

Calculating LWD Metrics

1. Assign a **LWDCellSizeCode** for each cell on the field form. It will describe diameter (D1 through L4) and Length (L1 through L3).

LWD COUNT				Check Box if all are Zero []
	1.5-5 m	5-15 m	>15 m	Flag
10-30 cm	D1L1	D1L2	D1L3	
30-60 cm	D2L1	D2L2	D2L3	
60-80 cm	D3L1	D3L2	D3L3	
> 80 cm	D4L1	D4L2	D4L3	

Figure 1. Large Woody Debris box, as it appears on the Thalweg Form. Blue codes describe the LWDSIZECLASS for each cell of the box.

2. Assign a mean **LWDCellPieceVolume** (in m³) to each cell as follows:

LWD COUNT				Check Box if all are Zero []
	1.5-5 m	5-15 m	>15 m	Flag
10-30 cm	0.058	0.182	0.438	
30-60 cm	0.333	1.042	2.501	
60-80 cm	0.932	2.911	6.988	
> 80 cm	3.016	9.421	22.62	

Figure 2. Large Woody Debris box, as it appears on the Thalweg Form. Blue codes describe the average volume of one piece of LWD for each cell of the box. These are calculated according to Robison, E.G. 1998. *Reach Scale Sampling Metrics and Longitudinal Pattern Adjustments of Small Streams*. Ph.D. Dissertation. Dept. of Forest Engineering and Hydrology. Oregon State University, Corvallis, OR. 254 p.

$$\text{Volume} = \pi * [(\text{minDiam} + (\text{maxDiam} - \text{minDiam})/3)^2] * [\text{minLength} + (\text{maxLength} - \text{minLength})/3]$$

where the extra large diameter class maxes out at 2m, and the long length maxes out at 30 m.]

3. Assign a **LWDSIZECODE** to each cell on the field form.

LWD COUNT				Check Box if all are Zero []
	1.5-5 m	5-15 m	>15 m	Flag
10-30 cm	T	S	M	
30-60 cm	S	M	L	
60-80 cm	S	L	L	
> 80 cm	M	L	X	

Figure 3. Large Woody Debris box, as it appears on the Thalweg Form. Blue codes describe the LWDSIZECODE for each cell of the box, where: T = Tiniest; S = Small; M = Medium; L = Large; X = Extra-Large.

4. Define each of 5 **LWDClasses**.

TtoX	All	Includes T,S,M,L,X
StoX	Except tiniest	Includes S,M,L,X
MtoX		Includes M,L,X
LtoX		Includes L,X
XtoX	Only Extra Large	Includes X

