MEMORANDUM

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May 21, 2021

Mr. Michael Lozeau, Lozeau/Drury LLP
1939 Harrison Street, Suite 150
Oakland, CA 94612

Subject: Estimated Roadway and Skid Trail Sediment Yields,
Little THP: 1-18-095 MEN, Mendocino County, California

Dear Mr. Lozeau:

I have been retained to estimate the sediment yield from surface erosion of roadways and skid trails within and appurtenant to the Little THP and lying within the Little North Fork Gualala River watershed. This letter presents the approach, methods and results of the road and skid trail surface erosion analysis.

It is important to note that other sources of erosion and sediment yield from road related gullying, road related landslides and road-stream crossing failures were not estimated in this analysis due to the lack of available information. Including these processes and sediment yields would significantly increase the sediment yield values presented herein.

1.0 Approach and Methods

Estimating road surface erosion volumes followed the "Measuring and Estimating Future Erosion Volumes" (page X-34) approach and methods presented in Part X (Upslope Erosion Inventory and Sediment Control Guidance) of the California Salmonid Stream Habitat Restoration Manual (March 2006). Specific variables and assumptions used in this analysis include the following.

- Road and skid trail types and lengths were determined and measured from the Little THP Road Points Maps (see Figure 1a and 1b), Little THP WLPZ Facilities Maps (see Figure 2a and 2b), and Little THP Appurtenant Roads Map (Figure 3).

- This analysis included only roads draining to the Little North Fork Gualala River. The cumulative drainage area within the THP boundaries that contributes runoff to the Little North Fork Gualala River is 0.405 square miles.

- The road and cut bank width are assumed to be 25 feet, a common assumption presented in California North Coast THP Erosion Control Plans such as the Elk THP (1-19-098-MEN) and Little THP (1-18-095-MEN). The width of the skid trails is assumed to be 12-feet.

- Road surface lowering (erosion rates in feet/year[ft/yr]) from the Habitat Restoration Manual were applied as follows:

    - Native surfaced (unimproved, dirt) roads and adjacent cutbanks and continually bare soil areas - 0.03 ft/yr; and
    - Rock surfaced roads and adjacent cutbanks and continually bare soil areas - 0.02 ft/yr.

- Skid trails were treated as unimproved, dirt roads.

- To convert sediment volume to weight, a wet bulk density of 1.55 grams per cubic centimeter (g/cc) (96.76 pounds per cubic foot [lbs/ft^3]) was applied. This bulk density is representative of Bigriver loamy sand soil, which underlies the majority of THP and appurtenant roadways. The site soil map and bulk density value was obtained from the U.S. Department of Agriculture, Natural Resources Conservation Service (NRCS) Web Soil Survey site[1].

2.0 Results

Table 1 presents the total length, area and eroded sediment yield of THP roads and skid trails. A road surface erosion rate of 0.02 ft/yr was applied to permanent road types, while an erosion rate of 0.03 ft/yr was applied to all other road types (seasonal) and skid trails. The total sediment yield to Little North Fork River from road and skid trail surface erosion is 938.7 cubic yards per year (yd^3/yr).

Table 2 presents the conversion of sediment yield from yd^3/yr (Row 1) to tons/yr (Row 5). Dividing the sediment yield of 1,226 tons/yr by the THP drainage area to the Little North Fork Gualala River (0.405 square miles) yields a maximum annual sediment yield of 3,026 tons/mi^2/yr. This value assumes 100% of road surface erosion is delivered to the river.

In addition to roads within the THP boundary, the appurtenant haul routes and skid trails experience surface erosion that yields sediment to the river. Table 3 presents the total length, area and sediment yield from the appurtenant roadways and skid trails. These appurtenant roads and appurtenant skid trails will contribute an additional 517.9 yd^3/yr (677 tons/yr) of sediment to the river assuming 100% of appurtenant roadway erosion is delivered to the river (see Tables 3 and 4).

