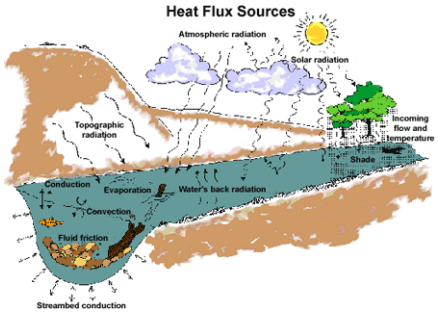
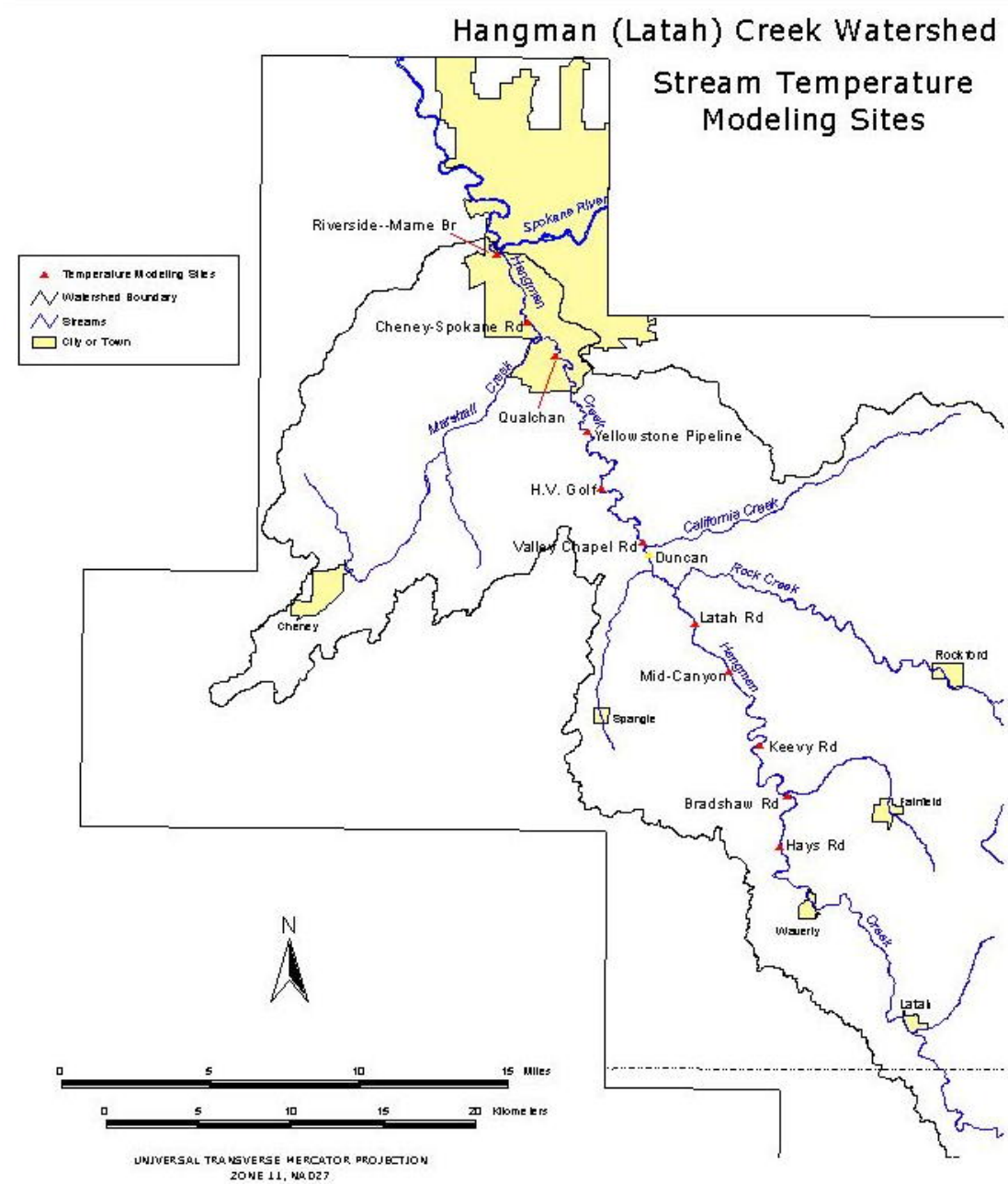
Models/Tools for Temperature TMDLs



