

HOW TO USE A

Stand Density Management Diagram

*Getting the Stand
and Site Data*



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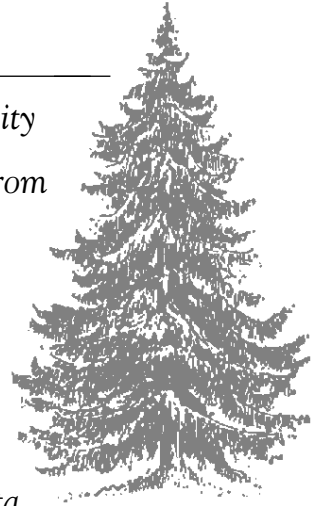
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ONE - Introduction

Accurate stand and site data is required to correctly use a stand density management diagram (SDMD). In many cases, the data available from a silviculture survey do not match the input requirements of the SDMD. This document provides you, the silviculturist, with one step-by-step example of how to obtain the necessary input data.

For the example covered in this booklet, some data are provided in a recently completed FS 770. You must decide whether the FS 770 data is suitable as input to a SDMD. Where you conclude that the FS 770 data are inadequate, or the required data are not provided, you must return to the field to collect additional data.



TWO - What is the data used for?

You require specific stand and site data to:

1. determine whether the SDMD is the right tool for the job,
2. select the right SDMD to use,
3. select the right site index curve to use,
4. position the stand on the diagram, and
5. project stand growth through time to rotation.

THREE - The current FS 770

This is the current silviculture survey data available to you for the stand used in this example.



BRITISH COLUMBIA



PRE-STAND TENDING SITE DESCRIPTION / PRESCRIPTION

USE TO SUMMARIZE, PREFERABLY IN THE FIELD, FROM THE UNIT INFORMATION FOR SILVICULTURE TREATMENT (FS 747) AND THE PRE-STAND TENDING SURVEY (FS 748).

AREA IDENTIFICATION																		
T.S.A.	Soo		T.S.B.			DATE OF SURVEY	Y 96	M 06	D 28	LOCATION	Conroy Creek							
DISTRICT	Squamish			AREA NAME			UNIT	15		OPENING: Map Sheet	92G095							
AIR PHOTO NUMBERS		BCC 94116-72, 73				U.T.M. GRID REFERENCE			HISTORY RECORD KEY									
PROJECT PROPOSED BY:	F.S. Number		Licensee Name		OR													
F.S. ADMINISTRATION NUMBER	SU96DSQB001			F.S. PROJECT NUMBER			SECTION 88 REFERENCE NUMBER											
AREA DESCRIPTION *																		
NET AREA TO BE TREATED	9.0 ha		ECOSYSTEM SUB-ZONE AND ASSOCIATION			CWHmsl		01		SOILS		SL						
DRAINAGE	good, well drained			AVERAGE SLOPE PERCENT	20		SLOPE POSITION	c-d		SLASH CLASS	Low		SLASH PERCENT	15		BRUSH CLASS	mod. - high	
ASPECT	N		ELEVATION RANGE	650 - 750		TOPOGRAPHY			rolling - broken			MACHINE TRAFFICABILITY			fair			
STAND DESCRIPTION *																		
INVENTORY COMPONENT				SILVICULTURE COMPONENT				DOMINANCE PATTERN										
Hw8 Cw2 -15-3.5-M-35310(96)(7)				Hw90 Cw10-21-5.8-M-857 (96)(7)				<input type="checkbox"/> Unexpressed <input checked="" type="checkbox"/> Emerging <input type="checkbox"/> Established										
SITE (G.M.P.L)		M		HISTORY	L72, 73 P75		WELL-SPACED S.P.H.	857		FREE-GROWING S.P.H.	829		ESTIMATED SNAGS PER HECTARE	0				
TALLIES AND INFORMATION																		
TREE LAYER TALLY - DENSITY						COMPETITOR SPECIES TALLY												
SPP	DIAMETER (CLASS OR AVERAGE AND RANGE)					TOTAL	SPP	PERCENT COVER	HEIGHT (m)									
	Regen	0-5	5-10	10-15	15+				Current	Est. 19 ____								
Hw	705	1421	627	248		3001	Vacc. spp.	32	1.1									
Cw	132	260	125	13		530	Rub. spp.	10	1.3									
							Epi angu	<5	1.7									
Totals:	837	1681	752	261		3531												
SAMPLE TREE INFORMATION																		
SPP	DBH (cm)		HEIGHT (m)		AGE		PERCENT LIVE CROWN											
	Average	Range	Average	Range	Average	Range												
Hw	6.7	5.4 - 8.0	5.1	4.2 - 5.9	17	15 - 20	97											
Cw	4.5	3.1 - 5.7	3.5	3.1 - 4.6	12	10 - 13	99											

