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Surge Tower Shadow Data Sources and Assumptions

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17F.1 Data Sources

Reports

- CER - PTO Addendum COMPLETE Oct2010.pdf
- Draft_CER_All_Tunnel_Option_Volume_2,_Rev_A.pdf

GIS

- Eng_Rev10b (KMZ files showing facilities for PTO Alternatives 1 through 8)

Shadow Modeling

- <http://www.suncalc.org/>

17F.2 Assumptions

Shadow Modeling

- Shadow modeling assumes worst-case scenarios using the winter (December 21), spring (March 20), summer (June 21), and fall (September 23) solstices for 2015. Refer to Table 17F-1, below.
- Time of sunset is used to evaluate shadow impacts, as opposed to time of dusk, because sunset is the time that the sun (i.e. the light source) sinks below the horizon line and ceases to provide direct lighting upon natural and built features that will cast shadows. Due to the lack of direct overhead lighting, lighting levels are very low at dusk, in general, and naturally creates large, spread shadows across the landscape, so that individual cast shadows are often indistinguishable.
- The shadow modeling does not allow for a width to be assigned to the cast shadow that is modeled. Therefore, the width of shadows shown on Figures 17F-1 through 17F-3 do not reflect the width of the actual towers, and the tower widths would be narrower than the shadow reflected on those figures.
- Vegetation along the Southern Pacific Rail Line was modeled at a height of 30' (9.144 m) to account for small trees. While many taller trees that are present, 30' represents a very conservative estimate for analysis purposes. Figures 17F-1c, 17F-2d, and 17F-3a-3d show the cast shadows of vegetation along the Southern Pacific Rail Line.

1 **Intakes 1 (Alternatives 1A, 2A, 3, 5, and 6A)**

- 2 • Intake 1 Surge Tower Dimensions: Two 16' diameter surge towers with top rim at 70' (21.34
3 m) NAVD88
- 4 • Intake 1 Surge Tower Locations: Surge tower is located at approximately N 38°25'51.69", W
5 121°30'59.25" and the closest tower is approximately 4,520' away from the closest Stone
6 Lakes National Wildlife Refuge boundary

7 **Intake 2 (Alternatives 1A, 2A, 3, 5, 6A, 7, and 8)**

- 8 • Intake 2 Surge Tower Dimensions: Two 16' diameter surge towers with top rim at 65' (19.81
9 m) NAVD88
- 10 • Intake 2 Surge Tower Locations: Surge tower is located at approximately N 38°24'22.48", W
11 121°30'39.07" and the closest tower is approximately 1,300' away from the closest Stone
12 Lakes National Wildlife Refuge boundary

13 **Intermediate Forebay (Alternatives 1A, 2A, 3, 5, 6A, 7, and 8)**

- 14 • Surge Tower Location: Intermediate Forebay surge towers are located at approximately N
15 38°19'33.23", W 121°30'39.96' and the closest tower is approximately 2,300' away from the
16 closest Stone Lakes National Wildlife Refuge boundary
- 17 • Surge Tower Dimensions: Two 33' diameter surge towers with top rim at 105' (32.0 m)
18 NAVD88

1 17F.3 Shadow Duration Summary Table

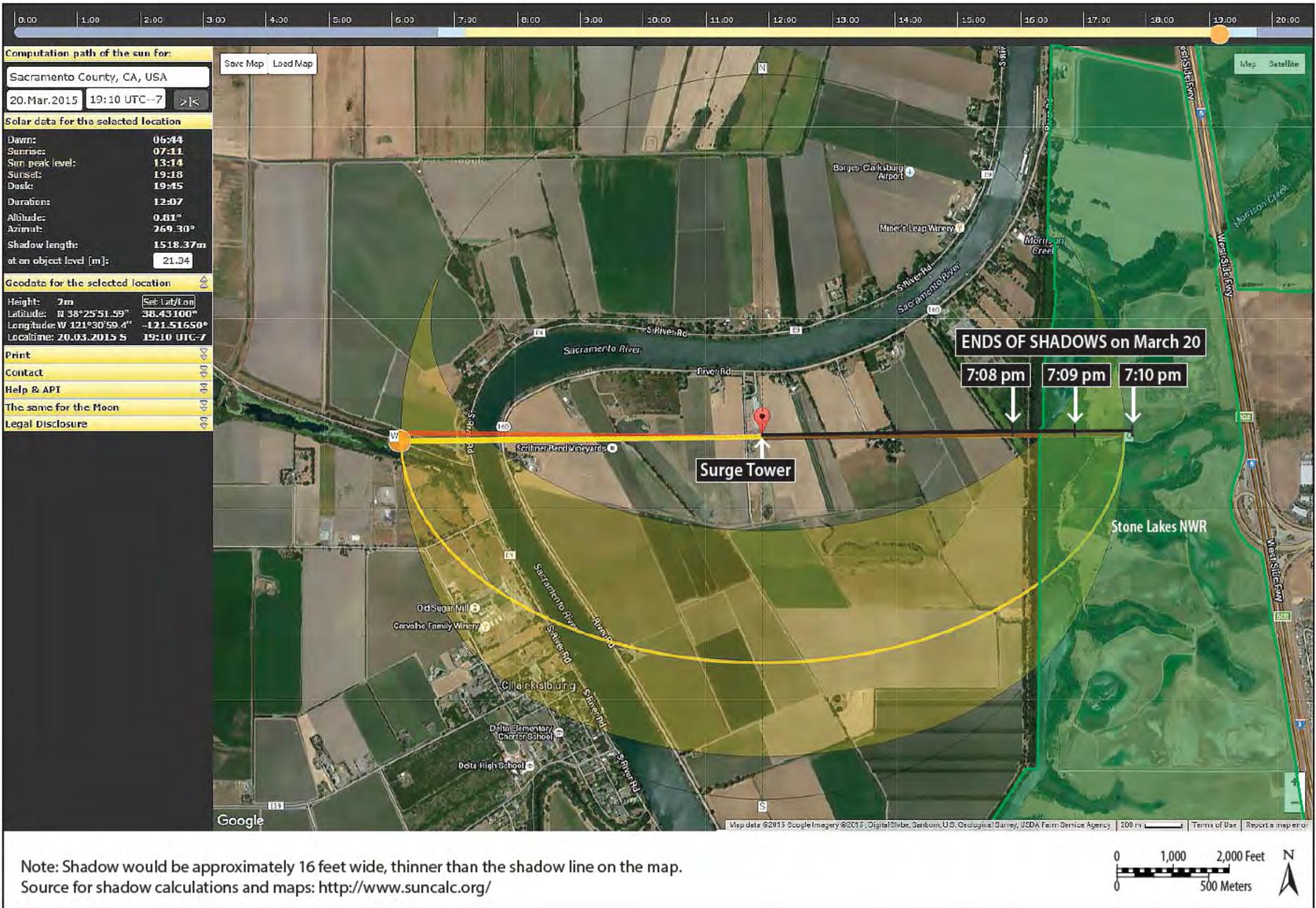
2 **Table 17F-1. Duration of Shadows Affecting Stone Lakes National Wildlife Refuge**

