



Deconstruction & Demolition Report

Prepared by:

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Title page photo credits: FEMA/Marilee Caliendo, EPA Deconstruction and Building Materials Reuse - Innovations and Opportunities

March 1, 2021 update: Report was revised using a plastic density of 382kg/m<sup>3</sup>, replacing the previous value of 1,450kg/m<sup>3</sup>.

## Content

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1.	Introduction	4
2.	Waste from Demolition & Deconstruction Practices	4
3.	When to Deconstruct and when to Demolish	8
4.	Material Flow	.12
5.	Best Practices	.13
	How to dispose of specific materials	.17
	How to salvage and reuse materials	.18
	Find local contractors and facilities	.18
6.	Market Opportunities for Material Reuse and Sale	.18
7.	Recommendations	.21
APP	ENDIX 1: References	.23
APP	ENDIX 2: Full List of CRD Waste Management Policy Options (CCME 19)	.26
APP	ENDIX 3: Online Material Exchange/Marketplace Platforms Reviewed	. 30

## 1. Introduction

The District of Squamish has commissioned a report on demolition and deconstruction to document the flow of building materials in the region, along with a review of "best practices" for the management of construction and demolition (C&D) waste in other jurisdictions and an investigation of market opportunities for deconstruction materials.

## 2. Waste from Demolition & Deconstruction Practices

#### CURRENT ESTIMATION OF CONSTRUCTION AND DEMOLTION WASTE:

Based on the value of the building permits submitted in Squamish to the end of October in 2020, we have estimated the amount of construction waste generated by material for each type of occupancy and for the type of work (demolition, alteration and new construction). The estimates for the waste generated by Single Unit Dwellings (SUDs) and nonresidential (demolition only) are based on the following:









For all other types of construction, the waste data collected from the Canada Green Building Council new construction projects certified under LEED Canada 2009 (Light House 2020) and the Metro Vancouver 2018 Construction & Demolition Waste Composition Study (TRI 2019) was used.

Material	Weigh (kg)	% by Weight	Volume (m3)	% by Volume
Asphalt	63,475	3%	146	2%
•				
Cardboard/Paper	25,107	1.2%	418	6%
Concrete/Stone	1,066,913	51%	2,091	30%
Drawall	80 715	10/	260	1%
Diywali	80,715	470	209	470
Foam/Insulation	84	0.0%	3	0%
Class	C 251	0.20/		0.10/
Glass	0,251	0.3%	5	0.1%
Metal	144,075	7%	240	3%
Mixed Waste	4,708	0.2%	22	0.3%
Organics	2 995	0.1%	20	0.3%
Organies	2,333	0.170	20	0.370
Other	44,284	2%	213	3%
Plastic	38,050	2%	76	1.1%
Wood	573.815	27%	3.188	46%
	0,0,010	2770	0,100	
Waste	58,450	3%	278	4%
Total	2,108,923	100%	6,971	100%

### Squamish "Non-SUD" Buildings Waste Estimate (All Work Types) January 1 – November 2, 2020





SUD New

Total

SUD Demolition<sup>1</sup>

Non-SUD (All)



The above estimates are calculated based on the weight of waste generated per cost of construction or demolition, with the exception of SUD demolition, which is based on the number of permits and the median home size in BC. These estimates are intended to give an indication of the source and

quantities of the various types of waste in order to best direct diversion efforts.

670

3,401

6,971

12,015

6%

28%

58%

100%

Base	e <mark>d on</mark> the numbe	r of SUD	demolition	permits and	using the	average E	3C house	size of	1,430 ft².
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## 3. When to Deconstruct and when to Demolish

## **Defining Green Demolition and Deconstruction**

**Green demolition** is defined in this report as a more environmentally friendly version of traditional demolition that diverts waste materials from landfill/incineration to recycling. Green demolition and deconstruction may look for diversion opportunities in the fixtures and finishes, depending on the quality of material. However, traditional demolition will most likely send all the finishes and fixtures to the landfill for the fastest possible timeframe. Green demolition practices identify as many recycling opportunities as possible and source separate as much as possible, however, wood and other materials are usually not preserved in a state that allows for reuse and are commonly only recycled.

**Deconstruction** is the systematic dismantling of a structure and building components, specifically for reuse, recycling, and responsible waste management. It is typically done by hand by a team of people. Deconstruction usually applied to single family homes but can be done at the commercial level by utilizing heavier machinery to manage large building components safely. Often large beams are salvaged from old warehouses as they have a high resale value and are highly sought after.

Material/product	Traditional Demo	Green Demo	Deconstruction
Finishes/fixtures	Landfill	Recycled / Reused	Reused
Lumber	Landfill	Recycled	Reused
Concrete	Landfill	Recycled	Recycled
Metals	Landfill	Recycled	Recycled

Differences between traditional demolition, green demolition and deconstruction

Wood is a large portion of the waste that comes from a single-family home. A, "2,000-square-foot, wood-framed, single-family house uses upwards of 16,000 board feet of framing" (CE Centre 2010). Old growth wood is a finite resource in our lifetime and has a high value. If a building avoids moisture issues with the envelope, the wood structure will be kept preserved behind the drywall and insulation and will be in great condition for reuse.

