Tree Strike Risk Calculation for

Upper Lake 1101
Keswick 1101
Middletown 1102
Middletown 1103
Konocti 1102
Mariposa 2102
Bucks Creek 1101

Calculate Tree Strike Residual Risk of Non-Hardened Circuits
Count Trees within 6 ft of Conductor Assuming Generic OH

November 25, 2020

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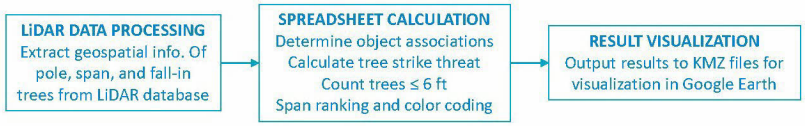
Applied Technology Services

Committed to delivering practical solutions to challenging problems

CALCULATION WORKFLOW

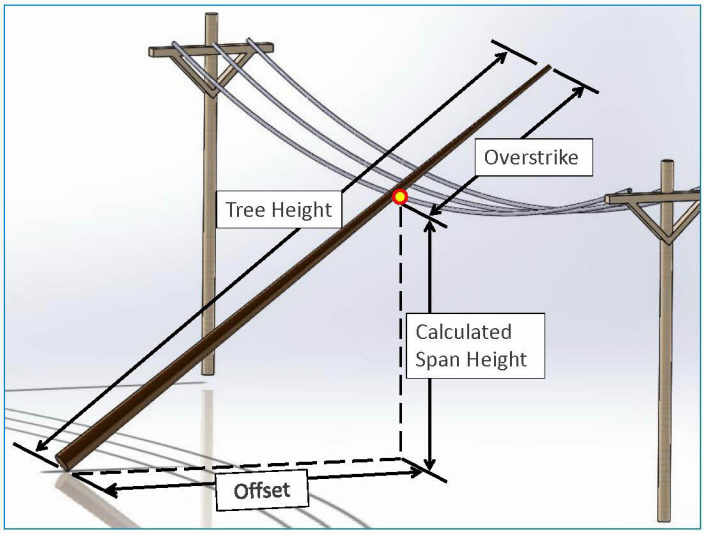
- LiDAR data processing
  - Extract pole, span, and fall-in tree geospatial information from LiDAR database
- Import processed data into Excel spreadsheet
  - Determine Tree–Span–Pole associations based on the LiDAR geospatial info
  - **Tree strike threat**: Calculate number of fall-in trees in each span that can touch the line
  - **Trees within 6 ft**: Calculate number of fall-in trees in each span that are within 6 ft from the line
  - Rank and color code the spans in each category based on the number of trees in each span
- Output results to Google Earth for visualization
  - For each circuit, span, pole, and tree results are output to separate KMZ files such that they are shown as different layers in Google Earth



PGE-DIXIE-NDCAL-000003932

Assumptions for Non-Hardened System

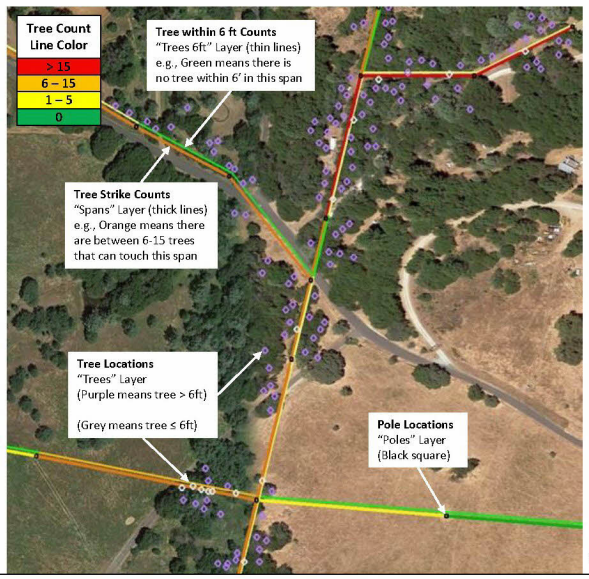
- Tree-Span relationship is tagged in LiDAR (see figure)
- All fall-in trees have potential to strike the span regardless of wind speed and wind direction
- Tree strike failure is counted as true when a tree is tagged as fall-in with non-zero Overstrike
- Spans are ranked based on the number of fall-in trees in each span



