of the materials stored off-site.

Gennifer Costanzo, Executive Director of Habitat Nantucket, and her colleagues at Habitat Cape Cod have proposed a deconstruction pilot that could serve as an interim solution until an on-island salvage facility can be established. The proposed 6-to-9 month pilot would involve sending trained Habitat Cape Cod deconstruction specialists to Nantucket to perform targeted deconstruction, primarily kitchens, on specific homes slated for demolition, and then transport the materials back to the two (2) Habitat ReStores on Cape Cod[9]. The materials would then be sold, with a percentage of the proceeds going to Habitat Nantucket to help support their affordable housing mission. Such a pilot would potentially require supplemental grant funding and would need to take place in fall or spring due to lack of summer ferry availability.

The Habitat Nantucket-Habitat Cape Cod deconstruction pilot could be a viable short-term solution to demonstrate the viability of deconstruction practices until an on-island facility can be established. While the pilot concept was supported by most interviewees, the stakeholders also believe that there is enough on-island demand to support a closed-loop Nantucket facility.

[8] MassDEP's 2030 Solid Waste Master Plan establishes goals to reduce disposal statewide by 30 percent (from 5.7 million tons in 2018 to 4 million tons in 2030) over the next decade. It sets a long-term goal of achieving a 90 percent reduction in disposal to 570,000 tons by 2050.

[9] The Habitat Cape Cod ReStores are located in South Yarmouth and Falmouth.

5. New Ordinance Development

This section presents model ordinance language for encouraging deconstruction on Nantucket. As shown in the preceding sections, there are several ways of encouraging deconstruction, each of which has its own advantages and disadvantages. For this reason, we present different options for Nantucket Preservation Trust and its partners to consider.

For ordinances that impose fees or fines, several people we interviewed suggested using the funds to support affordable housing development on Nantucket.

Note that the following language is modeled off ordinances in other municipalities and has not been reviewed by legal professionals. It is meant for informational purposes only. We provide additional commentary in bold below some of the ordinance language.

5.1. Ordinance: Diversion & Recycling Requirement

This ordinance shall be applicable to all residential and commercial projects that include a whole structure demolition requiring a demolition permit. All applicants and other persons who undertake a covered project shall complete a salvage survey provided by a reuse organization or other third party approved by the Town, prior to the issuance of a demolition permit. The survey shall itemize the materials and items eligible for salvage and reuse and the estimated weights.

Upon completion of the deconstruction and source separation of materials, the applicant or person responsible for the covered project shall ensure the items listed on the salvage survey are delivered to, collected by or received by, and certified by a reuse organization or other third party approved by the Town, and shall submit to the Town proof of delivery of salvage items in accordance with Town regulations.

All applicants and other persons who undertake a covered project where materials can be recycled or composted shall deconstruct buildings and structures in a manner to divert the maximum feasible amount of materials and debris from disposal in landfills. All construction and deconstruction materials shall be source separated. Materials to be source separated for recycling include, but are not limited to, steel, glass, brick, concrete, asphalt, roofing material, pipe, gypsum, sheetrock, lumber, wood, pallets, rocks, sand, soil, clean cardboard, paper, plastic, carpet, wood and metal scraps. Materials to be composted include, but are not limited to, trees, shrubs, plant cuttings, food scraps, and other material as designated by the Town.

All persons undertaking a covered project shall submit proof of reuse, recycling and composting in accordance with Town regulations. The Town shall be authorized to inspect, upon reasonable notice, and audit individual waste streams generated at covered projects to determine compliance with this section.

In several municipalities we reviewed, waste diversion requirements range from 50% of non-hazardous construction materials to 95%. Some municipalities apply a minimum diversion requirement only to homes of a certain age, generally pre-1950. Some municipalities also require that 100% of soils, concrete, and asphalt must be recycled. Madison, Wisconsin, requires that 100% of untreated wood, non-toxic metals, drywall, cardboard, and shingles be reused or recycled.

5.2. Ordinance: Banned Materials

The following materials are banned from landfill disposal: clean wood (untreated, unpainted), cardboard, metal, new gypsum scrap, asphalt paving, bricks, and concrete.

An alternative approach is to put limits on landfill disposal. Austin, Texas, currently limits disposal of C&D waste to 1.5 pounds per square foot of a project's area. In 2030, the limit will be reduced to 0.5 pounds per square foot.

5.3. Ordinance: Refundable Deposits

Each person who applies for a demolition permit shall remit a diversion deposit in the amount set forth by resolution of the Town Select Board. The diversion deposit shall be remitted at the same time the permit application is filed. The Town may authorize the refund of a diversion deposit when at least fifty (50) percent of the waste generated by the project was diverted from landfill disposal. The Town may authorize a partial refund of a diversion deposit when less than fifty (50) percent by weight of the waste generated by the project was diverted from landfill disposal.

The Town shall not authorize the refund of any diversion deposit, or any portion thereof, unless the original building permit applicant files a written request for refund no later than twelve (12) months after the building permit is no longer active for any reason (including because the project has been completed, the permit has been withdrawn, or the permit has been revoked), and the applicant provides documentation satisfactory to the Town in support of the request.

