

# Construction Wood Debris Recycling Pilot Project Report

Natural Resources Department  
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## TABLE OF CONTENTS

<b>I. EXECUTIVE SUMMARY.....</b>	<b>1</b>
<b>II. PROJECT BACKGROUND .....</b>	<b>1</b>
<b>III. PILOT PROJECT DESIGN .....</b>	<b>2</b>
IMAGE 1 – WOOD RECYCLING PILOT PROJECT SIGN. ....	3
<b>IV. CONTRACTED SERVICES.....</b>	<b>3</b>
IMAGES 2 AND 3 - 10-CUBIC YARD AND 30-CUBIC YARD PILOT PROJECT CONTAINERS. ....	4
IMAGE 4 – CONSTRUCTION WOOD DEBRIS PILE AT LARIMER COUNTY LANDFILL. ....	5
<b>V. PROJECT PARTICIPANTS AND PROJECT SIZE.....</b>	<b>5</b>
TABLE 1 – PARTICIPATING CONSTRUCTION COMPANIES, LOCATION AND PROJECT SIZE. ....	6
IMAGE 5 – PARTICIPATING BUILDING DURING ‘SIDING’ PHASE.....	7
<b>VI. PROJECT RESULTS .....</b>	<b>7</b>
TABLE 2 – CITY OF FORT COLLINS WOOD PILOT PROJECT RESULTS – 2000. ....	8
GRAPH 1 – POUNDS OF WOOD COLLECTED / SQ. FT. PER PARTICIPATING BUILDER. ....	8
<b>VII. WOOD DEBRIS COMPOSITION AND CONTAMINATION.....</b>	<b>9</b>
GRAPH 2 - COMPOSITION OF COLLECTED CONSTRUCTION WOOD DEBRIS.....	9
IMAGES 6 AND 7 - CONTAMINATION IN SOURCE SEPARATED CONSTRUCTION WOOD DEBRIS. ...	10
<b>VIII. WASTE DIVERSION .....</b>	<b>10</b>
TABLE 4 –CONSTRUCTION WOOD DEBRIS PILOT PROJECT DIVERSION RATES. ....	11
<b>IX. COST SAVINGS ANALYSIS .....</b>	<b>11</b>
TABLE 5 - POTENTIAL COST SAVINGS UNDER TWO SCENARIOS. ....	12
<b>X. POTENTIAL WOOD DEBRIS STREAM.....</b>	<b>12</b>
<b>XI. SURVEY RESULTS .....</b>	<b>13</b>
<b>XII - PROJECT SUMMARY AND FUTURE PROGRAMS.....</b>	<b>14</b>
PILOT PHASE II – SPRING 2001.....	15
<b>APPENDIX A - SURVEY OF ALL PILOT PROJECT PARTICIPANTS. ....</b>	<b>16</b>

## **I. EXECUTIVE SUMMARY**

Between July 1 and mid-November, 2000, eight construction companies participated in a City sponsored pilot program to separate and recycle wood debris from 13 construction sites. Wood was collected by a City-contracted hauler and taken to the Larimer County Landfill, where it was staged for processing into a landscaping mulch product. The objectives of the pilot program were 1) to quantify the volume of wood debris generated from new construction sites in Fort Collins, and 2) to identify potential barriers and opportunities for future wood recycling efforts.

The average size of participating construction sites ranged from 1,500 square feet to 8,500 square feet. Eleven sites were residential construction and two were commercial. A total of 330 cubic yards (75,000 pounds) of wood debris was diverted from landfill disposal during the pilot project.

## **II. PROJECT BACKGROUND**

Because of the rapid growth in our community, the City of Fort Collins Natural Resources Department has monitored construction debris issues and the impact on the lifespan of Larimer County's landfill, which is currently scheduled for closure in the next six or eight years. In 1999, Fort Collins' City Council approved a one-time budget for a project to collect data on wood waste generation from construction sites and to study effective methods of diverting this waste from landfill disposal.