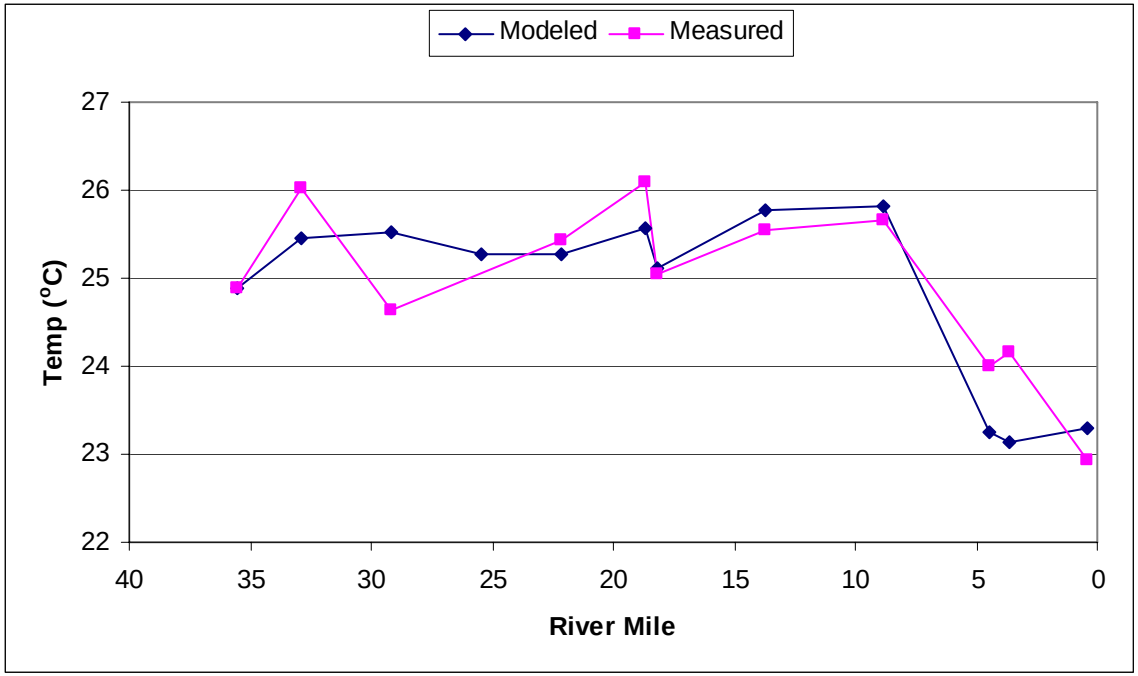
- SNTEMP (Stream Network Temperature)
  - A steady-state stream model predicting mean water temperatures (supported by USGS).
- Ttools for ArcView
  - A tool to extract elevation, distance, and landcover data from computer based maps for input into the calculator for riparian shade and topography.
- Shade
  - A tool for estimating shade from riparian vegetation.

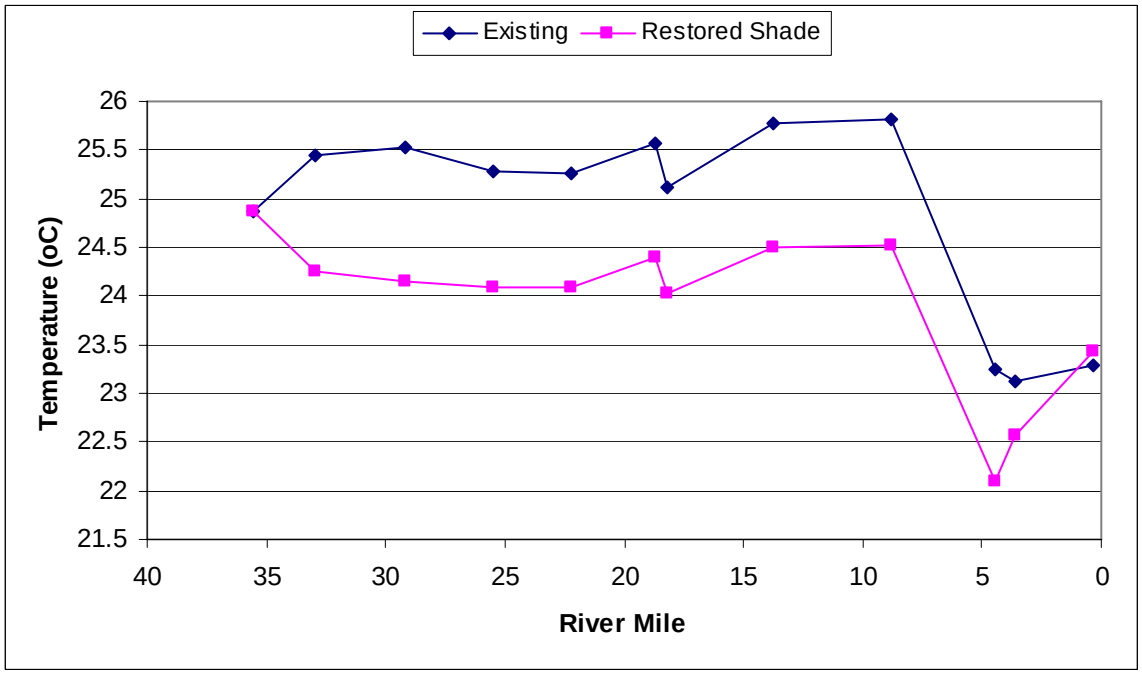
Hangman Temperature TMDL

- Use SNTEMP results and conclusions from Hardin-Davis (2003) Instream Flow Study to 'package' the TMDL:
  - Current water temperature conditions in most of Hangman Creek from June – August far exceed the 18ºC criterion.
  - Shading has more effect on lowering temperatures than small increases in flow (1 – 3 cfs).
  - Tributary and mainstem shading and increased flow will have a synergistic effect on lowering water temperatures.
  - Maximum shading will not result in meeting the 18ºC criterion, but will improve habitat for salmonids.
- Calculate solar radiation influx for current shade conditions using GIS and temperature modeling tools
- Calculate potential shade with the modeling tools using vegetation estimates based on historical and soils data, and consulting SCCD



Hangman Creek
SNTEMP study
Hardin-Davis (2003)





