Module 2 – Residual Harvesting Best Practices

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Agenda

- Language (continued)
- Common products
- Residue composition
- Machinery and transport
- Residual harvest techniques
- Planning (primary harvester)
- Pile management
- Planning (secondary harvester)
- Contaminants
- Post harvest (secondary harvester)

Common biomass / woody debris language

Primary harvesting

- Refers to the initial phase of logging where sawlogs or pulp are harvested, usually in roundwood form.

Common biomass / woody debris language

Secondary harvesting

- Refers to the phase of logging which involves the harvest of the residuals left after the primary harvest.

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Common Products

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Common products

Hog fuel

- Term ‘hog fuel’ encompasses a large variety of products

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Common products

Hog fuel

- Hog fuel has a variety of uses:
  - Fuel for heat and power facilities
  - Compost
  - Animal bedding
  - As a primary feedstock for pellet production

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Common products

Hog fuel

- Variance in hog fuels:
  - Particle size
  - Wood species
  - Moisture content
  - Portion of the tree the fibre came from
  - Contaminants

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Common products

Chips

- Used for pulp production or as a hog fuel replacement
- Generally two methods of collection:
  - Chip on site (in-woods)
  - Haul unprocessed and chip at satellite or mill yard

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Common products

Chips

- Chipping generally creates a clean product that is suitable for pulp if the bark is removed

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Common products

Pellets

- Pellets are used for heating residential and industrial buildings, and as an alternative to coal, natural gas and hog fuel

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Common products

Pellets

- Pellets are valued because:
  - High energy density
  - High combustion efficiency
  - Cheaper to transport than solid wood (denser)
  - Renewable energy source
  - Less ash than firewood
  - Consistent size and properties

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Common products

Pellets

- Harvesting residues for pellets has expanded exponentially in the last few years (especially in the Prince George region

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Common products

Firewood

- Has been collected for decades
- Residues can provide an easy access source of firewood
- Can be harvested on an industrial level or a single person operation

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Logging Residue Composition

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Residue composition

- Composition can vary greatly due to a variety of factors:
  - Merchantability specifications
  - Harvest prescriptions
  - Operator technique
  - Species harvested
  - Terrain
- Most piles are made of a composition of tops, long butts and brush

Residue composition

Tops

- Refers to the uppermost piece of a tree leftover after the sawlog and/or pulp logs have been removed

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Residue composition

Long butts

- Refers to the lowermost piece of a tree that is often cut off and disposed of due to quality problems such as rot or excessive sweep

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Residue composition

Brush

- Refers to the branches, needles and loose bark that removed from a tree stem during the processing phase of logging

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Residue composition

- In an average second growth stand (but can vary greatly):
  - 75 - 85% tops
  - 10 - 15% long butts
  - 5 - 10% brush
- In an average old growth stand (can also vary greatly):
  - 40 - 50% tops
  - 35 - 45% long butts
  - 15 - 25% brush

Machinery

Machinery

Horizontal grinders

- Large machine that smashes debris into small enough pieces that they will pass through a screen
- High productivity
- High fuel consumption
- High maintenance requirement
- Requires a companion loader

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Machinery

Horizontal grinders

- Tracked grinders
  - Versatility
  - Can move to the residue
  - Operated through remote control
  - More expensive than wheeled
- Wheeled grinders
  - Less maneuverable
  - Must be moved with another machine
  - Cheaper

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Grinding Techniques

Grind to Truck

- Means that residues are placed into the grinder, comminuted, and then trucks are filled directly with the grinder's conveyor (front to back)
- Grinding directly to truck is usually the cheapest method and produces the smallest amount of contamination due to the smallest amount of handling

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Grinding Techniques

Grind to Ground

- The comminuted residues are conveyed to the ground where they are loaded onto trucks at a later date
- Sometimes appropriate if trucks are in short supply
- Studies have shown that 10% of the comminuted volume must be left on the ground to avoid introducing contaminants

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Grinding Costs and Productivity

- Average cost for grinding (including loader) is usually around $20-$25 per oven dry tonne
- Average productivity is usually around 25 odt per productive hour
- Note: these costs vary with operator experience, terrain, moisture content, machine size, etc

Machinery

Tub grinders

- Usually wheeled
- Can work well for short pieces and brush
- Longer pieces can cause blockage problems