Feature	Solstice (Date)	Figure Number	Sunset Time	Time Shadow Hits Stone Lakes NWR Boundary	Duration Stone Lakes NWR Affected Prior to Sunset
Intake 1 (Alternatives 1A, 2A, 3, 5, and 6A)	Winter (December 21, 2015)	Figure 17F-1a	16:49 (4:49 pm)	16:39 (4:39 pm)	10 minutes
	Spring (March 20, 2015)	Figure 17F-1b	19:18 (7:18 pm)	19:09 (7:09 pm)	9 minutes
	Summer (June 21, 2015)	Figure 17F-1c	20:34 (8:34 pm)	20:23 (8:23 pm)	11 minutes
	Fall (September 23, 2015)	Figure 17F-1d	19:03 (7:03 pm)	18:53 (6:53 pm)	10 minutes
Intake 2 (Alternatives 1A, 2A, 3, 5, 6A, 7, and 8)	Winter (December 21, 2015)	Figure 17F-2a	16:49 (4:49 pm)	16:30 (4:30 pm)	19 minutes
	Spring (March 20, 2015)	Figure 17F-2b	19:18 (7:18 pm)	18:58 (6:58 pm)	20 minutes
	Summer (June 21, 2015)	Figure 17F-2c	20:34 (8:34 pm)	20:11 (8:11 pm)	23 minutes
	Fall (September 23, 2015)	Figure 17F-2d	19:03 (7:03 pm)	18:43 (6:43 pm)	20 minutes
Intermediate Forebay (Alternatives 1A, 2A, 3, 5, 6A, 7, and 8)	Winter (December 21, 2015)	Figure 17F-3a	16:49 (4:49 pm)	16:25 (4:25 pm)	24 minutes
	Spring (March 20, 2015)	Figure 17F-3b	19:18 (7:18 pm)	18:55 (6:55 pm)	23 minutes
	Summer (June 21, 2015)	Figure 17F-3c	20:34 (8:34 pm)	20:10 (8:10 pm)	24 minutes
	Fall (September 23, 2015)	Figure 17F-3d	19:03 (7:03 pm)	18:40 (6:40 pm)	37 minutes

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Figure 17F-1a
Intake 1 Surge Tower Shadow, Winter Solstice



Note: Shadow would be approximately 16 feet wide, thinner than the shadow line on the map.
 Source for shadow calculations and maps: <http://www.suncalc.org/>

Figure 17F-1b
Intake 1 Surge Tower Shadow, Spring Equinox



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Figure 17F-1c
Intake 1 Surge Tower Shadow, Summer Solstice