PGE-DIXIE-NDCAL-000003933

Definition of KMZ Layer Symbols and Line Colors

- Tree strike threat color coding
  - Thick red lines: Spans that have more than 15 fall-in trees that can touch the line
  - Thick orange lines: Spans that have 6 to 15 fall-in trees that can touch the line
  - Thick yellow lines: Spans that have 1 to 5 fall-in trees that can touch the line
  - Thick green lines: Spans that have zero fall-in tree that can touch the line
- Tree distance color coding
  - Thin red lines: Spans that have more than 15 fall-in trees within 6 ft of the line
  - Thin orange lines: Spans that have 6 to 15 fall-in trees within 6 ft of the line
  - Thin yellow lines: Spans that have 1 to 5 fall-in trees within 6 ft of the line
  - Thin green lines: Spans that have zero 15 fall-in tree within 6 ft of the line



PGE-DIXIE-NDCAL-000003934

RESULTS 1/2

- Tree strike threat calculation
  - Tree counts that can touch the non-hardened line
- Residual risk calculation

$$= \frac{No.\ of\ Spans\ in\ Threat\ Level}{Total\ Spans} \times Weight\ Factor$$

Upper Lake 1101

Threat Level	Trees Touching Non-Hardened (No. of spans)	Linear Span Length (miles)	Tree Strike Residual Risk	
			Weight Factor	Non-Hardened
High (15+ trees)	75	4.76	1	0.087
Medium (5-15 trees)	228	13.30	0.75	0.199
Low (1-5 trees)	333	18.44	0.50	0.194
None	223	11.10	0	0.000
Total:	**859**	**47.61**		**0.480**

Keswick 1101

Threat Level	Trees Touching Non-Hardened (No. of spans)	Linear Span Length (miles)	Tree Strike Residual Risk	
			Weight Factor	Non-Hardened
High (15+ trees)	17	1.04	1	0.014
Medium (5-15 trees)	133	6.04	0.75	0.079
Low (1-5 trees)	459	19.36	0.50	0.182
None	650	24.84	0	0.000
Total:	**1,259**	**51.28**		**0.275**

Konocti 1102

Threat Level	Trees Touching Non-Hardened (No. of spans)	Linear Span Length (miles)	Tree Strike Residual Risk	
			Weight Factor	Non-Hardened
High (15+ trees)	540	28.01	1	0.208
Medium (5-15 trees)	629	30.78	0.75	0.182
Low (1-5 trees)	775	36.46	0.50	0.150
None	647	29.90	0	0.000
Total:	**2,591**	**125.15**		**0.540**

Mariposa 2102

Threat Level	Trees Touching Non-Hardened (No. of spans)	Linear Span Length (miles)	Tree Strike Residual Risk	
			Weight Factor	Non-Hardened
High (15+ trees)	110	7.99	1	0.024
Medium (5-15 trees)	1,063	61.44	0.75	0.174
Low (1-5 trees)	2,382	123.21	0.50	0.260
None	1,032	52.18	0	0.000
Total:	**4,587**	**244.82**		**0.457**

PGE-DIXIE-NDCAL-000003935

RESULTS 2/2

- Tree strike threat calculation
  - Tree counts that can touch the non-hardened line
- Residual risk calculation

$$= \frac{No.\ of\ Spans\ in\ Threat\ Level}{Total\ Spans} \times Weight\ Factor$$

Bucks Creek 1101

Threat Level	Trees Touching Non-Hardened (No. of spans)	Linear Span Length (miles)	Tree Strike Residual Risk	
			Weight Factor	Non-Hardened
High (15+ trees)	13	0.74	1	0.078
Medium (5-15 trees)	51	2.35	0.75	0.229
Low (1-5 trees)	60	2.36	0.50	0.180
None	43	1.78	0	0.000
Total:	**167**	**7.23**		**0.487**

Middletown 1102

Threat Level	Trees Touching Non-Hardened (No. of spans)	Linear Span Length (miles)	Tree Strike Residual Risk	
			Weight Factor	Non-Hardened
High (15+ trees)	4	0.34	1	0.005
Medium (5-15 trees)	47	2.61	0.75	0.042
Low (1-5 trees)	325	14.39	0.50	0.192
None	471	19.61	0	0.000
Total:	**847**	**36.95**		**0.238**

