SOP Title: FO – SOP 20 Utilization

Purpose:

Through field inspections of timber harvest sites an ESRD field inspector is to ensure that the harvest of the timber resource is maximized as measured against the criteria used for the timber allocation or allowable cut determination.

The purpose of this SOP is to define an acceptable method for assessing waste of merchantable timber in timber harvesting operations.

Definition of Merchantable Timber

A timber disposition must define the species, tree size (minimum merchantable length for a given minimum butt and top diameter with a stated stump height), and the condition of the standing timber (trees) that are to be included in the allowable cut. These parameters form the utilization standards (merchantable timber criteria) for the harvest authority.

Assessing Merchantability

It is the expectation that all trees that meet the minimum utilization standard shall be used to the fullest extent of operational reasonability. There may however be provisions of exclusion as provided by such considerations as defect allowances, harvest ground rule relaxations or other allowances such as that for cut to length processes. (Note: that these exclusions are typically addressed through prior agreements or approvals for AAC reductions or % volume charge back) A field inspector must be aware of such considerations, which may be company specific, when making a field evaluation of unused merchantable wood (waste) left.

Responsibilities:

A field inspector shall consider all timber meeting the following criteria in an assessment of residual timber or waste excepting where there is pre-determined provision for exemption:

1) Trees that meet or exceed the minimum utilization standards for the timber disposition

2) Pieces that meet or exceed the minimum operating ground rules (OGR) defined for the timber disposition holder

3) Pieces which do not meet the minimum criteria but did form part of the merchantable fibre allocation and were not used due to timber harvest inefficiency. The objective is to identify and account for such pieces occurring as a consequence of regular improper practice such as cutting off below the utilization top diameter.

4) For stumps, any portion of a stump over the maximum stump height as defined in the disposition document and/or Company Operating Ground Rules.

5) Any trim piece exceeding the allowable 0.6 metres (m) in length which was removed from the main stem as a result of butt rot.

(Note: Specifications will vary depending on OGR, or disposition utilization conditions. Any piece with 67% or greater defect is considered cull and not waste.)

A guideline to use when assessing waste is that "the benefit of doubt goes to the company".

Examples where the pieces may not be considered waste:

- Clearly cull trees will not always be bucked every 0.61m, such as a dispersed aspen tree displaying advanced decay at the cut and a large number of conks.
- When determining whether a piece is waste or not we can't always see the other piece that it was cut from. Inspectors need to be aware of this especially when assessing pieces embedded in top piles.
    - Deciduous branches (can be mistaken for the stem)
    - Large tops (under utilization) may be from a non-merchantable tree, as opposed to the top of a merchantable tree

Stump Heights

Individual stumps are assessed by taking a measurement, usually with a scaling stick or carpenters tape, from the highest point of the stump to average ground level. Ground level is simply where the bark of the tree meets the duff. Occasionally harvesting will compact the duff around the tree, reducing the ground level. This is usually evident by the different colour of the recently exposed bark - stump height should be measured from the higher, pre-harvest ground level.

Legislation clearly specifies "average ground level", but there are several situations where professional discretion is required and higher stumps may be difficult, or even unsafe, to avoid. Maximum stump heights are specified in the disposition document and/or Operating Ground Rules. Generally stump height is 30 cm from ground level in normal operations and 15 cm from ground level where directed by the timber supply analysis (TSA).

IF there is a need to quantify the number of high stumps based on an initial ocular estimate, then the following could be applied:

a. Establish random grids (recommended 5m X 5m) and tally the height of every 10th stump. Average height can then be compared to approved stump height (15cm, 30cm or as approved);
b. Use the following transect establishment ("Survey Methodology – Dispersed Waste") procedures. Within these randomly established transects, measure every 10th stump height and average for comparison

NOTES:

a. There are provisions for allowing high stumps in certain operations where agreements with companies exist such as rub posts during understory protection harvesting; boundary markers between adjacent conifer and deciduous cut units or to protect watercourses from equipment entry. Be familiar with the local Operating Ground Rules (OGR's) and specific agreements in your forest area.
b. Bucking for butt flare is generally not an accepted practice, but the inspector needs to be aware that the TSA is in part based on stump height assumptions.

As such, if (for example) 30cm is the accepted stump height for a given TSA, and the average stump heights measured are 20cm, then it MAY be feasible for the company to buck 10cm. Due diligence must be exercised here however and it is strongly recommended that the inspector observe active bucking practices, so it is clear that the potential flares (from butt) being bucked are indeed coming off of the appropriate stump that has been measured at less than the minimum required height.

An inspector should keep in mind risk to the crown, and determine if high stumps is an isolated incident or a chronic issue. **The critical issue to keep in mind when inspecting high stumps is the severity and frequency of the incident(s).**

Pre-Survey Assessment

Forest Officer (and industry representative if available) shall make a preliminary visual estimate of waste, to determine if there is an unacceptable quantity present. If the amount of waste is deemed to be reasonable given the operational constraints and performance of the company, no further assessment is required. If not, then the inspector has the option to proceed with a waste survey with the associated laid-out transects to quantify it, or assess as per “Alternatives to Survey”.

