



*In-woods Treatment of Forest Residues for Productions of  
Quality Feedstocks*

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Forest Operations  
Laboratory



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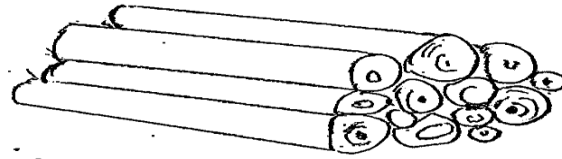
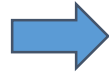
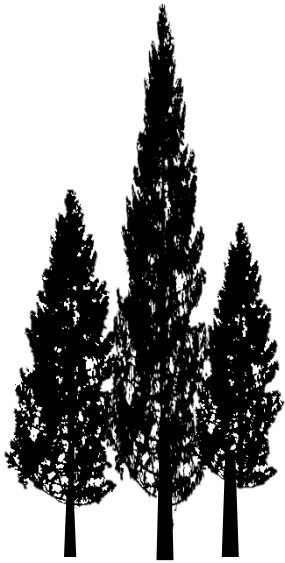


*For more information please visit [WasteToWisdom.com](http://WasteToWisdom.com)*

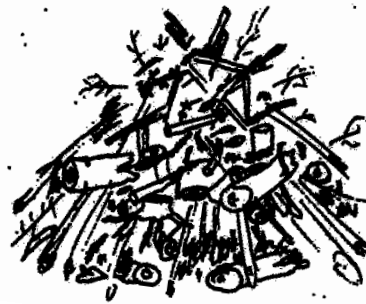
# Back ground

- MBCT(torrefaction, biochar, and gasification) can enhance the economic potential of forest residues
- Require higher quality feedstock with less contamination
- Difficult to produce quality feedstock from forest residues containing mixed materials





Sawlogs



Forest residues

No sorting  
(current  
practice)

Sorting tree  
tops



Sawlogs



Processed  
tops



Slash  
piles



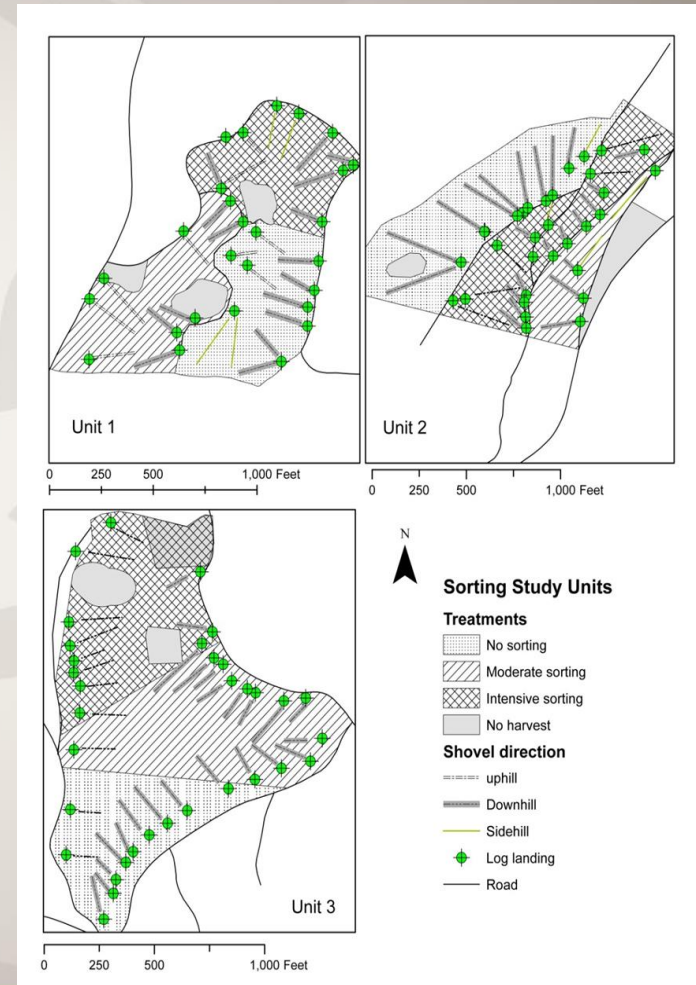
# Objectives

- Estimate the cost differences associated with the varying degrees of processing and sorting forest residues
- Identify major factors that affect the overall cost and productivity



# Study site and operation

- Industrial timberland property in Humboldt County, California
- Three timber harvesting units approximately 1 mile apart
- Coast redwood, Douglas-fir, western hemlock, and tanoak
- Even aged operation with ground-based primary transportation