5. Calculate site counts of large woody debris: **LWDPieces**_____

Table 1. LWD pieces per site

Metric for # Pieces per Site	Raw Data Source	Operation
LWDPieces D1L1	LargeWoodyDebris	\sum (LWDCount for 10 segments, where LWDSIZECLASS = D1L1)
LWDPieces D2L1	LargeWoodyDebris	\sum (LWDCount for 10 segments, where LWDSIZECLASS = D2L1)
LWDPieces D3L1	LargeWoodyDebris	\sum (LWDCount for 10 segments, where LWDSIZECLASS = D3L1)
LWDPieces D4L1	LargeWoodyDebris	\sum (LWDCount for 10 segments, where LWDSIZECLASS = D4L1)
LWDPieces D1L2	LargeWoodyDebris	\sum (LWDCount for 10 segments, where LWDSIZECLASS = D1L2)
LWDPiecesD2L2	LargeWoodyDebris	\sum (LWDCount for 10 segments, where LWDSIZECLASS = D2L2)
LWDPiecesD3L2	LargeWoodyDebris	\sum (LWDCount for 10 segments, where LWDSIZECLASS = D3L2)
LWDPiecesD4L2	LargeWoodyDebris	\sum (LWDCount for 10 segments, where LWDSIZECLASS = D4L2)
LWDPieces D1L3	LargeWoodyDebris	\sum (LWDCount for 10 segments, where LWDSIZECLASS = D1L3)
LWDPieces D2L3	LargeWoodyDebris	\sum (LWDCount for 10 segments, where LWDSIZECLASS = D2L3)
LWDPieces D3L3	LargeWoodyDebris	\sum (LWDCount for 10 segments, where LWDSIZECLASS = D3L3)
LWDPieces D4L3	LargeWoodyDebris	\sum (LWDCount for 10 segments, where LWDSIZECLASS = D4L3)
LWDPiecesTtoX	LargeWoodyDebris	\sum (LWDPiecesD1L1)+ \sum (LWDPiecesD1L2)+ \sum (LWDPiecesD1L3)+ \sum (LWDPiecesD2L1)+ \sum (LWDPiecesD2L2)+ \sum (LWDPiecesD2L3)+ \sum (LWDPiecesD3L1)+ \sum (LWDPiecesD3L2)+ \sum (LWDPiecesD3L3)+ \sum (LWDPiecesD4L1)+ \sum (LWDPiecesD4L2)+ \sum (LWDPiecesD4L3)
LWDPiecesStoX	LargeWoodyDebris	\sum (LWDPiecesD1L2)+ \sum (LWDPiecesD1L3)+ \sum (LWDPiecesD2L1)+ \sum (LWDPiecesD2L2)+ \sum (LWDPiecesD2L3)+ \sum (LWDPiecesD3L1)+ \sum (LWDPiecesD3L2)+ \sum (LWDPiecesD3L3)+ \sum (LWDPiecesD4L1)+ \sum (LWDPiecesD4L2)+ \sum (LWDPiecesD4L3)
LWDPiecesMtoX	LargeWoodyDebris	\sum (LWDPiecesD1L3)+ \sum (LWDPiecesD2L2)+ \sum (LWDPiecesD2L3)+ \sum (LWDPiecesD3L2)+ \sum (LWDPiecesD3L3)+ \sum (LWDPiecesD4L1)+ \sum (LWDPiecesD4L2)+ \sum (LWDPiecesD4L3)
LWDPiecesLtoX	LargeWoodyDebris	\sum (LWDPiecesD2L3)+ \sum (LWDPiecesD3L2)+ \sum (LWDPiecesD3L3)+ \sum (LWDPiecesD4L2)+ \sum (LWDPiecesD4L3)
LWDPiecesXtoX	LargeWoodyDebris	\sum (LWDPiecesD4L3)

6. Calculate site counts of large woody volume: **LWDSiteVolume**_____

Table 2. LWD volume per site

Metric for LWD Volume per site	Raw Data Source	Operation
LWDSiteVolume D1L1	LargeWoodyDebris	LWDPieces D1L1 (0.058)
LWDSiteVolumeD2L1	LargeWoodyDebris	LWDPieces D2L1 (0.333)
LWDSiteVolumeD3L1	LargeWoodyDebris	LWDPieces D3L1 (0.932)
LWDSiteVolumeD4L1	LargeWoodyDebris	LWDPieces D4L1 (3.016)
LWDSiteVolumeD1L2	LargeWoodyDebris	LWDPieces D1L2 (0.182)
LWDSiteVolumeD2L2	LargeWoodyDebris	LWDPiecesD2L2 (1.042)
LWDSiteVolumeD3L2	LargeWoodyDebris	LWDPiecesD3L2 (2.911)
LWDSiteVolumeD4L2	LargeWoodyDebris	LWDPiecesD4L2 (9.421)
LWDSiteVolumeD1L3	LargeWoodyDebris	LWDPieces D1L3 (0.438)
LWDSiteVolumeD2L3	LargeWoodyDebris	LWDPieces D2L3 (2.501)
LWDSiteVolumeD3L3	LargeWoodyDebris	LWDPieces D3L3 (6.988)
LWDSiteVolumeD4L3	LargeWoodyDebris	LWDPieces D4L3 (22.62)
LWDSiteVolumeTtoX	LargeWoodyDebris	$\Sigma(LWDPiecesD1L1*0.058)+$ $\Sigma(LWDPiecesD1L2*0.182)+$ $\Sigma(LWDPiecesD1L3*0.438)+$ $\Sigma(LWDPiecesD2L1*0.333)+$ $\Sigma(LWDPiecesD2L2*1.042)+$ $\Sigma(LWDPiecesD2L3*2.501)+$ $\Sigma(LWDPiecesD3L1*0.932)+$ $\Sigma(LWDPiecesD3L2*2.911)+$ $\Sigma(LWDPiecesD3L3*6.988)+$ $\Sigma(LWDPiecesD4L1*3.016)+$ $\Sigma(LWDPiecesD4L2*9.421)+$ $\Sigma(LWDPiecesD4L3*22.62)$
LWDSiteVolumeStoX	LargeWoodyDebris	$\Sigma(LWDPiecesD1L2*0.182)+$ $\Sigma(LWDPiecesD1L3*0.438)+$ $\Sigma(LWDPiecesD2L1*0.333)+$ $\Sigma(LWDPiecesD2L2*1.042)+$ $\Sigma(LWDPiecesD2L3*2.501)+$ $\Sigma(LWDPiecesD3L1*0.932)+$ $\Sigma(LWDPiecesD3L2*2.911)+$ $\Sigma(LWDPiecesD3L3*6.988)+$ $\Sigma(LWDPiecesD4L1*3.016)+$ $\Sigma(LWDPiecesD4L2*9.421)+$ $\Sigma(LWDPiecesD4L3*22.62)$
LWDSiteVolumeMtoX	LargeWoodyDebris	$\Sigma(LWDPiecesD1L3*0.438)+$ $\Sigma(LWDPiecesD2L2*1.042)+$ $\Sigma(LWDPiecesD2L3*2.501)+$ $\Sigma(LWDPiecesD3L2*2.911)+$ $\Sigma(LWDPiecesD3L3*6.988)+$