Hangman Creek SNTEMP model Results for Week 28

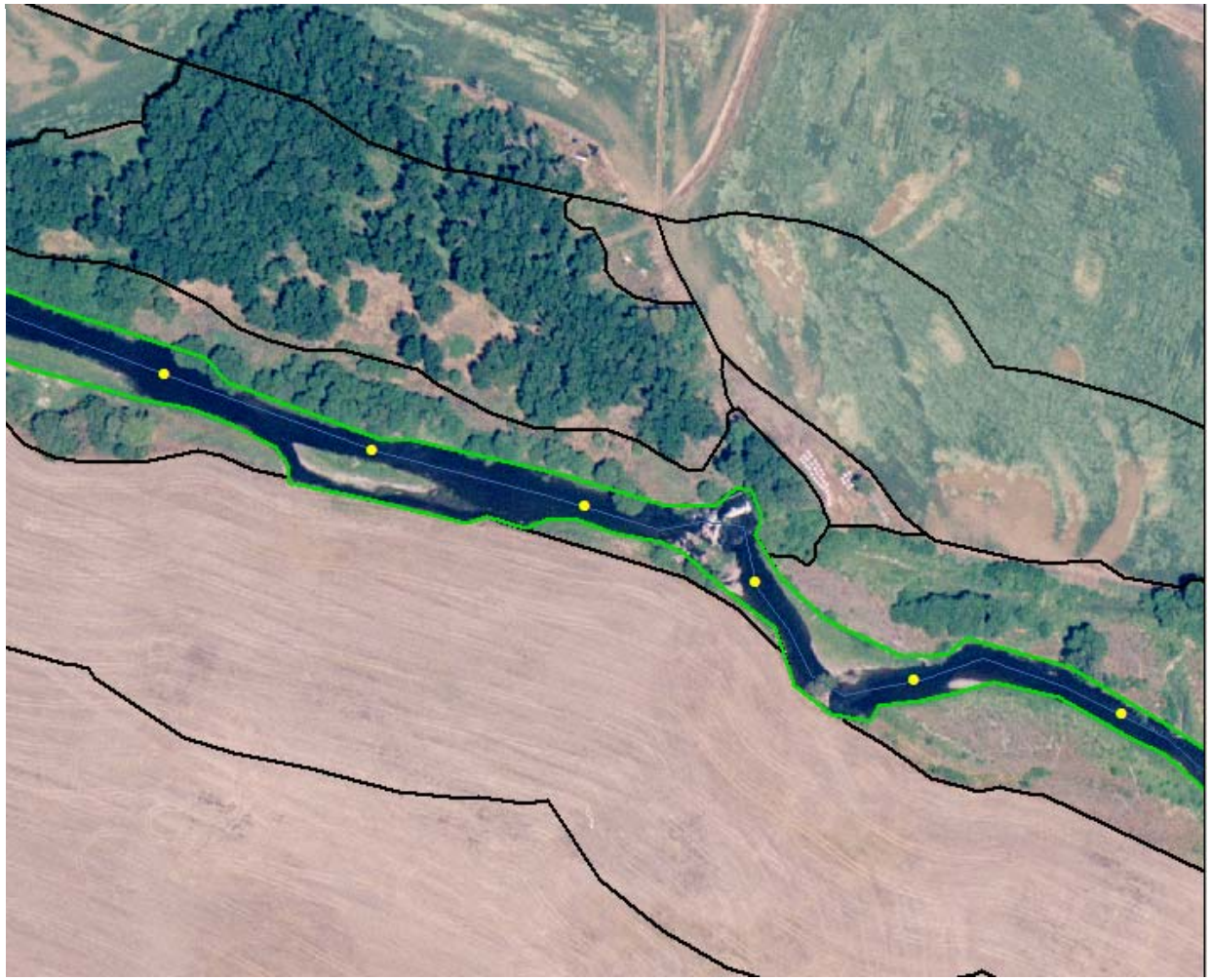
- Hardin-Davis (2003)

Digitizing Vegetation

- **A 300-500 foot area is created around the stream and different vegetation polygons are delineated using GIS.**

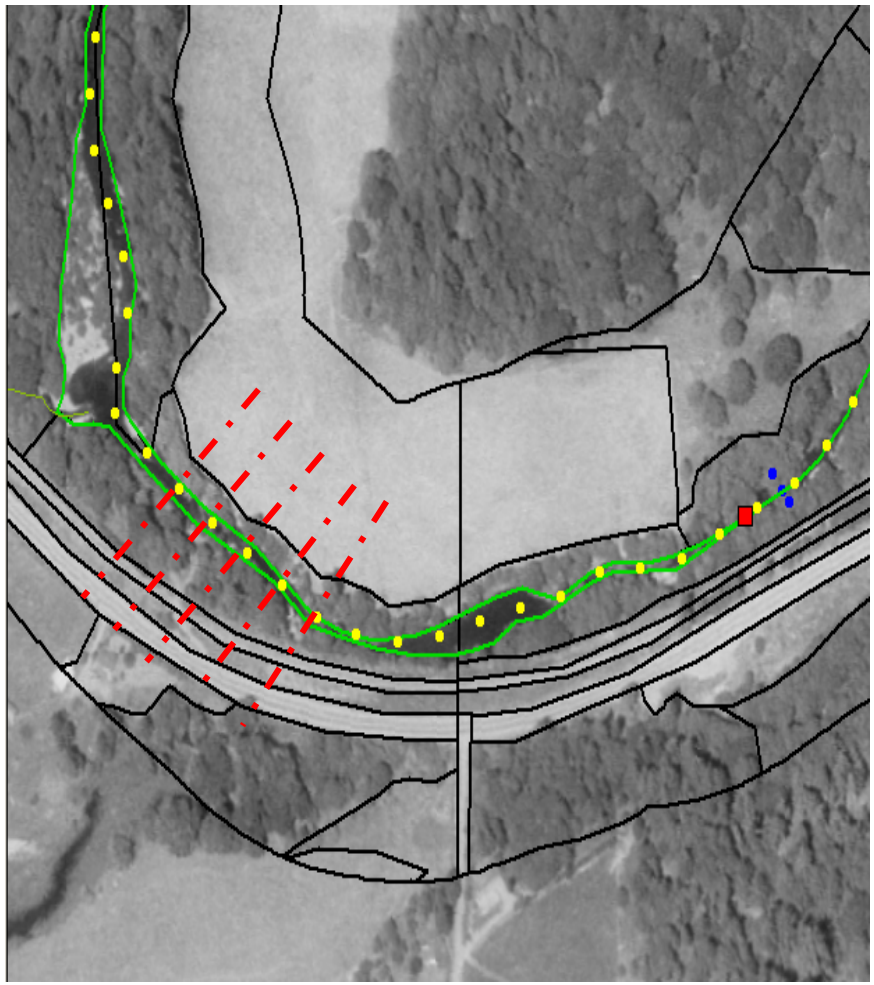
- **Vegetation polygons are classified by average tree height, canopy density and by general type (i.e. deciduous, conifer, mixed).**