In 1999, four years after the City Council had adopted strong new policies for solid waste reduction, Fort Collins successfully reached the goal of diverting 20% of its waste stream from landfill disposal. The City Council then set a new goal of diverting 35% of the waste stream by 2004, calling for strategies to target specific materials such as wood debris.

Larimer County's end-of-year reports in 1998 showed that construction waste constituted approximately 55% of all wastes entering the Country Landfill, with wood representing a significant portion of this waste stream.<sup>1</sup> The City's pilot construction debris project was approved as a strategy to better understand and target this growing segment of the waste stream, so that the community's overall diversion rates could be improved.

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<sup>1</sup> January 18, 1999 Coloradoan article on construction waste and Larimer County Natural Resources.

### **III. PILOT PROJECT DESIGN**

The wood recycling pilot project was designed to model a source separation and collection system that could potentially be applied in the market driven economy of the construction industry. The City was able to voluntarily enlist eight construction companies in Fort Collins as partners in the project. The amount of wood debris they generated at the 13 building sites was quantified and the project was evaluated for its economic feasibility and sustainability.

For these 13 sites, the City paid full costs to remove all wood waste generated during the first half of the construction project lifespan, i.e., foundation work, framing, roofing, and siding. The program was not designed to carry through to interior trim work stages of construction, based on the advice of industry members, who explained that relatively little wood is generated during the latter part of building projects.

All wood debris was source separated by construction workers and collected in designated roll-off containers. Acceptable material included dimensional lumber, plywood / oriented strand board (OSB), and particleboard. Nails and other metal attachments were accepted with the wood. The disposal of all remaining non-wood waste generated during the project was the responsibility of the contractor.

Signs were placed on designated containers to indicate that these bins were for wood debris recycling only (see Image 1). This sign was attached to the sides of 10- and 30-cubic yard containers and was printed in both Spanish and English.

Data from the City's construction project will help provide local landfill managers with information about the volumes of "clean" (trash-free), source separated wood that may be collected from the local construction industry. This, in turn, may contribute to future landfill management decisions about the feasibility of financial incentives (e.g., reduced tipping fees) for clean materials that can be diverted for re-use or recycling.

Furthermore, information from this pilot project will be used in education/outreach programs to help motivate the construction industry to separate, re-use, and recycle its waste stream.

**IMAGE 1 – WOOD RECYCLING PILOT PROJECT SIGN.**



#### **IV. CONTRACTED SERVICES**

A recycling company was selected to haul wood debris for the pilot project using a Request for Proposals (RFP) process. Applicants were evaluated for specific experience in providing service to the construction industry. The contractor was required to provide educational assistance to help reduce contamination of wood bins and to ensure that construction crews were trained to separate the wood.

Pedersons Recycling and Disposal (Berthoud, CO.) and their subcontractor, Waste Not Recycling (Pierce, CO.) were awarded the contract based on their combined experience, commitment to the principles of recycling, and ability to provide services. Together, the two contractors were able to meet the need for several sizes of bins (10- and 30-cubic yards).

As most participating buildings were between 1,800 and 4,000 square feet in size, a 10-yard container proved to be sufficient for collecting wood debris. Only one site, at 8,850 square feet,

was large enough to warrant a 30-yard container. Generally, containers were removed and emptied twice a month.

**IMAGES 2 AND 3 - 10-CUBIC YARD AND 30-CUBIC YARD PILOT PROJECT CONTAINERS.**



On-site contractors notified the hauler (Pedersons) when containers became full, and they were then taken to the Larimer County Landfill to be emptied at a separate staging area. Wood load weights were recorded at the scale at the landfill (located at the recycling plant) and the driver visually estimated the composition of the wood stream (percentage of dimensional lumber, particleboard, and plywood). Estimates of the amount of contamination and trash in the wood containers were also made at this point. Data were recorded by the contractor and submitted on a monthly basis to the City’s project manager.

The construction wood debris was stored at a designated site at the landfill to await processing. Image 4 shows the wood debris pile near project completion at approximately 315 cubic yards, 15 cubic yards short of the project total. (The City anticipates that a contractor will be hired to grind the wood into a landscaping mulch product during the early part of 2001.)

