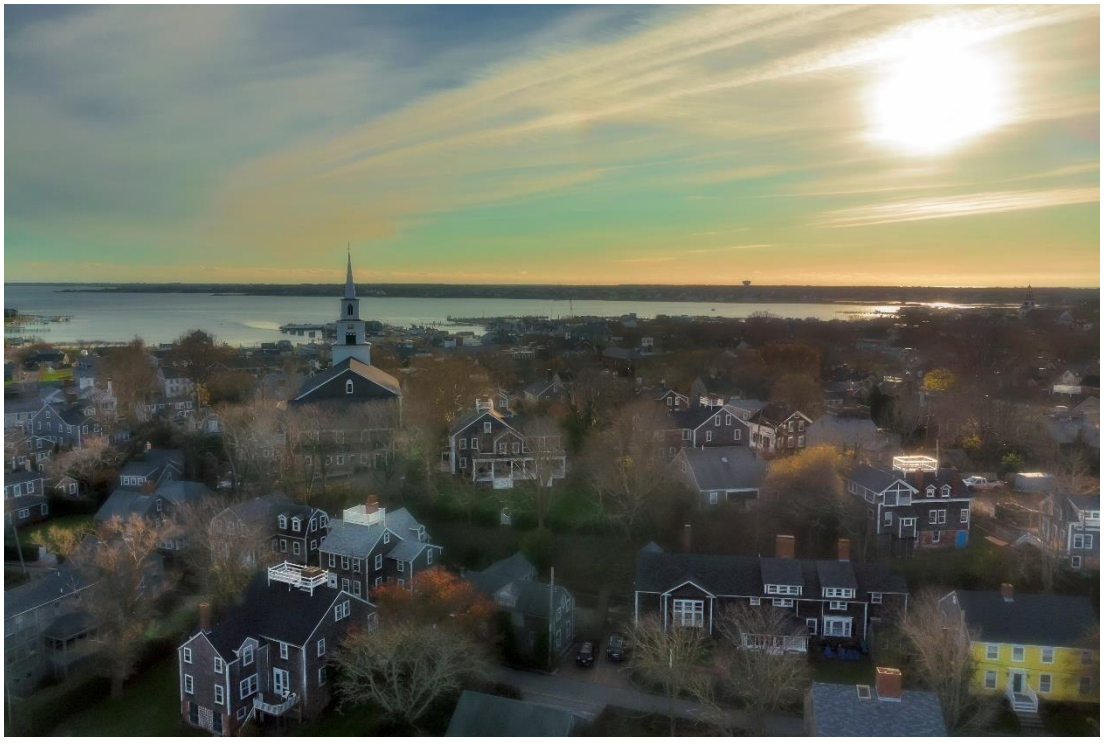
Nantucket Building Material Salvage Study

Phase 1 Interim Report

ReMain Nantucket & Nantucket Preservation Trust

April 26, 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.

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.

Acknowledgements

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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.

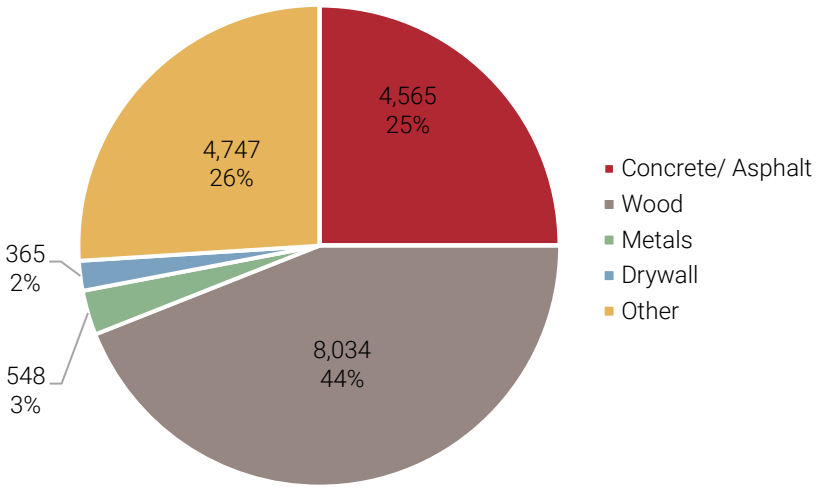
Table 3. Estimated Annual Reusable Building Materials from Residential and Commercial Demolition and Renovation (tons)

	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.

