**CT – Chip Trees**

**SLT – Small Log Trees (<=80 ft3)**

**LLT – Large Log Trees (>80 ft3)**

**SL – Small Trees (<=80 ft3)**

**ALT – All Log Trees**

#### Removals, trees/acre

|  |  |  |
| --- | --- | --- |
|  |  | () |
|  |  | () |
|  |  | () |

#### Volume Per Acre, ft3/acre

|  |  |  |
| --- | --- | --- |
|  |  | () |
|  |  | () |
|  |  | () |
|  |  | () |
|  |  | () |
|  |  | () |

#### Tree Volume, ft3/tree

|  |  |  |
| --- | --- | --- |
|  |  | () |
|  |  | () |
|  |  | () |

### Other Assumptions

|  |  |  |
| --- | --- | --- |
|  |  | () |
|  |  | () |
|  |  | () |
|  |  | () |
|  |  | () |
|  |  | () |
|  |  | () |
|  |  | () |
|  |  | () |
|  |  | () |

### Calculated Intermediates

#### DBH

DBH – Diameter at Breast Height, in

|  |  |  |
| --- | --- | --- |
|  |  | () |
|  |  | () |
|  |  | () |
|  |  | () |
|  |  | () |
|  |  | () |

#### Tree Height

|  |  |  |
| --- | --- | --- |
|  |  | () |
|  |  | () |
|  |  | () |
|  |  | () |
|  |  | () |
|  |  | () |

#### Wood Density

**If the wood density for chip trees, small log trees or large log trees is not specified by users, then it is 50 lb/ft3 by default.**

|  |  |  |
| --- | --- | --- |
|  |  | () |
|  |  | () |
|  |  | () |

#### Hardwood Fraction

**If the hardwood fraction for chip trees, small log trees or large log trees is not specified by users, then it is 0 by default.**

|  |  |  |
| --- | --- | --- |
|  |  | () |
|  |  | () |
|  |  | () |

#### Butt Diameter

|  |  |  |
| --- | --- | --- |
|  |  | () |
|  |  | () |

#### Logs Per Tree

**Logs per chip tree was assumed as 1.**

|  |  |  |
| --- | --- | --- |
|  |  | () |
|  |  | () |
|  |  | () |
|  |  | () |
|  |  | () |
|  |  | () |

#### Log Volume

|  |  |  |
| --- | --- | --- |
|  |  | () |
|  |  | () |
|  |  | () |

#### CTL Logs Per Tree

**The minimum for CTLLogsPerTree is 1.**

|  |  |  |
| --- | --- | --- |
|  |  | () |
|  |  | () |

#### CTL Log Volume

|  |  |  |
| --- | --- | --- |
|  |  | () |
|  |  | () |

#### BFperCF

|  |  |  |
| --- | --- | --- |
|  |  | () |

#### Bole Weight

|  |  |  |
| --- | --- | --- |
|  |  | () |
|  |  | () |
|  |  | () |
|  |  | () |
|  |  | () |
|  |  | () |

#### Residue Weight

RF – Residue Fraction

|  |  |  |
| --- | --- | --- |
|  |  | () |
|  |  | () |
|  |  | () |
|  |  | () |
|  |  | () |
|  |  | () |

#### Manual Machine Size

**The maximum of ManualMachineSize is 1.**

|  |  |  |
| --- | --- | --- |
|  |  | () |
|  |  | () |

#### Mechanized Machine Size

**The maximum of MechMachineSize is 1.**

|  |  |  |
| --- | --- | --- |
|  |  | () |

#### Chipper Size

**The maximum of ChipperSize is 1.**

|  |  |  |
| --- | --- | --- |
|  |  | () |

#### NonSelfLevelCabDummy

|  |  |  |
| --- | --- | --- |
|  |  | () |
|  |  | () |
|  |  | () |

#### CSlopeFB&Harv (Mellgren 90)

|  |  |  |
| --- | --- | --- |
|  |  | () |

#### CRemovalsFB&Harv (Mellgren 90)

|  |  |  |
| --- | --- | --- |
|  |  | () |

#### CSlopeSkidForwLoadSize (Mellgren 90)

|  |  |  |
| --- | --- | --- |
|  |  | () |

#### Chardwood

|  |  |  |
| --- | --- | --- |
|  |  | () |
|  |  | () |
|  |  | () |
|  |  | () |
|  |  | () |
|  |  | () |

### System Product Summary

#### Amounts Recovered Per Acre

ResidueRecoveredPrimary – WT residue recovered as part of primary product, GT/ac

ResidueRecoveredOptional – Optional residue recovered, GT/ac

|  |  |  |
| --- | --- | --- |
|  |  | () |
|  |  | () |
|  |  | () |
|  |  | () |
|  |  | () |

#### Amounts Unrecovered and Left within the Stand Per Acre

GroundFuel – Activity fuels (residues) on the ground, GT/ac

|  |  |  |
| --- | --- | --- |
|  |  | () |

ResidueLLT not times 1-ResidueRecovFracWT?