Green Demolition can be done on any building whereby deconstruction is typically seen to be performed on older buildings to harvest the old wood from the structure.

## What components can typically be easily salvaged?

Materials/components that are typically easily salvaged depend on the age of the home and how recently it has been renovated. For interior finishes, older homes can have materials that are very valuable for resale, such as clawfoot tubs, vintage appliances, solid wood doors, flooring, stained glass windows etc. Newer homes or homes that have been renovated within the last 5-10 years, will

have more interior finishes that can be reused such as kitchen cabinetry, appliances, flooring, light fixtures, vanities, toilets, sinks, doors, double pane or better windows, landscape material, etc.

For structural materials, the drywall will have to removed and recycled accordingly, or an abatement process will be conducted to deal with asbestos issues. Then the insulation will be double bagged and disposed of or a second use for the insulation is sourced. This leaves the structure to be easily accessed for deconstruction. Older homes will likely not have substances like spray foam insulation to complicate the removal. However, this is a consideration for newer homes that will have to scrape off the spray foam from the structure and potentially make it a more time-consuming candidate for reuse and make it difficult to recycle. The lumber harvested from newer homes can be reused, even the 2x4's, however, it has less value with lower quality wood and more effort to disassemble. Over the years, the demands on the forestry industry has increased which has resulted in dimensional lumber being wood that is fast growing like pine or spruce, more recycled alternatives like finger jointed studs, and cheaper alternatives like laminated structural beams.

For any type of component/building, it makes it more difficult to disassembly based on these qualifiers:

- 1. Height of the structure,
- 2. proximity to other structures, and
- 3. space on site.

## Type of connections

The more fixed the building component connections, the more difficult the salvage of this material. The more flexible a connection point is, the more interchangeable its components are that make it easier to fix, replace, remove, recycle and/or reuse. The following table gives examples of connection types based on the protocol developed by Buildings as Material Banks (BAMB) (Durmisevic 2018).



#### Connection Types

### light house

#### Examples of Connection Types

1. Construction glue



2. Nails



Source: Youtube Real Antique Wood

3. Roof truss gussets

Source: https://www.firefightingincanada.com/trainers-corner-14682/



Source: https://ozcobp.com/product/beam-hanger-flush -6-8/

More generally, the following are situations that make it challenging to disassembly that are commonly experienced based on building standards in British Columbia.

- Smaller dimension lumber: such as 2x4s are more challenging to salvage as they have a lower value of resale and still require denailing like larger dimensions of wood.
- Windows: can be dangerous to manage and challenging to store and transport. There is also the challenge to find specific uses for them as windows are often made for custom sized opening.
- Interior finishes: can be difficult to salvage if glues have been used.
- Quality of material: If the component is made of a composite material, it is much less likely the material can be salvage and reused especially if glues are used.

• Gusseted roof trusses: Though roof trusses have a dimensional lumber is desirable, it can be time consuming to disassemble because of the gussets attaching components together (type 3 connection in *Examples of Connection Types*).

## Other considerations:

Modular construction or prefabricated panels are possible to be disassembled and reused in future applications if that was the intention during construction. If glues or chemical composites are used, these panels can be unusable. Additionally, the lifespan of the materials within the panels needs to be in consideration as the panel will likely only last as long as the shortest lifespan of its component ie. when one component fails, the whole panel fails. This is an issue if the components of a panel are completely integrated and inaccessible. If the panel was designed and built for future consideration, repairs and replacements can be made and the panel be utilized in the future.

Interconnected building components may result in more complex disassembly. This can be seen in some custom-built finishes that are integrated into the structure of the building to have more minimalistic appeal. The more integrated the building components, the more challenging it will be disassembly for reuse or recycling purposes. Steward Brand has identified 6 building components as "shearing levels" below and their associated life span.



Source: (Brand 2012) Chapter 2: Shearing Layers," in How Buildings Learn: What Happens after They're Built

## 4. Material Flow

#### Material Flow diagram



Deconstruction and green demolition play a significant role in creating new lines of quality products that are growing in demand. According to the Vancouver Economic Commission, if the region were "to universally adopt a deconstruction model, the resulting value of Metro Vancouver's salvaged wood would be approximately \$342 million per year (as estimated by current retail values of \$2,403 per tonne of wood). Assuming a decrease in value as the supply expands, even at just 15 percent of the current value salvaged materials would represent an annual value of \$52 million." Squamish has a similar opportunity to build the market for the harvest and resale of salvaged old growth wood within the community. This unique material is much higher quality than the wood that is being used to build houses today and is a limited resource.