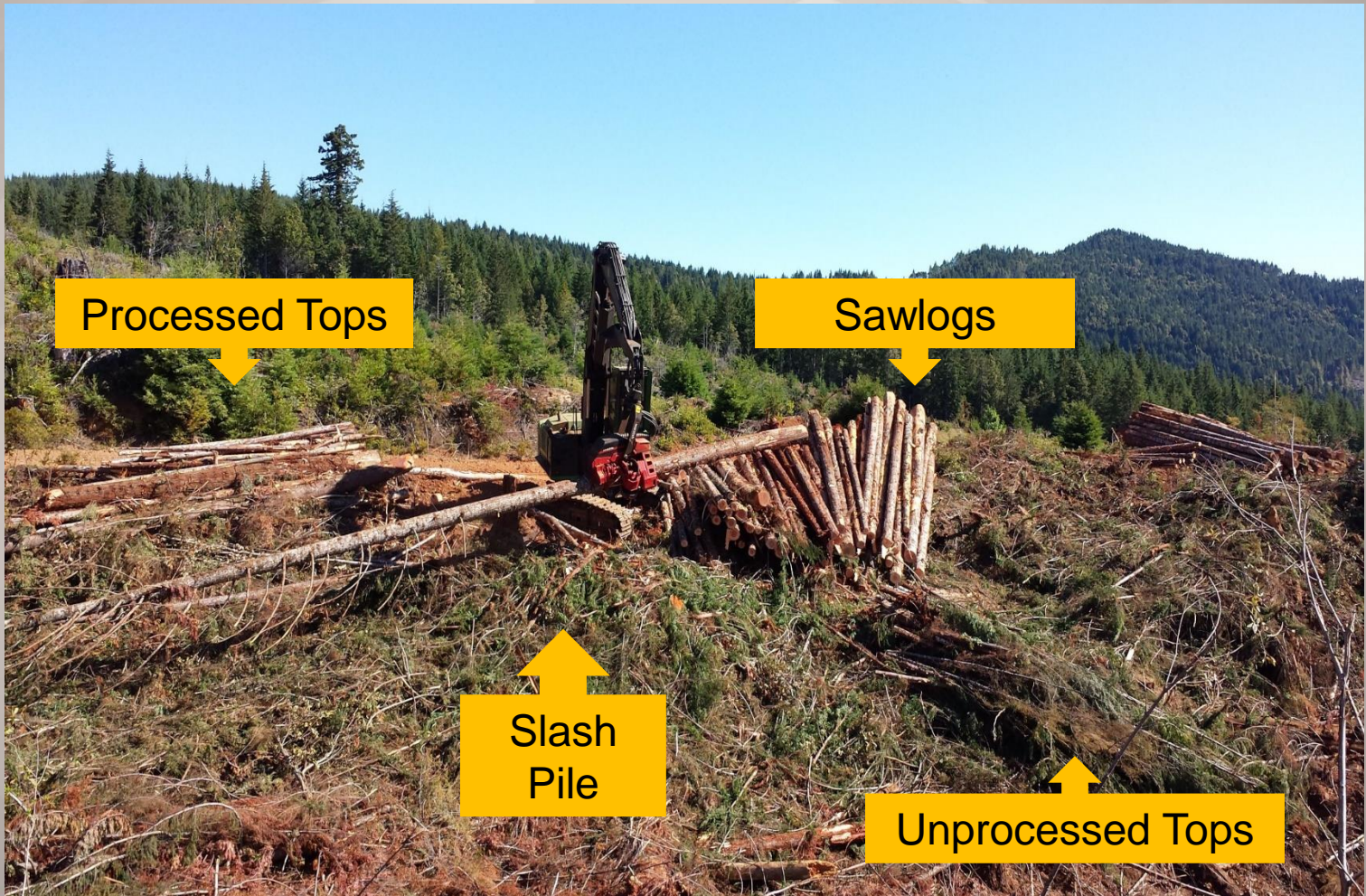


# Experimental design

- No sorting: “business as usual”
- Moderate sorting: Processed tops were sorted into conifer and hardwood tree top piles by the processor
- Intensive sorting: Forest residues were processed and sorted into 5 classes:
  - Processed conifer tops
  - Unprocessed conifer tops
  - Processed hardwood tops
  - Unprocessed hardwood tops
  - Slash