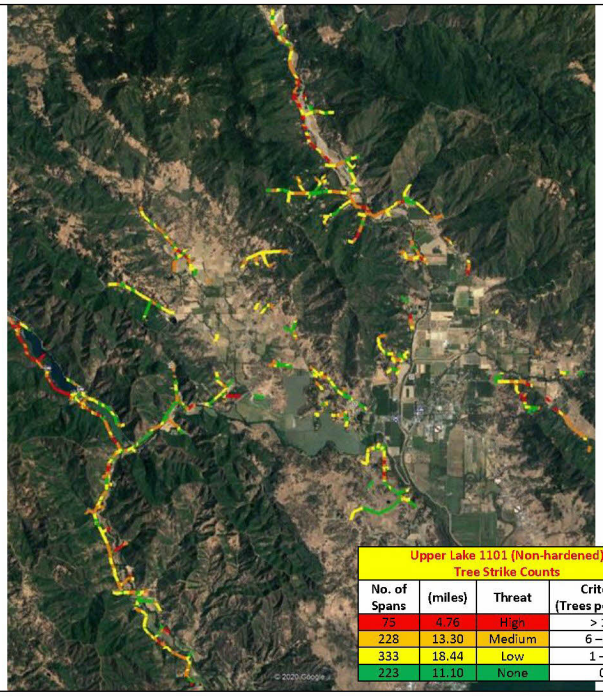
Middletown 1103

Threat Level	Trees Touching Non-Hardened (No. of spans)	Linear Span Length (miles)	Tree Strike Residual Risk	
			Weight Factor	Non-Hardened
High (15+ trees)	15	1.44	1	0.045
Medium (5-15 trees)	60	4.33	0.75	0.136
Low (1-5 trees)	115	7.11	0.50	0.174
None	141	8.54	0	0.000
Total:	**331**	**21.43**		**0.355**

PGE-DIXIE-NDCAL-000003936

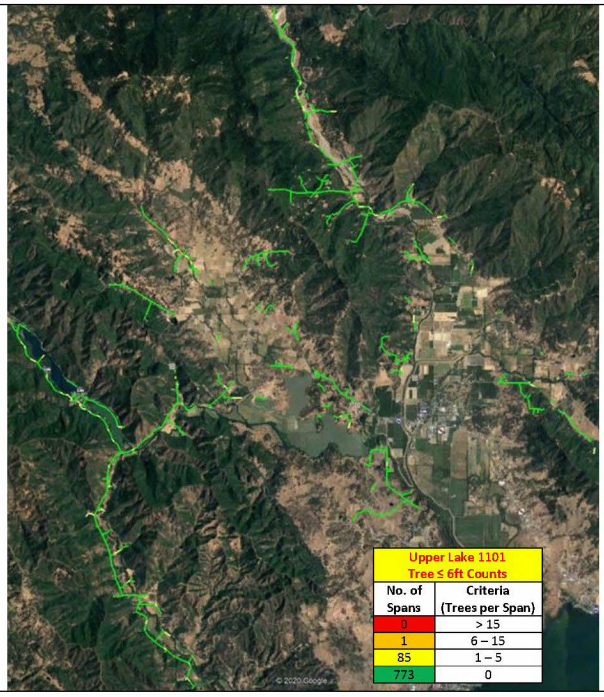
Upper Lake 1101

- * - Spans.kmz
- Based on 2019 LiDAR
- Trees that can touch the line
  - 75 spans have more than 15 trees in each span that can strike
  - 228 spans have 6 – 15 trees in each span that can strike
  - 333 spans have 1 – 5 trees in each span that can strike
  - 223 spans have zero tree in each span that can strike



Upper Lake 1101 (Non-hardened) Tree Strike Counts			
No. of Spans	(miles)	Threat	Criteria (Trees per Span)
75	4.76	High	> 15
228	13.30	Medium	6 – 15
333	18.44	Low	1 – 5
223	11.10	None	0

- * - Trees 6ft.kmz
- Trees that are within 6 ft of line
  - 0 span have more than 15 trees in each span that are within 6 ft
  - 1 span have 6 – 15 trees in each span that are within 6 ft
  - 85 spans have 1 – 5 trees in each span that are within 6 ft
  - 773 spans have zero tree in each span that are within 6 ft