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Machinery

Loaders

- Grinders typically need a companion loader to place residue onto the infeed system
- Excavators and butt ‘n’ top loaders are most common
- A power grapple is the preferred attachment

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Machinery

Portable chippers

- Chippers are similar to grinders in productivity but utilize a system of knives to slice chips off of woody pieces
- There are two common types of portable chippers: Those with flails to remove bark and branches and those without flails
- Chippers may or may not need a companion loader but usually need a support machine to bring them feedstock

Chipping Technique

Residue chipping

- Relatively new to BC (at least in recent times)
- Tops and possibly long butts are transported to the chipper
- Residues are debarked and chipped
- Chips can be blown directly into trucks or possibly onto the ground (with 10% loss if chipping onto dirt)
- Tracked chippers are starting to emerge and have the same flexibility as tracked grinder, eliminating or reducing the need for support machines
- Users need to consider waste bark and branches from the delimbing/debarking process

Chipping Costs and Productivity

- Average residue chipping costs is around $30 per oven dry tonne
- Average chipping residue productivity is between 15-25 odt per productive hour
- Like grinding, these costs and productivities are highly variable

Machinery

Microchippers

- Relatively new on the market compared to grinders and chippers
- Create very small chips suitable as a pellet feedstock. However, may need to blend with non-bark material to meet pellet specifications

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Unprocessed Collection

Unprocessed collection

- Includes loading residues into bins or onto hayracks to be comminuted at a secondary location
- The difficulty in loading bins comes from the creation of air space (different sized and shaped pieces)
- Hayracks can be very effective at transport, but require a loader to both load and unload the truck
- Also, hayrack have difficulty transporting small pieces (long butts)

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Transportation

Transportation

B-trains

- Chip vans that consist of two trailers
- B-trains are permitted to haul the largest loads in BC (63,500 kg for truck and trailer).
- Average load for comminuted biomass (chips or hog) is approximately 22.5 oven dry tonnes (dependent on moisture content and particle size

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Transportation

B-trains

- B-trains tend to be fragile when employed on rough forest roads
- Most B-trains need a ‘tipper’ to unload, although some ‘side-dumpers’ can be found in BC

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Transportation

Walking or shuffle floors

- Trailer floor consists of a series of metal strips that, when powered, move back and forth in a rhythm that expels the biomass from the back of the truck
- Average load for comminuted biomass (chips or hog) is approximately 15 oven dry tonnes (dependant on moisture content and particle size)
- Probably the most common biomass hauler in the woods in BC

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Transportation

Walking or shuffle floors

- Less fragile than B-trains, but operators still need to take care in order to avoid damage
- Road corner radius needs to be larger than with a B-train because the trailer is one unit

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Transportation

Bin trucks

- Can consist of one or two bins, in numerous configurations
- Probably the most common coastal biomass haulers in BC
- Average load for comminuted biomass (chips or hog) is approximately 10 oven dry tonnes (dependent on moisture content and particle size)

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Transportation

Bin trucks

- Far more sturdy than B-trains or walking floors
- Usually much easier to turn around where space is limited
- Can also be used to haul uncomminuted material although load size is usually significantly less (as much as 50% smaller loads)

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Transportation

Hayracks

- Used to haul uncomminuted biomass (generally tops and logs, pieces longer than 3 metres)
- Popular in residual chipping operations where residue needs to be brought to the chipper

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Best Practices Primary Harvester

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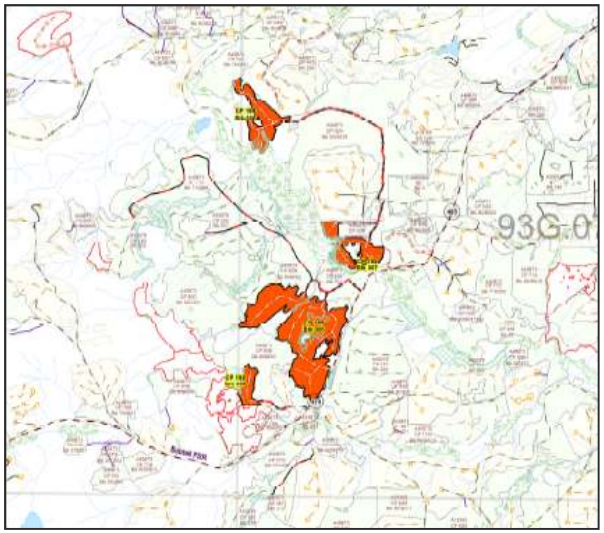
Primary Harvester

Planning

- Planning is critical and needs to start before layout begins
- Planners need to consider how much biomass might be available, how it will be harvested and how and where it will be transported



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Primary Harvester

Communication!