Where possible, it is strongly encouraged that ESRD personnel and industry conduct ocular assessments jointly to calibrate what constitutes excessive waste in an opening. It’s expected that FOMP Team Leads or more experienced mentor junior staff on how to conduct these ocular assessments.

Waste Survey

General Provisions

Surveys of harvest blocks are conducted to estimate the total volume and volume per hectare of wasted merchantable timber. “Unacceptable waste”, although it might be determined against, is often expressed as a comparison of the measure of waste relative to the total harvested or estimated timber volume.

The Alberta Timber Scaling Manual provides the standards of measurement used to determine the quantity and quality of timber harvested in Alberta. In addition, the manual provides information about compiling and reporting harvest data and describes non-standard scale methods used to estimate volumes of decked and stacked timber.

Waste surveying in Alberta uses the *Alberta Timber Scaling Manual*. Pieces are measured using the Alberta scaling stick along with the field volume table as this allows the immediate calculation of volume (using Smalian’s formula) in the field. Surveys to be used for enforcement purposes should be verified by a licensed Alberta scaler.

There is one exceptions to the application of the Alberta Scaling Manual. OGRs allow for bucking 0.61m lengths when greater than 50% BA of a large end exhibits advanced decay.

The survey must be completed when all pieces are clearly visible, if there has been snow since skidding or processing it may be better to wait for spring to complete the survey.

When assessing a volume based penalty for a contravention of Section 100(1) (e) of the Timber Management Regulation an estimated volume is sufficient, but recommend a waste survey to fully quantify waste within the opening.

If the company disagrees with the results of this survey they may submit their own survey results. It would be at the Crown's discretion on a case by case basis whether or not the company survey is acceptable.

Survey Methodology – Dispersed Waste

Dispersed waste is that found throughout the block, **excluding the area taken up by roads and where wood is accumulated at the roadside or landing for processing.**

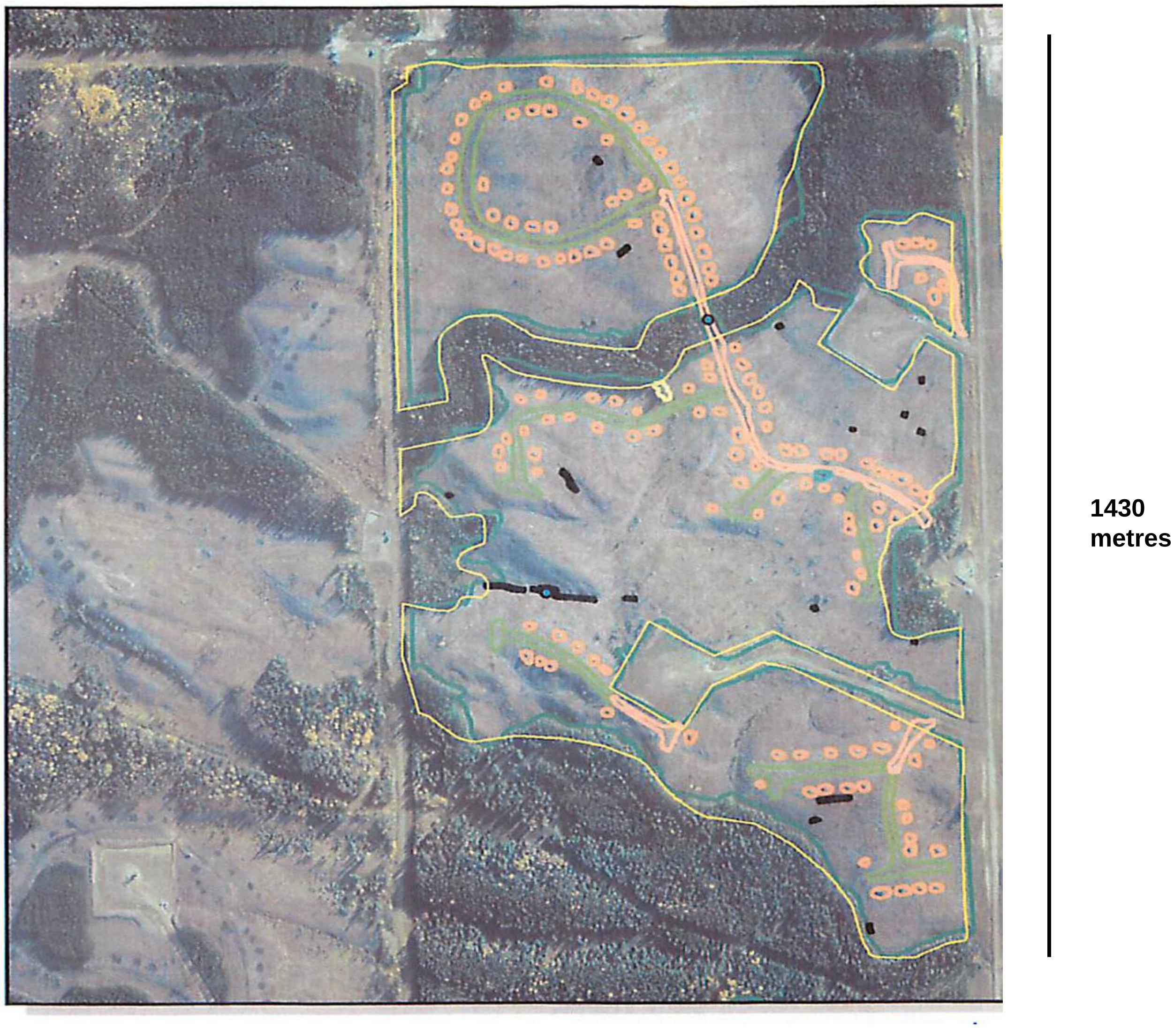
The minimum sampling based on block size is as follows:

Table 1.

Block size (ha)	Number of plots (transects)
< 20.0	3
20.0 to 40.0	4
40.1 to 60.0	5
60.1 to 80.0	6
80.1 to 100.0	7
> 100.0	8

On smaller blocks space may limit the number of transects possible, but there is also the option to measure 100% of the waste rather than sampling. More transects may be used on larger blocks if variability suggests the need for more sampling. Line or strip locations are randomly located, and no part of the transect should fall within the accumulated (top pile/landing) area.

Random Distribution of Transect Locations – Example 1



Forest Officers will need to determine the best placement of the transects in terms of how they best parallel the block shape and size. In this example, because the block is relatively rectangular, transects could run North/South or East/West. The key concept is that a transect is ideally 100 metres by 10 metres and cannot “run” through debris piles, or cross a delineated feature like the road or decking/processing area (previous slide). If a 100m X 10m transect cannot be established then a transect with different parameters can be used, as long as 0.1 ha is the size i.e. 50m X 20m, or 40m X 25m etc.

Step 1 - In this example, the opening is (approximately) 780m wide and 1430m long. We are also going to assume the scale is 1:10,000. Depending on the “best-fit” transects (typical methodology would parallel the access road or internal road system), Forest Officer determines which way the transects will run. We will use East/West transects in this example, which means the 1430 metre length will be used to determine our transect intervals.
Step 2 - The dispersed block area is 68.3 ha, so based on Table 1, we need to establish a minimum of 6 transects. Now we can calculate the systematic interval of the transects we need

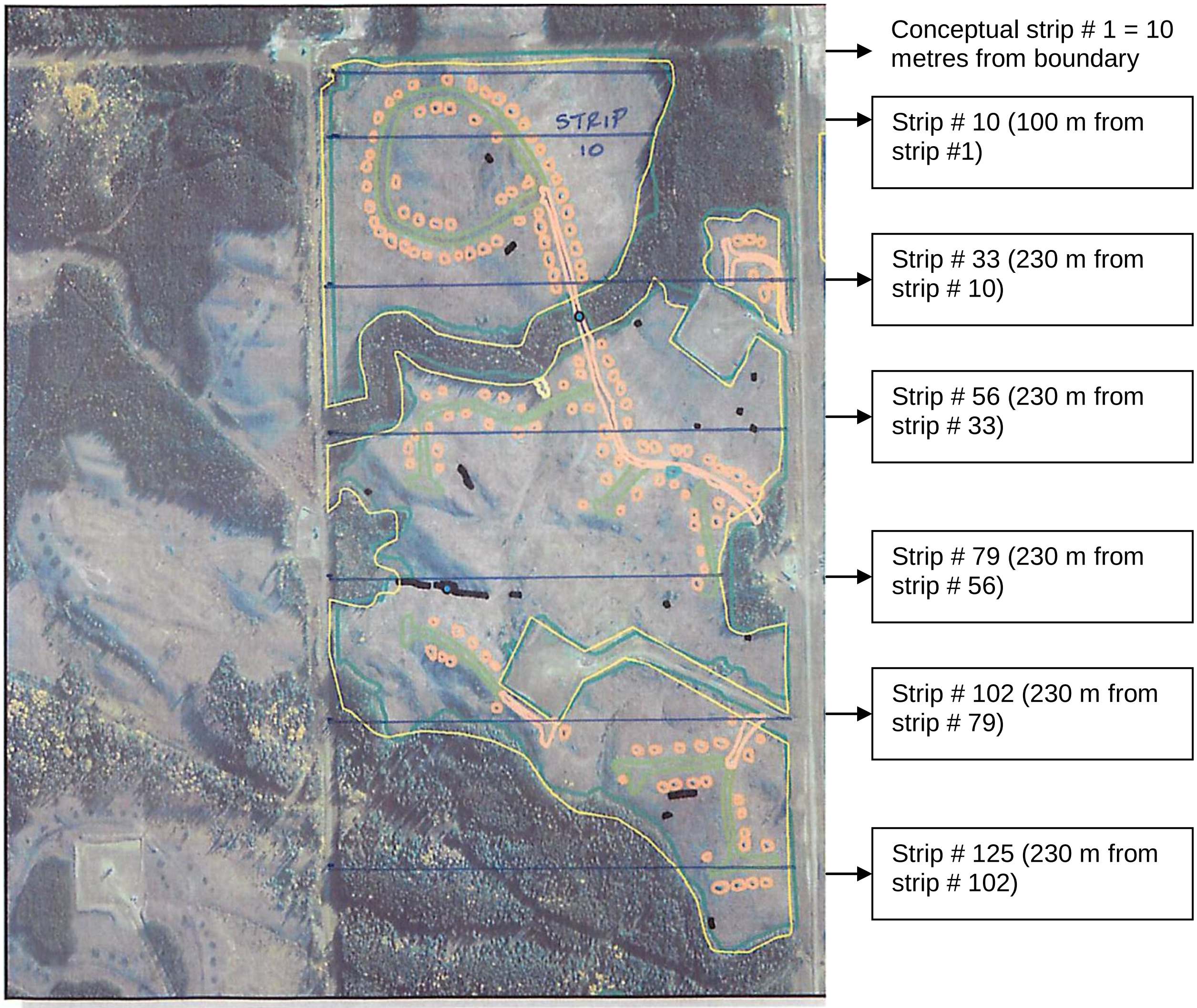
to establish based on the formula **k=N/n**, where **k** will be the interval, **N** is the total number of strips, and **n** is the minimum number of transects. These values will be "conceptual" and measured on ground once chosen.