PGE-DIXIE-NDCAL-000003938

Keswick 1101

- * - Spans.kmz
- Based on 2019 LiDAR
- Trees that can touch the line
  - 17 spans have more than 15 trees in each span that can strike
  - 133 spans have 6 – 15 trees in each span that can strike
  - 459 spans have 1 – 5 trees in each span that can strike
  - 650 spans have zero tree in each span that can strike

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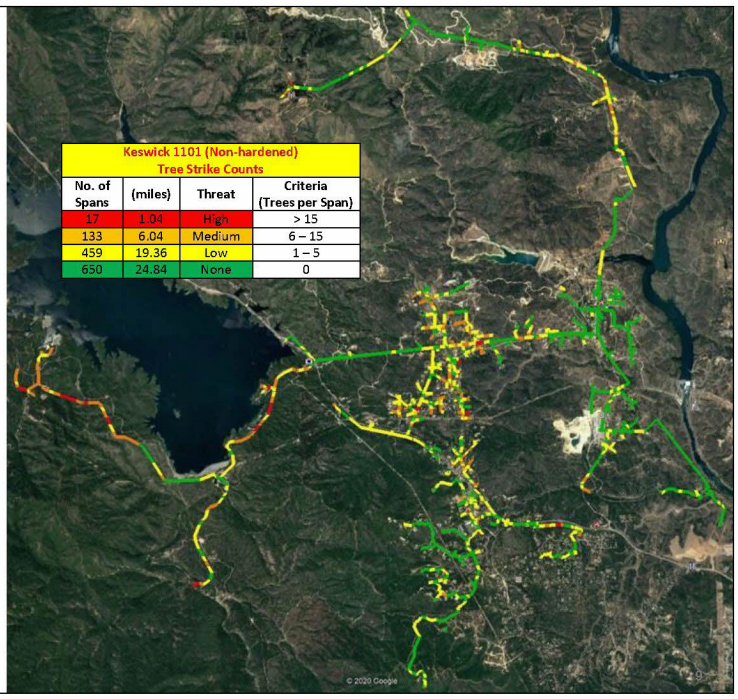

Keswick 1101 (Non-hardened)
Tree Strike Counts

No. of Spans	(miles)	Threat	Criteria (Trees per Span)
17	1.04	High	> 15
133	6.04	Medium	6 – 15
459	19.36	Low	1 – 5
650	24.84	None	0

- * - Trees 6ft.kmz
- Trees that are within 6 ft of line
  - 0 span have more than 15 trees in each span that are within 6 ft
  - 0 span have 6 – 15 trees in each span that are within 6 ft
  - 8 spans have 1 – 5 trees in each span that are within 6 ft
  - 1,251 spans have zero tree in each span that are within 6 ft