- Communication between primary and secondary harvesters need to start early to ensure maximum efficiency of both operations
- Residues piled for fire or deactivated roads can add significant costs to the secondary harvester (as much as $\$6/m^3$ in a recent residual chipping trial)
- If both users can reduce material handling, both will save

OR

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Primary Harvester

Ideal Scenario

Step 1

During the primary harvester's cutblock planning stage, the secondary harvester identifies a target area showing which cutblocks are within range of its operations and are likely to contain desirable residue attributes.

Step 2

Once the primary harvester has determined the location and amount of harvest in the secondary's target area, the secondary commits to specific blocks from which to extract residues, and to harvest in a timely manner that will not cause undue hardship for the primary

Primary Harvester

Ideal Scenario

Step 3

The primary then performs the primary harvest, leaving the residues in the state desired by the secondary. The state of the residues will be determined by the secondary's usage of the residues.

Step 4

Once the secondary user has completed a timely harvest, the secondary notifies the primary so that the primary can complete any outstanding obligations to the their permit(s).

Piling Best Practices

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Common biomass / woody debris language

Burn piles

- Residue from timber harvesting that is piled into a shape or structure conducive to burning
- Commonly call ‘waste piles’, ‘haystacks’ or ‘stick piles’
- Historically burnt in the fall each year to meet fire abatement regulations

Traditional piling practices

- Residue burned to eliminate or reduce fire hazard created by the presence of the residue
- Burn piles are very difficult for secondary harvesters to extract

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Common biomass / woody debris language

Oriented piles

- Logging residues that have been handled carefully to create a neatly stacked ‘deck-like’ formation that is much easier for secondary harvesters to handle

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Piling Best Practices

- Piling formations depend on the end use, the road grade and the cut or fill slope
- FPI has developed an operator card to assist decision making in the field (it's the last two pages of the guidebook)

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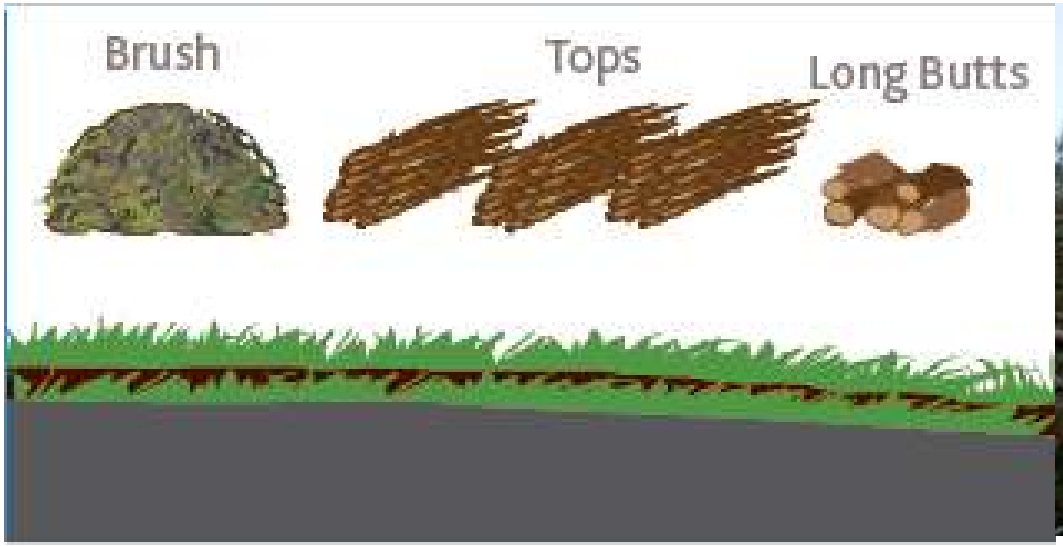
Primary harvester – Pile formation

Grinding

- Keep tops aligned (don’t have to be perfect, just roughly parallel)
- Keep long butts separate if grinding for pellet feedstock (co-gen hog can be mixed)



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Primary harvester – Pile formation

Grinding

- Two studies, one in the interior and one on the coast, demonstrated that there was no loss of productivity in the processing stage when operators dropped tops neatly.