- **The vegetation map is coded in the office and compared with SCCD densiometer measurements and vegetation plot data.**



Riparian and Topographic Data from GIS

- Elevation values sampled at 9 places on either side of the stream
- Aspect (orientation) and gradient at the stream center
- Topographic shade angle out to 9 miles



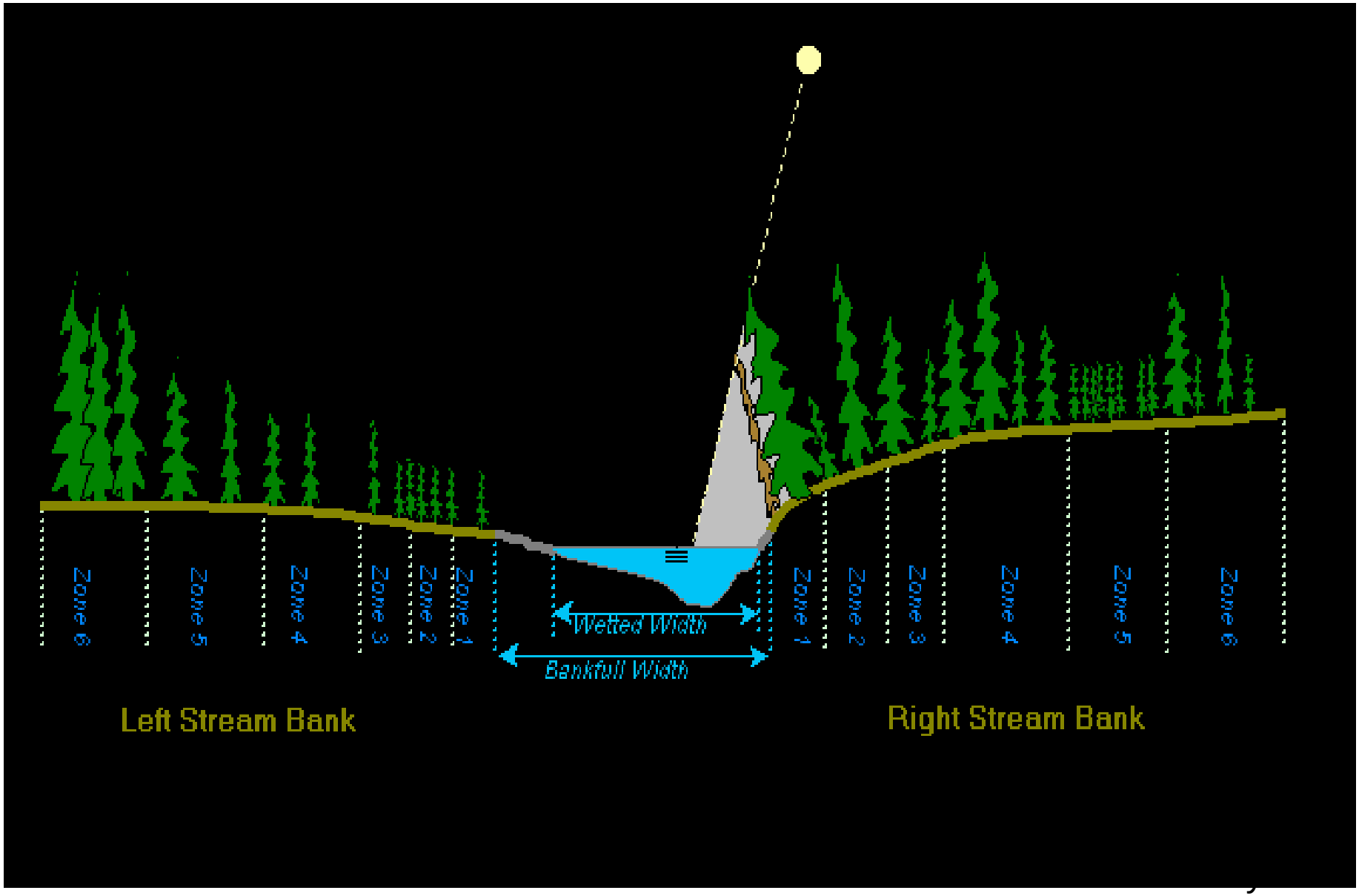
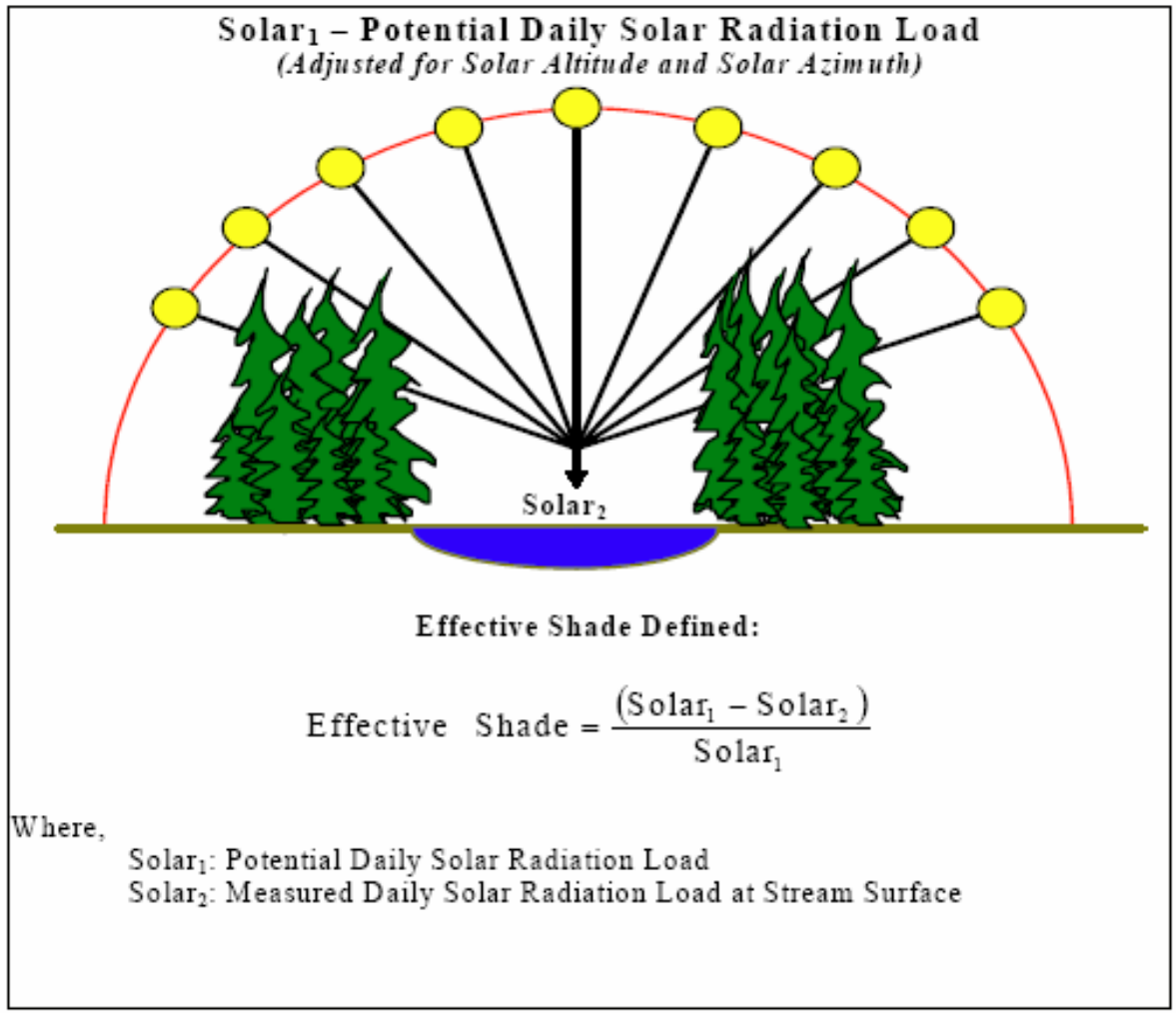