In STEP 1, we determined that the "best-fit" for our transects would be East/West based on the length of the block and the access roads that parallel both sides of the block.

1. Total number of strips: N = 1430 (length of block in metres)/10 (width of transects) = 143 total strips (again – **conceptual**)

2. Systematic interval: k = N/n = 143 (total)/6 (minimum # of transects from Table) = 23.8 = 23 (we use a "flooring" or rounding down). This means we will systematically establish a transect (actual measured) at some point on every 23rd conceptual strip (**we use conceptual here since we would not expect an officer to physically draw or map all 143 strips**)

3. Select a random number between 1 and 23 (23 being the systematic interval). In this example, we will select 10 as the random number which means we will be establishing a transect on strips 10, 33, 56, 79, 102, and 125. **Alternatively one could consider that a transect will be established every 230 metres (since we are assuming a 10m wide transect)**

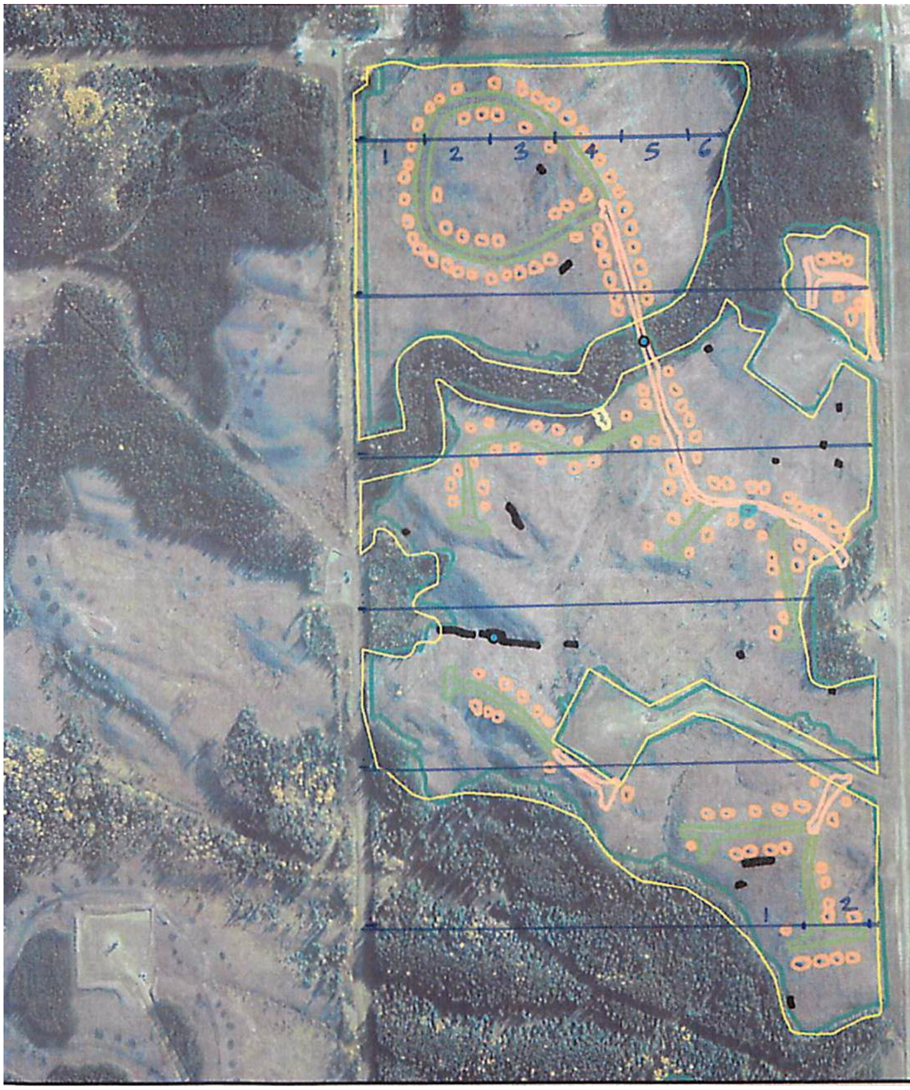


Step 3

1. The first “conceptual” strip should be located a transect width from the direction your transects will parallel. In this case, since our transects were determined to run East/West, the first strip would run 10m off of the block boundary in an East/West direction.

2. We randomly selected that our first transect would be established on the 10th strip, which would be located 100m (10 strips X 10m wide transect) from the first strip.

3. The corresponding strips on which a transect will be established have also been identified. i.e. 10, 33, 56, 79, 102 and 125 (or **alternatively from block boundary @100m, 330m, 560m, 790m, 1020m, and 1250m**)



Strip # 10 has potential for 6 (100 m X 10 m) transects

Strip # 125 has potential for 2 (100 m X 10 m) transects

Step 4 - Now that the strips have been identified where the transects will be established, we simply need to set up the transects. In order to get our minimum number of transects (6 in this case), we need only to establish **one (1) per strip**. The key here is that because the locations of the strips have been systematically selected, we can put our transect anywhere along the designated strip using the following guidelines:

> **1.** Always use a 100m X 10m strip first, since that is the assumption we used in determining our intervals;
>
> **2.** A transect cannot cross any delineated area such as roads, processing/decking areas, or burn piles – the potential waste from these areas is captured in the accumulated waste measurement.

3. If a 100m X 10m transect cannot be established due to #2, establish a transect of varying width or length, ensuring that the area still = 0.1ha (50m X 20m, or 40m X 25m e.g.)

In this example, Strip 10 (randomly selected from exercise) has been divided into potential 100m X 10m transects. Using the previous guidelines we can see that:

Transects 1, 2, 3 and 4 would not work because they cross over and incorporate delineated burn piles and/or roadside accumulation area;
Transect 5 is acceptable
Transect 6 is acceptable, provided you do not run out of block before you get 100m

NOTE: A 50m X 20m could potentially be established at one of these points; provided the guidelines are met (no delineated areas are incorporated). Again, **only one transect needs to be established per strip to meet our minimum (6)**.

Looking at strip 125, we can see that both potential transect locations (1 and 2) may not be feasible for a 100m X 10m transect. If another dimension transect (50 X 20 =0.1 ha) also cannot be established on that strip, then an additional transect needs to be established, beginning on strip 1. If an additional transect cannot be established there, we would systematically add one to the next strip (strip 33) until the transect we couldn't establish on strip 125 is replaced.

NOTE: we can also exceed the minimum number of transects as long as the guidelines are met.

Transect Sampling

Sampling is done by measuring all of the waste wood in a 100m by 10m transect or a transect of equivalent dimension (area) where the length is constrained (this is a 0.1 ha sample, multiplying the results by ten allows us to express the dispersed waste as **m^3/ha volume**). Multiplying this by the number of ha gives us a **total waste volume**. This is a relatively easy survey to do and should be practiced occasionally to gauge "normal" utilization.

From the transect start point the surveyor measures any waste observed within 5m either side of the centre line as they walk the 100m length. If a piece is only partially within the transect, only the portion within the transect is measured, Measurements are normally separated into conifer and deciduous, but circumstances may indicate that only a combined volume is required, or that further break down by species is required.

It may be necessary to segregate the block if noticeably different waste levels or types are encountered. An example may be a lowland area where a lot of small but merchantable black spruce have been knocked down and left, within a predominantly upland white spruce block. If the area is small enough a 100% piece measure can be done, and this area is separated from the rest of the survey. If it is larger, a separate transect or group of transects are surveyed.

Similarly, you may encounter isolated missed drags or bunches. Normally missed drags are not included in the transect as they will skew the results when converted to an m^3/ha expression. Whether or not they fall within a transect they should be measured, and their volume added to the total volume, not the transect volume.
This can then be reflected in the m^3/ha volume without skewing the results.