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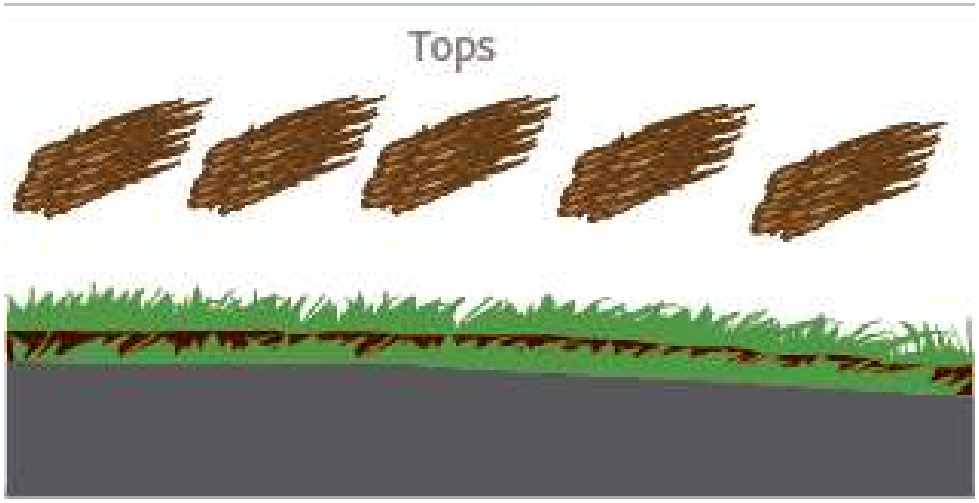
Primary harvester – Pile formation

In-wood chipping

- Keep tops aligned (just like for grinding)
- Some operators may attempt to chip long butts, if so, then long butts should be piled separately from brush
- Brush is not used to make pulp chips and should be spread to avoid concentrations (and need to burn)



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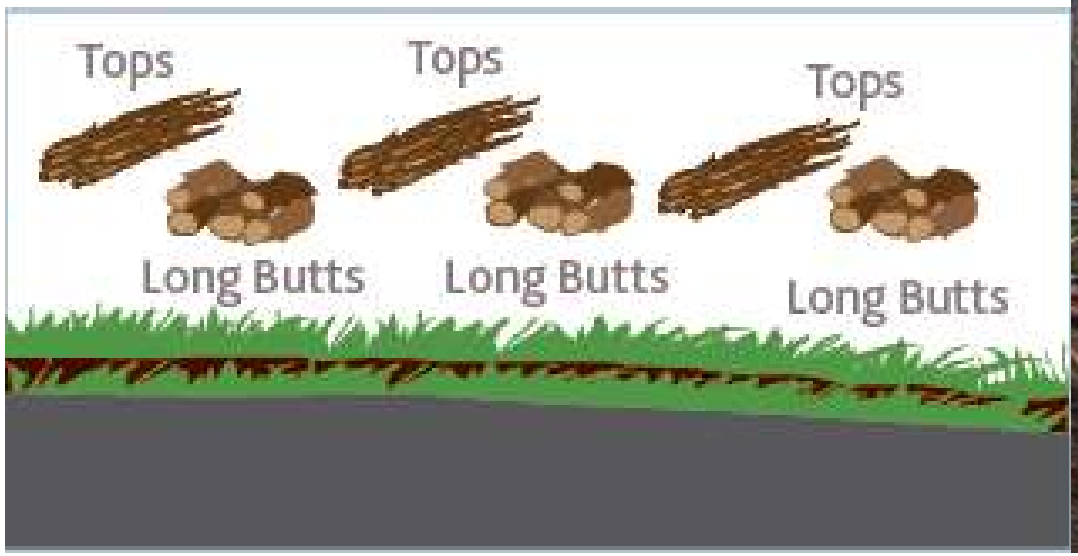
Primary harvester – Pile formation

Unprocessed collection

- Keep tops aligned (just like for grinding and chipping)
- Long butts should be piled separately from brush
- Brush should scattered to avoid concentration and to provide nutrients for reforestation