		$\Sigma(\text{LWDPiecesD4L1} * 3.016) +$ $\Sigma(\text{LWDPiecesD4L2} * 9.421) +$ $\Sigma(\text{LWDPiecesD4L3} * 22.62)$
LWDSiteVolumeLtoX	LargeWoodyDebris	$\Sigma(\text{LWDPiecesD2L3} * 2.501) +$ $\Sigma(\text{LWDPiecesD3L2} * 2.911) +$ $\Sigma(\text{LWDPiecesD3L3} * 6.988) +$ $\Sigma(\text{LWDPiecesD4L2} * 9.421) +$ $\Sigma(\text{LWDPiecesD4L3} * 22.62)$
LWDSiteVolumeXtoX	LargeWoodyDebris	$\Sigma(\text{LWDPiecesD4L3} * 22.62)$

7. Calculate site counts of large woody debris, normalized to 100m of stream length: **LWDPiecesPer100m**_____

Table 3. LWD pieces per 100m

Metric for # Pieces per 100 m	Raw Data Source	Operation
LWDPiecesPer100mD1L1	LargeWoodyDebris SiteLayout	$(\text{LWDPieces D1L1})(100)/\text{Length}$
LWDPiecesPer100mD2L1	LargeWoodyDebris SiteLayout	$(\text{LWDPieces D2L1})(100)/\text{Length}$
LWDPiecesPer100mD3L1	LargeWoodyDebris SiteLayout	$(\text{LWDPieces D3L1})(100)/\text{Length}$
LWDPiecesPer100mD4L1	LargeWoodyDebris SiteLayout	$(\text{LWDPieces D4L1})(100)/\text{Length}$
LWDPiecesPer100mD1L2	LargeWoodyDebris SiteLayout	$(\text{LWDPieces D1L2})(100)/\text{Length}$
LWDPiecesPer100mD2L2	LargeWoodyDebris SiteLayout	$(\text{LWDPieces D2L2})(100)/\text{Length}$
LWDPiecesPer100mD3L2	LargeWoodyDebris SiteLayout	$(\text{LWDPieces D3L2})(100)/\text{Length}$
LWDPiecesPer100mD4L2	LargeWoodyDebris SiteLayout	$(\text{LWDPieces D4L2})(100)/\text{Length}$
LWDPiecesPer100mD1L3	LargeWoodyDebris SiteLayout	$(\text{LWDPieces D1L3})(100)/\text{Length}$
LWDPiecesPer100msD2L3	LargeWoodyDebris SiteLayout	$(\text{LWDPieces D2L3})(100)/\text{Length}$
LWDPiecesPer100mD3L3	LargeWoodyDebris SiteLayout	$(\text{LWDPieces D3L3})(100)/\text{Length}$
LWDPiecesPer100mD4L3	LargeWoodyDebris SiteLayout	$(\text{LWDPieces D4L3})(100)/\text{Length}$
LWDPiecesPer100mTtoX	LargeWoodyDebris SiteLayout	$(\text{LWDPiecesTtoX})(100)/\text{Length}$
LWDPiecesPer100mStoX	LargeWoodyDebris SiteLayout	$(\text{LWDPiecesStoX})(100)/\text{Length}$
LWDPiecesPer100mMtoX	LargeWoodyDebris SiteLayout	$(\text{LWDPieces MtoX})(100)/\text{Length}$
LWDPiecesPer100mLtoX	LargeWoodyDebris SiteLayout	$(\text{LWDPiecesLtoX})(100)/\text{Length}$
LWDPiecesPer100mXtoX	LargeWoodyDebris SiteLayout	$(\text{LWDPiecesXtoX})(100)/\text{Length}$