FOUR - Stand data

To use the SDMD, you require the following stand data:

1. density (trees/ha),
2. top height, and
3. species composition.

4.1 Density

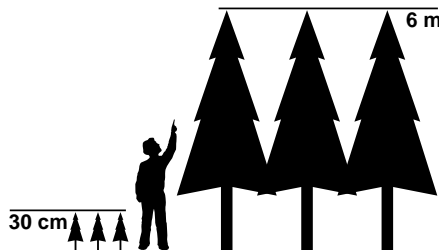
INVENTORY COMPONENT	
Hw8 Cw2 -15-3.5-M-3531/0(96)(7)	
SITE (G.M.P.L)	HISTORY

In this example, and in most other cases, you can obtain your estimate of density from total trees/ha on the inventory label – as long as the label is current and accurate. In this example, density is 3531 trees/ha.

STAND DESCRIPTION	
SILVICULTURE COMPONENT	
Hw90 Cw10-21-5.8-M-857 (96)(7)	
72	FREE-GROWING S

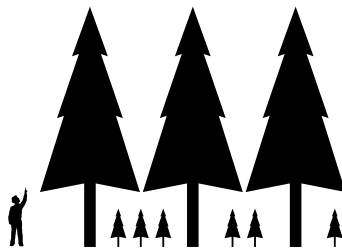
Density is not usually taken from the silviculture label because the SDMD requires total trees/ha – not well-spaced trees/ha or free growing trees/ha.

Below are two cases where you should not use total trees/ha from the inventory label.



Stand height <6 m

When your stand is less than approximately 6 m tall (top height), you must estimate trees/ha at 6 m top height. The X-axis of the SDMD is positioned at about 6 m top height. In young stands, the current trees/ha must be adjusted to account for expected ingrowth and early mortality to a top height of 6 m.



Abundant regeneration

Generally, the SDMD is not appropriate for multi-layer, multi-aged stands. However, where you have a tall, closed canopy, even-aged overstory with a dense regeneration layer, you can exclude the regeneration from the density tally to obtain SDMD predictions for the overstory.

4.2 Top height

In this example, and in most other cases, an accurate measurement of top height is not provided on the FS 770. To obtain the top height you require for this example, you must return to the block and measure hemlock top height.

The diagram shows two overlapping labels. The top label is the 'INVENTORY COMPONENT' label with the code 'Hw8 Cw2 -15-3.5-M-35310(96)(7)'. Below it is the 'STAND DESCRIPTION' label with the code 'Hw90 Cw10-21-5.8-M-857 (96)(7)'. A vertical arrow points from the 'Hw8' in the inventory label down to the 'Hw90' in the stand description label. A horizontal arrow points from the 'Hw8' in the inventory label to the right, and another horizontal arrow points from the 'Hw90' in the stand description label to the left, meeting at the vertical arrow. This indicates that the 'Hw' (hemlock) top height is measured from the inventory label but applies to the stand description.

INVENTORY COMPONENT	
Hw8 Cw2 -15-3.5-M-35310(96)(7)	
SITE (G.M.P.L)	HISTORY

STAND DESCRIPTION	
SILVICULTURE COMPONENT	
Hw90 Cw10-21-5.8-M-857 (96)(7)	
WELL-SPACED S.P.H.	FREE-GROWING S

If you use the growth intercept method to estimate site index, you can get top height by calculating the average total height of your growth intercept sample trees (see 5.1 Site index). Top height is often 10–20% greater than the average height in the inventory and silviculture labels.

Top height must be accurately measured – not visually estimated.