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Piling best practices

Processor or loader operators

- Try to align tops loosely (doesn't have to be perfect)
- Avoid incorporating contaminants into the feedstock. This includes: sand, rocks, metal, snow, oil buckets, tires etc
- Where possible, avoid placing long butts and brush in front of tops decks, place to the side instead
- If brush is not being collected, try to scatter concentrations to avoid creating a fire fuel hazard or impediment to reforestation

Piling best practices

- Does it work?
- Recent trial work showed the following results:
  - Reduced piling costs ~ $2-3 per odt (licensee)
  - Reduced hoechucking costs ~ $5.50 per odt (secondary harvester)
  - Reduced loading costs ~ $10 per odt (unprocessed, chipping)
  - Reduced grinding costs ~ $2 per odt

Piling best practices

Road grades

- Road grades can limit areas accessible to secondary harvesters
- Communication is key! The guidelines below are just guidelines, consult your secondary harvester about any limits they may have.

Road Grade	Piling Instructions
<10%	Pile for grinding
10-15%	Pile with secondary harvester agreement only
>15%	Pile for burning if 15% pitches are longer than 50 metres

Piling best practices

Cutslope height

- Cutslope height above the road or fill slope below the road can determine whether secondary harvest can occur.
- As with the road slopes in the last slide, the guidelines below are just guidelines, consult your secondary harvester about any limits they may have

Cutslope Height	Piling Instructions
<3 metres	Pile for grinding
3 to 5 metres	Pile with secondary harvester agreement only
>5 metres	Pile for burning

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Best Practices
Secondary Harvester

Planning – Secondary harvester

Communication

- Broken record!!!! – Communication is key!
- Secondary harvesters should explain limitations of their operations to the primary harvester
- Secondary harvesters may want to visit the site during the primary harvest to help explain what residual pieces are desired or which areas are unworkable and need to be piled for alternate disposal

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Planning – Secondary harvester

Roads

- Secondary harvesters should drive the road system prior to harvest
- Chipping operators should visit the site to determine appropriate chipper pad locations and whether any road upgrade may be needed to facilitate loading

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Planning – Secondary harvester

Legalities, Regulations, Guides

- Secondary harvesters should make themselves familiar with rules and regulations that pertain to the work they will be doing. This may include:
  - Soil disturbance
  - Reforestation
  - Fish and wildlife values
  - Air quality
  - Coarse woody debris
  - Road use restrictions

- When in doubt, secondary harvesters should consult the licensee, the primary harvester and/or FLNRORD for more information

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Contaminants

- In woody debris, contaminants are considered to be anything that isn't wood fibre: salt, rocks, sand, metal, oil and snow, etc
- Large rocks or metal can severely damage comminution machinery.
- Sand and gravel can cause wear and damage at processing facilities

Contaminants - Prevention

- Primary harvesters should take care not to incorporate contaminants in piles
- Pile stumps separately from potential feedstocks
- Avoid adding plastic from lunches or maintenance as plastic causes major problems in the pulping process. This applies to residues destined for the hog fuel pile as plastics can easily blown across a storage yard
- Secondary harvesters should also take care not to incorporate contaminants in feedstock. If piles are filled with dirt and other contaminants they should be left for alternate disposal

Contaminants

- Moisture is also considered a contaminant but is often difficult to control
- Snow can cause problems with the feedstock freezing in the trailer
- Excessive moisture in the feedstock is costly for haulers and in drying costs associated with pellet production

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Contaminants - Prevention

- Processor or loader operators should attempt to pile residues as high as possible in snow heavy areas
- Tarping residues with biodegradable wrappers has been successful in Europe and eastern Canada for reducing or maintaining low moisture content in residue piles

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Post secondary harvest

- After the harvest of residues, secondary harvesters (communicate with licensees!) need to make sure that there are adequate spots for reforestation and that the fire hazard has been mitigated.
- Residue concentrations should be broken up and scattered or piled for burning if excessive
- Windrow formations may also be acceptable in some areas (communicate with licensees!)

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Take home messages

- We need to work together (primary and secondary, licensee and government) if we want to start utilizing residues. Understanding the viewpoints of the process participants is critical. Let's talk to each other!
- We need to stop viewing logging residues as if they are 'waste' and start thinking about them as another product with value.
- We need to be willing to try new methods; the old paradigms around 'waste' disposal are becoming less and less acceptable to society.
- Changing methods doesn't always mean an increase in cost.

Thank you!

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