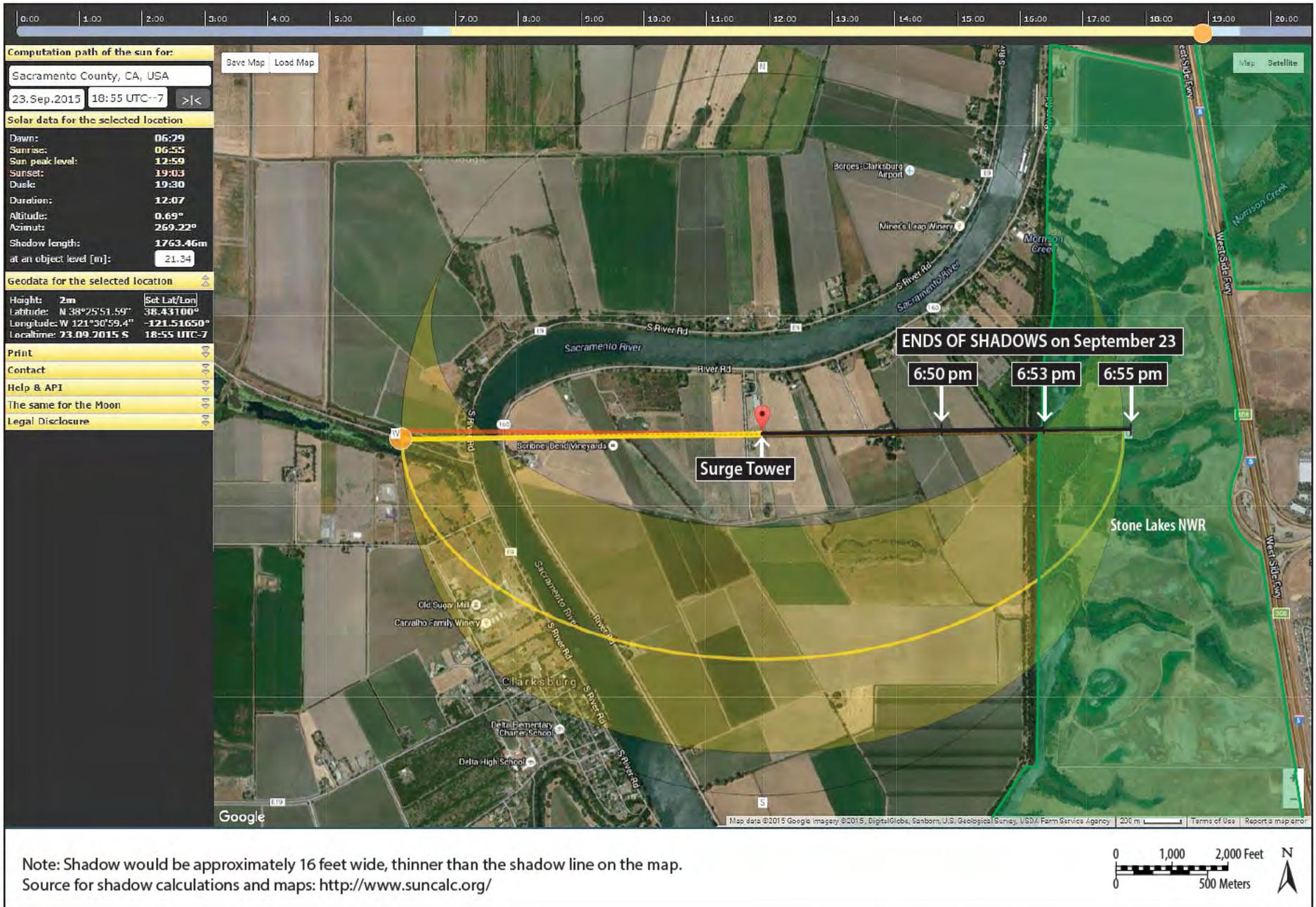


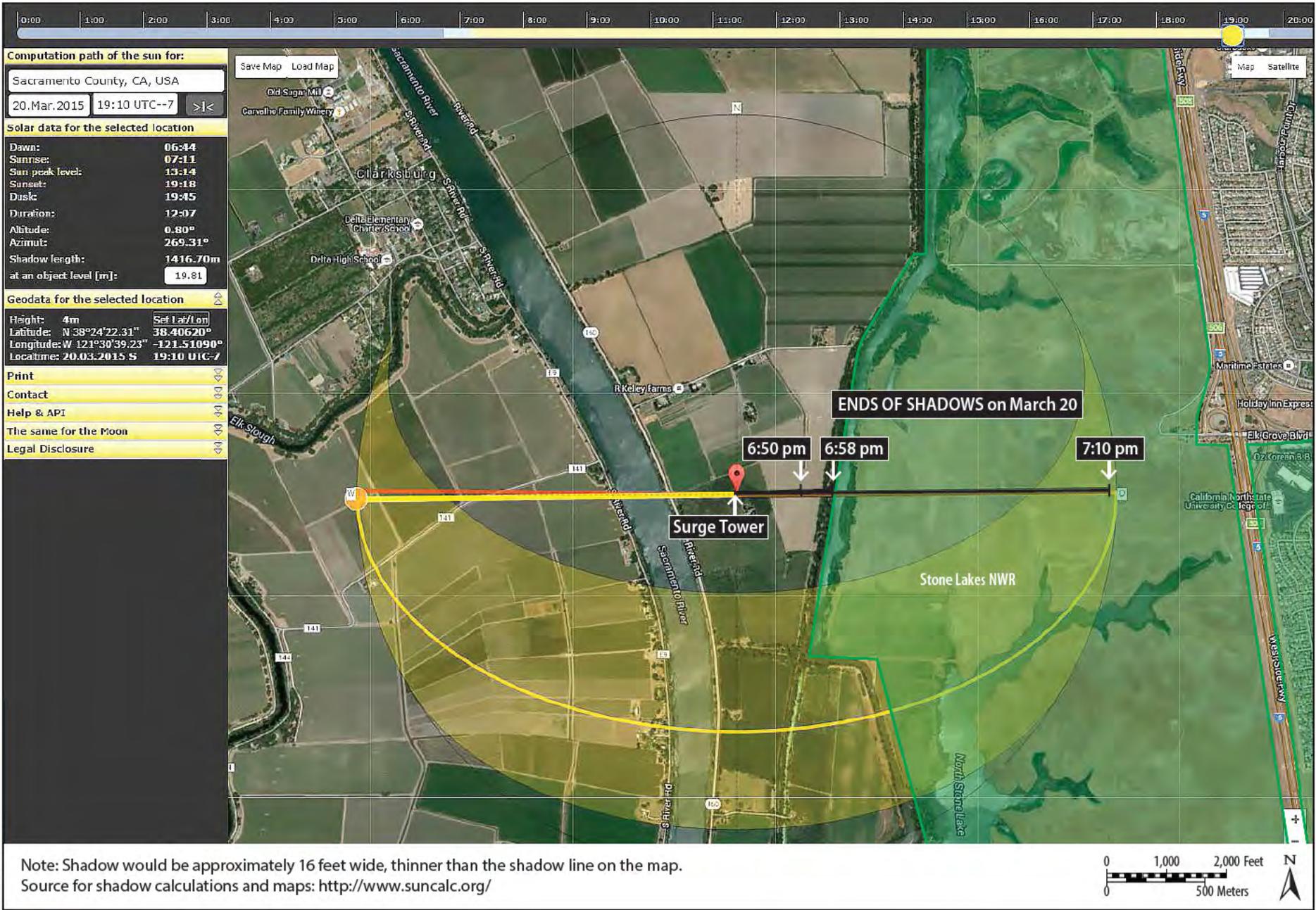
Figure 17F-1d
Intake 1 Surge Tower Shadow, Fall Equinox