3.0 Discussion of Results

Because the Little THP is proposed on private lands and roads, I was not able to conduct a site inspection of the THP area to estimate the degree to which roads and skid trails are or would be hydrologically connected or disconnected from the river. It is unrealistic to assume 100% of roads and skid trails will be hydrologically connected to the river. There are some THPs that present estimates where "typically 50 percent" of roads had been hydrologically

[1] https://websoilsurvey.sc.egov.usda.gov/App/WebSoilSurvey.aspx

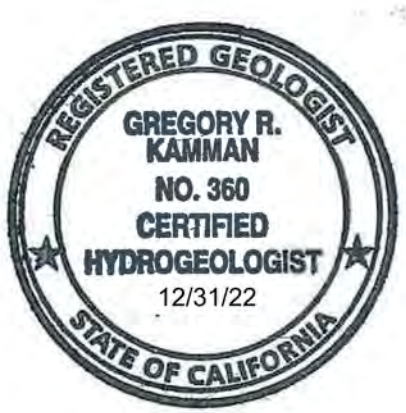
disconnected (THP No. 1-19-00098 MEN (Elk), sec. 5, p. 261 and THP No. 1-18-095 MEN (Little), sec. 5, p. 100.2 & 240).

Assuming that 50 percent of the roads and skid trails within the THP boundary are hydrologically disconnected from the creek results in 1,513 tons/mi^2/yr of road and skid trail sediment (Table 2) delivery to the Little North Fork Gualala River. Tables 2 also presents annual sediment delivery rates for roads and skid trails that are 20%, 5% and 1% hydrologically connected to the river as examples where a greater percentage of roads and skid trails are hydrologically disconnected from the river. In addition to the THP road and skid trail sediment sources, contributions from THP appurtenant roads further contribute sediment to the river to varying degrees depending on the percentage of hydrologic connection or these roads (see Table 4).

Please feel free to contact me with any questions regarding the material and conclusions contained in this letter.