**IMAGE 4 – CONSTRUCTION WOOD DEBRIS PILE AT LARIMER COUNTY LANDFILL.**



## **V. PROJECT PARTICIPANTS AND PROJECT SIZE**

A total of eight individual construction companies participated in the wood recycling pilot project at a total of 13 different project sites. The types of construction for participating companies are classified as ‘single family’ units, ‘multi family’ units, and ‘office/bank/professional’.<sup>2</sup> Table 1 lists the companies and the locations of building sites where wood recycling took place. The square footage of each building, building type (residential or commercial) and company contact person is also listed.

The largest building in this study was 8,850 square feet (Spanjer Construction) and the smallest was 1,500 square feet (Bartran Construction). Average square feet for all 13 structures is 3,485 square feet and the total area for all participating structures was 45,312 square feet. It is important to note, however, that Table 2 combines data for two sites, Bartran and Sovick Design in order to more efficiently report the data provided by these companies, which results in an average site size of 4,119 square feet.

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<sup>2</sup> Classifications based on Monthly Construction Activity Report – City of Fort Collins Building Inspection Department. ‘Office/Bank/Professional’ also represents commercial for the purposes of this study.

**TABLE 1 – PARTICIPATING CONSTRUCTION COMPANIES, LOCATION AND PROJECT SIZE**

<b>Participating Company</b>	<b>Contact</b>	<b># Lots</b>	<b>Project Site Location</b>	<b>Size sq. ft.</b>
Bartran Construction (Residential)	Dan Bartran / Dan Ziggler	2	2608 Paddington 2615 Paddington	• 1,500 • 1,500
Bronsert Construction (Residential)	Ken Bronsert	1	2021 Lookout Lane	• 2,000
Dohn Construction (Residential)	Steve Strong	1	3945 Landings Drive	• 6,000
Engle Homes (Residential)	Paul McWilliam	2	Lot 8 - 6002 Huntington Hills Drive Lot 152 - 450 Huntington Hills Drive	• 2,919 • 2,430
Mark Twain Homes (Residential)	Aletha Langham- Godwin / Jim Dixon	1	4245 Applegate Court	• 2,200
Sovick Design (Residential)	Dennis Sovick	2	415 Mason Court 508 W. Mountain	• 1,872 • 3,000
Spanjer Construction (Commercial)	Steve Spanjer / Brian Schumm	2	3945 Landings Drive Bldgs. A & B	• 8,850 • 8,850
U. S. Homes # 1 & #2 (Residential)	Bill Stenberg	2	#1 - 7221 Egyptian Drive #2 - 208 Triangle Drive	• 2,491 • 1,700
	<b>Total # Lots</b>	<b>13</b>	<b>Total Square Footage</b>	<b>45,312</b>

Participating companies learned about the pilot project through a variety of channels including word of mouth, announcements in construction industry newsletters, and through letters sent by the City’s Natural Resources Department to members of the construction community to solicit volunteers.

Interested program applicants were selected based on the relative timing of their construction activities. Participants needed to be in the initial stages of framing (or earlier) to ensure that data were collected during the greatest wood-generating period of the construction process (again, this project was not designed to include finish construction stages). Image 5 shows an example of one residential site, a 2,000-square foot home built by Bronsert Construction on Lookout Lane, during the siding stage.

Participating buildings were primarily residential single-family and multi-family homes, and two buildings were commercial structures (Spanjer A & B). Project results combined data for all buildings, commercial and residential, and participating sites were not classified as to whether they were ‘custom built’ or ‘prefabricated design’. While project results were averaged together and not broken down by type of structure, it is believed that the range of data observed for participating sites, presented in the next section, can be partly explained by the type construction being undertaken, i.e., custom, pre-fabricated, or commercial.