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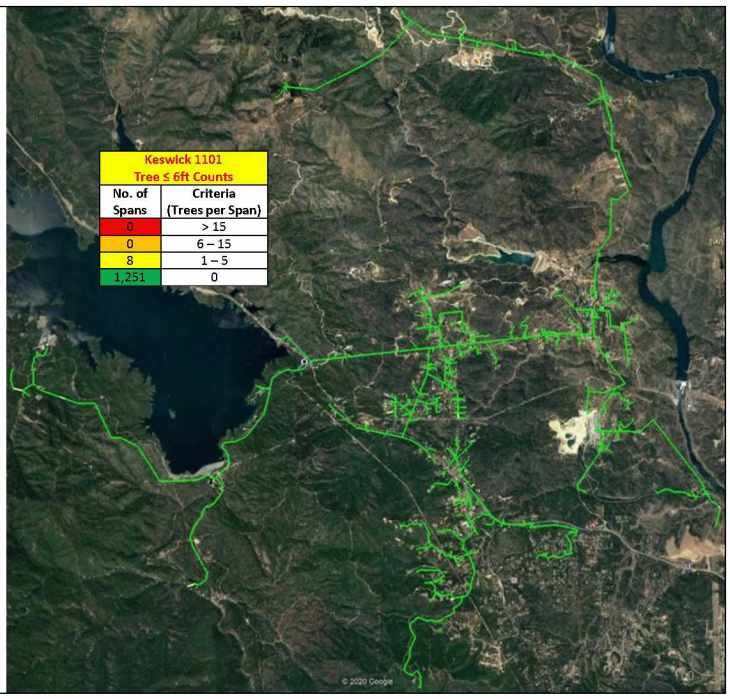
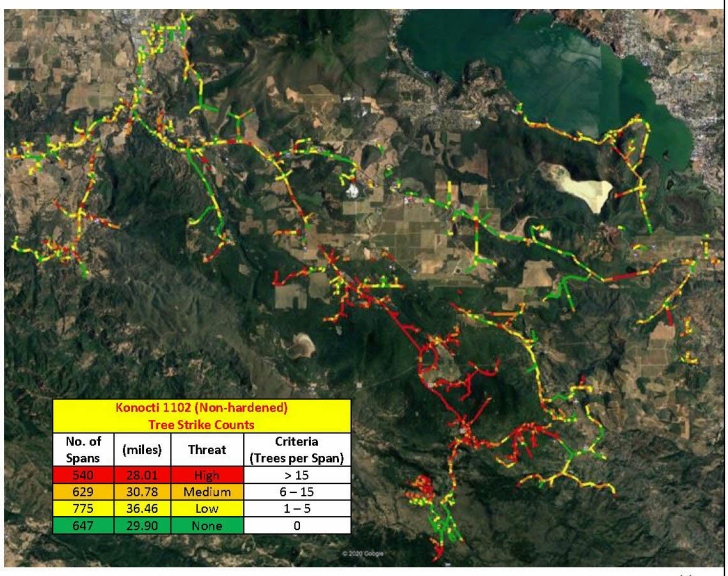


Konocti 1102

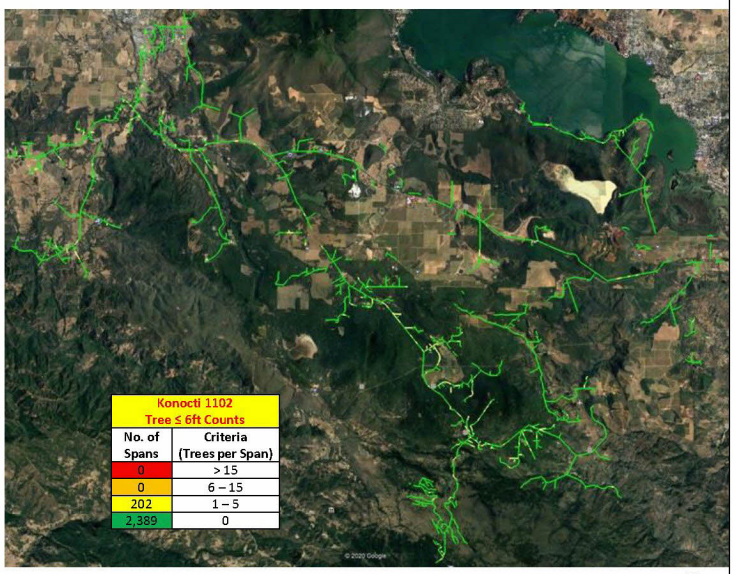
- * - Spans.kmz
- Based on 2019 LiDAR
- Trees that can touch the line
  - 540 spans have more than 15 trees in each span that can strike
  - 629 spans have 6 – 15 trees in each span that can strike
  - 775 spans have 1 – 5 trees in each span that can strike
  - 647 spans have zero tree in each span that can strike



Konocti 1102 (Non-hardened)
Tree Strike Counts

No. of Spans	(miles)	Threat	Criteria (Trees per Span)
540	28.01	High	> 15
629	30.78	Medium	6 – 15
775	36.46	Low	1 – 5
647	29.90	None	0