8. Calculate site counts of large woody debris, normalized to m³ of stream bankfull channel surface area: **LWDPiecesMSq**_____

Table 5. LWD pieces per m²

Metric for # Pieces per square meter	Raw Data Source	Operation
LWDPiecesMSqD1L1	LargeWoodyDebris SiteLayout PrimaryTransects	(LWDPieces D1L1)/(Length*Mean Bankfull Width)
LWDPiecesMSqD2L1	LargeWoodyDebris SiteLayout PrimaryTransects	(LWDPieces D2L1)/(Length*Mean Bankfull Width)
LWDPiecesMSqD3L1	LargeWoodyDebris SiteLayout PrimaryTransects	(LWDPieces D3L1)/(Length*Mean Bankfull Width)
LWDPiecesMSqD4L1	LargeWoodyDebris SiteLayout PrimaryTransects	(LWDPieces D4L1)/(Length*Mean Bankfull Width)
LWDPiecesMSqD1L2	LargeWoodyDebris SiteLayout PrimaryTransects	(LWDPieces D1L2)/(Length*Mean Bankfull Width)
LWDPiecesMSqD2L2	LargeWoodyDebris SiteLayout PrimaryTransects	(LWDPieces D2L2)/(Length*Mean Bankfull Width)
LWDPiecesMSqD3L2	LargeWoodyDebris SiteLayout PrimaryTransects	(LWDPieces D3L2)/(Length*Mean Bankfull Width)
LWDPiecesMSqD4L2	LargeWoodyDebris SiteLayout PrimaryTransects	(LWDPieces D4L2)/(Length*Mean Bankfull Width)
LWDPieces MSqD1L3	LargeWoodyDebris SiteLayout PrimaryTransects	(LWDPieces D1L3)/(Length*Mean Bankfull Width)
LWDPiecesMSqD2L3	LargeWoodyDebris SiteLayout PrimaryTransects	(LWDPieces D2L3)/(Length*Mean Bankfull Width)
LWDPiecesMSqD3L3	LargeWoodyDebris SiteLayout PrimaryTransects	(LWDPieces D3L3)/(Length*Mean Bankfull Width)
LWDPiecesMSqD4L3	LargeWoodyDebris SiteLayout PrimaryTransects	(LWDPieces D4L3)/(Length*Mean Bankfull Width)
LWDPiecesMSqTtoX	LargeWoodyDebris SiteLayout	(LWDPiecesTtoX)/(Length*Mean Bankfull Width)

	PrimaryTransects	
LWDPiecesMSqStoX	LargeWoodyDebris SiteLayout PrimaryTransects	$(LWDPiecesStoX)/(Length*Mean\ Bankfull\ Width)$
LWDPiecesMSqMtoX	LargeWoodyDebris SiteLayout PrimaryTransects	$(LWDPieces\ MtoX)/(Length*Mean\ Bankfull\ Width)$
LWDPiecesMSqLtoX	LargeWoodyDebris SiteLayout PrimaryTransects	$(LWDPiecesLtoX)/(Length*Mean\ Bankfull\ Width)$
LWDPiecesMSqXtoX	LargeWoodyDebris SiteLayout PrimaryTransects	$(LWDPiecesXtoX)/(Length*Mean\ Bankfull\ Width)$