**IMAGE 5 – PARTICIPATING BUILDING DURING ‘SIDING’ PHASE.**



## **VI. PROJECT RESULTS**

Data from the pilot project provide average weights and volumes of wood debris collected per square foot of building space. These are presented in Table 2 in 1) pounds of wood debris generated per square foot of building space, and 2) volume of wood debris generated per 1,000 square foot of building space.<sup>3</sup> Approximately 1.7 pounds of wood debris were generated per square foot of building space. The volume of wood waste generated per square foot was approximately .0072 cubic yards per square foot, or 7.27 cubic yards per 1,000 square feet, of construction. Graph 1 shows the proportion of building square footage to pounds of wood debris collected for all participating companies.

Of 11 total sites, only the two Spanjer Construction sites represent commercial construction. In this pilot project, the data were not characterized as commercial vs. residential. However, when the two commercial sites are separated out, the size of the remaining residential buildings averages 3,068 square feet each, and the average weight rises slightly to 1.8 pounds per square foot.

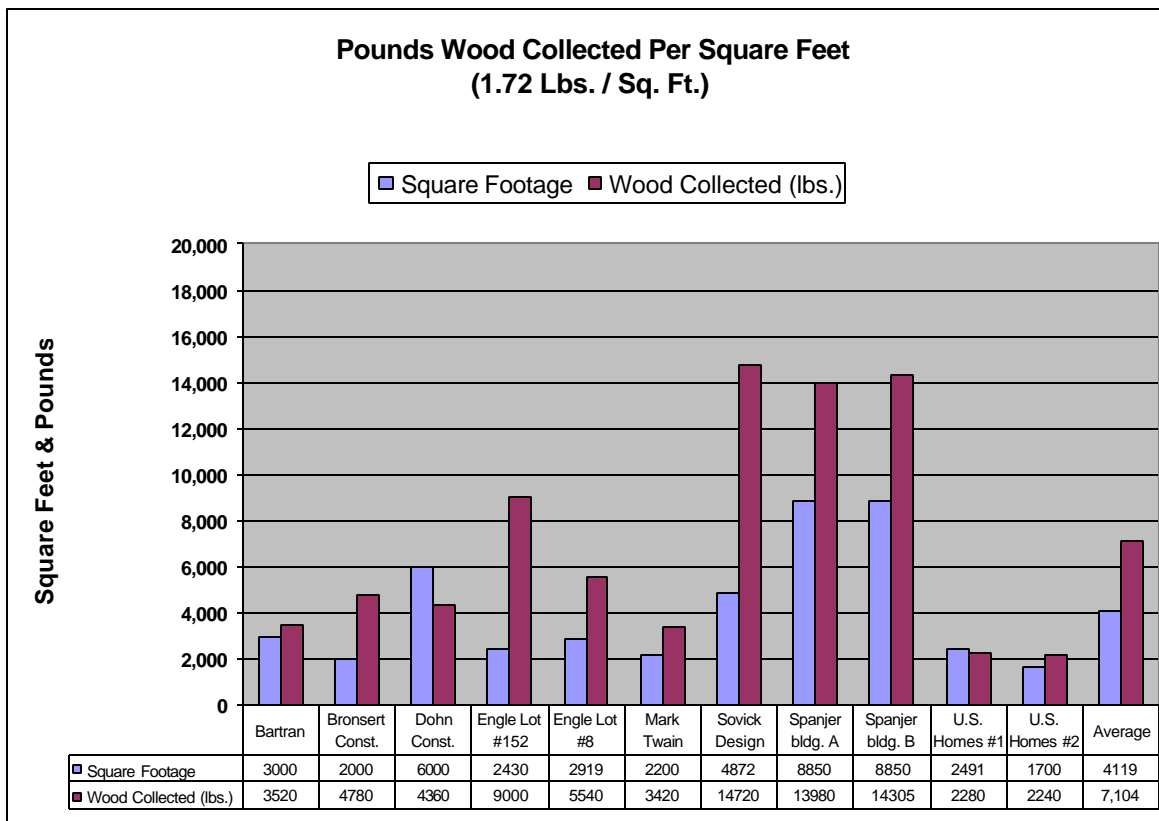
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<sup>3</sup> In Table 2, only 11 company sites listed, as the Bartran and Sovick Design sites were combined in order to more efficiently report available data from these sites.