Dispersed Waste Survey Example 2

A 34ha cutblock has 1.4ha taken up in roads and 0.6ha taken up in roadside debris accumulations. Four 10m x 100m transects were completed on the 32ha (34ha – (1.4 + 0.6) =32) dispersed area. One missed drag was measured outside of the transects.

Line 1	0.52m^3	Missed drag = 3.20m^3
Line 2	0.40m^3	
Line 3	0.00m^3	
Line 4	0.33m^3	

Total = 1.25m^3

Transect average = 1.25m^3 / 4 = 0.31m^3

Preliminary dispersed m^3/ha = 0.31m^3 x 10 = 3.1m^3/ha

Preliminary dispersed block total = 3.1m^3/ha x 32 = 99.20m^3

These preliminary volumes would be final volumes if there had not been the missed drag.

Actual total = 99.20m^3 + 3.20m^3 (missed drag) = **102.4m^3**

Actual m^3/ha = 102.4 / 32 = **3.2m^3/ha**

Survey Methodology – Accumulated Waste

Accumulated waste is more difficult to accurately measure than dispersed waste. This is because most often the piece from which the potential waste was trimmed is not apparent so the reason for the trimming is often unknown. Also, if debris has been piled only the visible waste can be measured and the buried waste only estimated. Merchantable pieces or waste measured in a survey of debris piles should be marked with paint or crayon in the event the company disagrees

Climbing on accumulated piles also presents a greater risk to the surveyor. It is advisable to have a partner when carrying out an accumulated waste survey.

If dealing with piled waste, the total number of piles is counted within the block. They may be segregated as conifer, deciduous or mixed piles. Generally a minimum of four piles should be measured. They should be randomly chosen, for example by dividing the number of piles by five then measuring piles at the interval of this number (20 piles, divided by 5 is 4, measure piles 4, 8, 12, 16). Alternately, for larger blocks measure every tenth or twentieth pile for a 10% or 5% sample.

When measuring individual pieces you must ensure enough of the piece is visible to determine whether it meets merchantability standards. If this is not possible, the piece is not included in the survey. Pieces such as this may be marked with an X to indicate they were assessed, but not tallied. If a piece is determined to be merchantable but partially imbedded in the pile, only the visible portion is measured.

For each pile measured the surveyor must estimate the relative size of the sampled pile to the total. A usual range is from 1/3 to 1/2 of the pile measured. If you estimate that 1/3 of the pile was measured, the volume measured is multiplied by three to determine the estimated volume for that pile. If 1/2, the volume measured is doubled.

An average volume per pile is determined and multiplied by the number of piles to determine a **total volume**. This is divided by the cutblock area to determine **m^3/ha volume**.

If accumulated waste has not been piled, but is still laid out along a roadside, another method is used. Assuming tops and other debris are perpendicular to the road, the length of these accumulations is measured along the road. Then sampling such as a 10% sample can be used. For every 100m length of roadside accumulations, all the waste in a 10m length would be measured (10% sample). Again, you would want a minimum of four sample locations. The volumes from these samples would be averaged then applied to the entire length of the accumulations for a **total volume**. This is divided by the cutblock area to determine **m^3/ha volume**.

Accumulated Waste Survey Example

For the same 34ha block that we surveyed for dispersed waste, there were 44 roadside piles.

Sample pile interval = 44 / 5 = 8.8 = 9

Piles 9, 18, 27 and 36 are selected to be sampled.

It was estimated that half of the wood in piles 9, 18 and 27 was visible and measured, 1/3 of the wood in pile 36.

Pile 9	$0.12m^3$ x 2 = $0.24m^3$
Pile 18	$0.24m^3$ x 2 = $0.48m^3$
Pile 27	$0.43m^3$ x 2 = $0.86m^3$
Pile 36	$0.33m^3$ x 3 = $\underline{0.99m^3}$
Total	$2.57m^3$/ha

Average pile volume = $2.57m^3$ / 4 = $0.64m^3$

Total accumulated volume = $0.64m^3$ x 44 piles = **$28.16m^3$**

m^3/ha = $28.16m^3$ / 34ha = **$0.83m^3$/ha**

Survey Results

Survey results can be expressed in several terms but ultimately should be expressed as a **total volume** and **m^3/ha volume** for a specified cutblock. Other expressions could include dispersed conifer, accumulated conifer, dispersed and accumulated conifer, dispersed deciduous, accumulated deciduous, dispersed and accumulated deciduous, dispersed (C and D), accumulated (C and D), all expressed as either a total volume or m^3/ha volume.

Survey results should be communicated to the company using the FOM form. If the Forest Officer feels the waste volume is high this should be made clear to the company.
Follow up could include additional clean up, changed practices on other blocks, or enforcement actions. Quantifying waste volume is important but still does not define "excessive waste". 1-$2m^3$/ha of waste can be expected under normal operating conditions. Circumstances vary considerably, however, where less than this may be excessive and

more than this could still be considered reasonable depending on the processing practice(s) demonstrated by the company. Rather than set an arbitrary level, or set out on an onerous sampling program to establish benchmarks, defining “excessive waste” will be left to Forest Officer discretion. If surveying is part of an investigation within the enforcement framework, it will ultimately be the Delegated Authority who determines what is or isn’t “excessive waste”.