4.3 Species composition

In this example, and in most other cases, you can adequately assess species composition if you have current and accurate forest cover labels. Look at both the inventory and silviculture labels to make sure that yours is a pure species stand – or close to it.

The diagram shows two overlapping labels. The top label is the 'INVENTORY COMPONENT' label with the code 'Hw8 Cw2 -15-3.5-M-35310(96)(7)'. Below it is the 'STAND DESCRIPTION' label with the code 'Hw90 Cw10-21-5.8-M-857 (96)(7)'. A vertical arrow points from the 'Hw8' in the inventory label down to the 'Hw90' in the stand description label. A horizontal arrow points from the 'Hw8' in the inventory label to the right, and another horizontal arrow points from the 'Hw90' in the stand description label to the left, meeting at the vertical arrow. This indicates that the 'Hw' (hemlock) species composition is assessed from the inventory label but applies to the stand description.

INVENTORY COMPONENT	
Hw8 Cw2 -15-3.5-M-35310(96)(7)	
SITE (G.M.P.L)	HISTORY

STAND DESCRIPTION	
SILVICULTURE COMPONENT	
Hw90 Cw10-21-5.8-M-857 (96)(7)	
WELL-SPACED S.P.H.	FREE-GROWING S

In this example, the forest cover labels tell you that 1) the species composition is appropriate for using a SDMD (almost pure) and 2) a Hw SDMD and a Hw site index curve should be used.

FIVE - Site data

To use the SDMD, you require the following site data:

1. site index, and
2. region.

5.1 Site index

1 1100 0000 10 00 1100 00	
SITE (G,M,P,L)	HI
M	

In this example, site class, not site index, is provided on the FS 770, so you must return to the block and accurately determine Hw site index. In all cases, to correctly use the SDMD, you need an accurate estimate of site index.

Frequently, in stands like the one in this example, the most accurate estimate of site index will be generated using the growth intercept method.

5.2 Region

DISTRICT	A
Squamish	
AIR PHOTO NUMBERS	

CUMBY CREEK	
OPENING: Map Sheet	Opening
92G095	14
HISTORY RECORD KEY	

In this example, and in most other cases, you can adequately determine region from the area identification information on the FS 770. In this example, your hemlock stand is on the coast, so you conclude that a coastal Hw SDMD and the coastal Hw site index curve should be used.

SIX - Additional assessments

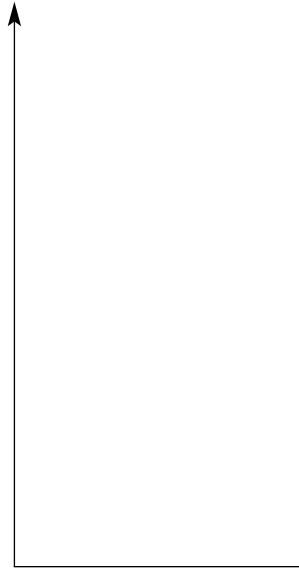
To use the SDMD, you need to make three additional assessments. You need to determine if:

1. the stand is even-aged,
2. the pattern of stand development will match that assumed by the SDMD, and
3. trees are clumped or evenly spaced.

6.1 Is your stand even-aged?

TREE LAYER TALLY - DENSITY						
SPP	DIAMETER (CLASS OR AVERAGE AND RANGE)					TOTAL
	<i>Regen</i>	0-5	5-10	10-15	15+	
Hw	705	1421	627	248		3001
Cw	132	260	125	13		530
Totals:	837	1681	752	261		3531