**TABLE 2 – CITY OF FORT COLLINS WOOD PILOT PROJECT RESULTS – 2000.**

Company	Square Footage	Lbs. wood collected	Lbs. wood / sq. foot	Yards wood collected	Yards wood / 1000 sq. foot
Bartran	3,000	3,520	1.17	19	6.3
Bronsert	2,000	4,780	2.39	17	8.5
Dohn	6,000	4,360	0.73	18	3.0
Engle Lot # 152	2,430	9,000	3.70	30	12.3
Engle Lot # 8	2,919	5,540	1.90	20	6.9
Mark Twain	2,200	3,420	1.55	12	5.5
Sovick Design	4,872	14,720	3.02	62	12.7
Spanjer bldg. A.	8,850	13,980	1.58	65	7.3
Spanjer bldg. B.	8,850	14,305	1.62	67	7.6
U.S. Homes #1	1,700	2,280	1.34	10	5.9
U.S. Homes #2	2,491	2,240	0.90	10	4.0
<b>Sum</b>	<b>45,312</b>	<b>78,145</b>		<b>330</b>	
<b>Average</b>	<b>4,119</b>	<b>7,104</b>	<b>1.72</b>	<b>30</b>	<b>7.2748</b>

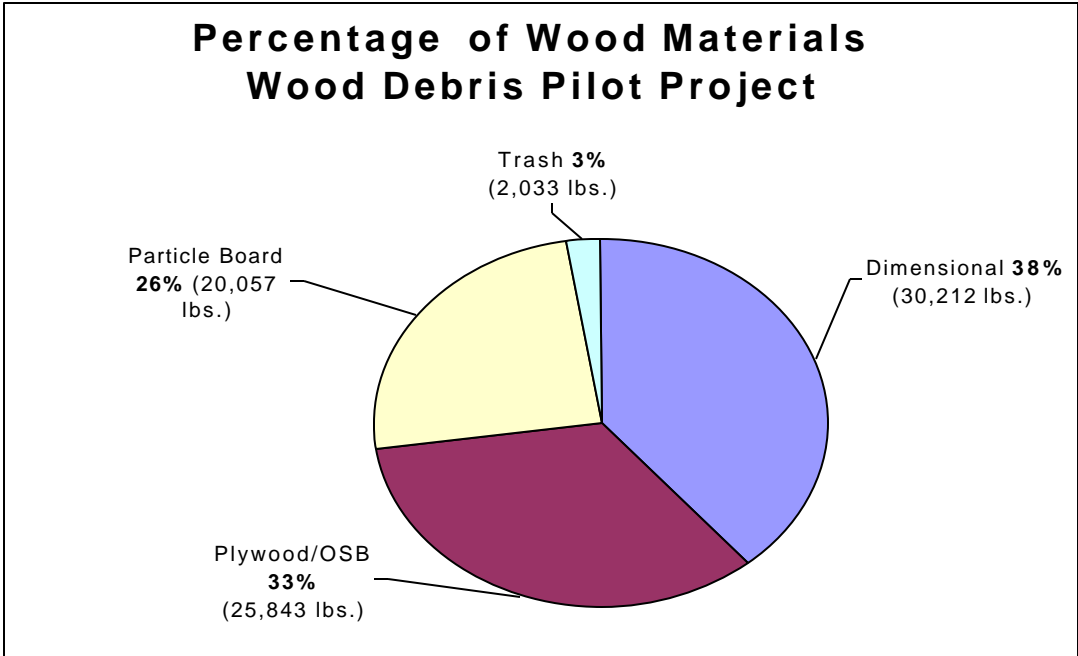
**GRAPH 1 – POUNDS OF WOOD COLLECTED / SQ. FT. PER PARTICIPATING BUILDER.**



**VII. WOOD DEBRIS COMPOSITION AND CONTAMINATION**

Wood debris was categorized (Graph 2) into three building materials; dimensional lumber, particleboard, and plywood/oriented strand board (OSB). Approximately 59% of the entire wood waste stream consisted of structural and non-structural wood products (plywood/OSB and particleboard)<sup>4</sup>. The remaining collected debris consisted of 38% dimensional lumber and 3% trash contamination.