9. Calculate site counts of large woody debris volume, normalized to 100m of stream length: **LWDSiteVolumePer100m**_____

Table 6. LWD volume per 100m

Metric for LWD Volume per 100 m	Raw Data Source	Operation
LWDSiteVolumePer100m D1L1	LargeWoodyDebris SiteLayout	[(LWDPieces D1L1)(LWDPieceVolume for D1L1)(100)/Length]
LWDSiteVolumePer100m D2L1	LargeWoodyDebris SiteLayout	[(LWDPieces D2L1)(LWDPieceVolume for D2L1)(100)/Length]
LWDSiteVolumePer100m D3L1	LargeWoodyDebris SiteLayout	[(LWDPieces D3L1)(LWDPieceVolume for D3L1)(100)/Length]
LWDSiteVolumePer100m D4L1	LargeWoodyDebris SiteLayout	[(LWDPieces D4L1)(LWDPieceVolume for D4L1)(100)/Length]
LWDSiteVolumePer100m D1L2	LargeWoodyDebris SiteLayout	[(LWDPieces D1L2)(LWDPieceVolume for D1L2) (100)/Length]
LWDSiteVolumePer100m D2L2	LargeWoodyDebris SiteLayout	[(LWDPiecesD2L2)(LWDPieceVolume for D2L2)(100)/Length]
LWDSiteVolumePer100m D3L2	LargeWoodyDebris SiteLayout	[(LWDPiecesD3L2)(LWDPieceVolume for D3L2) (100)/Length]
LWDSiteVolumePer100m D4L2	LargeWoodyDebris SiteLayout	[(LWDPiecesD4L2)(LWDPieceVolume for D4L2) (100)/Length]
LWDSiteVolumePer100m D1L3	LargeWoodyDebris SiteLayout	[(LWDPieces D1L3)(LWDPieceVolume for D1L3) (100)/Length]
LWDSiteVolumePer100m D2L3	LargeWoodyDebris SiteLayout	[(LWDPieces D2L3)(LWDPieceVolume for D2L3) (100)/Length]
LWDSiteVolumePer100m D3L3	LargeWoodyDebris SiteLayout	[(LWDPieces D3L3)(LWDPieceVolume for D3L3) (100)/Length]
LWDSiteVolumePer100m D4L3	LargeWoodyDebris SiteLayout	[(LWDPieces D4L3)(LWDPieceVolume for D4L3) (100)/Length]
LWDVolumePer100mTtoX	LargeWoodyDebris SiteLayout	LWDSiteVolume Per100m D1L1+ LWDSiteVolume Per100m D2L1+ LWDSiteVolume Per100m D3L1+ LWDSiteVolume Per100m D4L1+ LWDSiteVolume Per100m D1L2+ LWDSiteVolume Per100m D2L2+ LWDSiteVolume Per100m D3L2+ LWDSiteVolume Per100m D4L2+ LWDSiteVolume Per100m D1L3+ LWDSiteVolume Per100m D2L3+ LWDSiteVolume Per100m D3L3+ LWDSiteVolume Per100m D4L3
LWDVolumePer100mStoX	LargeWoodyDebris SiteLayout	LWDSiteVolume Per100m D2L1+ LWDSiteVolume Per100m D3L1+ LWDSiteVolume Per100m D4L1+