Sincerely,

Gregory Kamman, PG, CHG
Principal Hydrologist



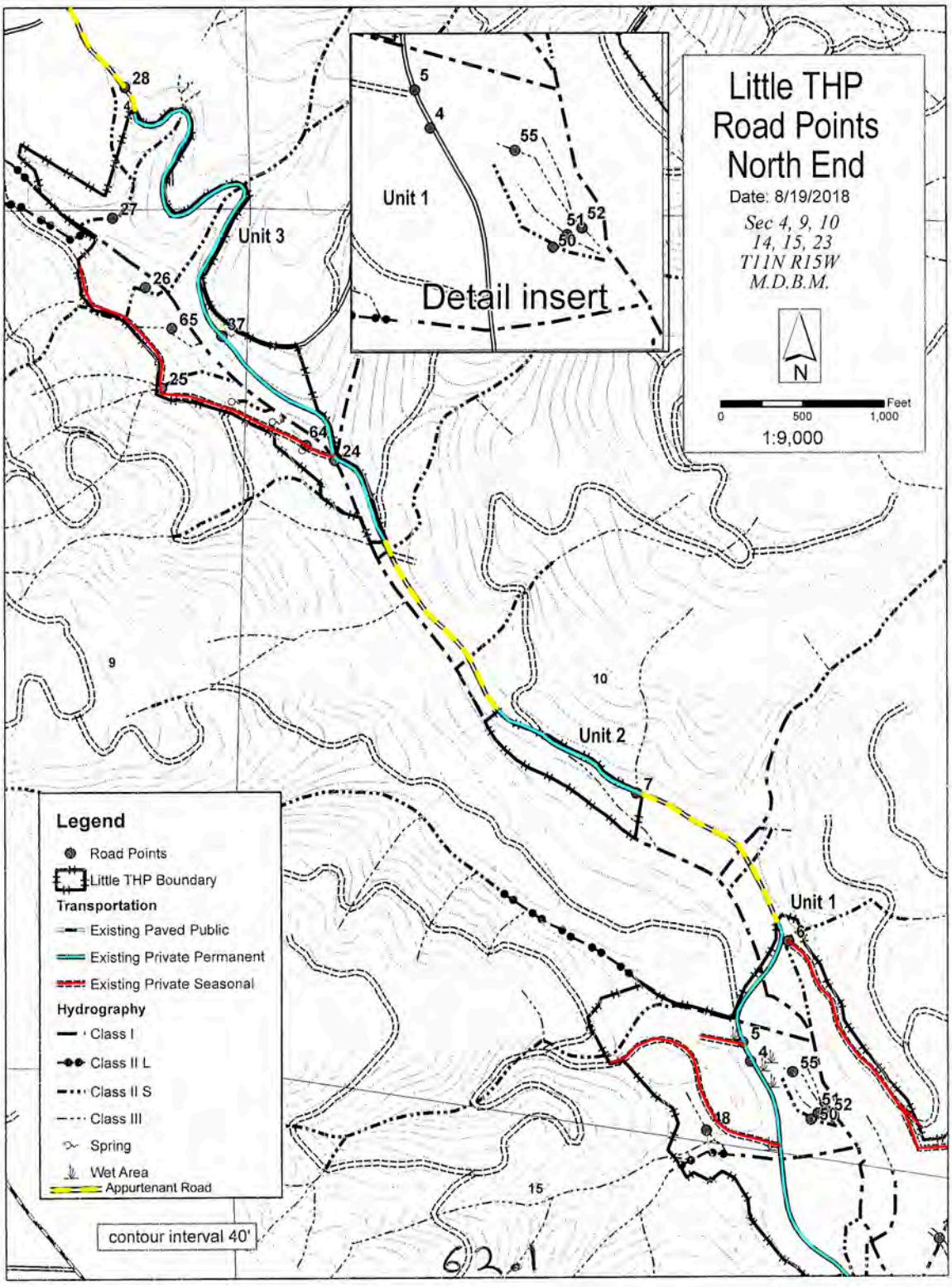


FIGURE 1a: THP road types and locations (North End)