**GRAPH 2 - COMPOSITION OF COLLECTED CONSTRUCTION WOOD DEBRIS.**



One of the goals of this project was to evaluate whether wood collected from construction activities generates a usable secondary stream that can then be processed into an end product. Contamination that may prevent wood debris from being recycled includes building materials such as shingles, caulking tubes, cement bags, plastic tubing, and worker food and beverage waste. In general, contamination occurred more frequently at larger construction sites compared to smaller sites, possibly due to larger crew sizes and farther distance to bins.

Contamination also depended on prevailing systems for site clean up. At larger sites (6,000 square feet +), trash removal was often done using a front loader to collect all waste inside a

<sup>4</sup> Particleboard is not a structural component in construction but used as a surface board. It is recognized that the 26% composition of particle board found in this study may be higher than actual rates due to the estimation methods for determining debris composition used in this study.

building. This process combined wood debris with other wastes, forcing it to be dumped with regular trash or manually separated out at a later time. A preliminary finding of this study suggests that separating out wood waste becomes more complex and costly as the size of construction projects increases. For the two larger participating sites in this project, additional resources had to be allocated to ensure that wood was properly segregated from trash.

Overall, the 3% contamination level is considered minimal and does not significantly impact the ability to process source separated construction wood debris into a landscaping mulch product. Although it was a concern that had been raised by participants, there was no illegal or “midnight dumping” from off-site sources. Images 6 and 7 illustrate contamination that occurred during this project.

**IMAGES 6 AND 7 - CONTAMINATION IN SOURCE SEPARATED CONSTRUCTION WOOD DEBRIS.**



### **VIII. WASTE DIVERSION**

An average total waste stream diversion rate of 39.3 % was reached during the City’s project for the 11 building sites due to separation of wood materials (Table 4). Figures are based on the volumes of wood that were recycled, divided by the sum of the volume of remaining trash

that was removed for landfill disposal and the wood volumes. Data on remaining non-wood waste removed during construction were provided by the participating companies as a requirement of the pilot project. As Table 4 illustrates, the overall average diversion rate for participating companies ranged between 29% and 63%.

**TABLE 4 –CONSTRUCTION WOOD DEBRIS PILOT PROJECT DIVERSION RATES.**

Company	Total Wood Debris Removed (Cu. Yd.)	Remaining Trash Removed (Cu. Yd)	Overall MSW Diversion Rate
Bartran	23	29	44.23%
Bronsert	17	24	41.46%
Dohn	20	50	28.57%
Engle # 152	30	18	62.50%
Engle # 8	20	27	42.55%
Mark Twain	12	30	28.57%
Sovick	62	81	43.35%
Spanjer A	65	120	35.14%
Spanjer B	67	120	35.82%
US Homes #1	10	23	30.30%
US Homes #2	10	15	40.00%
<b>Average</b>			<b>39.31%</b>

**IX. COST SAVINGS ANALYSIS**

The budget for the pilot project enabled the City to pay complete costs to haul and recycle the separated wood waste on a one-time basis in order to gain baseline information. With average wood recycling rates of nearly 40%, participating companies realized significant trash reductions and thus lower trash bills due to their wood separation efforts.

In a non-subsidized program, costs of wood recycling would be similar to standard waste removal and include hauling services and recycling/processing fees. To encourage wood separation on a large scale, it would be optimal if these costs were lower than costs for normal trash disposal. Reduced hauling / processing fees would help offset costs for the slight increase in labor that it takes to properly separate wood debris, which construction companies would incur in a source separated system.