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Figure 17F-2a
Intake 2 Surge Tower Shadow, Winter Solstice



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Figure 17F-2b
 Intake 2 Surge Tower Shadow, Spring Equinox

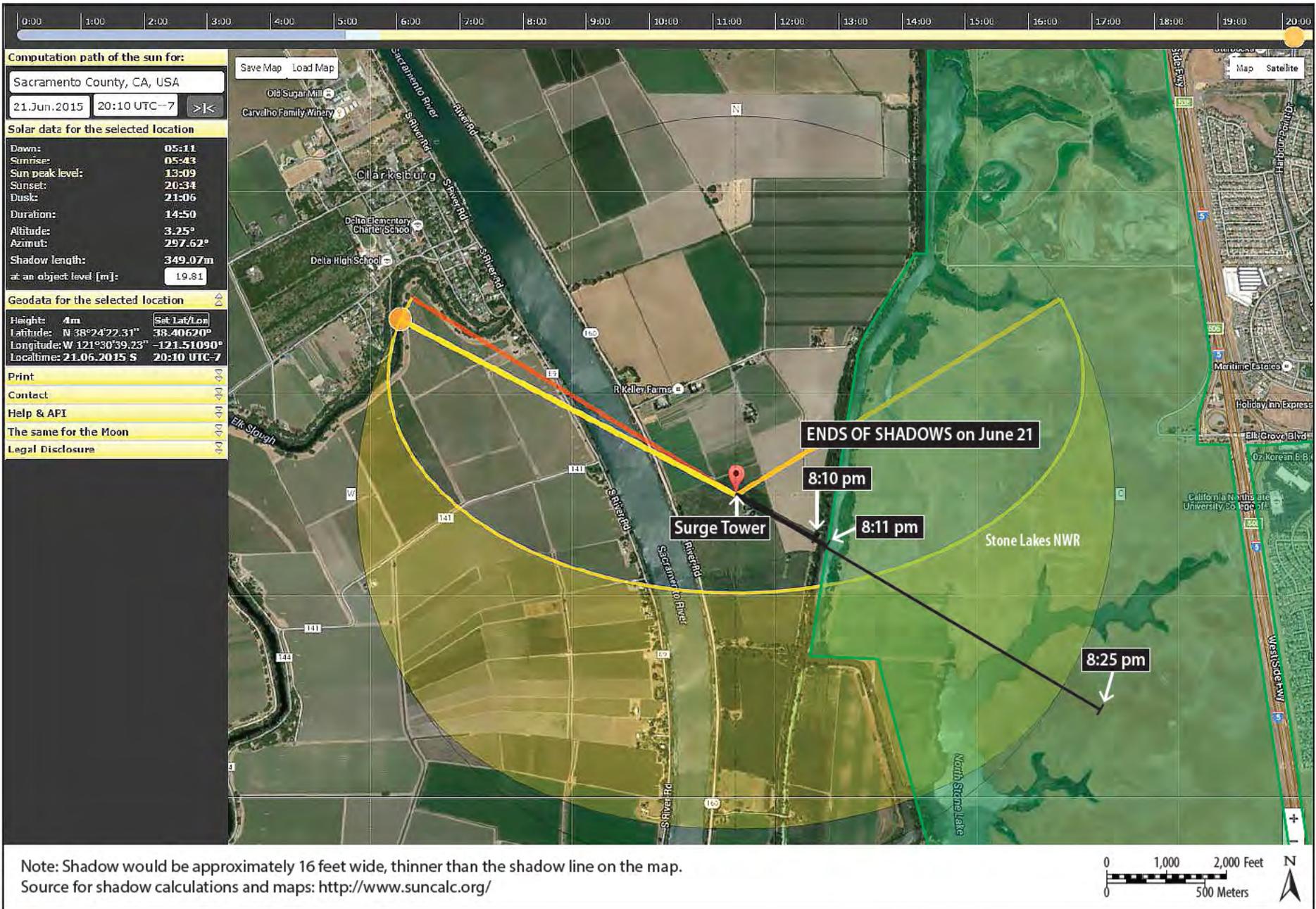
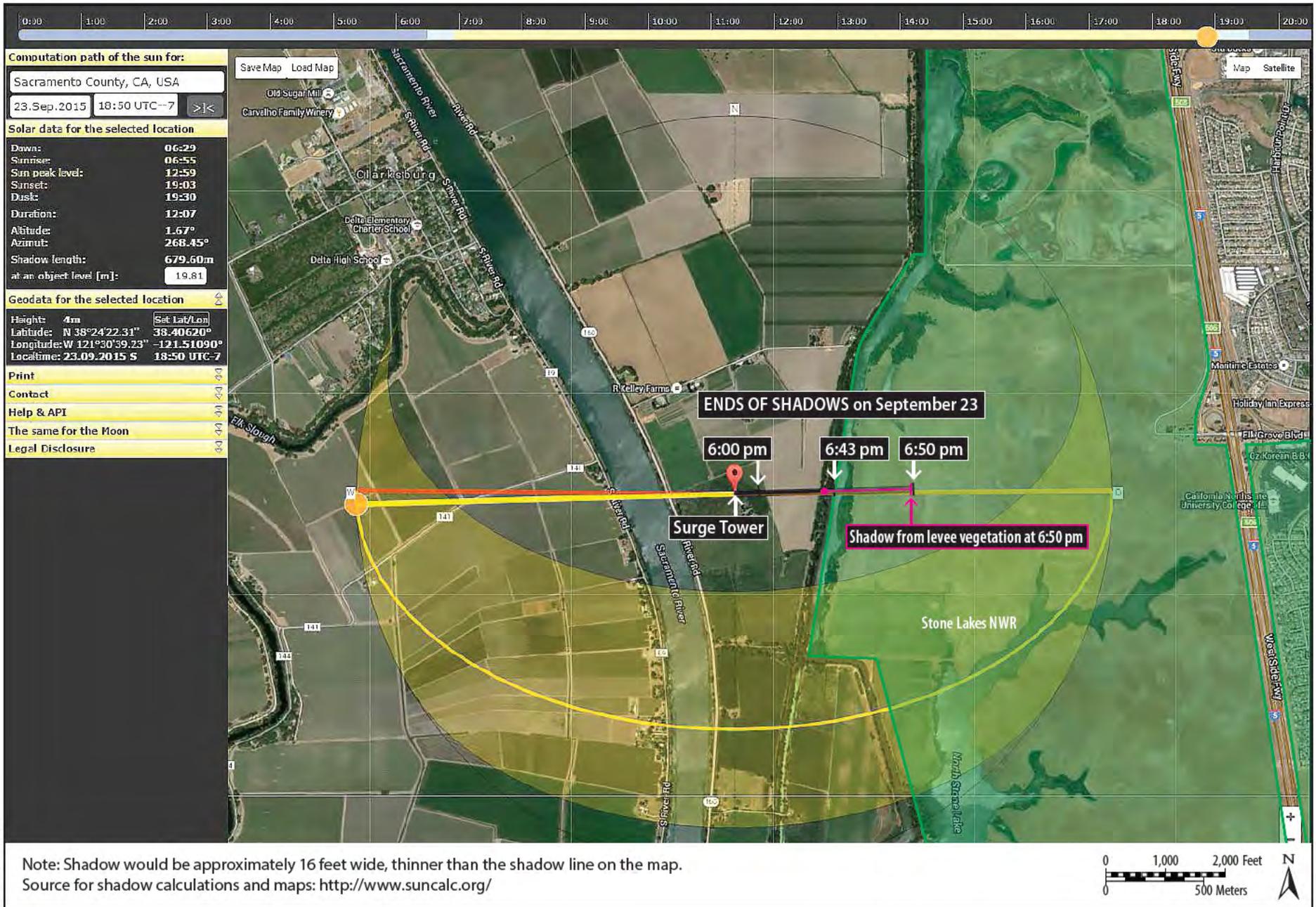