Deposit amounts vary based on the municipality. Two municipalities we reviewed charge a minimum refundable deposit of between $1,000-1,500, plus an additional $1 per square foot of demolition area. Concord, California, charges a refundable deposit of between 1.5-2.0% of a project's value.

5.4. Ordinance: Certified Deconstruction

Deconstruction work must be performed by a Certified Deconstruction Contractor. A Certified Deconstruction Contractor shall be assigned to the project throughout the course of deconstruction. Certified Deconstruction Contractors must comply with the requirements of this Chapter and the administrative rules. The Planning department will maintain on file and available to the public a list of current Certified Deconstruction Contractors.

Alternatively, the Town could maintain a list of "preferred contractors" that prioritize deconstruction over demolition in their work.

5.5. Ordinance: Sustainable Building Practices

All construction projects that are LEED[10] eligible must achieve LEED certification. Projects not eligible for LEED certification must use the Sustainable Infrastructure Scorecard, a sustainable development scorecard developed by the Town. The scorecard includes points for reuse of salvaged materials, use of on-site materials for construction, use of materials obtained within 500 miles of the jobsite, and points for projects designed for future deconstruction.

5.6. Ordinance: Heavy Machinery Restrictions

Heavy machinery may be used in deconstruction to assist in the salvage of materials for reuse or to remove material not required to be salvaged for reuse. Heavy machinery may not be used in deconstruction to remove or dismantle components of buildings in ways that render building components unsuitable for salvage. Heavy machinery includes, but is not limited to, track hoes, excavators, skid steer loaders, or forklifts.

5.7. Ordinance: Demolition Delay

The Demolition Delay falls under the Town of Nantucket zoning bylaws.[11] Most people we interviewed favor a longer demolition delay period. The predominant sentiment is that the current 60-day waiting period is inadequate to provide builders and homeowners with enough time to find alternative uses for houses and building materials. The reasons cited included, 1) the required posting of the public notice often occurs prior to issuance of approval for the demo, shortening the available time to secure demo alternatives, and 2) there are many steps required to coordinate moving a structure (e.g., approvals from HDC, ZBA, National Grid) which often takes significantly longer than 60 days. According to the Massachusetts Historical Commission:

> "Over 150 cities and towns in Massachusetts have established a demolition delay bylaw or ordinance[12]. With a demolition delay bylaw or ordinance, a window of opportunity is provided to find an alternative to the demolition of a significant building. The delay is typically 6, 12 or 18 months. Most of the demolition delay bylaws and ordinances in Massachusetts are based on the age of the building, such as buildings that are older than 50 years or 75 years."[13]

[10] U.S. Green Building Council's Leadership in Energy and Environmental Design (LEED) certification.
[11] Town of Nantucket, Division 1: Bylaws / Part II: General Legislation / Zoning, Article V: Administration and Enforcement, Section 139-26. Issuance of building and use permits.
[12] Demolition Delay Bylaws and Ordinances in Massachusetts
[13] Preservation Massachusetts website

Of the over 150 communities in the Commonwealth with a demolition delay bylaw or ordinance, the Town of Nantucket is an outlier as only one of only two communities with a delay period of less than 3 months. Similar Massachusetts communities with historic districts, such as Provincetown, Concord and Chatham, have demolition delay periods of 6 months, 12 months, and 18 months respectively.

5.8. Other Mechanisms

There are other ways to encourage deconstruction on Nantucket. One is to increase landfill tipping fees so that disposing of construction materials (instead of reusing them) becomes more costly for builders and homeowners. Tipping fees should be raised gradually, however, since raising them too much or too quickly could cause people to dispose of waste illegally to avoid the fees.

Another mechanism is queue jumping or accelerated demolition/building permit review for builders that deconstruct rather than demolish buildings. This could encourage deconstruction among homeowners who are working on an accelerated timeline, which we heard during our Phase 1 research is often the case.

A third option is to provide grants directly to builders to offset the added costs of deconstruction. The Town could design such a program to target buildings that are most likely to yield significant reusable material.

6. Conclusions & Recommendations

Moving away from building demolition on Nantucket, towards a paradigm of thoughtful and sustainable deconstruction and building material reuse, is a worthy goal that will pay multiple dividends to the Island of Nantucket and its residents in the form of overall financial savings, carbon and pollution emission reductions, and workforce development opportunities. As has been shown from the Envision Resilience Nantucket Challenge 2022 Survey, Nantucket residents, in addition to their own efforts to reduce their contribution to climate change, are supportive of their fellow homeowners, businesses, government actors, and other community stakeholders in efforts to increase sustainability and resilience on the Island. Further, the Town of Nantucket's Strategic Plan is guided by principles of sustainability, with a major focus on historic preservation. Through a series of research tasks and Nantucket stakeholder interviews, the EBP team has identified, categorized, and analyzed key strategies and leverage points to support the goal of building deconstruction and material reuse.