Zone 6
Zone 5
Zone 4
Zone 3
Zone 2
Zone 1
Wetted Width
Bankfull Width
Zone 1
Zone 2
Zone 3
Zone 4
Zone 5
Zone 6
Left Stream Bank
Right Stream Bank

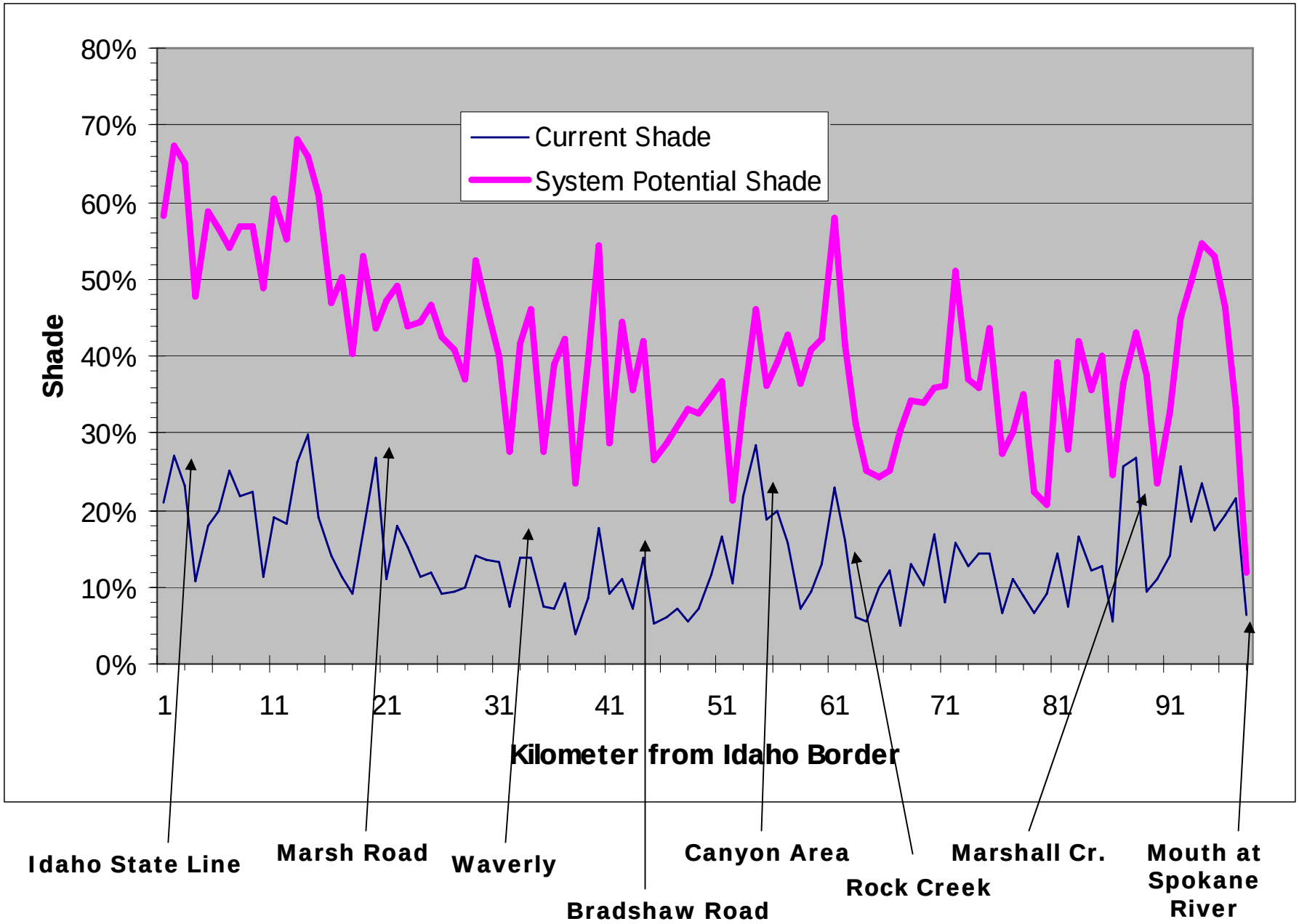
Figure 1-5. *Effective Shade – Defined*

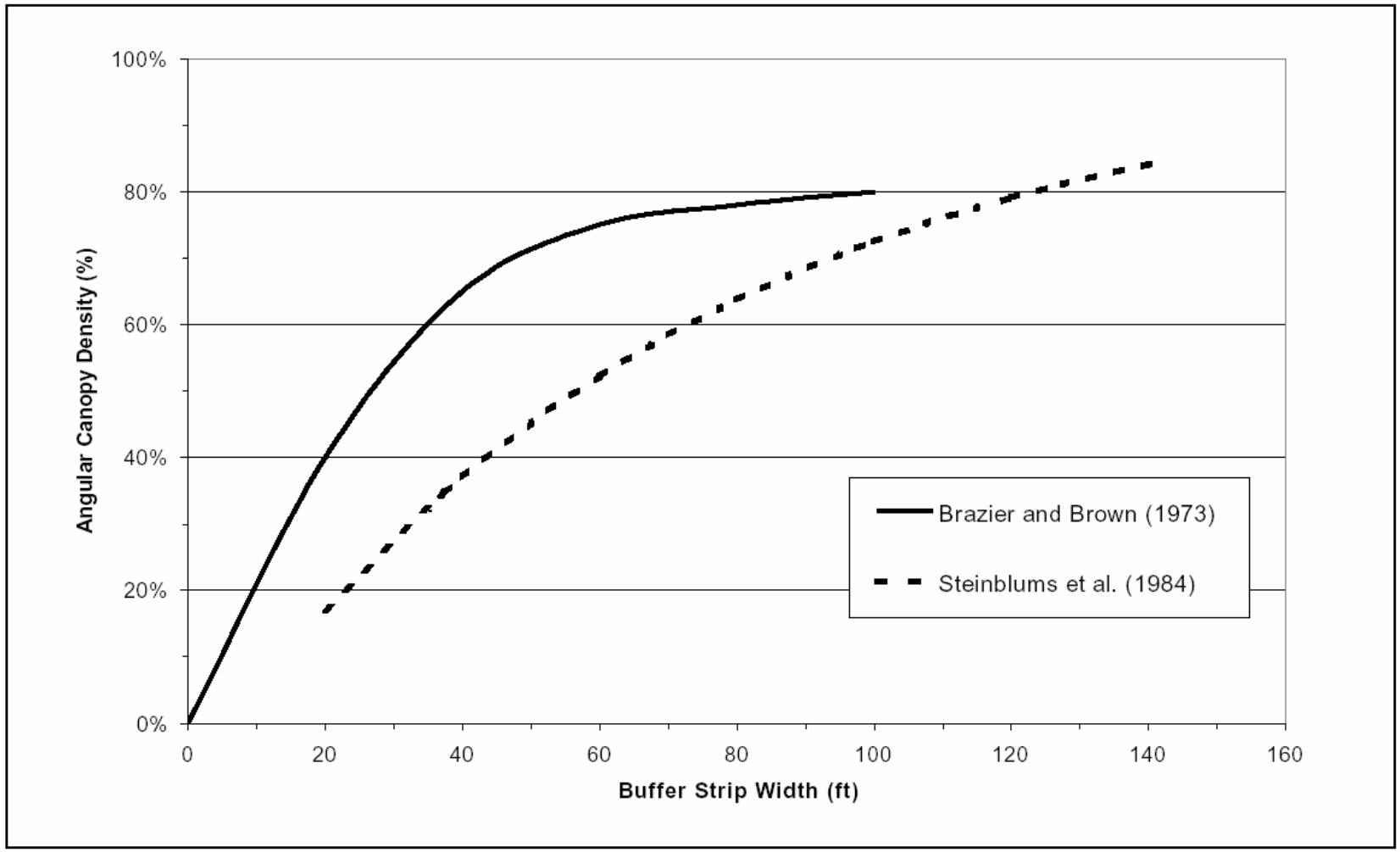


DATA SOURCE	SITE POTENTIAL TREE HEIGHT VALUES (feet)			NOTES
	Ave. height*	Max. height	Range in heights	
DNR: for the whole of Spokane County	98	114	73-114	patchy, mostly north Spokane County
DNR: clipped to WRIA 56	79	107	73-114	patchy data, covers 13% of WRIA
SSURGO: within WRIA 56	80	105	52-105	values for 36% of WRIA
SSURGO: within a 300ft buffer of Hangman	77	105	71-105	values for 16% of buffered area
Conservation District: within WRIA 56	*no tree height values*			