By increasing the salvage of these materials, it can present a lucrative opportunity that has the potential to create more jobs for both skilled and unskilled labor. Moving from traditional demolition practices that employ one machine operator for one or two days to demolish a house and fill a bin, to employing a crew of labourers for 1-2 weeks, offers opportunities for the local community. There were 17 demolition permits obtained in the first 10 months of 2020, this represents full time employment for that crew of labourers.

This example of deconstruction job creation does not include the additional retail and "value add" opportunities - After the material is extracted, there will be resale within the community and surrounding area. By transforming the wood into furniture, flooring and other goods, economic value is added. Based on the success of *Phase One* who created their own market for selling wood to private clients, there is a demand in the community.

## **5. Best Practices**

For a full list of construction, renovation, and demolition policy options, please see Appendix 2. This list has been extracted in its entirety from the *GUIDE FOR IDENTIFYING, EVALUATING AND SELECTING POLICIES FOR INFLUENCING CONSTRUCTION, RENOVATION AND DEMOLITION WASTE MANAGEMENT.* (CCME 2019)

In this section we highlight three "best practice" approaches successfully used in other regions or municipalities that are complimentary to one another and that would be appropriate for the District of Squamish.

## **REGIONAL DISTRICT OF NANAIMO**

In 2004 the Regional District of Nanaimo had a waste study completed that determined that CR&D waste, most of it wood, comprised 16% of all waste landfilled in the District (second highest category after organic waste). The Region's Zero Waste Plan proposed that this wood waste be banned from the landfill and to create a "Waste Stream Management Licensing System" to encourage private sector investment in wood recycling facilities. Before implementing both the ban and the licensing system, the district solicited the input of waste haulers, builders and processing facility operators on the program design. In general, there was support of the program as it provided the opportunity for economic development.



The new bylaw categorized wood as a recyclable material and banned it's disposal in the landfill, however as a convenience for "self-haul" customers clean wood was accepted at the landfill and a fee charged to cover it's transfer to the private facilities. The fee for source separated wood was set at \$200 per tonne, twice the fee for garbage and much more than what was charged at the private

facilities, this was to encourage the wood waste to be delivered to the private recycling facilities directly.

The Region did not provide any capital investment for the diversion and processing of the clean wood waste as these costs were covered by the private processing facilities. No additional staff were required at the landfill or transfer station.

The program was successful due in large part to the collaboration of the District with the private sector, and due to the communication and education with wood waste generators and haulers with respect to the wood ban prior to the implementation of the bylaw.

The ban resulted in an 87% decrease in the wood waste sent to landfill with the remaining amount being "dirty" wood waste that was ground and used as landfill cover. Similar bans are in effect in the Cowichan Valley Regional District, the Fraser Valley Regional District and Metro Vancouver. (RDN n.d.)

### WHISTLER

Whistler's *Re-Use-It Centre* is a non-profit thrift store run by the Whistler Community Services Society. This store's revenues are over \$1 million annually for a permanent population of just under 12,000 plus an estimated 2,430 seasonal residents. In comparison, two of the *ReStores* in Metro Vancouver, run by Habitat for Humanity of Greater Vancouver, generate \$1.2 million (approximately \$600,000 each) and serve a population of almost 2 million people. The Whistler Re-Use-It Centre has less than one tenth of the floor space of the ReStores, but generates over 100 times the revenue per capita. (CCME 2019)

The success of the Re-Use-It Centre is attributed to various factors, including the high number of seasonal residents who would need to both sell and buy household goods annually. However its the location next to the recycling depot which allows for convenient drop off of reusable materials and the frequent opportunity for purchase as well (Whistler does not have curbside recycling pick-up, which increases the traffic to this location) that much of it's success is attributed to. There is also the reinforcement of a "virtuous circle" where the revenue from the store helps to fund community services, so residents know that their donations and their purchases will benefit Whistler directly and are then more likely to do both.

The *Re-Build-It Centre*, also operated by the Whistler Community Services Society, does not benefit from co-location with a recycling depot but does have the same advantages otherwise. Re-Build-It also has a tool lending library that allows residents to be able to make use of the available building material whereas they might not be able to without this service. The tool library has both a social benefit in terms of equity, and can help to increase the sale of reused building supplies by putting tools into the hands of a demographic that's more likely to purchase salvaged building materials.