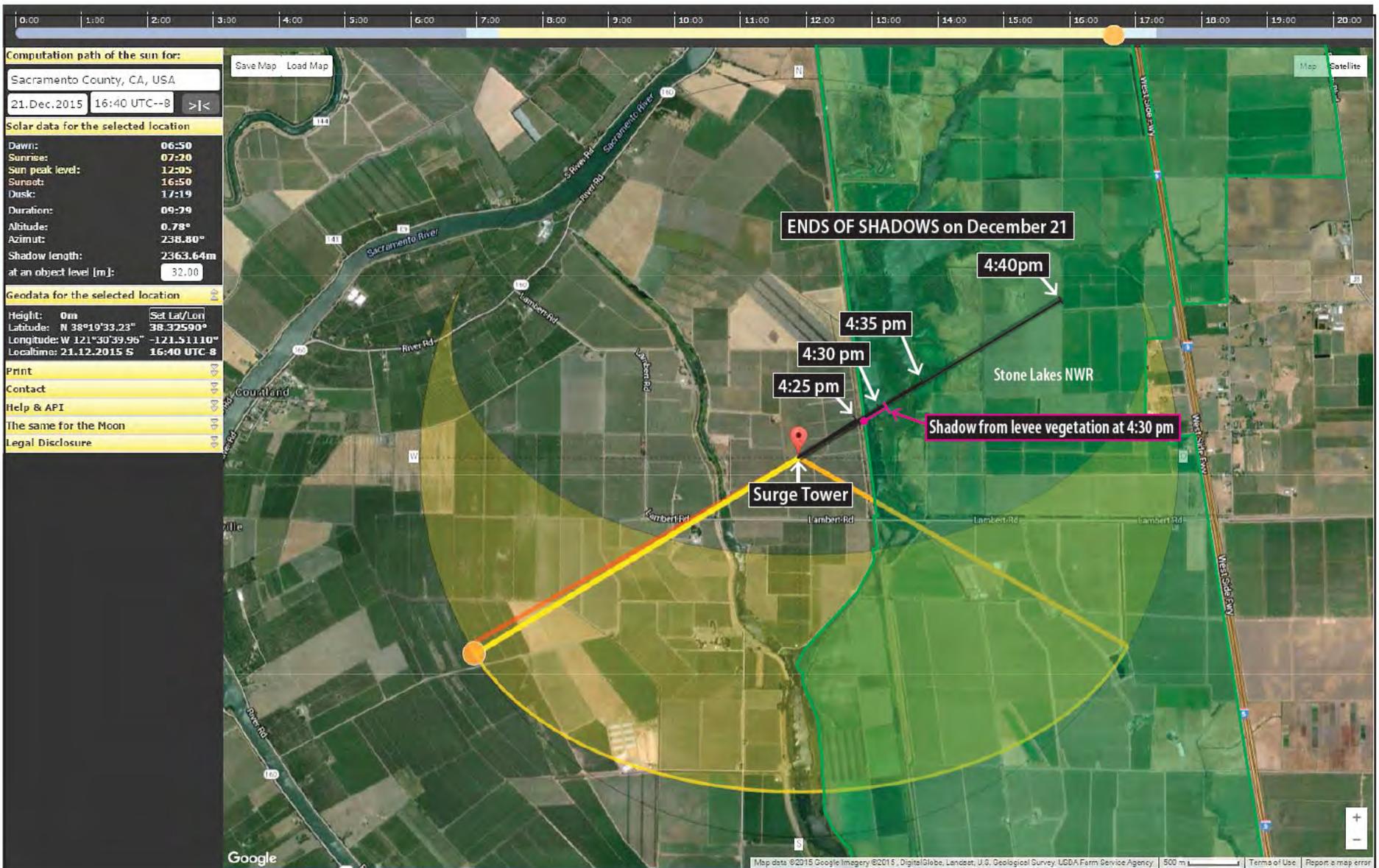
Figure 17F-2c
Intake 2 Surge Tower Shadow, Summer Solstice



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Figure 17F-2d
Intake 2 Surge Tower Shadow, Fall Equinox



Note: Shadow would be approximately 16 feet wide, thinner than the shadow line on the map.
 Source for shadow calculations and maps: <http://www.suncalc.org/>