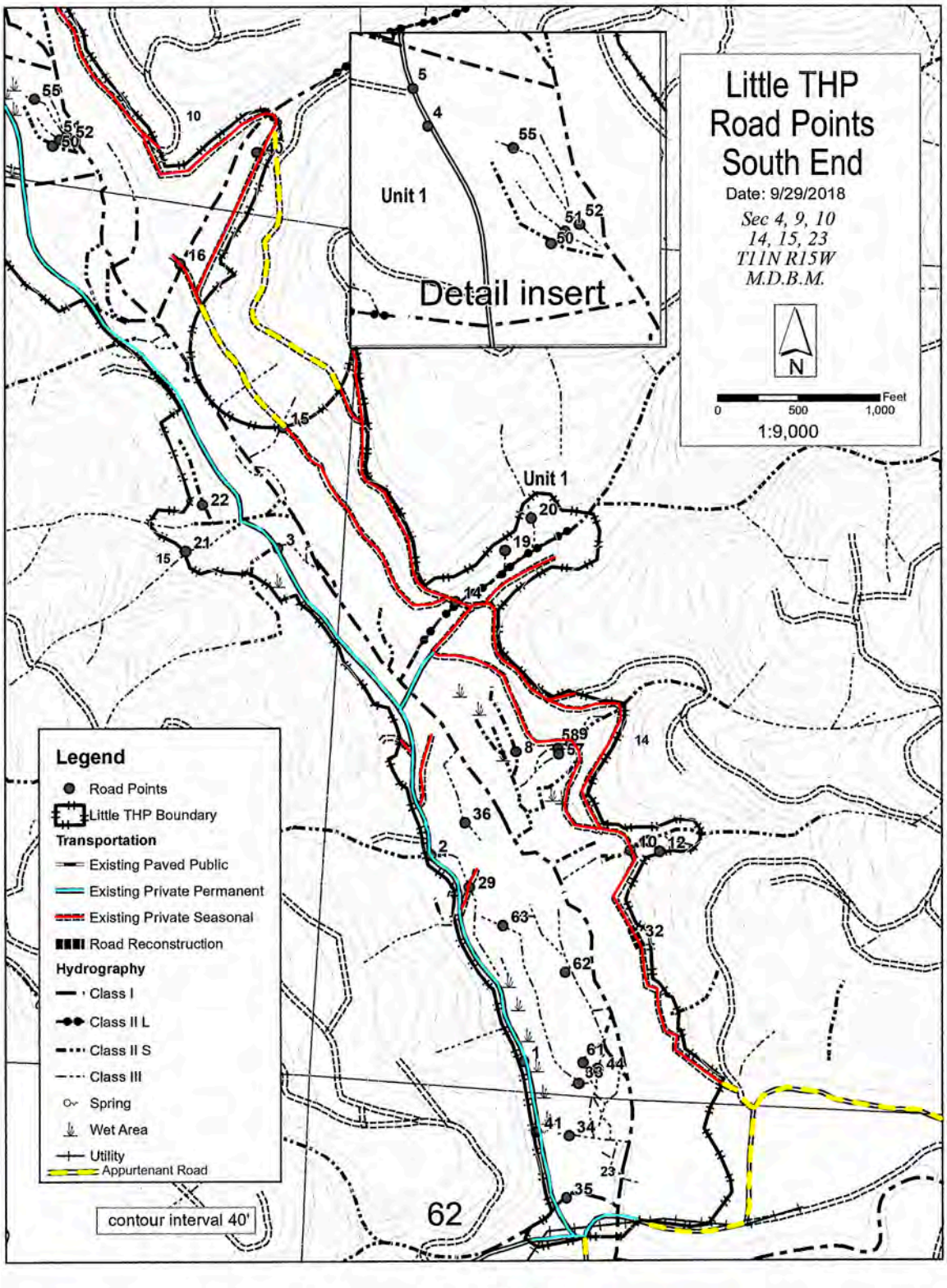


FIGURE 1b: THP road types and locations (South End)