#### Amounts Unrecovered and Left at the Landing

PiledFuel – Piled activity fuels (residues), GT/ac

|  |  |  |
| --- | --- | --- |
|  |  | () |

No CT and LLT residue Piled? Assume all ResidueLLT left within the stand?

#### TotalResidues

|  |  |  |
| --- | --- | --- |
|  |  | () |

### System Cost Elements

#### For Primary Products (boles & WT residues), $/CCF of material treated by the activity



#### For Optional Residues, $/GT of additional residue recovered

|  |  |  |
| --- | --- | --- |
|  |  | () |
|  |  | () |

What is the point of residue move-in costs?

#### For All Products, $/ac

|  |  |  |
| --- | --- | --- |
|  |  | () |
|  |  | () |
|  |  | () |
|  |  | () |
|  |  | () |
|  |  | () |
|  |  | () |
|  |  | () |
|  |  | () |
|  |  | () |
|  |  | () |

### System Cost Summaries

|  |  |  |
| --- | --- | --- |
|  |  | () |
|  |  | () |
|  |  | () |

### Limits

|  |  |  |
| --- | --- | --- |
|  |  | () |
|  |  | () |
|  |  | () |
|  |  | () |
|  |  | () |
|  |  | () |
|  |  | () |
|  |  | () |
|  |  | () |
|  |  | () |
|  |  | () |
|  |  | () |
|  |  | () |
|  |  | () |

## **Fell&Bunch**

CostFellBunch

|  |  |  |
| --- | --- | --- |
|  |  | () |

### I. Drive-To-Tree

#### A) Melroe Bobcat (Johnson, 79)

PMH – Per Productive Machine hour

|  |  |  |
| --- | --- | --- |
|  |  | () |
|  |  | () | |
|  |  | () | |
|  |  | () | |
|  |  | () | |

#### B) Chainsaw Heads (Greene&McNeel, 91)

|  |  |  |
| --- | --- | --- |
|  |  | () |
|  |  | () | |
|  |  | () | |
|  |  | () | |
|  |  | () | |
|  |  | () | |

#### C) Intermittent Circular Sawheads (Greene&McNeel, 91)

|  |  |  |
| --- | --- | --- |
|  |  | () |
|  |  | () | |
|  |  | () | |
|  |  | () | |
|  |  | () | |
|  |  | () | |

#### D) Hydro-Ax 211 (Hartsough, 01)

|  |  |  |
| --- | --- | --- |
|  |  | () |
|  |  | () | |
|  |  | () | |
|  |  | () | |
|  |  | () | |
|  |  | () | |
|  |  | () | |

### II. Swing Boom

#### A) Drott (Johnson, 79) not used at present

|  |  |  |
| --- | --- | --- |
|  |  | () |
|  |  | () | |
|  |  | () | |
|  |  | () | |
|  |  | () | |
|  |  | () | |

#### B) Timbco 2520&Cat 227 (Johnson, 88)

|  |  |  |
| --- | --- | --- |
|  |  | () |
|  |  | (155) |
|  |  | () | |
|  |  | () | |
|  |  | () | |
|  |  | (159) | |
|  |  | (160) | |
|  |  | (161) | |
|  |  | (162) | |

#### C) JD 693B&TJ Timbco 2518 (Gingras, 88)



UnmerchTreesPerHaIIC=285

UnmerchPerMerchIIC =MIN(1.5,285/(2.47\*RemovalsST))

BoomReachIIC=24

TreesInReachIIC =RemovalsST\*PI()\*BoomReachIIC^2/43560

ObsTreesPerCycleIIC =(4.36+9-(0.12+0.34)\*DBHST+0.00084\*2.47\*RemovalsST)/2

TreesPerCycleIIC =MAX(1,MIN(TreesInReachIIC,ObsTreesPerCycleIIC))

TreesPerPMHIIC =(127.8+21.2\*TreesPerCycleIIC-63.1\*UnmerchPerMerchIIC+0.033\*UnmerchTreesPerHaIIC)/(1+CSlopeFB\_Harv)

VolPerPMHIIC =TreeVolST\*TreesPerPMHIIC

CostPerPMHIIC =PMH\_SwingBoom\*NonSelfLevelCabDummy+PMH\_SelfLevel\*(1-NonSelfLevelCabDummy)

CostPerCCFIIC =100\*CostPerPMHIIC/VolPerPMHIIC

RelevanceIIC =IF(DBHST<12,1,IF(DBHST<18,3-DBHST/6,0))\*IF(Slope<5,0,IF(Slope<20,-1/3+Slope/15,1))

#### D) Timbco (Gonsier&Mandzak, 87)



TimePerTreeIID =(0.324+0.00138\*DBHST^2)\*(1+CSlopeFB\_Harv+CRemovalsFB\_Harv)

VolPerPMHIID =TreeVolST/(TimePerTreeIID/60)

CostPerPMHIID =PMH\_SelfLevel

CostPerCCFIID =100\*CostPerPMHIID/VolPerPMHIID

RelevanceIID =IF(DBHST<15,1,IF(DBHST<20,4-DBHST/5,0))\*IF(Slope<15,0,IF(Slope<35,-3/4+Slope/20,1))