Alternatives to Survey

Completing a waste survey is a useful option for inspection and enforcement purposes, but is not mandatory. Sometimes it is not possible, as when piles have been burned or the dispersed area site prepared. In other cases, the time or expertise to complete the survey may not be available.

Identifying a number of individual waste pieces without completing a survey can be sufficient to identify “excessive waste”. This is supported by Schedule 2 of the Timber Management Regulation which allows for a penalty range, as well as a volume estimate based penalty, for contravention of Section 100(e) of the Timber Management Regulation.

Individual pieces can be assessed in groups of ten in multiple locations so waste can be expressed as a percentage. This is particularly useful for assessing oversized tops. Trimming high % of tops over the utilization standard may not result in over significant waste volume, but could still be “excessive waste”. All tops measured need to be marked with paint or crayon so they can be revisited. The key point when assessing top size is to visit operations early and correct problems before they escalate.

Though usually considered too onerous, there is always the option to complete a 100% piece measurement to determine waste volume.

Related QMS Documents:

Waste Survey Tally Sheet Form

Other Documents:
Alberta Timber Scaling Manual –
http://esrd.alberta.ca/lands-forests/forest-harvest-operations/alberta-timber-scaling-manual.aspx

Authorities:

Section 100(1) (f) TMR

Utilization standards are specified either directly in dispositions or within the applicable Operating Ground Rules. Compliance with Operating Ground Rules is normally a condition of the Annual Operating Plan and/or the disposition. Section 100(1) (a) and (b) of the Timber Management Regulation specify that operators harvest in compliance with the conditions of both the Annual Operating Plan and the disposition. Section 100(1) (e) of the Timber Management Regulation specifies that operators “avoid excessive waste”.

Section 76.1 (a) of the Timber Management Regulation identifies waste wood volume as eligible for the calculation of timber dues. Schedule 2 of the Timber Management Regulation specifies the penalties available for contravention of section 100(1) (e) of the Timber Management Regulation

Note : There are cases where a relaxation in utilization is granted by ESRD, inspectors need to know where to find these letters and how it will impact monitoring inspections.

Appendix A. Alberta Scale Stick and Volume Table from Alberta Scaling Manual, Appendices.

SMALIAN SCALE
HALF VOLUMES OF CYLINDERS
M3 (1000x)