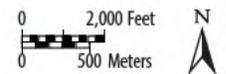
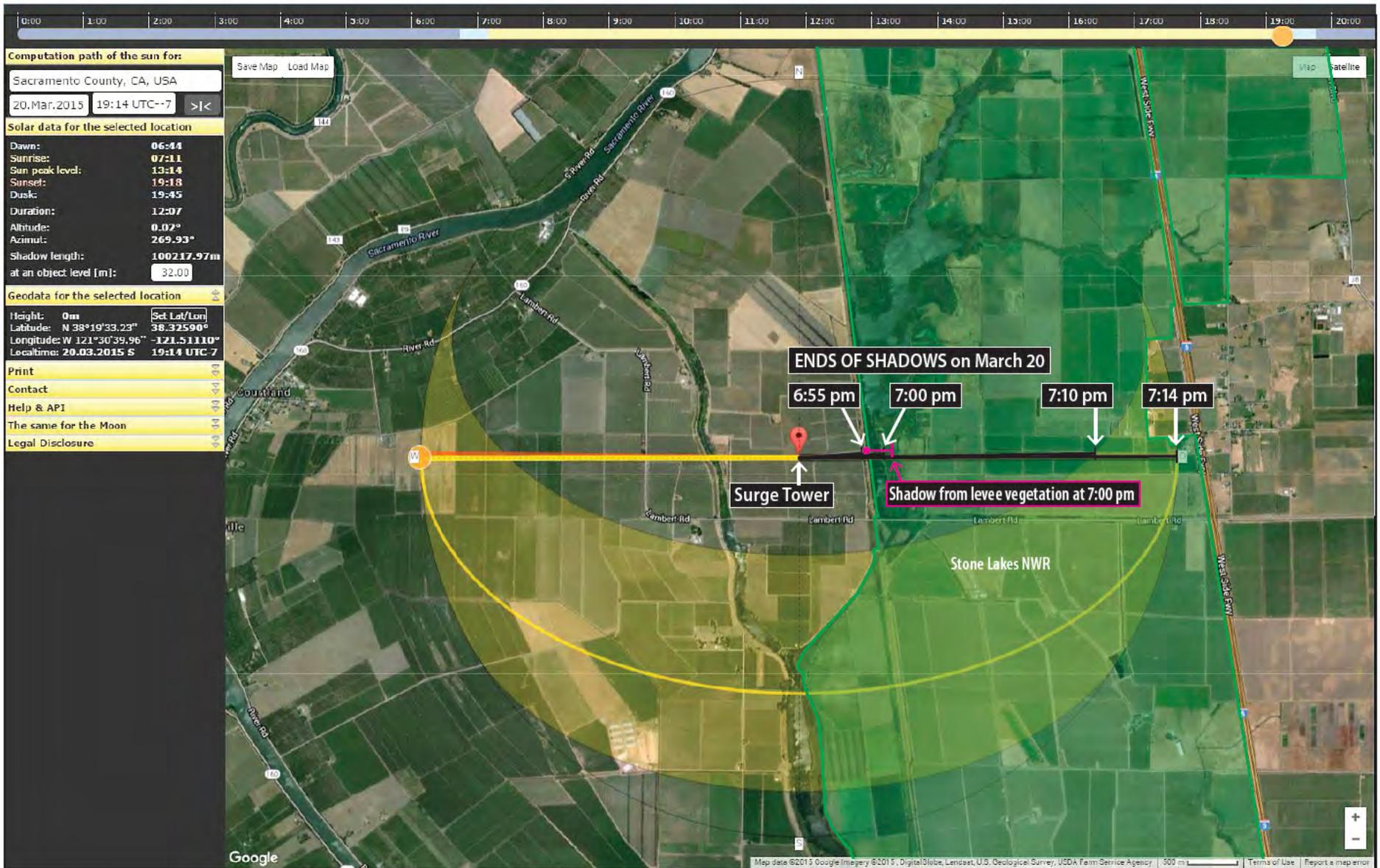


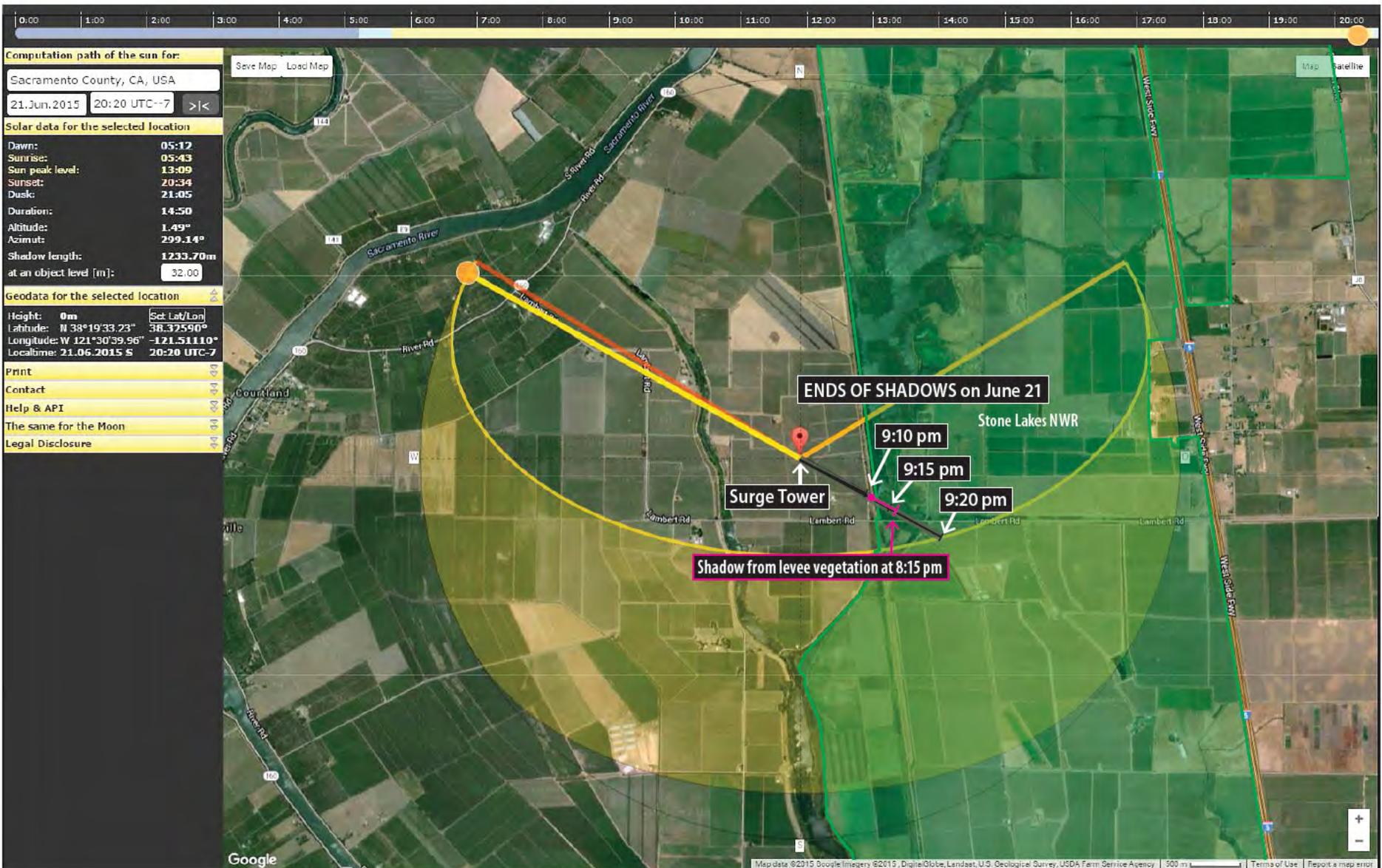
Figure 17F-3a
Intermediate Forebay Surge Tower Shadow, Winter Solstice