With the goal of providing actionable policy insights into how to encourage the best use of Nantucket's building and construction resources to have a positive impact on the Island's long-term sustainability, we offer the following insights and recommendations:

- Organize a meeting of Nantucket stakeholders, including key Town officials, to further build strategic support and to assist in building deconstruction and reuse ordinance design and implementation strategy.
- Propose a comprehensive deconstruction ordinance, for approval at Town Meeting, that combines waste diversion and recycling requirements, a demolition fee or refundable deposits, and restrictions related to banned materials, heavy machinery, and certified deconstruction and sustainable building practices.
- Consider baseline deconstruction or recycling minimums that apply to a broad category of structures, such as all residential buildings or all single-family residential buildings, with higher thresholds and/or additional requirements for historic structures (e.g., higher recycling minimum, requirement to salvage all wood for reuse, prohibition on machine demolition).
- Since Nantucket is only one of two towns in the Commonwealth to have a demolition delay period of less than 3 months, extend the delay period to at least 6 months, and preferably 12+ months to allow sufficient time to coordinate building reuse.
- Revise the demolition delay process so that it starts with seeking Historic District Commission approval and then proceeds to public notification (posting an ad). Ensure that the demo delay process and timeline is fixed and consistent for everyone so there will be no financial incentive to try and speed up the process.
- In addition to Massachusetts Historic Preservation Tax Credits, explore additional incentives for citizens who demonstrate a commitment to building deconstruction and material reuse, such as local tax credits or jumping to the front of the building permit, Historic District Commission, and/or Zoning board queue.
- Devote resources to training motivated trades people who want to make a business of building deconstruction.
- Establish an on-island salvaged materials facility where materials can be stored for sale and distribution. Explore the feasibility of expanding the 'Take It or Leave It' operation at the DPW to handle salvaged building materials, as well as the potential for a public-private partnership model to create and operate the facility. Also, put forward a proposal for a small public-facing space in the downtown area, showcasing high-end salvaged materials, including an online inventory of the materials available at the main facility. Develop a viable on-island distribution network of used building materials and offer deep discounts or free materials to affordable housing groups.
- As an interim approach until the ordinance and/or on-island salvaged materials facility can be established, partner with an existing building materials reuse operation off-island (e.g., EcoBuilding Bargains, Boston Building Resources) to store salvaged materials in transportation containers on island and have them periodically transported to the mainland for resale.
- Employ pilot concepts such as the Habitat Nantucket and Habitat Cape Cod proposal for a deconstruction pilot to send trained deconstruction specialists to Nantucket to perform

targeted deconstruction on specific homes slated for demolition and then transport the materials back to the Cape Cod ReStores, with proceeds to be shared between the two Habitat chapters. Explore other deconstruction pilot concepts with the Nantucket Land Bank and/or Housing Nantucket as viable short-term solutions to demonstrate the viability of deconstruction practices while the ordinance is being developed and the on-island facility established.

- Use funds collected through deconstruction ordinance fees and fines, and salvaged building materials sold, to support affordable housing development on the island.
- Create and launch a public education and awareness effort to promote building reuse, deconstruction, material salvage and reuse, and historic preservation.
- Make the new deconstruction policy, process, and support mechanisms straightforward and easy to understand and navigate. As one of the interviewed stakeholders said, "People will do the right thing if it's not too difficult. You have to make it easy for them."

As expressed in the thoughtful guidance document, 'Building with Nantucket in Mind'[14], "On Nantucket, where historic architecture is not just the stuff of museums but of day-to-day life, its protection goes beyond merely preserving a sense of place and enters the realm of public trust." And thus, "tearing down a building, then, is not a casual affair on Nantucket. Rather it is an option of last resort."

The multiple policy approaches available to Nantucket to encourage or require deconstruction and building material reuse can substantially address the challenges of depletion of natural resources and declining landfill capacity, while supporting the goals of historic preservation, affordable housing, and the long-term sustainability of the island.

[14] Building with Nantucket in Mind: Guidelines for Protecting the Historic Architecture and Landscape of Nantucket Island, by J. Christopher Lang and Kate Stout, Nantucket Historic District Commission (1992).

Appendix

Comparison of Key Characteristics of Selected Ordinances that Require or Encourage Deconstruction

Location	Year Established / Modified	Name	Deconstruction (Encouraged/Required)	Restricts the use of heavy machinery (Y/N)	Salvage/Reuse Minimums (Encouraged/Required)	Diversion requirements (Y/N)	Source Separation (Encouraged/Required)	Applies only to structures of a certain age, size, value, or type (A/S/V/T)	Program Website Lists or Links to Reuse Resources	Uses a Scorecard or Points System	Requires a Refundable Deposit	Fines for Non-Compliance	Final Occupancy Permit May be Delayed or Withheld (Y/N)	Use Municipally Approved Waste Hauler, or Disposal Facilities	Use Municipally Approved Contractors	Online Tracking Available/Required	Primarily Administered by Planning or Building Dept	Primarily Administered by Public Works Department	Ordinance Requires Municipality to Report Program Results to Public/Legislative Body	Notable Feature
Palo Alto, CA	2020	Deconstruction and Materials Management Ordinance	R				R							Y				Y		n/a
San Jose, CA	2001	Construction Demolition Diversion Deposit Program			E	Y	E	V	Y		Y			E			Y			n/a
Portland, OR	2016, expanded in 2019 and 2020	Deconstruction of Buildings Law	R	Y				A						Y	Y		Y			Applies only to buildings built in 1940 or earlier and historic homes
Vancouver, BC, Canada	(2014, expanded 2016 and 2022)	Green Demolition By-Law	E		R	Y	R	A			Y	Y	Y				Y			Reused materials credited at 5x the rate of their actual weight
San Mateo, CA	2002	Recycling and Diversion of Debris from Construction and Demolition	E		R	Y	R	V			Y							Y	Y	Site separation required "to the maximum extent feasible" for certain materials
Los Angeles County, CA	2005	Construction and Demolition Ordinance			E	Y		V				Y						Y		n/a
Concord, CA	2007	C&D Materials Recycling Ordinance				Y		V			Y	Y		Y		R		Y		Must self-haul, use approved hauler, or request a waiver
Madison, WI	2010	Construction and Recycling Ordinance	E			Y		S, T	Y							A				Program website provides extensive resources for deconstruction and reuse