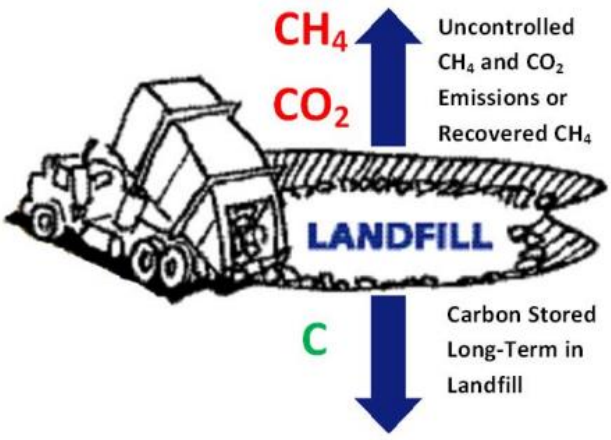
Material type	Avg. Annual Avoided C&D waste (tons)	GHG emissions per ton of new material (MtCO2e)	Avoided GHG emissions total (MtCO2Ee)
Concrete & Asphalt	1,114	0.11	124
Wood	1,961	2.13	4,181
Metals	134	3.65	488
Drywall	89	0.22	19
Other	1,159	0.10	116
Total	**4,456**		**4,928**

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)**

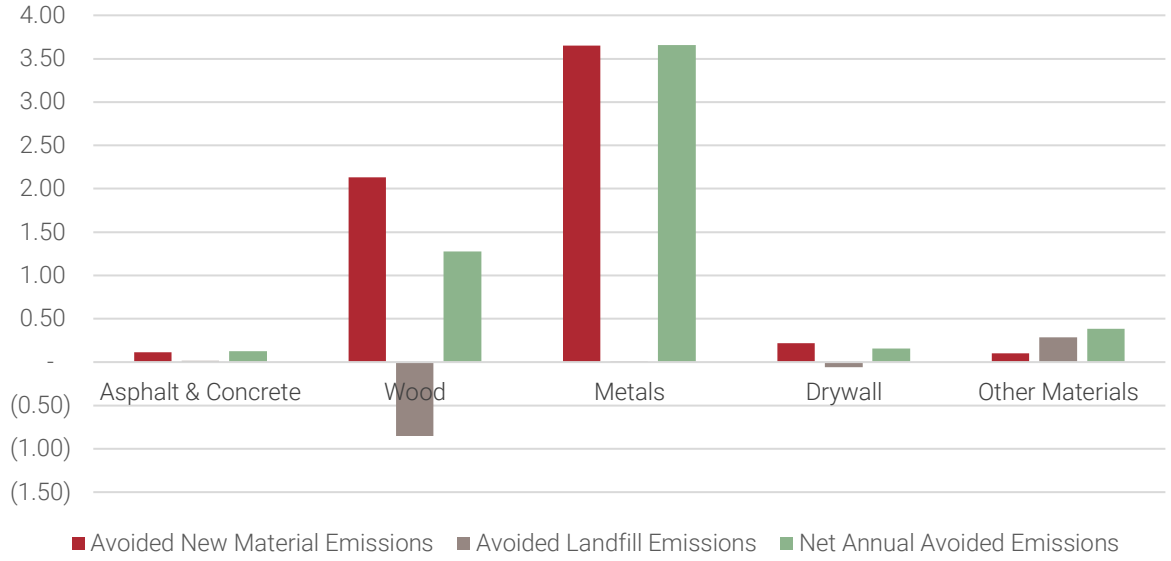
Source: GHG factors from EPA WARM.

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

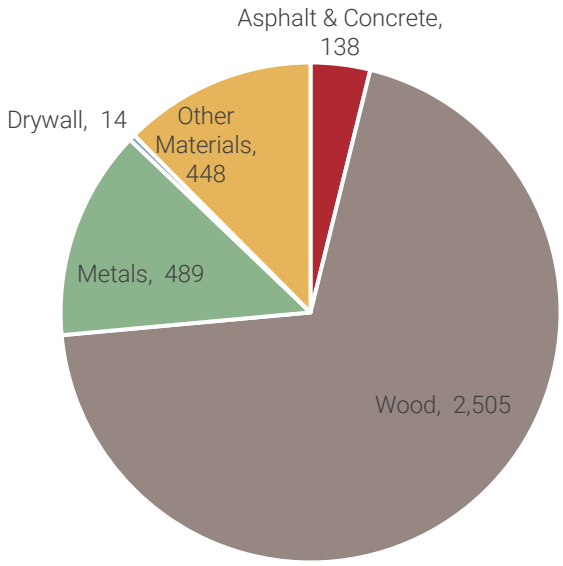
Since salvaging materials on Nantucket would both avoid the necessity for creating some new materials and lessen the volume of materials sent to the landfill, we can consider the net effect on embodied emissions by material type. Figure 4 shows the net embodied carbon savings per ton of salvaged material.

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.