# Sorting tree tops during timber harvesting



# Methods

## Productivity

- Stand inventory
- Time series
- Log deck measurement
- Scale tickets
- Machine rate calculation

## Factors affecting

- Standardized comparison
- Component analysis



# Cost of operation

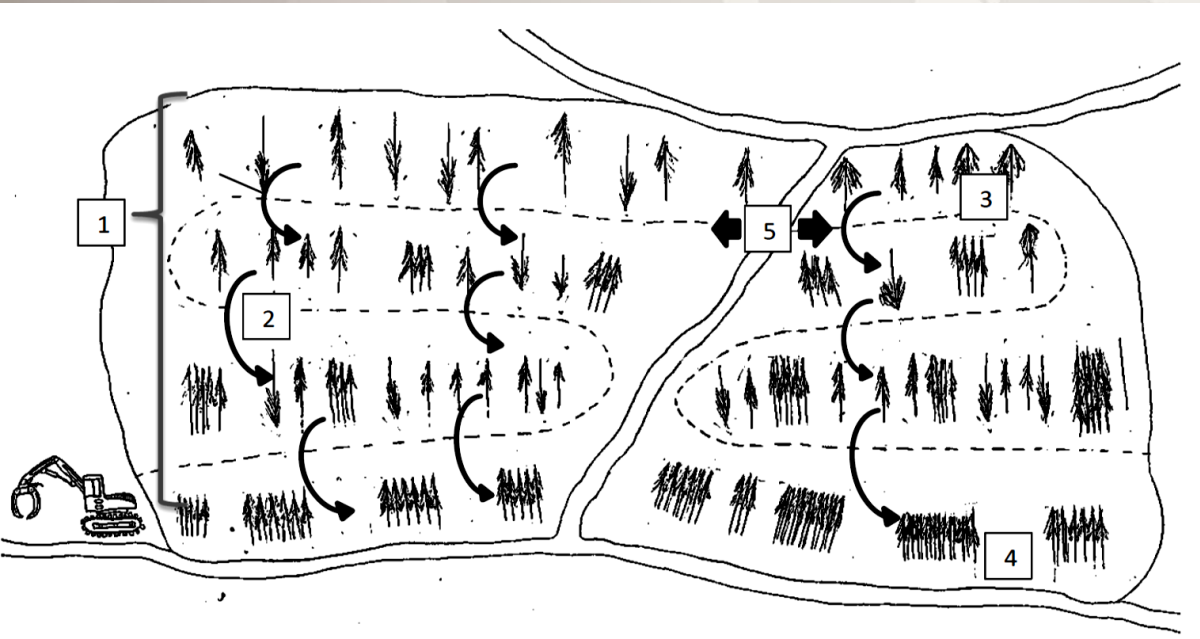
## Sawlog (\$/MBF)

	Sorting		
	No sorting	Moderate	Intensive
Feller Buncher	\$ 13.28	\$ 12.46	\$ 15.43
Shovel	\$ 45.68	\$ 47.43	\$ 46.30
Processor	<b>\$ 18.98</b>	<b>\$ 21.97</b>	<b>\$ 26.04</b>
Loader(loading)	\$ 12.64	\$ 12.31	\$ 12.40
Loader(sorting)	\$ 6.18	\$ 6.08	\$ 6.02
<b>Total</b>	<b>\$ 96.76</b>	<b>\$ 100.24</b>	<b>\$ 106.19</b>

## Non-merchantable (\$/BDT)

	Sorting		
	No sorting	Moderate	Intensive
Feller Buncher	\$ 6.67	\$ 5.82	\$ 5.67
Shovel	\$ 12.30	\$ 12.78	\$ 12.47
Processor	\$ 15.50	\$ 16.51	\$ 19.20
<b>Total</b>	<b>\$ 34.47</b>	<b>\$ 35.11</b>	<b>\$ 37.33</b>