		LWDSiteVolume Per100m D1L2+ LWDSiteVolume Per100m D2L2+ LWDSiteVolume Per100m D3L2+ LWDSiteVolume Per100m D4L2+ LWDSiteVolume Per100m D1L3+ LWDSiteVolume Per100m D2L3+ LWDSiteVolume Per100m D3L3+ LWDSiteVolume Per100m D4L3
LWDVolumePer100mMtoX	LargeWoodyDebris SiteLayout	LWDSiteVolume Per100m D4L1+ LWDSiteVolume Per100m D2L2+ LWDSiteVolume Per100m D3L2+ LWDSiteVolume Per100m D4L2+ LWDSiteVolume Per100m D1L3+ LWDSiteVolume Per100m D2L3+ LWDSiteVolume Per100m D3L3+ LWDSiteVolume Per100m D4L3
LWDVolumePer100LtoX	LargeWoodyDebris SiteLayout	LWDSiteVolume Per100m D3L2+ LWDSiteVolume Per100m D4L2+ LWDSiteVolume Per100m D2L3+ LWDSiteVolume Per100m D3L3+ LWDSiteVolume Per100m D4L3
LWDVolumePer100mXtoX	LargeWoodyDebris SiteLayout	LWDSiteVolume Per100m D4L3

10. Calculate volume of large woody debris, normalized to m³ of stream bankfull channel surface area: **LWDVolumesMSq**_____

Table 7. LWD volume per m²

Metric for volume per square meter	Raw Data Source	Operation
LWDVolumeMSqD1L1	LargeWoodyDebris SiteLayout PrimaryTransects	(LWDSiteVolume D1L1)/(Length*Mean Bankfull Width)
LWDVolumeMSqD2L1	LargeWoodyDebris SiteLayout PrimaryTransects	(LWDSiteVolume D2L1)/(Length*Mean Bankfull Width)
LWDVolumeMSqD3L1	LargeWoodyDebris SiteLayout PrimaryTransects	(LWDSiteVolume D3L1)/(Length*Mean Bankfull Width)
LWDVolumeMSqD4L1	LargeWoodyDebris SiteLayout PrimaryTransects	(LWDSiteVolume D4L1)/(Length*Mean Bankfull Width)
LWDVolumeMSqD1L2	LargeWoodyDebris SiteLayout PrimaryTransects	(LWDSiteVolume D1L2)/(Length*Mean Bankfull Width)
LWDVolumeMSqD2L2	LargeWoodyDebris SiteLayout PrimaryTransects	(LWDSiteVolume D2L2)/(Length*Mean Bankfull Width)
LWDVolumeMSqD3L2	LargeWoodyDebris SiteLayout PrimaryTransects	(LWDSiteVolume D3L2)/(Length*Mean Bankfull Width)
LWDPiecesMSqD4L2	LargeWoodyDebris SiteLayout PrimaryTransects	(LWDSiteVolume D4L2)/(Length*Mean Bankfull Width)
LWDVolume MSqD1L3	LargeWoodyDebris SiteLayout PrimaryTransects	(LWDSiteVolume D1L3)/(Length*Mean Bankfull Width)
LWDVolumeMSqD2L3	LargeWoodyDebris SiteLayout PrimaryTransects	(LWDSiteVolume D2L3)/(Length*Mean Bankfull Width)
LWDVolumeMSqD3L3	LargeWoodyDebris SiteLayout PrimaryTransects	(LWDSiteVolume D3L3)/(Length*Mean Bankfull Width)
LWDVolumeMSqD4L3	LargeWoodyDebris SiteLayout PrimaryTransects	(LWDSiteVolume D4L3)/(Length*Mean Bankfull Width)
LWDVolumeMSqTtoX NOTE: This is EMAPs' V1W_MSQ	LargeWoodyDebris SiteLayout PrimaryTransects	(LWDSiteVolumeTtoX)/(Length*Mean Bankfull Width)

LWDVolumeMSqStoX	LargeWoodyDebris SiteLayout PrimaryTransects	$(LWDSiteVolumeStoX)/(Length*Mean\ Bankfull\ Width)$
LWDVolumeMSqMtoX	LargeWoodyDebris SiteLayout PrimaryTransects	$(LWDSiteVolume\ MtoX)/(Length*Mean\ Bankfull\ Width)$
LWDVolumeMSqLtoX	LargeWoodyDebris SiteLayout PrimaryTransects	$(LWDSiteVolumeLtoX)/(Length*Mean\ Bankfull\ Width)$
LWDVolumeMSqXtoX	LargeWoodyDebris SiteLayout PrimaryTransects	$(LWDSiteVolumeXtoX)/(Length*Mean\ Bankfull\ Width)$