In order to determine if costs savings might result from a market driven recycling wood program, usage costs for the two most commonly sized bins in this project were evaluated under two separate scenarios. These two “discount” scenarios, 10%-25%, and 30% to 50%, are presented here (Table 5) in an attempt to calculate the cost savings that construction companies may need as a financial incentive to initiate their own, unsubsidized, wood recycling activities, given the additional labor and time that is involved for them in source separating the wood.

In calculating total potential costs savings, an average wood diversion rate of 40% - and thus a 40% reduction in trash costs - should be factored into the economic models.

**TABLE 5 - POTENTIAL COST SAVINGS UNDER TWO SCENARIOS.**

<b>Container Size</b>	<b>Average “Market” Cost per removal</b>	<b>Wood-only Container costs - 10% - 25% Discount</b>	<b>Wood-only Container costs - 30% - 50% Discount</b>
30 Cubic Yard	\$ 265	\$238 - \$198	\$185 - \$133
10 Cubic Yard	\$ 100	\$90 - \$75	\$70 - \$50
3 Cubic Yard	\$ 35	\$31.5 - \$26	\$25 - \$18
\$/ Square Feet	\$.14 / square foot	\$.126 - .105	\$.098 - \$.070

**X. POTENTIAL WOOD DEBRIS STREAM**

One of the goals of this project was to approximate the total available volume and weight of wood debris from new home construction in Fort Collins based on the results of this project. Approximating the total stream of construction wood debris generated in Fort Collins per year is critical to establishing regional end market outlets for wood debris.

This project diverted wood debris from a total of 45,312 square feet of new home construction. Participating sites are classified by the City of Fort Collins Building Inspection Department as 1) Single Family Units, 2) Multi-Family Units, 3) Office / Bank / Professional. For the year 2000, according to Construction Activity Reports by the Building Inspection Department, a total of 2,781,800 square feet of construction was permitted in Fort Collins for these three types of construction alone.

At 45,312 square feet, this pilot project represented just 1.6% of all construction taking place in Fort Collins under the applicable construction categories. Extrapolating 1.72 pounds of wood debris per square foot to all available construction for 2000 yields a total of 4,784,696 pounds of wood debris available for end market uses if all available debris is source separated.

Estimating half this amount yields 2,392,348 pounds of wood debris available for end market uses.

On a volume basis, 7.27 cubic yards of wood debris per 1,000 square feet of new construction can be extrapolated out for the relevant classes of construction to 20,224 cubic yards of wood debris. Estimating half this amount yields 10,112 cubic yards of wood debris for end market uses.

Additional types of permitted construction in Fort Collins may potentially generate wood waste but are not factored here as this pilot project did not have any participating sites in these categories. These categories, and the total square feet of construction for 2000 include: **Public Facilities** (75,959 sq. ft.); **Recreational Buildings** (34,769 sq. ft.); **Non-Residential Remodel** (312,046 sq. ft.); **Residential Remodeling** (59,233 sq. ft.); **Other Buildings** (90,252 sq. ft). The total for these classes of construction comes to 572,259 square feet.

## **XI. SURVEY RESULTS**

Following completion of the pilot project in November 2000, all eight program participants were surveyed by mail for direct feedback on the construction wood recycling project. Among other questions, companies were asked which “discount” scenario would most likely motivate them to initiate construction waste recycling activities on their own. Responses from the five surveys that were returned are summarized below. (The complete survey is attached in Appendix A of this report.)

**Question 1:** *“Under which scenario are you most likely to initiate wood recycling activities in the future?”*

- A. *If costs for removal were same as standard trash disposal.*
- B. *Only if costs were between 10% to 25% lower than standard trash removal fees.*
- C. *Only if costs were more than 30% to 50% lower than standard trash removal fees.*

Two respondents indicated that they would initiate wood recycling activities if costs for removal were the same as standard trash disposal. Two respondents indicated that trash removal costs would have to be decreased by 10% to 25% for them to initiate a construction waste program, in order to “**help offset the cost of separating**”. One respondent indicated that costs would have to be decreased by 30% to 50%.