Building product reuse centres need a continuous supply of materials. In Vancouver, *Unbuilders* (a for-profit deconstruction company) has partnered with the non-profit Habitat for Humanity to incentivize deconstruction over demolition by providing tax receipts for the charitable donation of

salvaged building materials to Habitat's ReStores. According to Unbuilders website<sup>2</sup>, an example cost comparison of deconstruction vs traditional demolition based on a 2,400 sqft home is as follows:

	unbuilders	Traditional Demolition
	\$14,595	\$26,500
HOUSE REMOVAL	\$38,500	\$22,000
FOUNDATION REMOVAL	\$4,500	\$4,500
FEDERAL TAX CREDIT	✓ - \$18,850	NO CREDIT
PROVICIAL TAX CREDIT	<ul><li>✓ - \$9,555</li></ul>	NO CREDIT
TOTAL	<u>\$14,595</u>	\$26,500

The following are the salvage/recycling rates for five of Unbuilder's projects in the Lower Mainland:

Project # (unit:tonne)	Materials Disposed	Wood Salvaged	Materials Recycled	Total Materials Processed	Diversion Rate %	Salvag Rate S
1	0.6	6.22	69.64	76.46	99.22%	8.13%
2	14.75	7.03	107.01	128.79	88.55%	5.46%
3	4.63	11.35	72.52	88.5	94.77%	12.829
4	7.65	9	73.98	90.63	91.56%	9.93%
5	1.1	15.48	77.43	94.01	98.83%	16.47%
Average	5.746	9.816	80.116	95.678	94.58%	10.26%

• Refer to appendix E for a breakdown of deconstruction sample projects/sample project diversion rate

#### From *The Business Case For Deconstruction* (Elliot 2020)

The following attributes of a building product reuse centre are beneficial:

- Non-profit, for the tax benefits
- Tool sharing program
- Co-located in the vicinity of waste disposal, transfer or major recycling facility
- Where the revenue directly benefits the community

Reuse generates the tax advantage thereby encouraging reuse over recycling, resulting in a higher portion of the diversion going to it's "highest and best" use as salvage.

<sup>2</sup> https://unbuilders.com/how-it-works/

## VANCOUVER

The City of Vancouver has aggressively targeted single family home demolition waste with their <u>Green Demolition By-law</u>. The following is currently required:

- Minimum reuse and recycling requirements for demolition waste for houses built before 1950<sup>3</sup> (75% of materials by weight, excluding hazardous materials)
- An additional *deconstruction* requirement for demolition of a heritage listed house, or a house built before 1910 (90% of materials by weight, excluding hazardous materials, with a minimum of 3 metric tonnes of wood salvaged)
- A Recycling and Reuse Plan for building or development permit
- <u>Recycling and Reuse Compliance Form</u> when demolition is complete, and prior to requesting a building inspection
- A wood salvage report for demolition of heritage listed, or pre-1910 houses
- A \$350 non-refundable waste compliance fee, along with a \$14,650 refundable green demolition deposit.

The deposit is refunded based on the following schedule from <u>By-law No. 11450 "A By-law to amend</u> <u>the Green Demolition By-law regarding fees and incentives for salvage:</u>

FOR PROJECTS WITH	75% RECYCLING REQUIRED	FOR PROJECTS WITH 90	% RECYCLING REQUIRED
Recycling rate achieved	Amount of deposit refunded	Recycling rate achieved	Amount of deposit refunded
75%	100%	90%	100%
71-74%	50	86-89%	70
66-70%	20	81-85%	40
Under 65%	0	75-80%	20
		Under 75%	0

The City enforces compliance by review of the completed forms to ensure:

- The waste amounts are within 15% of the Metro Vancouver estimates (547 kg/m2 (111lb/ft2))
- The Recycling & Reuse Compliance Report numbers are verified against receipts submitted, and
- All major categories of demo waste are represented by receipts from appropriate recycling/disposal facilities

The consequences of noncompliance are the forfeit of a portion or all of the deposit, project delays or prosecution for fraudulent submissions. Despite the City's best efforts, some owners/demolition contractors will bypass these requirement – one means of doing so is by classifying what is essentially demolition and new construction as a renovation project, which does not have the waste diversion requirements.

<sup>3</sup> Original By-law was for pre-1940 homes.

## light house



The "renovation" of a circa 1918 two-and-a-half storey home – only the 2 one-storey walls remain, 300 block E. 34<sup>th</sup> Ave. Vancouver, September 2020. Photo credit: Brenda Martens

A smaller community *may* be in a better position in terms of enforcement as there are fewer construction/demolition companies to 'regulate' and fewer permits to monitor. All of the measures undertaken by the City of Vancouver can be implemented by other municipalities under the Community Charter.

Other municipalities have implemented waste management requirements for demolition. Richmond requires a Waste Disposal and Recycling Services Fee to be paid for projects to receive a Demolition Permit. To have the project's deposit returned, the project must achieve 70% or greater levels of recycling of the total nonhazardous waste of the project. The fee is based on the square footage of the building/structure that is planned to be demolished (CoR 2020). New Westminster calculates the fee to be \$0.87 per square foot of project floor space, and will refund the full fee if 70% or more is recycled, with a prorated refund below that percentage (CoNW 2016)

Many of the City of Vancouver requirements mirror LEED requirements for waste diversion, where LEED represents "best practices" within the construction industry. Vancouver accompanied their requirements with an extensive toolkit referencing local resources for contractors and owners, these resources included:

#### How to dispose of specific materials

- <u>Construction industry waste toolkit, case studies, and regulations (Metro Vancouver)</u>
- <u>2008 demolition, land clearing, and construction waste management toolkit (Metro</u> <u>Vancouver</u>)
- Hazardous waste resources (BC Ministry of Environment and Climate Change Strategy)
- <u>Lead-containing paints and coatings: preventing exposure in the construction Industry</u> (WorkSafeBC)

- Occupational Health and Safety (OHS) Regulation (WorkSafeBC)
- <u>Safe Work Practices for Handling Asbestos (WorkSafe BC)</u>

#### How to salvage and reuse materials

• Salvage and reuse guide for green home renovations PDF file (1 MB)

#### Find local contractors and facilities

- Metro Vancouver Recycles
- <u>Recycling facilities (Recycling Council of BC database)</u>

## Case Study for Recycling

Taking as an example a two-storey 576m<sup>2</sup> restaurant project in Vancouver, we can compare the costs for recycling vs disposal of the construction and demolition waste. The project is LEED certified and achieved a 99% waste diversion rate. Below is the waste composition and cost comparison:

Type of Waste	Amount of Waste (kg)	Costs (\$) to recycle	Cost (\$) to dispose	Source for Costs
Garbage	10,396	\$936	\$936	CoV (2020)
				CoV (2020) Ecowaste
Concrete	1,082,000	\$3,246	\$36,788	Industries Ltd. (n.d.)
				CoV (2020)
Metal	22,282	(\$16,000)	\$0	Avada (2018)
Wood	66,358	\$5,309	\$5,309	CoV (2020)
Cardboard	4,920	\$0	\$445	CoV (2020)
				CoV (2020) Ecowaste
Asphalt	38,600	\$115	\$5,327	Industries Ltd. (n.d.)
Totals	1,224,556	Revenue (\$6,394)	\$47,915	\$54,309 Difference

Modified from Source: (McGratten 2020)

Source separation and recycling waste on this project represents a potential savings of \$54,309 over the cost of disposal (a net revenue of \$6,395). Salvage would increase these savings/revenue.

## 6. Market Opportunities for Material Reuse and Sale

Understanding the composition of the C&D waste streams, current constraints on materials recycling capacity in the region, and high landfill tipping fees to the commercial waste create an opportunity for the District of Squamish to develop and implement new programs that will increase the diversion of targeted materials into reuse, recycling, and energy recovery opportunities. It will help to reach the region's diversion goals. (DS, 2020)

## Deconstruction/Recycling/Surplus "Hub"

While there are only a few deconstruction companies and salvage brokers in the region, the challenge is encouraging more contractors to take the time and effort to deconstruct. Rather than demolish structures, encouraging contractors to salvage materials, sort them by type, and distribute

and introduce to the secondary raw material marketplace will close the loop in the construction ecosystem to create a circular economy. (DS, 2020)

Squamish ReBuild is currently the only <u>retail</u> facility that supports the District's C&D high disposal rate through diverting reusable construction waste from the landfills. The Squamish Rebuild Society was incorporated as a not-for-profit organization in 2011 with the vision of changing the way the community thinks about waste. They operate a physical space where they resale the donated reusable household and construction materials to reduce the waste diversion from the landfills. These materials are good quality, affordable, surplus and used building supplies. They support promoting and raising awareness around the three R's (reduce, reuse, and recycle) social, economic, and environmental benefits. (RS, 2020)

While building product reuse centres provide a physical space for the reusable building supplies and offer a service to the community, there are some challenges with these facilities:

#### Uncertainty of supply of salvage materials

First, there is an uncertainty of the material types, amounts, conditions, etc. that will be received. As a result, a substantial inventory of reusable building materials cannot be maintained on an ongoing basis to supply the contractors and builders of newly built projects or renovations. As per our conversation with Sarah Rose, Operations Manager, Squamish ReBuild is never approached by architectural firms or other professionals to request any of the reusable construction materials they offer to the community. They are interested in receiving more lumber and plywood types of materials to create a secondary raw materials market for the construction industry use.

#### Limited storage capacity and low inventory turnover rate

The second challenge of the building product reuse centres is the limited physical storage capacity. It limits the potential variety and size of the reused materials that could be resale; therefore, it restricts both the salvage materials' supply and demand in the region. According to our interviews with Squamish ReBuild, a portion of the donated materials are either outdated or low-quality materials, which slows down the inventory turnover rate since buyers are not interested in these materials. These slow-moving items eventually degrade or mold in the storage space and unfortunately end up in the landfill.

Squamish Rebuild also needed to issue a 'no donation' policy for some of the C&D materials (such as concrete, drywall, carpets, furniture, hot tubs, ceiling tiles, blinds, drapes, garage doors, toilets with bigger tanks, water heaters, furnaces, skylight windows, etc.) due to the limited outdoor storage space and at times suspend donations due to the overstock challenges caused by the limited storage capacity and slow resale rate. (SR, 2020)

These limitations may be the reason that most of the salvaged material in Squamish is supplied by deconstruction and demolition contractors in a "direct to customer" exchange. Phase One Dismantling Services for example manages, markets, and delivers all of their salvaged materials to their client base. According to others, "deconstruction contractors do not require this type of central community retail depot (building material reuse centre) for marketing and distribution of salvaged construction materials", and it has been suggested that surplus new building materials may be better suited to venues such as ReBuild, rather than salvage. However, it is unclear if this direct to customer model will support scaling up to the extent needed, and whether it would be the

preferred model, or just one of the models of exchange for a resilient deconstruction industry. The form the exchange of materials takes is best left to the private sector to determine.