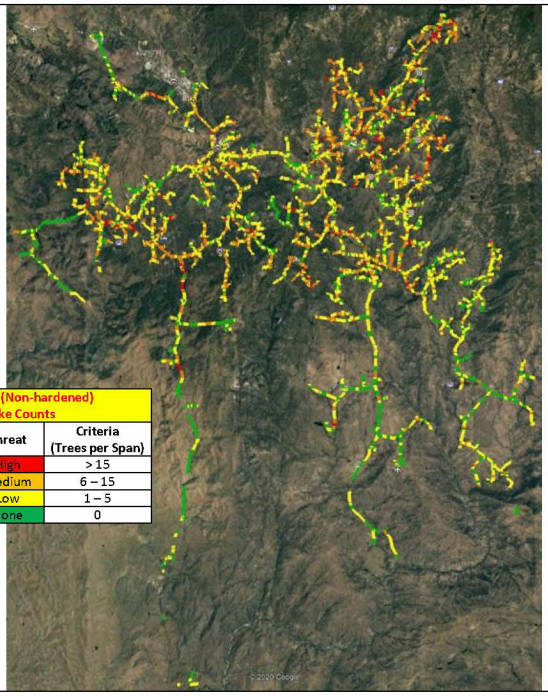
- * - Trees 6ft.kmz
- Trees that are within 6 ft of line
  - 0 span have more than 15 trees in each span that are within 6 ft
  - 0 span have 6 – 15 trees in each span that are within 6 ft
  - 202 spans have 1 – 5 trees in each span that are within 6 ft
  - 2,389 spans have zero tree in each span that are within 6 ft



PGE-DIXIE-NDCAL-000003942

Mariposa 2102

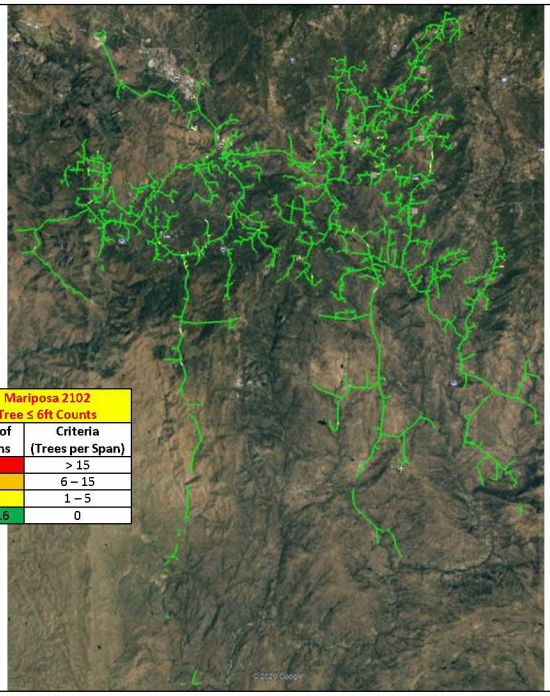
- * - Spans.kmz
- Based on 2019 LiDAR
- Trees that can touch the line
  - 110 spans have more than 15 trees in each span that can strike
  - 1,063 spans have 6 – 15 trees in each span that can strike
  - 2,382 spans have 1 – 5 trees in each span that can strike
  - 1,032 spans have zero tree in each span that can strike



Mariposa 2102 (Non-hardened) Tree Strike Counts			
No. of Spans	(miles)	Threat	Criteria (Trees per Span)
110	7.99	High	> 15
1,063	61.44	Medium	6 – 15
2,382	123.21	Low	1 – 5
1,032	52.18	None	0

PGE-DIXIE-NDCAL-000003943

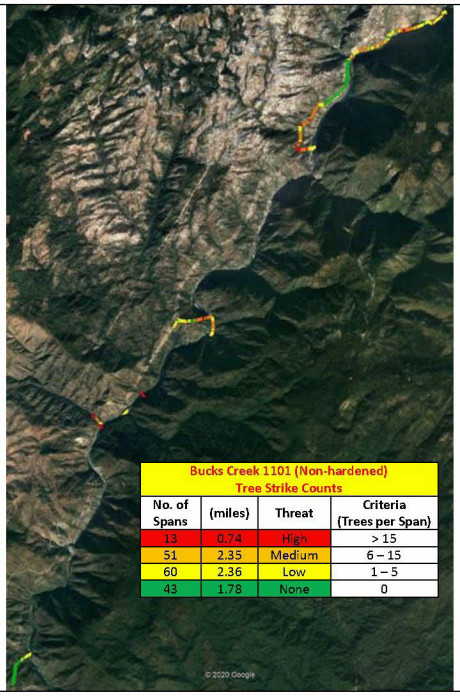
- * - Trees 6ft.kmz
- Trees that are within 6 ft of line
  - 0 span have more than 15 trees in each span that are within 6 ft
  - 0 span have 6 – 15 trees in each span that are within 6 ft
  - 71 spans have 1 – 5 trees in each span that are within 6 ft
  - 4,516 spans have zero tree in each span that are within 6 ft