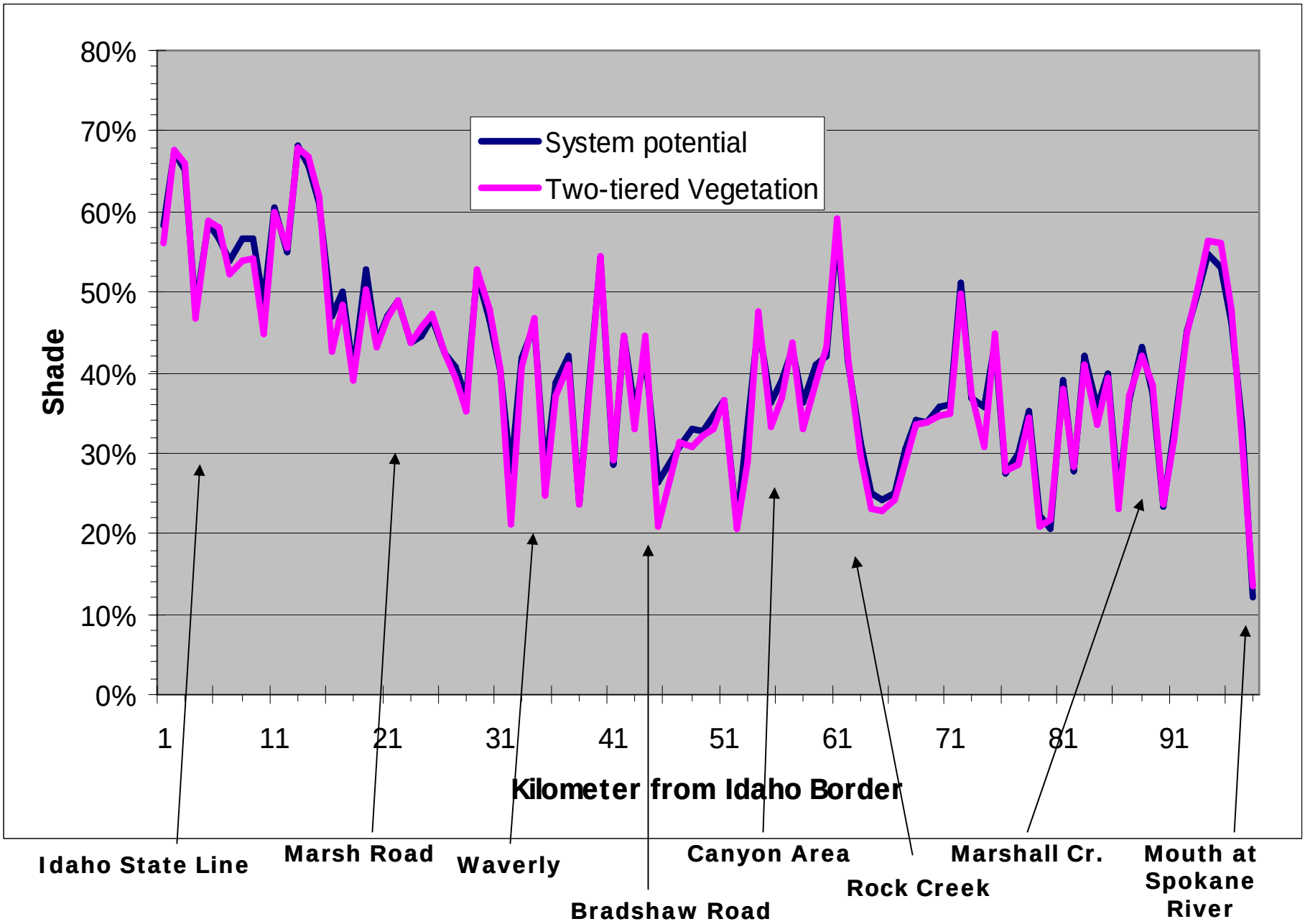
DATA SOURCE	Predominant Site Potential Species	
	Species name	% Cover
DNR: for the whole of Spokane County	Douglas Fir	42%
	Ponderosa Pine	46%
DNR: clipped to WRIA 56	Douglas Fir	38%
	Ponderosa Pine	50%
SSURGO: within WRIA 56	Ponderosa Pine	64%
	Grand Fir	13%
	Western Larch	12%
SSURGO: within a 300ft buffer of Hangman	Ponderosa Pine	57%
	Lodgepole Pine	18%
	Douglas Fir	17%
Conservation District: within WRIA 56	Evergreen Forest	27%
	Open Ponderosa Pine	30%
	Prairie	39%

After assessing these results and discussing them with temperature modelers at Ecology, we chose a value of **80 feet for system potential tree height** (from the SSURGO data within the WRIA) along the full length of Hangman Creek.