#### E) FERIC Generic (Gingras, J.F., 96. The cost of product sorting during harvesting. FERIC Technical Note TN-245)



VolPerPMHIIE =(50.338/0.028317\*(TreeVolST\*0.028317)^0.3011)/(1+CSlopeFB\_Harv+CRemovalsFB\_Harv)

CostPerPMHIIE =PMH\_SwingBoom\*NonSelfLevelCabDummy+PMH\_SelfLevel\*(1-NonSelfLevelCabDummy)

CostPerCCFIIE =100\*CostPerPMHIIE/VolPerPMHIIE

RelevanceIIE =IF(Slope<5,0,IF(Slope<20,-1/3+Slope/15,1))

#### F) (Plamondon, J. 1998. Trials of mechanized tree-length harvesting in eastern Canada. FERIC Technical Note TN-273)



VolPerPMHIIF =(5/0.028317+57.7\*TreeVolST)/(1+CSlopeFB\_Harv+CRemovalsFB\_Harv)

CostPerPMHIIF =PMH\_SwingBoom\*NonSelfLevelCabDummy+PMH\_SelfLevel\*(1-NonSelfLevelCabDummy)

CostPerCCFIIF =100\*CostPerPMHIIF/VolPerPMHIIF

RelevanceIIF =IF(TreeVolST<20,1,IF(TreeVolST<50,5/3-TreeVolST/30,0))\*IF(Slope<5,0,IF(Slope<20,-1/3+Slope/15,1))

#### G) Timbco 420 (Hartsough, B., E. Drews, J. McNeel, T. Durston and B. Stokes. 97. Comparison of mechanized systems for thinning ponderosa pine and mixed conifer stands. Forest Products Journal 47(11/12):59-68)



HybridIIG=0

DeadIIG=0

DelayFracIIG =0.0963

BoomReachIIG=24

TreesInReachIIG =RemovalsST\*PI()\*BoomReachIIG^2/43560

TreesPerAccumIIG =MAX(1,1.81-0.0664\*DBHST+3.64/DBHST-0.0058\*20-0.27\*0-0.1\*0)

MoveFracIIG =0.5/(TRUNC(TreesInReachIIG/TreesPerAccumIIG)+1)

MoveIIG =0.192+0.00779\*(BoomReachIIG+DistBetweenTrees)+0.35\*HybridIIG

FellIIG =0.285+0.126\*TreesPerAccumIIG+0.0176\*DBHST\*TreesPerAccumIIG-0.0394\*DeadIIG

TimePerAccumIIG =MoveFracIIG\*MoveIIG+FellIIG

TimePerTreeIIG =(TimePerAccumIIG\*(1+DelayFracIIG)/TreesPerAccumIIG)\*(1+CSlopeFB\_Harv)

VolPerPMHIIG =TreeVolST/TimePerTreeIIG\*60

CostPerPMHIIG =PMH\_SwingBoom\*NonSelfLevelCabDummy+PMH\_SelfLevel\*(1-NonSelfLevelCabDummy)

CostPerCCFIIG =100\*CostPerPMHIIG/VolPerPMHIIG

RelevanceIIG =IF(DBHST<15,1,IF(DBHST<20,4-DBHST/5,0))\*IF(Slope<5,0,IF(Slope<20,-1/3+Slope/15,1))

### III. User-Defined



UserDefinedVolPerPMH=0.001

UserDefinedCostPerPMH=null

UserDefinedCostPerCCF =100\*UserDefinedCostPerPMH/UserDefinedVolPerPMH

UserDefinedRelevance=0

### Felling&Bunching Summary

WeightedAverage =IF(TreeVolST>0,CHardwoodST\*100\*(CostPerPMHIA\*RelevanceIA+CostPerPMHIB\*RelevanceIB+CostPerPMHIC\*RelevanceIC+CostPerPMHID\*RelevanceID+CostPerPMHIIA\*RelevanceIIA+CostPerPMHIIB\*RelevanceIIB+CostPerPMHIIC\*RelevanceIIC+CostPerPMHIID\*RelevanceIID+CostPerPMHIIE\*RelevanceIIE+CostPerPMHIIF\*RelevanceIIF+CostPerPMHIIG\*RelevanceIIG+UserDefinedCostPerPMH\*UserDefinedRelevance)/(VolPerPMHIA\*RelevanceIA+VolPerPMHIB\*RelevanceIB+VolPerPMHIC\*RelevanceIC+VolPerPMHID\*RelevanceID+VolPerPMHIIA\*RelevanceIIA+VolPerPMHIIB\*RelevanceIIB+VolPerPMHIIC\*RelevanceIIC+VolPerPMHIID\*RelevanceIID+VolPerPMHIIE\*RelevanceIIE+VolPerPMHIIF\*RelevanceIIF+VolPerPMHIIG\*RelevanceIIG+UserDefinedVolPerPMH\*UserDefinedRelevance),0)

## **RelevanceWeightInputs**