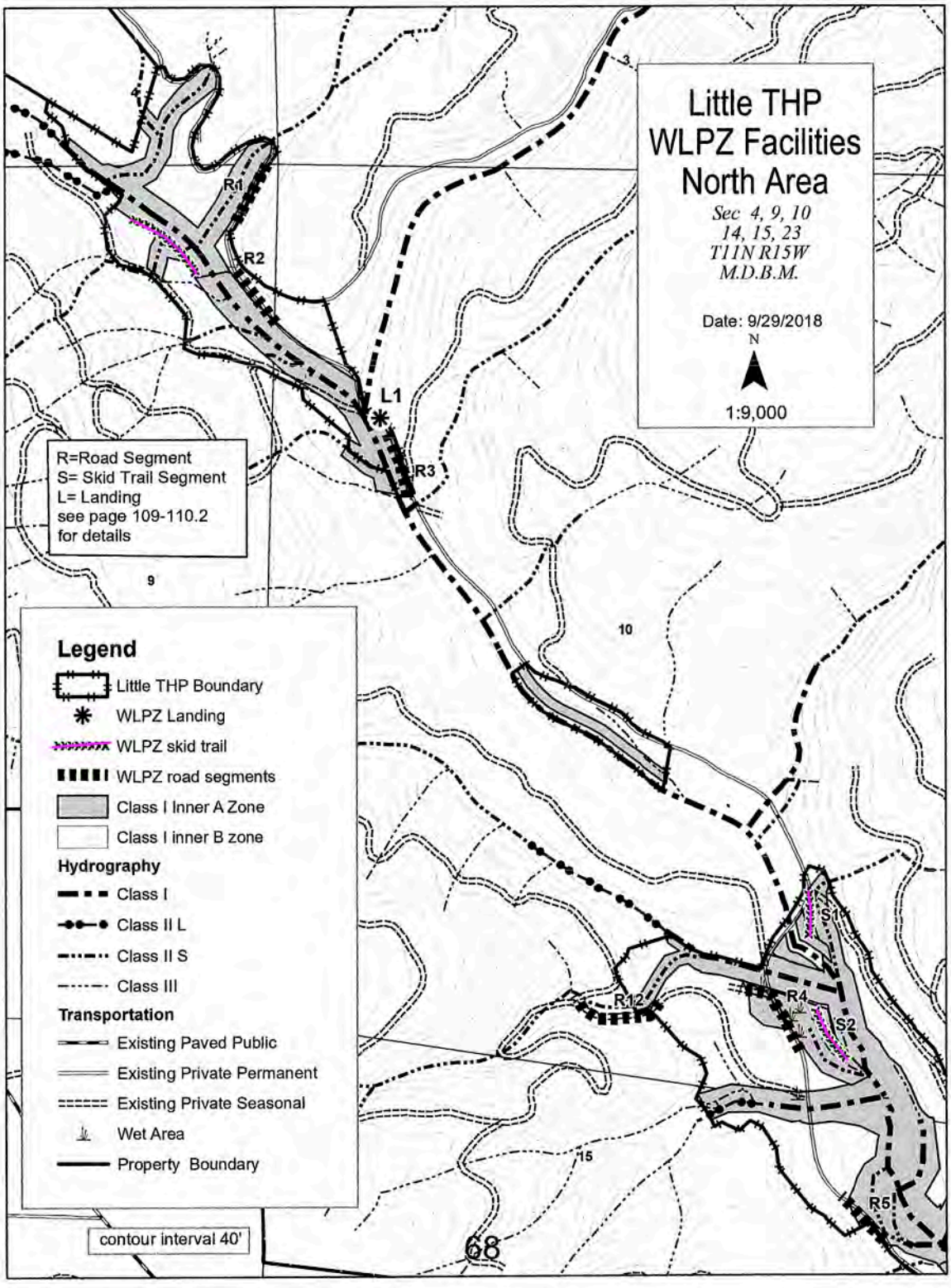


FIGURE 2a: Skid trail types and locations (North Area)