Location	Year Established / Modified	Name	Deconstruction (Encouraged/Required)	Restricts the use of heavy machinery (Y/N)	Salvage/Reuse Minimums (Encouraged/Required)	Diversion requirements (Y/N)	Source Separation (Encouraged/Required)	Applies only to structures of a certain age, size, value, or type (A/S/V/T)	Program Website Lists or Links to Reuse Resources	Uses a Scorecard or Points System	Requires a Refundable Deposit	Fines for Non-Compliance	Final Occupancy Permit May be Delayed or Withheld (Y/N)	Use Municipally Approved Waste Hauler, or Disposal Facilities	Use Municipally Approved Contractors	Online Tracking Available/Required	Primarily Administered by Planning or Building Dept	Primarily Administered by Public Works Department	Ordinance Requires Municipality to Report Program Results to Public/Legislative Body	Notable Feature
City of Boulder, CO	2008	Construction Waste and Deconstruction Management Ordinances	R		E	Y					Y							Y		Replaced Boulder Green Building Points Program in 2017
Boulder County, CO	2015	BuildSmart residential green building code	R		R		E	T									Y			Requires that cabinets, dimensional lumber, flooring, and solid core doors be donated, reused, or sold
Evanston, IL	2011	Green Building Ordinance	E		E			S, T		Y			Y				Y			Projects must meet a certain number of sustainability measures that include salvaging reusable materials and using recycled materials
Cook County, IL	2012	Cook County Demolition Debris Diversion Ordinance			R	Y		T				Y								In addition to salvage requirement, there is a 5% reuse requirement
King County, WA	2013	Green Building and Sustainable Development	E			Y			Y	Y		Y					Y			No specific diversion % but bans certain materials from landfill disposal (clean wood, cardboard, metal, new gypsum scrap)
Austin, TX	2016	Construction & Demolition Recycling Ordinance				Y		S,T						E				Y	Y	Diversion achieved through choice of diversion minimum % or disposal maximum weight; Diversion/Disposal Limits increase/decrease in 2020, 2030
Milwaukee, WI	2018	Deconstruction Ordinance	R	Y		Y		A,T	Y			Y			Y		Y			Appears modeled on Portland Ordinance

Summary Characteristics of Selected Ordinances that Require or Encourage Deconstruction

Location (Year estab.)	Ordinance Name	Summary	Applicability	Reporting	Administrative Responsibility	Penalty for Non-Compliance
Palo Alto, CA (2020)	Deconstruction and Materials Management Ordinance Palo Alto Municipal Code Title 5: Health and Sanitation Chapter 5.24	• "All applicants and other persons who undertake a covered project where materials can be recycled or composted shall deconstruct buildings and structures in a manner to divert the maximum feasible amount of materials and debris from disposal in landfills." • All construction and deconstruction materials shall be source separated for reuse, recycling, and composting, as designated by the City.	• All residential and commercial projects that include a whole structure demolition requiring a demolition permit (does not apply to those projects comprised solely of the demolition of an accessory dwelling unit) • Excludes dangerous structures ("structurally unsafe or otherwise hazardous to human life") and those with no suitable materials as determined by the Director of Public Works	• Salvage survey completed by a reuse organization or other third party approved by the city, prior to the issuance of a demolition permit. The survey shall itemize the materials and items eligible for salvage and reuse and the estimated weights. • Must submit proof of reuse, recycling and composting • The City is authorized to inspect and audit individual waste streams generated at covered projects to determine compliance • Must use waste containers provided by the city's collector (no unauthorized collectors may place containers within the city)	Director of Public Works	• Violation are subject to the provisions and penalties set forth in Title 1 of the Municipal Code which includes: (a) Fine of up to $250.00 for infractions; (b) Fine of up to $1,000.00 or by imprisonment in the county jail for up to six months, or both, for violations; (c) Multiple infractions within a preestablished time period can be upgraded to violations. (d) Each person is guilty of a separate offense for each and every day during any portion of which any violation of any provision of this code is committed, continued or permitted