80%
70%
60%
50%
40%
30%
20%
10%
0%
Shade
Current Shade
System Potential Shade
1
11
21
31
41
51
61
71
81
91
Kilometer from Idaho Border
Idaho State Line
Marsh Road
Waverly
Bradshaw Road
Canyon Area
Rock Creek
Marshall Cr.
Mouth at Spokane River



Relationship between angular canopy density and riparian buffer width for small streams in old-growth riparian stands (after Beschta et al., 1987 and CH2M Hill 2000).


80%
70%
60%
50%
40%
30%
20%
10%
0%
Shade
System potential
Two-tiered Vegetation
1
11
21
31
41
51
61
71
81
91
Kilometer from Idaho Border
Idaho State Line
Marsh Road
Waverly
Bradshaw Road
Canyon Area
Rock Creek
Marshall Cr.
Mouth at Spokane River

Temperature TMDL Load Allocations

istance om water thdrawal OR) to pstream egment oundary (Km)	Distance from water withdrawal (OR) to downstream segment boundary (Km)	Current shade condition (%)	System potential shade with current channel in Mill/ Yellowhawk Creek	System potential shade with future/natural channel? in Mill/ Yellowhawk Creek	Increase in % shade needed	Landmark RM station	Load allocation for daily average shortwave solar radiation on August 1 (watts/m2)	GIS ID
0	1.0	75.8%	71.3%		0.0%	32MIL-26.5	87.1	78
1.0	2.0	57.2%	64.1%		7.0%		108.9	88
2.0	3.0	55.3%	63.6%		8.3%		110.7	98
3.0	4.0	33.1%	60.1%		27.1%		121.1	108
4.0	5.0	44.4%	66.3%		21.8%		102.5	118
5.0	6.0	32.0%	67.3%		35.3%		99.5	128
6.0	7.0	30.5%	65.2%		34.6%	32MIL-21.3	105.8	138
7.0	8.0	19.2%	59.7%		40.4%		122.5	148
8.0	9.0	28.1%	34.7%		6.6%		198.4	158
9.0	10.0	22.9%	44.0%		21.1%		170.2	168
10.0	11.0	30.5%	57.0%		26.5%	32MIL-19.1	130.6	178
11.0	12.0	18.0%	37.8%		19.7%		189.1	188
12.0	13.0	18.6%	48.0%		29.5%		157.9	198
13.0	14.0	23.7%	47.3%		23.6%		160.0	208
14.0	15.0	15.9%	38.3%		22.3%	Blue Creek	187.6	218
15.0	16.0	13.7%	39.3%		25.6%		184.5	228
16.0	17.0	26.4%	52.4%		26.0%		144.7	238
17.0	18.0	26.5%	29.0%		2.5%		215.8	248
18.0	19.0	38.6%	35.1%		0.0%	32MIL-14.8	197.2	258
19.0	20.0	22.4%	31.6%		9.2%		207.8	268
20.0	21.0	27.0%	62.1%		35.2%		115.1	278
21.0	22.0	32.5%	58.5%		26.0%	32MIL-12.8 Five Mile Road	126.1	288
22.0	23.0	26.8%	39.2%		12.4%		184.9	298
23.0	24.0	24.4%	19.9%		0.0%		243.3	308
24.0	25.0	5.8%	9.3%		3.5%		275.5	318
25.0	26.0	7.5%	14.4%		6.9%		260.2	328
26.0	27.0	79.3%	96.8%		17.5%	Yellowhawk Creek	9.7	338
27.0	28.0	92.0%	96.7%		4.7%		10.0	348
28.0	29.0	82.3%	96.6%		14.3%		10.2	358

Temperature TMDL Wasteload Allocation

Class A: T_{NPDES} = [18 ºC-0.3ºC] + [chronic dilution factor] * 0.3 ºC

Table 1. Wasteload allocation for effluent temperature from the Dayton Wastewater Treatment Plant NPDES discharge to the Touchet River.

NPDES Facility	Chronic dilution factor	Water quality standard for temperature (degrees C)	Allowable increase in temperature at the mixing zone boundary (degrees C)	Tnpdes = Maximum allowable effluent temperature WLA (degrees C)
Dayton WWTP	13.6	18	0.3	21.8

Condition	7Q10 flow for receiving water July-August (Touchet R.)	25% of flow available for dilution	Effluent flow from WWTP	Chronic dilution factor Current Permit 13.6	Water quality standard for temperature (degrees C)	Allowable increase in temperature at the mixing zone boundary	Tnpdes = Maximum allowable effluent temperature WLA (degrees C)
Current condition. Average discharge June-September 2002	29.6 cfs (=19.13mgd, =0.838cms)	7.4cfs =4.78 mgd, =0.21 cms	0.51cfs =.328mgd, =0.014cms	15.58	18	0.3	22.37
					17.5		21.87
					16		20.37
WWTP Design flow condition			1.16 cfs =0.75mgd, =0.033cms	7.38	18	0.3	19.91
					17.5		19.41
					16		17.91
85% Design flow condition			0.99cfs =0.64 mgd, =.028cms	8.47	18	0.3	20.24
					17.5		19.74
					16		18.24

Hangman Creek Temperature TMDL

- SNTEMP modeling demonstrated that current water temperature conditions in most of Hangman Creek from June – August far exceed the 18ºC criterion.
- Water Quality Standard = 18ºC or Natural Conditions; System Potential Shade is consider natural condition therefore shade will be used to establish the load allocations along the stream.
- Maximum shading will not result in meeting the 18ºC criterion, but will improve more habitat for salmonids.
- Hangman Creek reaches require a 10% to 60% (30% average) increase in shade to meet the system potential shade.
- Shorter riparian vegetation may provide effective shade if the angular density from a 2nd tier of vegetation is also considered.
- Tekoa WWTP will require a temperature wasteload allocation based on mixing zone dilution requirements.