Diameter (cm) Inside Bark

Length (m)	8	10	12	14	16	18	20	22	24	26	28	30	32	34	36	38	40	42	44	46	48	50	52	54	56	58	60	62
0.6	2	2	3	5	6	8	9	11	14	16	18	21	24	27	31	34	38	42	46	50	54	59	64	69	74	79	85	91
0.8	2	3	5	6	8	10	13	15	18	21	25	28	32	36	41	45	50	55	61	66	72	79	85	92	99	106	113	121
1.0	3	4	6	8	10	13	16	19	23	27	31	35	40	45	51	57	63	69	76	83	90	98	106	115	123	132	141	151
1.2	3	5	7	9	12	15	19	23	27	32	37	42	48	54	61	68	75	83	91	100	109	118	127	137	148	159	170	181
1.4	4	5	8	11	14	18	22	27	32	37	43	49	56	64	71	79	88	97	106	116	127	137	149	160	172	185	198	211
1.6	4	6	9	12	16	20	25	30	36	42	49	57	64	73	81	91	101	111	122	133	145	157	170	183	197	211	226	242
1.8	5	7	10	14	18	23	28	34	41	48	55	64	72	82	92	102	113	125	137	150	163	177	191	206	222	238	254	272
2.0	5	8	11	15	20	25	31	38	45	53	62	71	80	91	102	113	126	139	152	166	181	196	212	229	246	264	283	302
2.2	6	9	12	17	22	28	35	42	50	58	68	78	88	100	112	125	138	152	167	183	199	216	234	252	271	291	311	332
2.4	6	9	14	18	24	31	38	46	54	64	74	85	97	109	122	136	151	166	182	199	217	236	255	275	296	317	339	362
2.6	7	10	15	20	26	33	41	49	59	69	80	92	105	118	132	147	163	180	198	216	235	255	276	298	320	343	368	392
2.8	7	11	16	22	28	36	44	53	63	74	86	99	113	127	143	159	176	194	213	233	253	275	297	321	345	370	396	423
3.0	8	12	17	23	30	38	47	57	68	80	92	106	121	136	153	170	188	208	228	249	271	295	319	344	369	396	424	453
3.2	8	13	18	25	32	41	50	61	72	85	99	113	129	145	163	181	201	222	243	266	290	314	340	366	394	423	452	483
3.4	9	13	19	26	34	43	53	65	77	90	105	120	137	154	173	193	214	236	258	283	308	334	361	389	419	449	481	513
3.6	9	14	20	28	36	46	57	68	81	96	111	127	145	163	183	204	226	249	274	299	326	353	382	412	443	476	509	543
3.8	10	15	21	29	38	48	60	72	86	101	117	134	153	173	193	215	239	263	289	316	344	373	404	435	468	502	537	574
4.0	10	16	23	31	40	51	63	76	90	106	123	141	161	182	204	227	251	277	304	332	362	393	425	458	493	528	565	604
4.2	11	16	24	32	42	53	66	80	95	111	129	148	169	191	214	238	264	291	319	349	380	412	446	481	517	555	594	634
4.4	11	17	25	34	44	56	69	84	100	117	135	156	177	200	224	250	276	305	335	366	398	432	467	504	542	581	622	664
4.6	12	18	26	35	46	59	72	87	104	122	142	163	185	209	234	261	289	319	350	382	416	452	488	527	566	608	650	694
4.8	12	19	27	37	48	61	75	91	109	127	148	170	193	218	244	272	302	333	365	399	434	471	510	550	591	634	679	725
5.0	13	20	28	38	50	64	79	95	113	133	154	177	201	227	254	284	314	346	380	415	452	491	531	573	616	661	707	755
5.2	13	20	29	40	52	66	82	99	118	138	160	184	209	236	265	295	327	360	395	432	470	511	552	595	640	687	735	785
5.4	14	21	31	42	54	69	85	103	122	143	166	191	217	245	275	306	339	374	411	449	489	530	573	618	665	713	763	815
5.6	14	22	32	43	56	71	88	106	127	149	172	198	225	254	285	318	352	388	426	465	507	550	595	641	690	740	792	845
5.8	15	23	33	45	58	74	91	110	131	154	179	205	233	263	295	329	364	402	441	482	525	569	616	664	714	766	820	876
6.0	15	24	34	46	60	76	94	114	136	159	185	212	241	272	305	340	377	416	456	499	543	589	637	687	739	793	848	906
6.2	16	24	35	48	62	79	97	118	140	165	191	219	249	281	316	352	390	429	471	515	561	609	658	710	764	819	877	936
6.4	16	25	36	49	64	81	101	122	145	170	197	226	257	291	326	363	402	443	487	532	579	628	680	733	788	845	905	966
6.6	17	26	37	51	66	84	104	125	149	175	203	233	265	300	336	374	415	457	502	548	597	648	701	756	813	872	933	996
6.8	17	27	38	52	68	87	107	129	154	181	209	240	273	309	346	386	427	471	517	565	615	668	722	779	837	898	961	1026
7.0	18	27	40	54	70	89	110	133	158	186	216	247	281	318	356	397	440	485	532	582	633	687	743	802	862	925	990	1057
7.2	18	28	41	55	72	92	113	137	163	191	222	254	290	327	366	408	452	499	547	598	651	707	765	824	887	951	1018	1087

Appendix B- Excerpt from Alberta Scaling Manual, Section 3.0: Scaling Method-Smalian Scale, pg 7.

3.1.3.2 Gross Volume Recording

Under the header information is the section where individual log measurements are recorded. Forty logs per page can be recorded. Unless indicated as PRIMARY CODES in the header information, a log's species, condition, and product code is recorded, as well as a gross volume.

When completing a TM32, as opposed to using Mscale, gross volumes are obtained by using the HALF VOLUMES OF CYLINDERS (M^3 1000X) volume table.

To determine a log's gross volume, the top diameter is correlated with the total log length on the Half Volumes of Cylinders table (HVC). The point at which these two values intercept on the table is the volume. Next, the butt diameter is correlated with the total log length; this results in another volume. The sum of these two volumes is equal to the total gross volume of the log.

The total log length is used to obtain both volumes, and this is why the HALF Volumes of Cylinders table is used.

All volumes are 1000x until the summary stage; this is done to eliminate the task of compiling volumes to three decimal places. Once the summary stage is reached volumes are converted from 1000x to 1x. All volumes are recorded as whole numbers until the appropriate summary section is reached (see section 3.1.2).

Revision History				
Revision #	**Revision Date**	**Revision Reason**	**Reviewed by**	**Approved by**
5.0	January 27, 2011 and April 28, 2011	Incorporated Stump Height SOP/Annual Document Review		Darren Fearon/ Andre Savaria
6.0	February 21, 2012	Incorporate sample size		Andre Savaria
7.0	April 23, 2012	Added procedure for transect establishment	Darren Fearon	Robert Popowich
8.0	April 15, 2013	Deleted reference to MPB under stump height section	Andre Savaria	
9.0	May 30, 2014	Added clarification on butt flare bucking and stump heights	Darren Fearon	Robert Popowich
10.0	October 1, 2015	Annual Review	Darren Fearon	Robert Popowich