## **Online Materials Marketplace**

In a study conducted by Stephanie Dalo (UBC Sustainability Scholar 2019 in Partnership with Metro Vancouver), it was found that actively managed, online resource marketplaces have huge potential to become a central source of information on C&D material in the region. These online resource marketplaces successfully support the exchange of C&D materials, and can address the gap between the suppliers of reusable building materials (C&D waste generators) with potential buyers.

A list of the existing online marketplaces that have been reviewed for this study are included in Appendix 3. We also included Stephanie Dalo's literature review of different online resource marketplaces in the US for the study to Metro Vancouver, Assessment of an Online Marketplace for Construction and Demolition Materials. According to her findings, these actively managed online resource exchange/marketplaces that include a vast amount of information, extending beyond facilitating a transaction between buyer and seller of the C&D material. These platforms also include information about how material can be reused, showcase projects that have been built with salvaged materials, put people in touch with brokers, consultants, etc. Furthermore, these platforms help inform people of workshops or training seminars to learn deconstruction methods. (DS, 2020)

While the online resource marketplaces provide business-to-business connections to repurpose byproducts, residuals, unused materials, and waste, there are some challenges with online material exchanges/marketplaces. Dalo highlights these challenges in her study as Seller's commitment and Buyer's uncertainty. First, sellers have access to other disposal options and may not fully commit to exchange. Second, buyers can face high uncertainty about the product exchanges and the transaction being undertaken. (SD, 2019)

Stephanie Dalo references a study conducted by Suvrat Dhanorkar (Pennsylvania State University – Department of Supply Chain and Information Systems) et al., it was found that regional repurposing policies and alternatives have had a complementary effect on sellers' commitment towards online material exchanges, resulting in increased exchanges using an online marketplace. However, it was also noted that regional disposal policies and alternatives have a substitution effect on the sellers' commitment, resulting in reduced exchange success (Dhanorkar et al., 2015). Further, the greater product and transaction information reduced the buyer's uncertainty and increased exchange success. The analysis provided by Dhanorkar et al. also concluded that users (buyers and sellers) heavily rely on their prior experience with online material exchanges. Specifically, the higher familiarity between the buyer-seller pair and familiarity with the online material exchange system leads to a higher likelihood of exchange success. (SD, 2019)

## Focus on Salvaged Wood Products

Among the various materials found in the District of Squamish's landfill, the most common material is wood, (followed by concrete, drywall, cedar shakes singles) which takes a long time to break down and fills up the landfill at a much quicker rate than other items as it is difficult to compact. This creates an additional problem since the Squamish Landfill is nearing the end of its life. (DS, 2020)

Similar research on the reuse of materials with an industrial symbiosis approach reported that a diverse network of engaging businesses across all sectors and sizes has proven to foster material reuse faster and more effectively. (NISP, 2020) Similar research on the reuse of salvaged materials

reported that there has been increased interest from restaurants and other business organizations who aim to improve purchase decisions by choosing to sustainably source material such as salvaged wood for furniture, trimmings, light fixtures and other finishes. Similarly, the film industry has been known to show interest in using salvaged wood for buildings sets since it is a more feasible option than purchasing new materials. (SD, 2019) An online resource marketplace will support these cross-sector opportunities for materials reuse by bringing companies together in the same medium. It will also connect Squamish local businesses with the Lower Mainland companies to foster regional materials reuse to divert the wood and C&D materials faster in Squamish landfills.

## 7. Recommendations

## **Policy Recommendations**

These recommendations, if accepted, should be undertaken in consultation with the community. Undoubtedly some of the best practices highlighted will have to be modified to the local context to be successful.

- Require a *Recycling and Reuse Plan* for permits for demolition, additions, new construction and alterations for <u>all</u> building types (or a subset of all building types based on deconstruction potential). LEED has demonstrated that this "best practice" allows all project types to target substantial reduction of construction and demolition waste. If the owner/contractor is aware of what the waste composition will be and knows what facilities accept those materials they are more likely to be successful in increasing waste diversion. A *Recycling and Reuse Plan* need not be onerous if a template is provided that auto populates with estimates of waste (based on square footage and Metro Vancouver's Calculator for example), along with a list of local recycling/reuse facilities.
- Require the reporting out of actual waste diversion, without mandatory compliance with diversion targets. Ask for voluntary compliance initially, and transition to mandatory compliance after a short period of adjustment. Incentivize meeting targets with a refundable deposit as other communities have done – Vancouver, Richmond and New Westminster for example – in their bylaws.
- 3. Set the waste diversion compliance targets by volume rather than weight, to incent the diversion of wood. Weight targets are most easily met with concrete, which is commonly recycled as fill regardless of regulation, and other heavy building materials. "Standard" weight-to-volume conversion numbers can be used as most receiving facilities report in weight.
- 4. To counter the increased difficulty of meeting diversion targets based on volume, and to incentivize deconstruction over demolition, have salvaged material weighted more heavily in the calculation for waste diversion targets. As an example, set the target percentage for salvage to half that required for recycling, effectively:

 $\frac{(\text{Volume of Salvage x 2}) + (\text{Volume of Recycling})}{\text{Total Volume of Waste}} \ge XX\%$ 

5. Create a program for the engagement and education of the construction industry regarding deconstruction, salvage, recycling and regulation. Engage the local Squamish waste hauling, construction and demolition industry for input, feedback and an opportunity to voice
 r comments prior to rolling out requirements.

6. Collaborate with the Resort Municipality of Whistler and other communities in the Sea to Sky Corridor to create coordinated construction and demolition waste policies and guidelines.

## Market Opportunities Recommendations

- 7. Support a "hub" of expanded recycling facilities, surplus building material and salvage material exchanges. The form this support takes is best determined in collaboration with the private sector. For-profit and non-profit examples have been provided. Some of the mechanisms the District has available include the zoning of industrial land for these types of uses, setting fees or creating a "Waste Stream Management Licensing System", using incentives and regulations to increase the volume of deconstruction and green demolition work, etc.
- 8. Support an Online Marketplace to create a salvaged supply chain in the digital environment. This would support multiple models of exchange, including "direct to customer" and physical building material reuse centres. It supports Squamish business and promotes cross-region and cross-sector opportunities.
- 9. Create an education and awareness program for the public, to increase the awareness of, and demand for salvaged building materials.

## **Future Recommendations**

10. Current North American construction practices do not support the future deconstruction of our buildings. To effectively eliminate waste you have to change the initial building design and construction. Consider adopting guidelines for "reversible design" or "design for disassembly", otherwise the generations that follow us will be burdened with our construction waste.

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We have attempted to accurately represent and credit the papers, reports, websites, individuals and other sources referenced in this report. If there are any errors in citation these should be brought to our attention and we will correct them. Unless otherwise attributed the views expressed represent the opinions of the authors based on our collective experience working in the industry. We would like to disclose that Light House hosts *NISP Canada* and *BizBizBC*, and is affiliated with *BizBiz Construction*, which are surplus and waste utilization programs.

**APPENDIX 1:** 

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## **APPENDIX 2**

## Full List of Construction, Renovation and Demolition Waste Management Policy Options

POLICY TYPE	POLICY TOOLS
Regulations	
1. Performance- based standards	<ul> <li>Mandatory waste diversion performance (overall or for specific materials) to be demonstrated prior to issuance of building permit for demolition or occupancy permit for new construction.</li> </ul>
	<ul> <li>Zero-waste goals and policies designed to minimize the volumes of CRD waste generated.</li> </ul>
	<ul> <li>Landfill bans for CRD waste (overall or for specific materials with highest diversion potential or where alternatives exist).</li> </ul>
	On-site disposal (fill) limits.
	<ul> <li>"Outcome-based" building codes with mandatory sustainability and CRD waste diversion standards (e.g., green building certification, durability, climate- appropriateness, minimum requirements for the use of materials with reused/recycled content in new projects, minimum CRD waste diversion).</li> </ul>
	<ul> <li>Legislation that promotes renovation and adaptability (e.g., mandatory preservation/renovation of high-value/heritage buildings).</li> </ul>
	• Land use policy and policies describing desired building form, function and character that can encourage certain building types and uses (e.g., to locate an industrial consumer of wood waste close to an MRF) or prohibit certain building types and designs in high-risk locations to minimize premature repair/replacement.
	• Permits and licences for haulers, landfill operators and processing facilities.
	Limitations on transport (avoid taking to lower-cost jurisdiction).
	Regulations that prohibit, restrict or require the use of certain materials.
	Mandatory EPR or product "take-back" programs.
2. Design, process or	<ul> <li>Mandatory plans/narratives describing strategies for CRD waste management, diversion, deconstruction, zero waste and disassembly.</li> </ul>
standards	<ul> <li>"Prescriptive" building codes (functional-based building codes, form-based codes) that stipulate desired practices and processes.</li> </ul>
	<ul> <li>Mandatory recycling and source separation (including the use of specified demolition/deconstruction processes.</li> </ul>
	Requirements to use specific facilities or service providers.