Location (Year estab.)	Ordinance Name	Summary	Applicability	Reporting	Administrative Responsibility	Penalty for Non-Compliance
San Jose, CA (2001)	Construction Demolition Diversion Deposit Program San Jose Municipal Code section 9.10, part 15 (Section 9 governs Health and Safety)	Deposit charged based on building square footage, refundable upon documentation that a minimum of 50% of construction materials was recovered and diverted from landfill. Program recommends compliance through: (1) Source separating by material (e.g. cardboard, metal, wood, etc.) into individual bins to achieve higher recycling rates; (2) Commingle recyclable materials into one bin and deliver to a City-Certified C&D facility that specializes in sorting mixed C&D materials; or (3) Salvage and reused onsite.	• All residential alterations of $2,000 or more • All non-residential alterations of $5,000 or more • All residential and non-residential demolitions • Notable exclusions: Residential construction projects of less than $115,000 in value, and new nonresidential construction projects of less than $135,000 in value.	• Receipts documenting diversion deposits are collected and refunded upon verification; • Reuse and donation require documentation such as photos, estimated weight quantities, or receipts from donation centers listing materials and quantities. • For materials salvaged and reused onsite, must estimate the quantities, document the reuse with pictures, and keep records of all weight tickets and donation receipts. • The program website provides a map of local reuse and salvage businesses.	Director of Environmental Services and the Health Officer	• Issuance of building permit is subject to payment of deposit fees • Certificate of final occupancy is subject to compliance • Deposit forfeiture

Location (Year estab.)	Ordinance Name	Summary	Applicability	Reporting	Administrative Responsibility	Penalty for Non-Compliance
Portland, OR (2016, expanded in 2019 and 2020)	Deconstruction of Buildings Law (City Code Chapter 17.106) See also: • Deconstruction ordinance • Deconstruction resolution	• Work must be performed by a Certified Deconstruction Contractor (the agency provides a list of current Certified Deconstruction Contractors); • Deconstruction sites must have a posted sign visible to pedestrians and motorists that notifies that the structure is being deconstruction and provides city contact information for questions or concerns; • Heavy machinery may only be used to assist in the salvage of materials for reuse or to remove material not required to be salvaged for reuse, and may not be used in ways that render materials unsuitable for salvage	• Primary dwelling structures that were built in 1940 or earlier according to building permit records on file with the Bureau of Development Services (or County tax assessor information if no permit records exist) • Primary dwelling structures that have been designated as a historic resource subject to the demolition review or 120-day delay provisions of Title 33.	• Building permit applications require a completed Pre-Deconstruction Form • Certified Deconstruction Contractors must maintain receipts for donation, sale, recycling, and disposal of all materials for any deconstruction project. • Materials intended for reuse on site must be documented with photographs. • The Director may ask that a Certified Deconstruction Contractor produce the receipts or photographs for inspection any time until the demolition permit is approved to be finaled. • A completed Post-Deconstruction Form and all required documentation must be submitted to the Bureau of Planning and Sustainability before a demolition permit can be approved as finaled.	Director of the Bureau of Planning and Sustainability	Violations by any party: • Fine of up to $500 for the first violation, up to $1,000 for the second violation, and $up to $1,500 for the third and subsequent violations by the same person • Penalties may be imposed on a per month, per day, per incident, or such other basis at the Director's discretion Additional enforcement actions for Certified Deconstruction Contractors: • First violation: Removal from list of approved Certified Deconstruction Contractors for up to 6 months; • Second violation: Removal from list of approved Certified Deconstruction Contractors for up to 12 months; • Third and subsequent violations may result in revocation of certification whereby a contractor may not apply for recertification for a period of 18 months.

Location (Year estab.)	Ordinance Name	Summary	Applicability	Reporting	Administrative Responsibility	Penalty for Non-Compliance
Vancouver, BC, Canada (2014, expanded 2016 and 2022)	Green Demolition By-Law No. 11023	A $14,650 deposit (in addition to the permit application fee) is required as part of the application for a demolition permit. The deposit will be refunded if the following reuse, recycling, and salvage requirements are met: • 75% of materials by weight must be reused or recycled for houses built before 1950; • 90% of materials by weight must be reused or recycled for houses built before 1950 and deemed as a character house by the building department; • Minimum wood salvage requirement of 3 metric tons for houses listed on the Vancouver Heritage Register or built before 1910. • Any material that is reused rather than disposed of or recycled, can be credited towards compliance at a rate of 5 times its actual weight	• Minimum salvage (deconstruction) requirement applies to houses built before 1910 • Minimum reuse and recycling requirements apply for demolition of homes built before 1950 • Applies to non-hazardous materials only • Structures being moved may be exempted	• Recycling and reuse plan as part of the building or development permit application • Recycling and reuse compliance form when demolition is complete • A wood salvage report for demolition of heritage listed, or pre-1910 houses	Chief Building Official	• Suspend building permit issued • Fine of $250 to $10,000 for each offence • Offences of a continuing nature subject to fine of $250 to $10,000 for each day the offence is continued

Location (Year estab.)	Ordinance Name	Summary	Applicability	Reporting	Administrative Responsibility	Penalty for Non-Compliance

San Mateo, CA (2002)	Construction and Demolition Debris Ordinance Chapter 7.33 Recycling and Salvaging of Construction and Demolition Debris	"It shall be the responsibility of the owner, the general contractor and all subcontractors to recover the maximum feasible amount of salvageable materials prior to demolition."
		