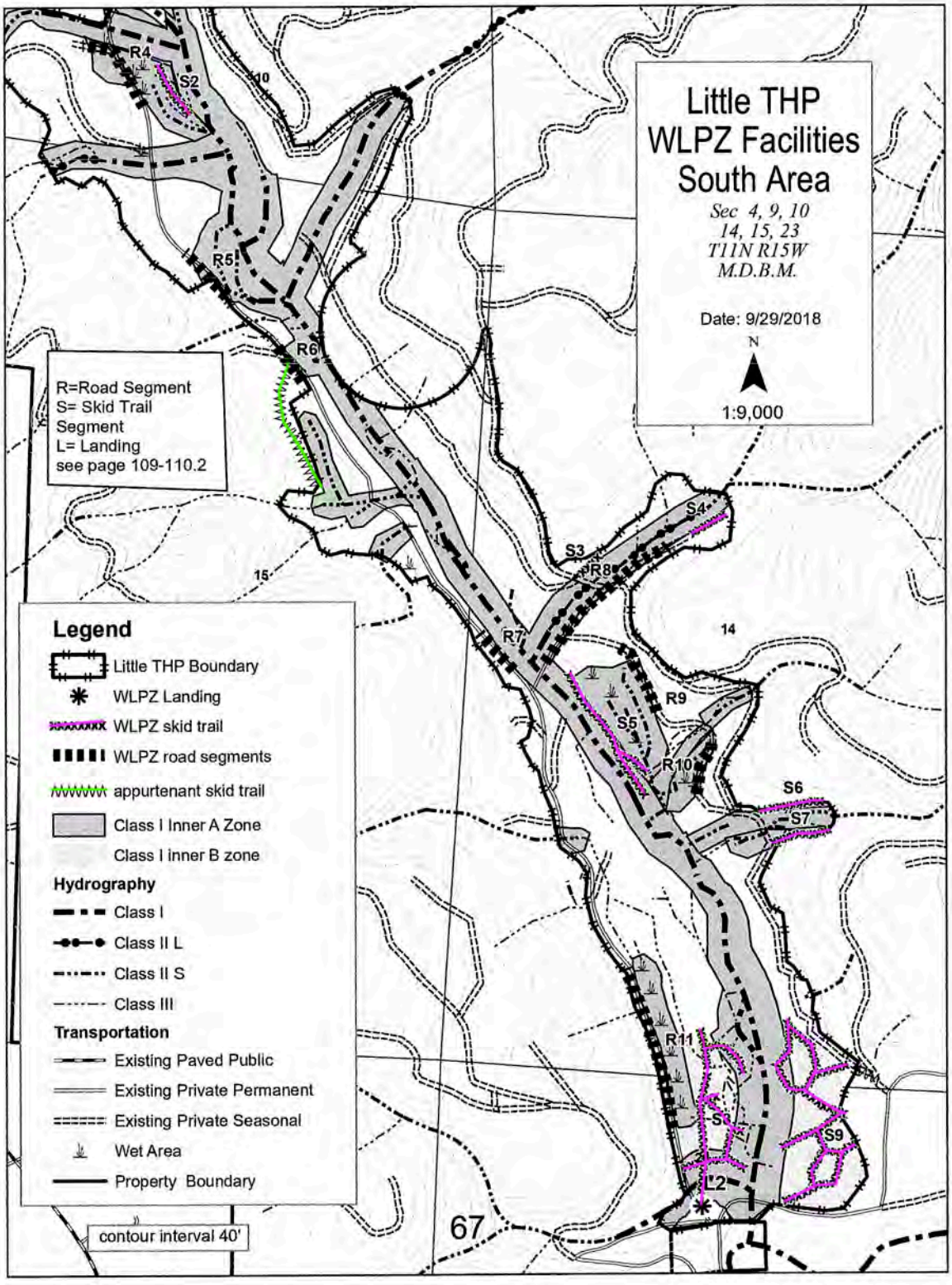


FIGURE 2b: Skid trail types and locations (South Area)