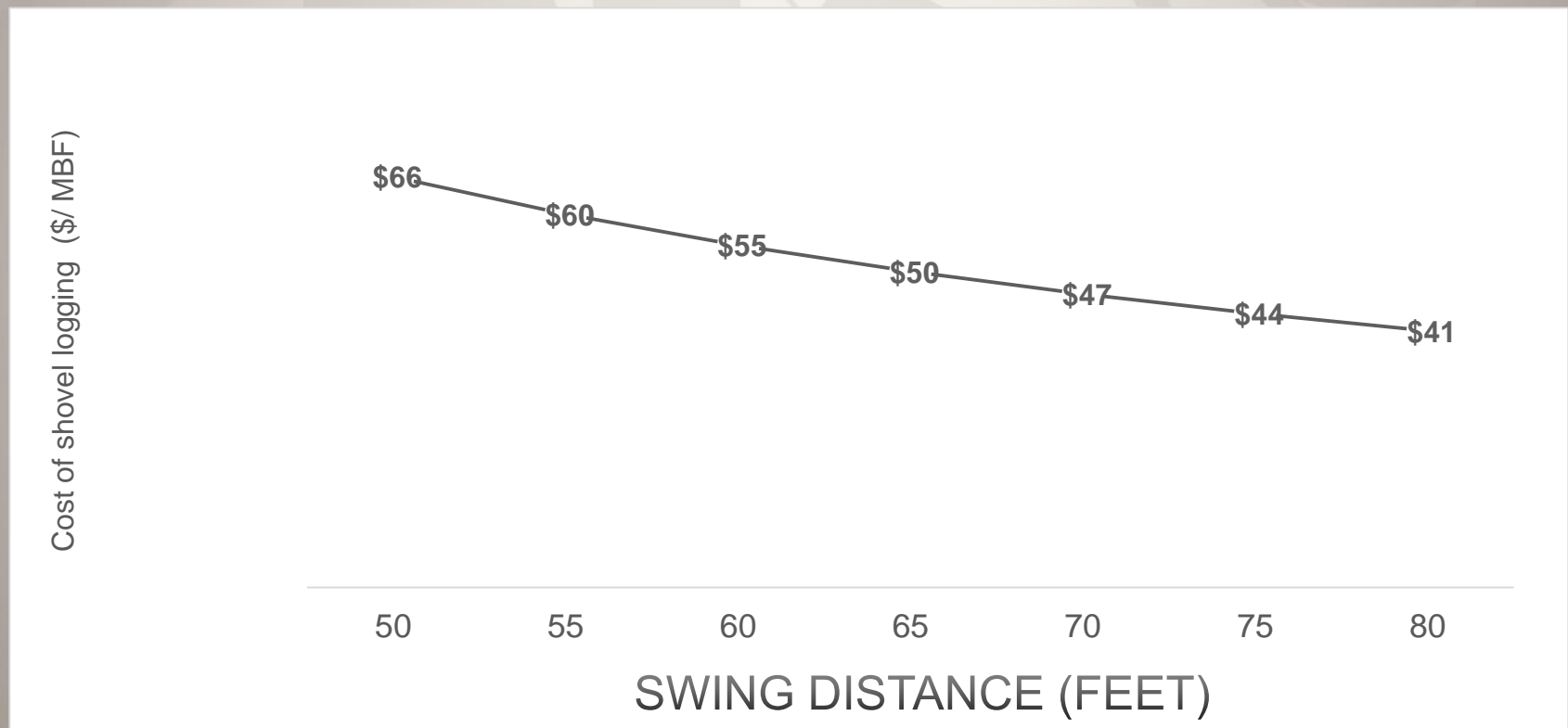
# Shovel yarding pattern



1. External yarding (shoveling) distance
2. Swing distance
3. Felled trees
4. Unprocessed log decks
5. Shovel machine movement