		Diversion requirements:
		
		• 100% of inert solids such as soil, concrete, and asphalt must be recycled (but do not count toward diversion goals)
		• 60% diversion for demolition and new construction, 50% for renovation/alteration
		• Recovered or salvaged materials may be given or sold on the premises, or may be removed to a reuse warehouse or other reuse facility for storage or sale
		
		Site separation required "to the maximum extent feasible" for:
		
		• Scrap wood, clean green waste
		• Gypsum wallboard, dimensional lumber, cardboard (new construction)
		• Recyclable/reusable materials must be kept separate from non-recyclable/non-reusable materials
		
		Deposit requirements:
		
		• Minimum deposit $1,000
		• Residential and commercial demolition: $1/square foot
		• New construction/renovation: 3% of project cost up to $10,000
			• All new construction or full demolition of all residential and commercial buildings of any value
			• Alteration of any building where the value of the alteration is $50,000 or greater
			• Exemption may be granted for projects where more than 40% of waste tonnage is non-recyclable/non-reusable
				• Construction & Demolition Recycling & Waste Reduction Plan Form
				  ○ An estimate of the tonnage of C&D debris generated
				  ○ How the material will be separated/ collected
				  ○ What machinery will be used for the work and transport of materials
				• Within 60 days of project completion, contractor must submit documentation showing actual tonnage data for diverted and disposed materials, supported by receipts and weight tags or other records of measurement from recycling companies, deconstruction contractors and/or landfill and disposal companies.
				
				Director of Public Works must report annually the number and type of permits issued, the number and type of projects covered by diversion requirements, the total tonnage generated and the estimated diversion resulting from these projects.
					• Director of Public Works	• Forfeiture of deposit

Location (Year estab.)	Ordinance Name	Summary	Applicability	Reporting	Administrative Responsibility	Penalty for Non-Compliance
Los Angeles County, CA (2005)	C&D Debris Recycling and Reuse Ordinance (Los Angeles County Code Chapter 20.87 Ordinance No. 2005-0004)	• Minimum 50% of C&D materials generated, no more than two-thirds of which may be inert materials, must be reused or recycled. Minimum 50% of all inert materials must be reused or recycled. .	• Any work requiring one or more permits with a total value greater than $100,000 • Demolition of structures (regardless of the value of the demolition work)	• Construction and Demolition Debris Recycling and Reuse Plan • Monthly Progress Report (for County projects; all other projects require an initial progress report at 90 days and then annual progress reports • Final Compliance Report to be filed within 45 days of project completion	Director of the Department of Public Works	• Fine up to $100 for the first violation, $200 for the second violation, and $500 for each subsequent violation • Each day of a continuing violation constitutes a separate violation (unless corrected within 30 days) • $250 fine per ton or fraction of a ton not compliant with regulation • Fines are capped at 15% of total project value or $50,000 whichever is less • Fines are deposited into the County "Solid Waste Management Fund"

Location (Year estab.)	Ordinance Name	Summary	Applicability	Reporting	Administrative Responsibility	Penalty for Non-Compliance

Concord, CA (2007)	C&D Materials Recycling Ordinance Concord Municipal Code Title 8 Article III Construction and Demolition Waste Recycling – Section 8.20.370	• Minimum 65% of waste materials (and 75% of inert debris - waste that is neither biologically nor chemically reactive) generated from C&D projects must be diverted from landfill.
		• Must self-haul, use a pre-designated Affiliate hauler, or submit a Request for Concord Disposal Hauling Services and/or Waiver Number
		• Applicants pay a Performance Security Fee, refunded if program requirements are met, based on permit value:
		  ○ 1.5% of valuation for projects valued $10,000-49,999 (min. fee of $500)
		  ○ 2.0% of valuation for projects valued $50,000 or greater (max fee $25,000)
		• Applicants also pay a non-refundable Program Fee of 0.3% of the permit value (e.g. $105 for a $35,000 project) that covers program administrative costs
			• All demolition projects
			• Residential or commercial projects with total costs valued at $50,000 or greater,
			• City-owned/City-sponsored project with total costs valued at $150,000 or greater.
			• Certain roofing projects
				• Prior to demolition or hauling, applicants must create a Debris Recovery Plan online at http://concord.wastetracking.com, a platform hosted by Green Halo Waste Management
				• Scan and upload all recycling facility receipts/tickets/reports to Green Halo
				• Once all receipts are uploaded and the final building inspection is complete, Green Halo creates a report that is submitted to the City
					• Waste Management Compliance Official	• Fines up to $10,000/day
						• Suspension of demolition, permit rejection
						• Civil action, misdemeanor prosecution

Location (Year estab.)	Ordinance Name	Summary	Applicability	Reporting	Administrative Responsibility	Penalty for Non-Compliance