POLICY TYPE	POLICY TOOLS
	<ul> <li>Required compliance with durability plans and standards (e.g., CSA S478-95 (R2007) Guidelines on Durability in Buildings).</li> </ul>
	<ul> <li>Compliance with technical standards for reused/recycled materials (establishment of "end-of-waste" criteria).</li> </ul>
Market approaches	
3. Taxes, fees	• Tipping fees, levies or landfill taxes (can be used to fund programs).
and charges	• Fines.
	<ul> <li>Front-end levies or fees (virgin materials, priority CRD materials, eco- fees on materials that are difficult to divert).</li> </ul>
4. Subsidies and	Reduced fee benefits (e.g., building permit fees, development cost charg
Incentives	<ul> <li>Process/approval benefits (e.g., density bonus, expedited plan review, expedited permitting, demolition prohibited until building permit for new building approved).</li> </ul>
	Tax credits/receipts (as deconstruction incentives for donating used mate
	Government-backed insurance.
	<ul> <li>Grants, subsidies, financing or preferential loans for owners maintain/upgrade existing buildings (rather than demolition), for compan and facilities providing diversion services (e.g., training, capital cost, R&amp; and so on.</li> </ul>
5. Combinations	<ul> <li>Deposit-refund on building permits (e.g., based on waste reduction or diversion target).</li> </ul>
	• Standard-price combinations (e.g., targets backed by fees or deposits).
6. Direct public sector investment	<ul> <li>Investment in infrastructure and service provision (e.g., public-private sector processing facility, reuse centres, expanded drop-offs, WtE options, right-sized recycling receptacles, pick up services).</li> </ul>
	<ul> <li>R&amp;D (e.g., developing new uses for recycled CRD wastes, LCA).</li> </ul>
	Pilot and demonstration projects.
7. Tradable assets	Tradable supplier obligations and responsibilities notes.
8. Information	• Waste diversion performance reports (project, business, landfill, MRF).
	Notification and registration of waste transports.
Voluntary approach	es
9. Information,	<ul> <li>Moral suasion diversion campaigns (e.g., zero waste).</li> </ul>
recognition	Public outreach and education.
(including outreach)	<ul> <li>Promotion of alternate models (e.g., Cradle to Cradle, closed-loop construction, circular economy, dematerialization, modern methods of construction, durability).</li> </ul>
	<ul> <li>Promotion and provision of databases of LCA of materials, assemblies and structures.</li> </ul>
	Competition and awards

POLICY TYPE	POLICY TOOLS
	Deconstruction and salvage guidelines and case studies.
	<ul> <li>Waste management tools (CWM plan templates, online tracking and reporting systems).</li> </ul>
	<ul> <li>Building design tools (catalogues of product and assemblies, directories of service providers, master specifications and templates).</li> </ul>
	Guidelines for preserving heritage and culturally important buildings.
	Benchmarking, data gathering and reporting frameworks.
10. Assistance, training and	<ul> <li>Training and capacity building for industry (e.g., job-site training and recycling programs, deconstruction).</li> </ul>
business	• Technical assistance (e.g., LCA, technology assessment, green building).
supports	<ul> <li>Enabling reuse (e.g., waste exchange program, free CW collection at builders' supplies stores, free/subsidized pick-up from sites).</li> </ul>
11. Voluntary	Industry-government memoranda of understanding.
plans, goals	<ul> <li>Industry leadership and self-managed programs (stretch goals).</li> </ul>
	Waste management, diversion, salvage or disassembly plans (non-binding).
12. Labelling and certification	<ul> <li>Product certification and labelling schemes (e.g., environmental choice label, EPDs).</li> </ul>
	LCA of building materials, assemblies and structures.
	Green building rating systems.
13. Government	Waste policies.
leadership	Emergency and natural disaster planning.
	<ul> <li>Sustainable procurement policies and regulations that promote the use of recycled building materials and require high diversion on public projects (e.g., through green procurement specifications such as building certifications [LEED, BOMA BEST, etc.], green building codes and other standards).</li> </ul>
Cross-cutting	
14. Zero waste goals	• Zero waste goals address environmental impacts acting across the whole material chain and therefore can be brought to bear on the building design process as well as construction and end of life.
15. Product responsibility approaches	<ul> <li>Depending on the approach, producer responsibility and chain-of-custody strategies can use all four policy categories noted above. They may be voluntary or mandatory.</li> </ul>

## **APPENDIX 3:**

## Online Material Exchange/Marketplace Platforms Reviewed

Austin Material Marketplace - https://austinmaterialsmarketplace.org/

BizBiz BC Marketplace<sup>4</sup> - <u>http://bc.bizbizshare.com/</u>

BizBiz Construction - https://bizbizconstruction.com/

Minnesota Material Exchange – <u>https://mnexchange.org/</u>

Planet Reuse – <u>https://www.reusemarketplace.org/</u>

Rebuilding Exchange – <u>https://www.rebuildingexchange.org/</u>

ReUse Consulting - <u>http://www.reuseconsulting.com/</u>

Second Use - https://www.seconduse.com/

<sup>4</sup> BizBizBC is hosted by Light House Sustainability