# Shovel logging

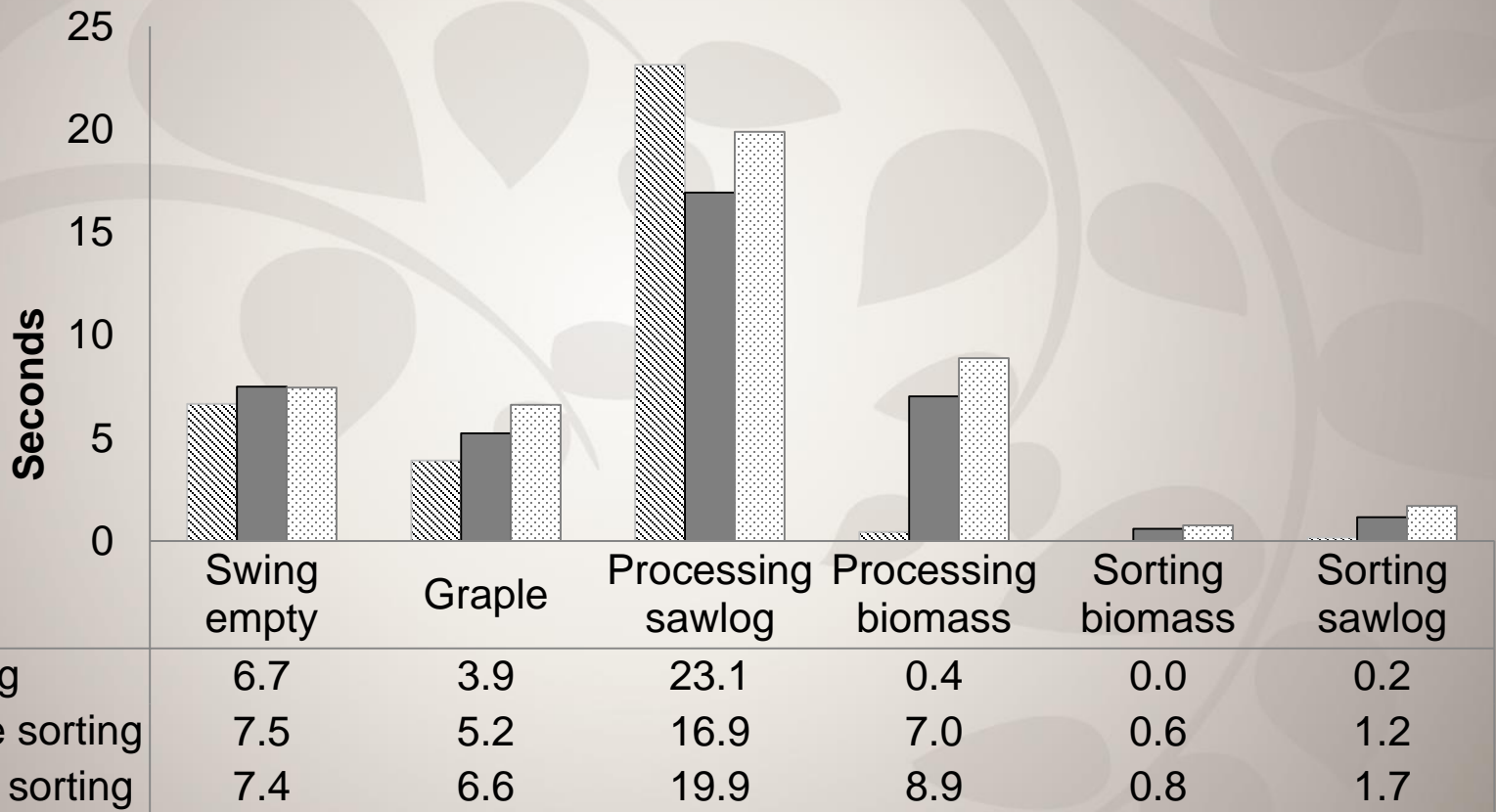
Effect of swing distance on cost of shovel logging





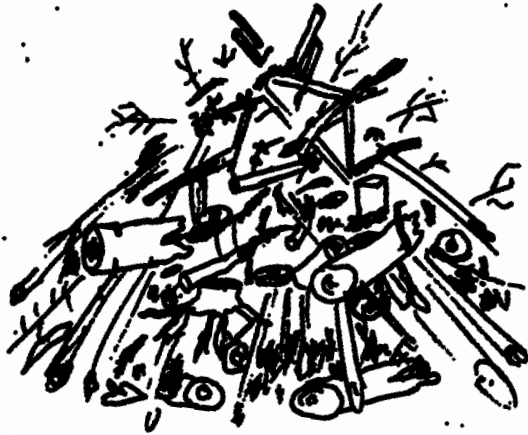
# Processing

## Time components of processor

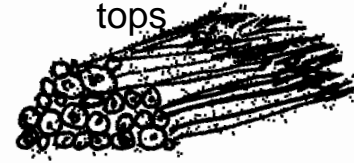


# Tops and slash generated

Forest residues



Processed tops



+



Slash piles

	Percentage (%)	
	Tops	Slash
Unit 1	24.7	75.3
Unit 2	19.1	80.9
Unit 3	24.4	75.6

# Tops and slash generated

The amount of tops and slash generated is directly related to:

- The minimum diameter for the sawlog processed
- Species processed (hardwood versus conifer)
- Trees per acre
- Non-merchantable trees



# Managerial impacts

- Increase in cost due to sorting and processing of forest residues : \$ 465/ acre
- Saving in site preparation cost: \$ 300 - 800 / acre

## Additional revenue

- Production of higher quality comminuted feedstock
- Market for “tree-top” logs as dowel, post-pole, etc.

***Thank you***

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