Madison, WI (2010)	Recycling and Reuse of Construction and Demolition Debris	• Buildings projects of steel and concrete supports must recycle or reuse 70% of materials.
		• Wood supported structures and remodeling projects exceeding $20,000 must reuse or recycle 100% of the following materials:
		  ○ Untreated wood
		  ○ Non-toxic metals
		  ○ Scrap drywall
		  ○ Corrugated cardboard
		  ○ Shingles.
		• Demolition permit holders are referred to the Deconstruction Manager for Habitat for Humanity ReStore to determine if there are items such as wood flooring, cabinets, windows, doors, or other materials that the ReStore can remove for resale (contributions are tax deductible).
			• All demolitions
			• Construction and renovation of multifamily residential buildings of concrete and steel construction
			• Construction and renovation of commercial buildings of steel and concrete construction 1,000 square feet or larger;
			• Residential structures (single family and multifamily) of wood frame construction
				• Recycling & Reuse Plan
				• Compliance Report
				  ○ Must document recycled and landfilled materials with weight tickets/receipts supplied by the recyclers and landfill.
				  ○ Reuse documented with receipts of donation to Habitat for Humanity or other reuse organization.
				• Option to submit report using WasteCapTRACE online system or email written report and supporting documentation to the Recycling Coordinator (the City provides a sample form but individuals and companies may use their own form or other reporting system)
					• Street Superintendent, Streets & Recycling Department	• Fines ranging from $25 to $500 per percentage point under threshold
						• Fines ranging from $250 to $1,000 for submission certification with false representation

Location (Year estab.)	Ordinance Name	Summary	Applicability	Reporting	Administrative Responsibility	Penalty for Non-Compliance
Boulder, CO (2017)	Construction Waste Recycling and Deconstruction Management Ordinances (Ordinance 8366, repealed prior Boulder Green Building Points Program initiated in 2008)	• Construction projects must demonstrate that all recyclable wood, metal, and cardboard materials will be donated, reused, or recycled. • Demolition projects required to divert for reuse or recycling 75 percent of the existing building materials by weight from the deconstruction (including 100 percent of concrete and asphalt). • Applicants pay a small administrative fee ($212) and a refundable deposit equal to $1 per square foot of demolition or renovation area (minimum deposit of $1,500)	• New construction • Full demolition • Level 4 Alterations	• Sustainable Deconstruction Plan proposing to divert at least three of the indicated material types (required for all full demolition and Level 4 Alteration projects) • Construction Waste Recycling Application (required for all new construction) • Construction & Demolition Waste Diversion Tracking spreadsheet and all hauler receipts, weight tickets and facility sign-offs/invoices • Submit final completed waste diversion report showing tonnage of materials salvaged for recycling and reuse, supported by original weight receipts or documentation that verifies that materials generated from the site have been accepted for recycling, reuse , or salvage.	• Planning & Development Services department	• Permit rejection • If the required diversion percentage is not fully complied with, the remainder of the deposit shall be forfeited to the city as a civil penalty
Boulder County, CO (2015)	BuildSmart residential green building code	• Section N1101.15 makes deconstruction mandatory • Requires that cabinets, dimensional lumber, flooring, and solid core doors be donated, reused, or sold • Section N1101.16 requires that all construction jobsite waste be recycled including wood, scrap metal, cardboard, and concrete • Source separated or mixed load sent to a recycling center that will verify weights by material	• All new residential construction and additions in unincorporated Boulder County, CO	• Deconstruction plan, written description of deconstruction work, or the County Deconstruction Checklist • Recycling plan • Verification of deconstruction including receipts or a written log, maintained by the homeowner or general contractor, which includes the volume or weight of materials and the destination where they were transported • Verification of recycling	• Building Division	• Buildings that are demolished or partially demolished rather than deconstructed will receive a stop work notice for up to 30 days

Location (Year estab.)	Ordinance Name	Summary	Applicability	Reporting	Administrative Responsibility	Penalty for Non-Compliance
Evanston, IL (2011)	Green Building Ordinance	• Requires that projects meet a specified number of Evanston Sustainable Building Measures for Interior Renovations (ESBMIR) or Evanston Sustainable Building Measures for New Construction (ESBMNC) – • ESBMIR requirements (for renovations): o 3 measures for projects <5,000 square feet; o 5 measures for projects 5,000-20,000 square feet; o 7 measures for projects >20,000 square feet o The 27 ESBMIR measures include (1) Sell, donate, or reuse 10% or more of existing project materials, (2) Use recycled content materials for no less than 10% of project materials, (3) Use recycled content materials for no less than 20% of project materials (counts as 2 measures). • ESBMNC requirements (for new construction/additions): o 8 measures from at least 5 ESBMNC categories o The Materials and Reuse Category includes a Construction Waste Management measure "Recycle and/or salvage at least 50% of non- hazardous construction and demolition materials and waste.	• New construction or additions to all City-owned or City-financed buildings • Commercial and multi family buildings of 10,000 square feet or more • Interior renovations	• ESBMIR Measure Summary • ESBMNC Measure Summary • Post-Construction documentation that measures were met submitted to building official before Final Certificate of Occupancy may be issued	• Building Inspection Services Department	• Final Occupancy Certificate withheld