Note: Shadow would be approximately 16 feet wide, thinner than the shadow line on the map.
 Source for shadow calculations and maps: <http://www.suncalc.org/>



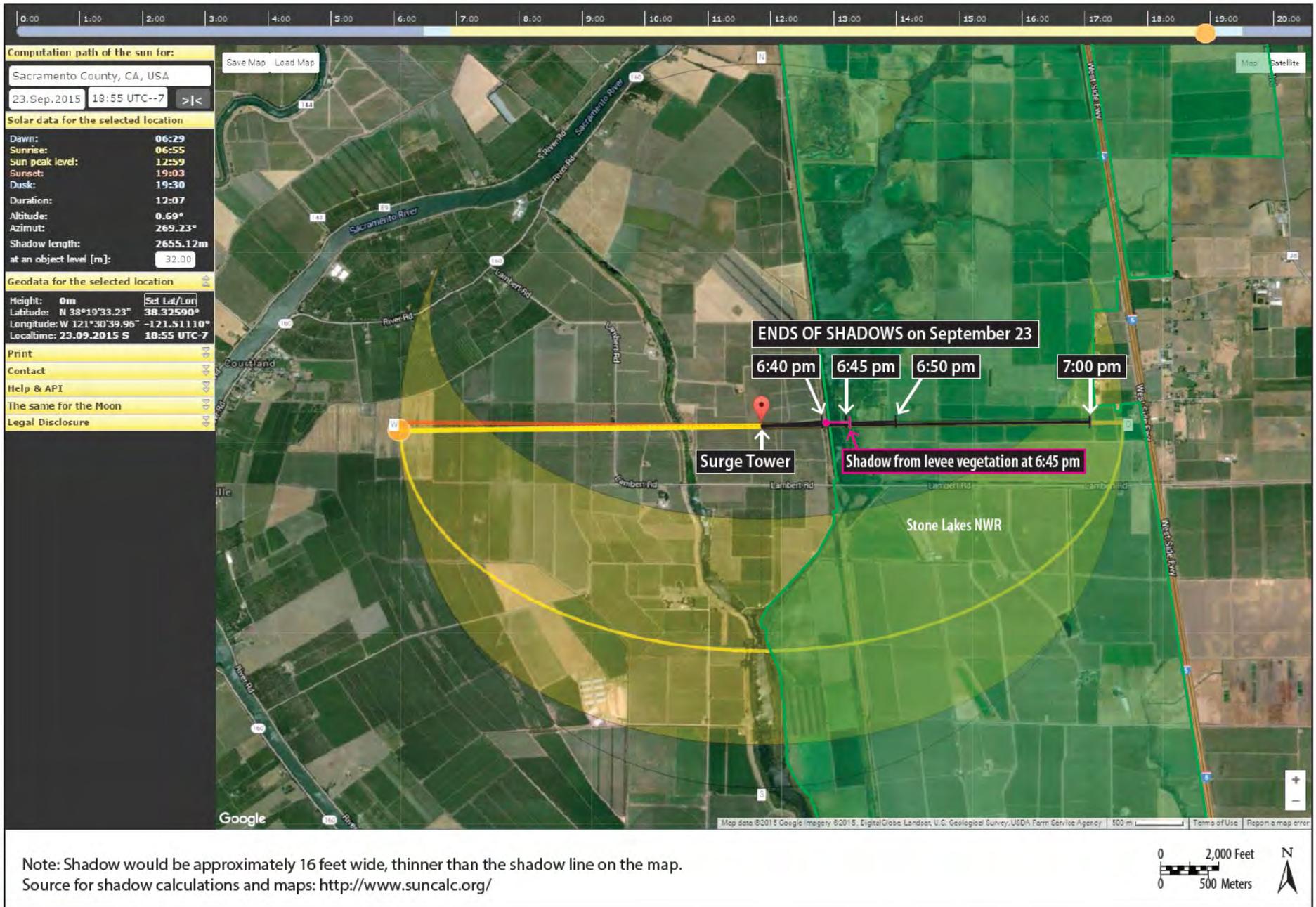
Figure 17F-3b
Intermediate Forebay Surge Tower Shadow, Spring Equinox



Note: Shadow would be approximately 16 feet wide, thinner than the shadow line on the map.
 Source for shadow calculations and maps: <http://www.suncalc.org/>



Figure 17F-3c
Intermediate Forebay Surge Tower Shadow, Summer Solstice



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Figure 17F-3d
Intermediate Forebay Surge Tower Shadow, Fall Equinox