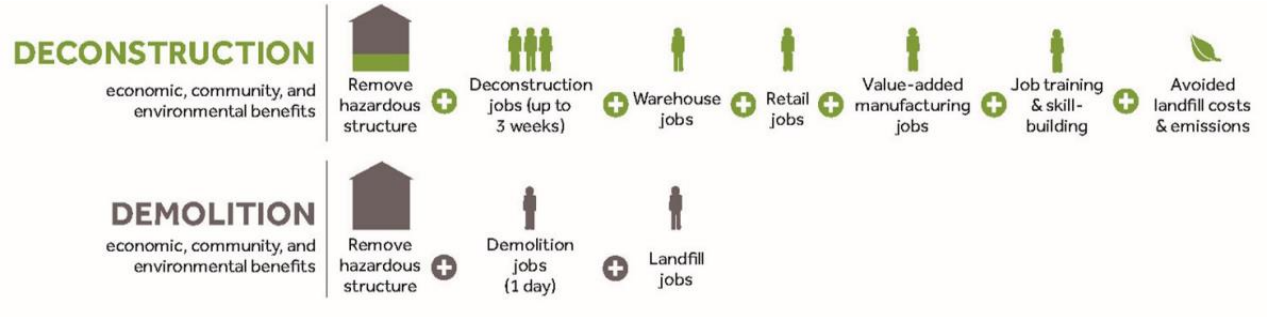
[39] Cook County, "Deconstruction Strategy Report", July 2011, p. 23, https://www.cookcountyil.gov/sites/g/files/ywwepo161/files/service/cook-county-deconstruction-strategy-report-draft-2011.pdf.

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

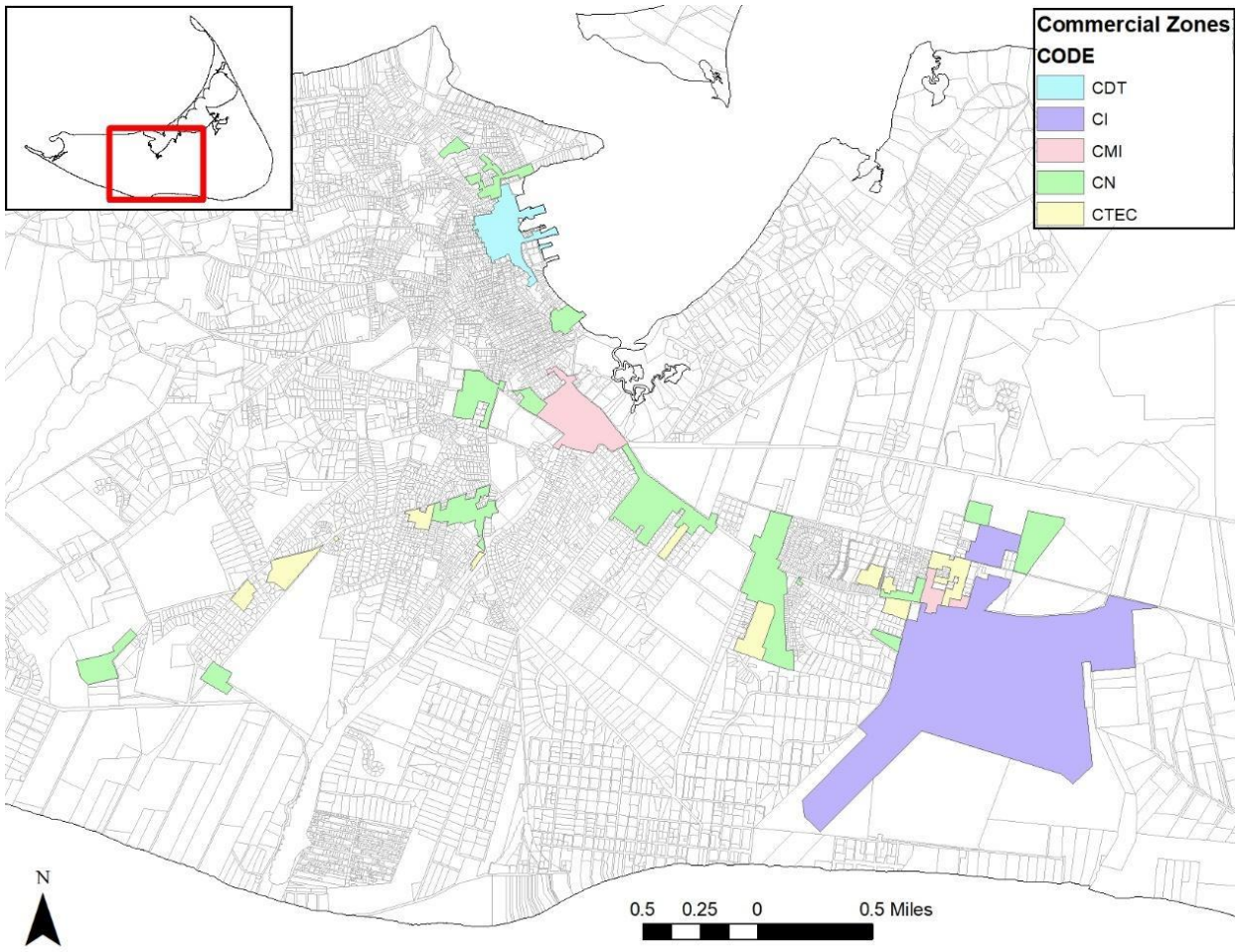


Figure 7 shows that there is a large concentration in the select commercial zoning districts at and around the airport, which is located within the large purple CI district. Note that the only CI zones are located at and across from the airport. The only area where there is CDT zoning is downtown, while 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 MtCO2e, 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.