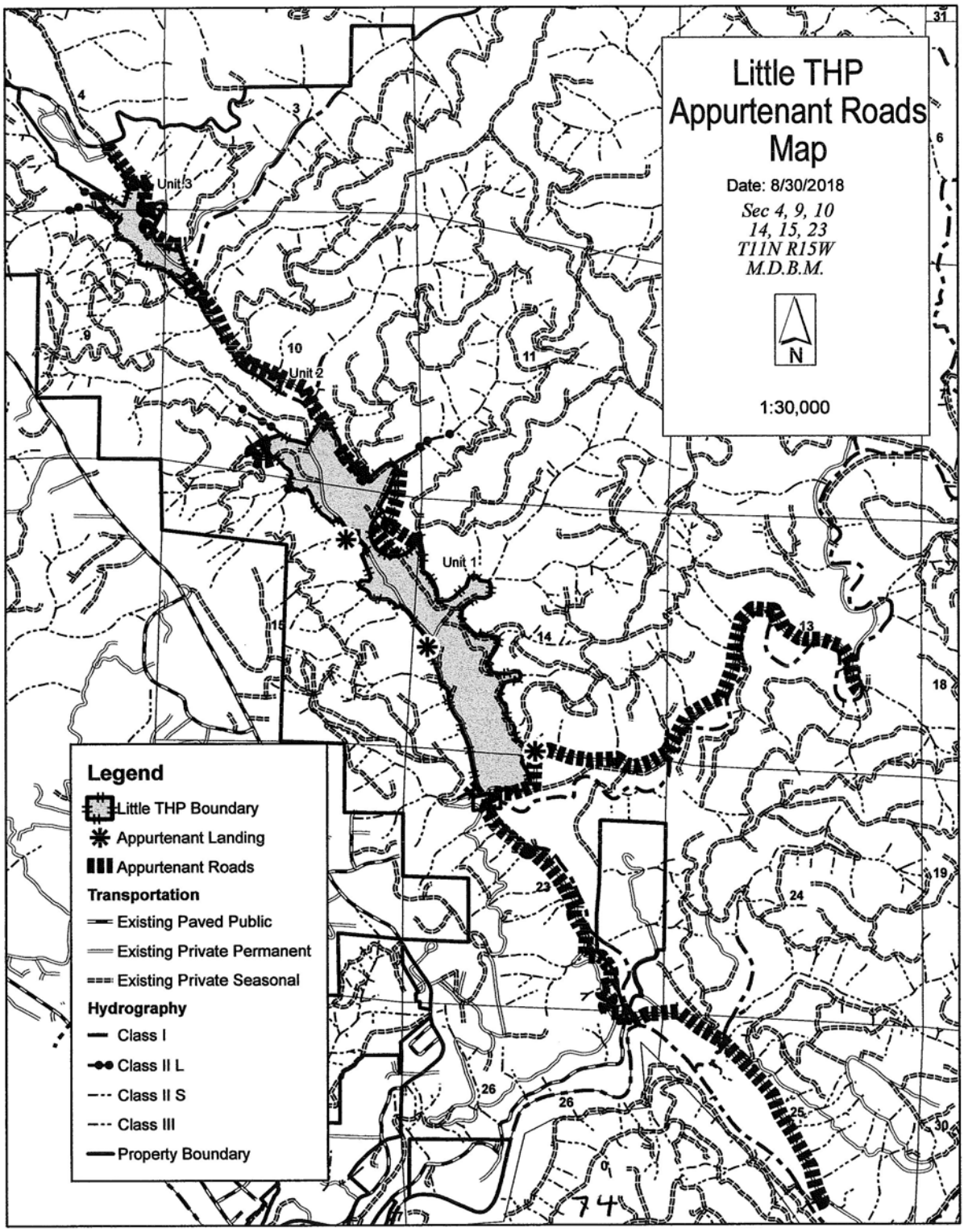


FIGURE 3: Appurtenant Road Map.

TABLE 1: Lengths, surface areas and sediment yield estimates for roads and skid trails within Little THP boundary

	Little THP Road Types			
	Existing Private Permanent	Existing Private Seasonal	Skid Trail	
total road lengths (ft)	15,116	19,457	8,876	
road width (ft)	25	25	12	
road area (ft^2)	377,900	486,425	106,512	
erosion rate (ft/yr)[1]	0.02	0.03	0.03	
sediment yield (ft^3/yr)	7,558	14,593	3,195	
sediment yield (yd^3/yr)	279.9	540.5	118.3	**938.7** yd^3/yr

Notes

1) Erosion rates: a) native surface (unimproved, dirt) roads = 0.03 ft/yr; rock surfaced roads=0.02 ft/yr) (Source: Upslope Erosion Inventory and Sediment Control Guidance, Part X, California

TABLE 2: Calculation of total sediment yield for disconnected roads and skid trails within the Little THP boundary

Row	Calculations	Notes
1	938.74 yd^3/yr	sed yield: assumes 100% delivery
2	96.76 lbs/ft^3	wet density from NRCS soil survey
3	2,612.61 lbs/yd^3	
4	1.31 tons/yd^3	
5	1,226.29 tons/yr	sed yield: assumes 100% of erosion delivered to creek
6	0.405 mi^2	total drainage area
7	**3,026 tons/mi^2/yr**	**sed yield: assumes 100% of erosion delivered to creek**
8	**1,513 tons/mi^2/yr**	**sed yield: assumes 50% of erosion delivered to creek**
9	**605 tons/mi^2/yr**	**sed yield: assumes 20% delivery**
10	**151 tons/mi^2/yr**	**sed yield: assumes 5% delivery**
11	**30 tons/mi^2/yr**	**sed yield: assumes 1% delivery**

TABLE 3: Lengths, surface areas and sediment yield estimates for appurtenant roads and skid trails to the Little THP boundary

	Little THP Appurtenant Roads and Skid Trails		
	Permanent	Appurtenant Skid Trail	
total road lengths (ft)	27,355	848	
road width (ft)	25	12	
road area (ft^2)	683,875	10,176	
erosion rate (ft/yr)[1]	0.02	0.03	
sediment yield (ft^3/yr)	13,678	305	
sediment yield (yd^3/yr)	507	11	**517.9** yd^3/yr

TABLE 4: Calculation of total sediment yield from appurtenant roads and skid trails to the Little THP boundary

Calculations	Notes
517.9 yd^3/yr	sed yield: assumes 100% delivery
96.76 lbs/ft^3	wet density from NRCS soil survey
2,612.61 lbs/yd^3	
1.31 tons/yd^3	
677 tons/yr	**sed yield: assumes 100% of erosion delivered to creek**
338 tons/yr	**sed yield: assumes 50% of erosion delivered to creek**
135 tons/yr	**sed yield: assumes 20% of erosion delivered to river**
34 tons/yr	**sed yield: assumes 5% of erosion delivered to river**
7 tons/yr	**sed yield: assumes 1% of erosion delivered to river**