**Question 2:** *“Describe difficulties experienced in conducting the wood recycling program.”*

“**Time to separate materials**” and “**Sufficient space for containers on small lot**” were reasons cited by respondents as primary difficulties in participating. “**Better signage on receptacles would also help**” was also mentioned.

**Question 3:** *“Do you see opportunities for recycling other construction materials commonly produced on site?”*

“**Cardboard**” was cited as the primary recycling opportunity beyond wood. One survey listed “**Aluminum.**” No other materials were identified by participating builders with recycling potential.

**Question 4:** *“Please list any other questions, comments, or recommendations you may have regarding this program.”*

“**End-user to minimize dump fees**” was listed as the primary recommendation.

## **XII - PROJECT SUMMARY AND FUTURE PROGRAMS**

This project collected all forms of wood waste generated from selected new home construction sites in Fort Collins during the summer/fall of 2000. Information from the pilot produced baseline data on the amount and types of wood debris that are generated by new construction. An average of 1.7 pounds of construction wood debris was produced per square foot of new home development, and approximately 7.3 cubic yards of wood were produced for every 1,000 square feet of new homes that were built.

At the conclusion of this study, a luncheon was held in December to honor participating companies and to further discuss wood debris recycling in Fort Collins. The meeting was also attended by representatives of regional wood waste processing firms, Colorado State Forestry Department, Home Builders Association of Northern Colorado, regional waste hauling firms, Fort Collins Natural Resources Advisory Board, and other regional construction companies operating in Fort Collins with an interest in wood debris recycling.

Comments at the luncheon were positive about efforts to continue promoting wood waste separation and recycling at construction sites. A regional compost company stated they could accept mixed wood waste at between \$2.75 to \$3.00 per cubic yard, which is a significant



reduction from standard hauling and disposing costs (\$8.00 - \$10.00 per cubic yard). The processor added that ground wood products containing “engineered” materials such as particleboard and plywood are most suitable as a bulking agent for use in making compost. If wood collected in a recycling program was limited to “dimensional” lumber, it would have higher value for use in making landscaping mulch, which is often dyed for a uniform, customized color (the binding agents in engineered wood prevent dyes from setting).

Another potential use for separated construction wood is as ground wood chips for landfill “daily cover”. This option will continue to be explored as an end market use. In addition, a possible end market for wood chips exists as an alternative fuel source in the cement making process for a local manufacturer.

### **Pilot Phase II – Spring 2001**

The City’s Natural Resources Department is considering implementing a second pilot phase in the Spring of 2001. The next phase may be redesigned so that the City only pays part of the costs associated with hauling and processing wood, in order to assess what portion of the costs the construction industry is willing to bear. The next pilot phase will have the following objectives:

1. Continue collecting data on wood waste; weights, and volumes, characteristics, and contamination rates.
2. Expand the number of participating companies in order to gain additional insight into what interest level the construction community has in practicing on-site separation of construction wood debris.
3. Research and document end market potential for separated construction wood waste.
4. Analyze if there is a level of discount on hauling charges that construction companies would have to receive to engage in source separation of wood waste on site.

## APPENDIX A - SURVEY OF ALL PILOT PROJECT PARTICIPANTS.

Date

Name,  
Address

Dear name, ,

In the interest of gaining feedback on the success of the wood debris recycling project this summer and fall, as a program participant, would you please take a couple minutes to fill out the following program survey? Responses will be incorporated into a final report on this pilot project and used to design future programs.

1. This City program paid for the costs to haul and recycle separated wood waste on a one-time basis. Under which scenario would you be most likely to initiate wood recycling activities in the future on your job site:
  - A. If costs for removal were same as standard trash disposal.
  - B. Only if costs were between 10% to 25% lower than standard trash removal fees.
  - C. Only if costs were more than 30% to 50% lower than standard trash removal fees.
2. Please describe any difficulties you experienced in conducting the wood recycling program with the city (time commitment, crew training, space for containers, etc.).
3. Do you see opportunities for recycling other construction materials commonly produced on-site?
4. Please list any other questions, comments, or recommendations you may have regarding this program.