SAMPLE TREE INFO



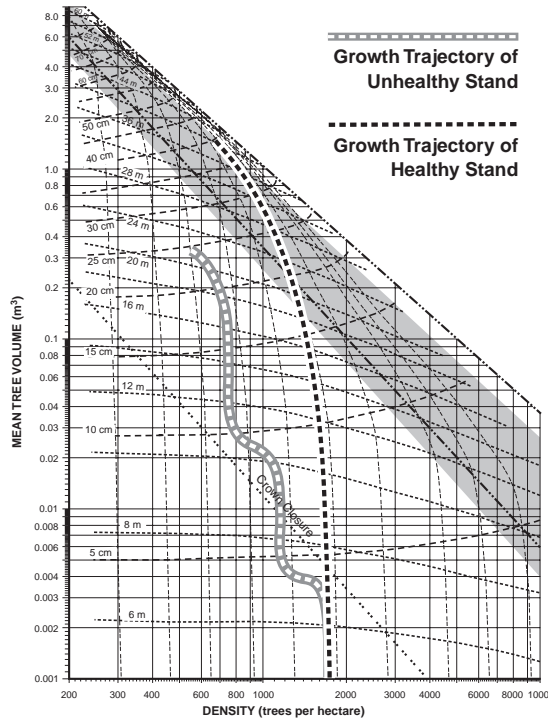
In this example, and in most other cases, you can make a preliminary assessment of whether your stand has an even-aged structure by knowing the typical structures of stands like yours, reviewing the stand history data, and examining the stand table (tree layer tally). In some cases, you will need to return to the block to confirm that the stand is even-aged.

If you determine that your stand is not even-aged, in most cases, you should not use the SDMD because the yields predicted by it will be incorrect.

The SDMD assumes that your stand has an even-aged structure. All trees should have originated at about the same time. There should be no residual overstory and no younger cohorts (layers) of trees initiated at a later date under the main canopy.

In this example, the stand table on the FS 770 and the sample tree information suggest that you can assume that the stand is essentially even-aged.

6.2 Will your stand deviate from the development pattern assumed by the SDMD?

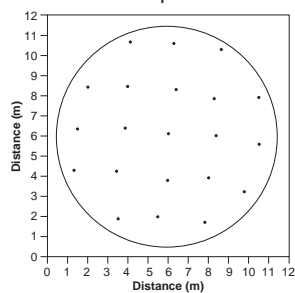


In this example, and in most other cases, you can make a preliminary assessment of likely stand growth trajectory by knowing the typical development pattern of stands like yours and reviewing the stand history data and forest health notes. In some cases, you will need to return to the block to evaluate.

The SDMD assumes that your stand will grow like a healthy, untreated stand. However, pests, disease, damage, and treatments may change vigor or survival in your stand causing your stand to deviate from the development patterns assumed in the SDMD. If you expect the growth or survival in your stand to differ from that in a similar healthy, untreated stand, in most cases, you should not use the SDMD because the yields predicted by it will be incorrect.

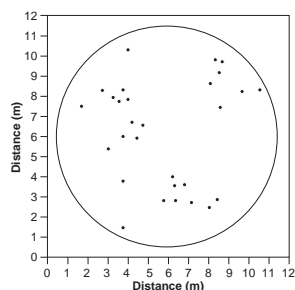
6.3 Are trees clumped or evenly spaced?

Use SDMD for planted stands.



In this example, and in most other cases, you must return to the block to determine whether the trees are regularly spaced or clumped. The FS 770 in this example contains no information on the degree of clumping. In the field assessment, determine if the inter-tree distances reflect natural or planted patterns.

Use SDMD for natural stands.



SEVEN - Optional stand data - QMD

In older stands, quadratic mean diameter (QMD) is a useful piece of additional information. The quadratic mean is an average diameter weighted to the larger trees.

7.1 Quadratic mean diameter

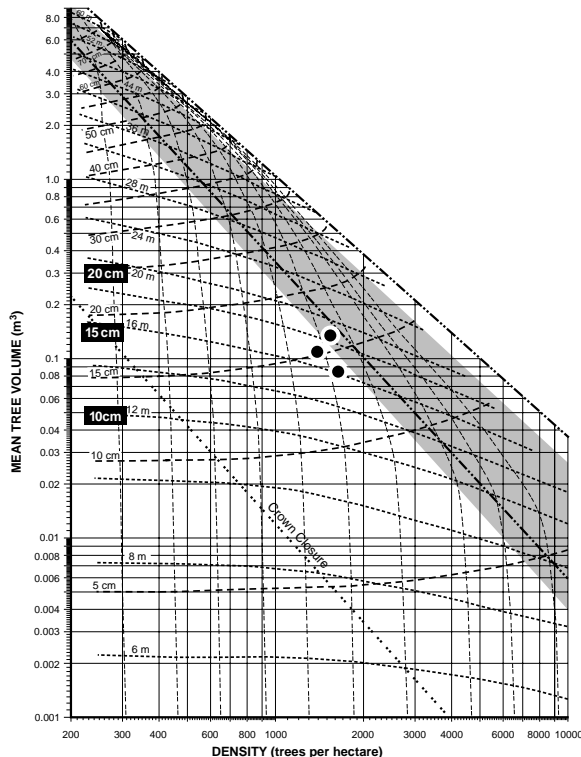
QMD can be computed from the stand table on the FS 770:

TALLIES AND INFO						
TREE LAYER TALLY - DENSITY						
SPP	DIAMETER (CLASS OR AVERAGE AND RANGE)					TOTAL
	Regen	0-5	5-10	10-15	15+	
Hw	705	1421	627	248		3001
Cw	132	260	125	13		530
Totals:	837	1681	752	261		3531

1. Determine the mid-point diameter for each diameter class e.g., 0-5 = 2.5.
2. Square the mid-point diameters e.g., $(2.5)(2.5) = 6.25$.
3. Multiply the squares by the trees/ha in the diameter class e.g., $6.25 (1681) = 10506$.
4. Sum the resulting values. e.g., $10506 + (7.5 (7.5) 752) + \dots = 93587$.
5. Divide this sum by total trees/ha e.g., $93587/3531 = 26.5$.
6. Take the square root e.g., $\sqrt{26.5} = 5.1 \text{ cm} = \text{QMD}$.

The quadratic mean diameter should be slightly larger than the simple average diameter.

7.2 Plot 3 data pairs



In older stands, where you have accurately determined top height, density, and quadratic mean diameter, it is useful to plot three points on the SDMD: (QMD, top height), (QMD, density), and (top height, density). If the three points do not form a tight cluster on the SDMD, you have an indication that 1) your stand has a stand structure that differs from that assumed by the SDMD, or 2) input data have been incorrectly collected or compiled. In either case, SDMD predictions for your stand will probably be incorrect.

E I G H T - Summary

Accurate stand and site data are required to correctly use a SDMD. In the example followed in this booklet, for a particular stand, recent silviculture survey data were available to you. You decided whether these data were suitable for input to a SDMD. Where you decided that these data were unsuitable, or not provided, you decided to return to the field and collect additional data.

The following table summarizes your plan for obtaining the input data required to use a SDMD to obtain rough yield predictions for your stand.

Stand and site data required to use the SDMD	Where to get the required data	What to do with the data
Density	Use inventory label total trees/ha and confirm in the field	Density is used to position stand on SDMD
Top height	Measure in the field with extra data collection	Top height is used to position stand on SDMD
Species composition	Use the inventory label species composition and confirm in the field	Species composition is used to make sure SDMD is right tool for job, select correct SDMD, select correct site index curve
Site index	Measure in field with extra data collection	Site index is used to convert height to age so that stand can be projected to rotation
Region	Use the Area Identification in the FS 770	Region is assessed to select correct SDMD and site index curve: coast or interior
Even-aged structure	Assess in the field – though you can make a preliminary assessment using the stand table in FS 770.	Even-aged structure is assessed to make sure SDMD is right tool for job
Stand growth trajectory	Assess in the field – though you can make some assessment from notes of forest health issues, previous treatments, and hazards in the FS 770	Stand growth trajectory is assessed to make sure SDMD is right tool for job
Stem distribution	Assess in the field	Stem distribution is assessed to select correct SDMD: planted or natural

N I N E - *Where to get more information*

Additional information on the stand density management diagrams used in this document can be obtained from the following sources:

1. Contact B.C. Ministry of Forests, Forest Practices Branch, Stand Development Specialist (tel 250-387-1191) for copies of the SDMDs and associated training material.
2. Contact Forestry Canada (tel: 250-363-0600) for a copy of the publication: Farnden, Craig. 1996. Stand density management diagrams for lodgepole pine, white spruce, and interior Douglas-fir. Pacific Forestry Centre. Information Report BC-X-360.
3. Access the B.C. Ministry of Forests, Forest Practices Branch web site at <http://mofwww.for.gov.bc.ca>.