Location (Year estab.)	Ordinance Name	Summary	Applicability	Reporting	Administrative Responsibility	Penalty for Non-Compliance
Cook County, IL (2012)	Cook County Demolition Debris Diversion Ordinance	• 5% re-use requirement for residential structures • 70% diversion requirement for residential and commercial structures	• All demolition activities affecting any structure except garages, sheds, utilities, and projects that do not demolish any load bearing walls.	• Demolition Debris Diversion Plan estimating the amount of waste, means of transport, and destination of debris • Demolition Debris Diversion Report within 45 days of project conclusion • Both the Plan and Report are submitted online at www.greenhalosystems.com • Permit holder must retain all receipts and weight tickets for materials reused, recycled or landfilled for a 3 year period after completion	• Cook County Department of Building and Zoning	• $1,000 fine for demolition without a permit • $1,000 fee for failing to complete and submit required documentation • $5,000 fine for failing to divert demolition debris as required • Fines ranging from $500-$3,000 for mis-handling of debris

King County, WA (2013)	Green Building and Sustainable Development Ordinance	• All construction projects that are LEED eligible must achieve LEED certification
		• Projects not eligible for LEED certification must use the Sustainable Infrastructure Scorecard, a sustainable development scorecard developed by the County
		• The scorecard includes points for reuse of salvaged materials, use of on-site materials for construction, use of materials obtained within 500 miles of the jobsite, and points for projects designed for future deconstruction (scorecard guidelines).
		• Deconstruction is encouraged, though not required
		• The following materials are banned from landfill disposal:
		  ○ Clean wood (untreated, unpainted)
		  ○ Cardboard
		  ○ Metal
		  ○ Gypsum scrap (new)
		  ○ Asphalt paving, bricks, concrete
			• All construction and demolition projects	• At 30% design, must submit:
				  ○ King County Sustainable Infrastructure Scorecard, LEED checklist, or alternative rating system checklist
				  ○ Construction and Demolition Plan
				• Annual reporting form (Appendix F)
				• Construction and Demolition report (at project completion)
					• Green Building Team Division	• Code citation
						• Up to 60 days of civil penalties followed by legal prosecution

Location (Year estab.)	Ordinance Name	Summary	Applicability	Reporting	Administrative Responsibility	Penalty for Non-Compliance

Austin, TX (2016)	Construction & Demolition Recycling Ordinance	• Projects must meet either diversion minimums or disposal maximums
		• Disposal limits and diversion requirements initially imposed in 2016; disposal limits decrease and diversion requirements increase in 2020, and 2030
		• Diversion requirements:
		  ○ 2016 = 50% minimum
		  ○ 2020 = 75% minimum
		  ○ 2030 = 95% minimum
		• Disposal limits:
		  ○ 2016 = 2.5 pounds per square foot of project area max
		  ○ 2020 = 1.5 pounds per square foot of project area max
		  ○ 2030 = 0.5 pounds per square foot of project area max
		• Qualified processors are registered by the City for 2-year periods
			• Construction projects requiring permits for more than 5,000 square feet of new, added, or remodeled floor area
			• Commercial and multifamily residential demolition projects of any size
				• Project disposal and diversion report must be submitted at the time final inspection is requested
				• Report must include quantities of materials:
				  ○ Put to beneficial use onsite;
				  ○ Delivered to a qualified processor;
				  ○ Delivered to a processor or end-user and diverted for beneficial use;
				  ○ Delivered to a processor or end-user and disposed;
				  ○ Delivered directly to a disposal facility;
				• City Manager is required to report the economic impact of disposal and diversion rates on household affordability and assessment of future markets for reuse of construction and demolition materials to the City Council in 2020 and 2030.
					• Austin Resource Recovery Department	• Failure to comply with disposal limits or diversion minimums is a Class C misdemeanor punishable by up to $500 per day, per offense
						• Qualified processors may be suspended for failure to comply

Location (Year estab.)	Ordinance Name	Summary	Applicability	Reporting	Administrative Responsibility	Penalty for Non-Compliance
Milwaukee, WI (2018)	Deconstruction Ordinance	• Requires deconstruction • Work must be performed by a certified Deconstruction Contractor listed on the building department's website • Heavy machinery may only be used to assist in salvage materials for reuse or remove material not required to be salvaged; may not be used in ways that render building components unsuitable for salvage • Salvaged material may be sold, donated, or reused on- or off-site • Must document 85% diversion by weight	• 1-4 unit residential buildings built in 1929 or earlier, designated historic structures, and structures in historic districts. • Exemptions for buildings to be moved, structures too unsafe for deconstruction, and buildings made primarily or substantially of materials not suitable for reuse	• Completed post-deconstruction form • Receipts for donation, sale, recycling, and disposal of all materials • Photos of materials reused on site and those for which no disposal receipt is obtainable	• Building Commissioner	• Penalty of up to $100 for the first violation, up to $2,000 for the second violation, and up to $3,000 for the third and subsequent violations by the same person • Penalty up to $20,000 for improper use of heavy machinery • Penalties may be imposed on a per month, per day, per incident, or such other basis at the Director's discretion • Removal of a contractor from the list of certified deconstruction contractors, or revocation of a contractor's certification as a certified deconstruction contractor.