Mariposa 2102 Tree ≤ 6ft Counts	
No. of Spans	Criteria (Trees per Span)
0	> 15
0	6 – 15
71	1 – 5
4,516	0

Bucks Creek 1101

- * - Spans.kmz
- Based on 2019 LiDAR
- Trees that can touch the line
  - 13 spans have more than 15 trees in each span that can strike
  - 51 spans have 6 – 15 trees in each span that can strike
  - 60 spans have 1 – 5 trees in each span that can strike
  - 43 spans have zero tree in each span that can strike

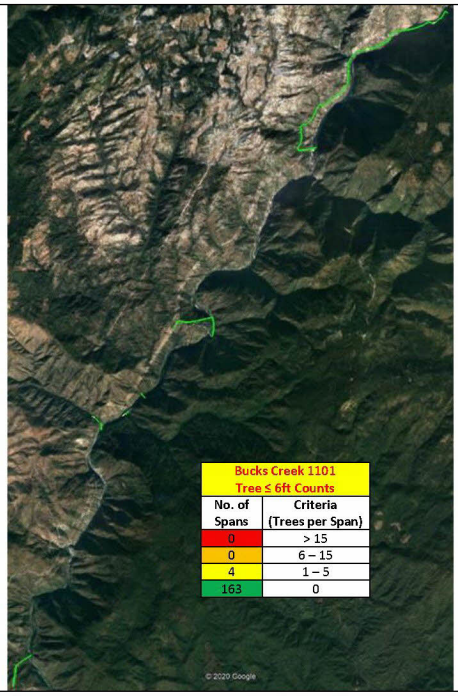


Bucks Creek 1101 (Non-hardened)
Tree Strike Counts

No. of Spans	(miles)	Threat	Criteria (Trees per Span)
13	0.74	High	> 15
51	2.35	Medium	6 – 15
60	2.36	Low	1 – 5
43	1.78	None	0

PGE-DIXIE-NDCAL-000003945

- * - Trees 6ft.kmz
- Trees that are within 6 ft of line
  - 0 span have more than 15 trees in each span that are within 6 ft
  - 0 span have 6 – 15 trees in each span that are within 6 ft
  - 4 spans have 1 – 5 trees in each span that are within 6 ft
  - 163 spans have zero tree in each span that are within 6 ft



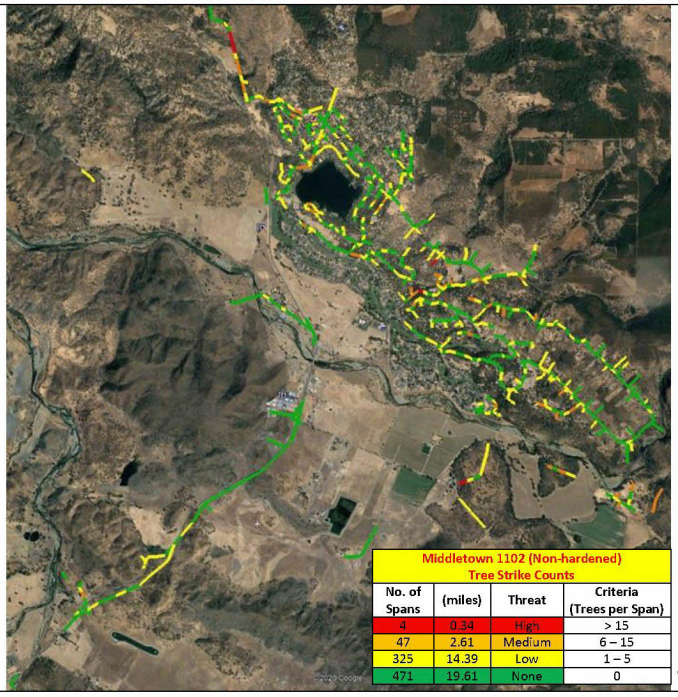
Bucks Creek 1101
Tree ≤ 6ft Counts

No. of Spans	Criteria (Trees per Span)
0	> 15
0	6 – 15
4	1 – 5
163	0

PGE-DIXIE-NDCAL-000003946

Middletown 1102

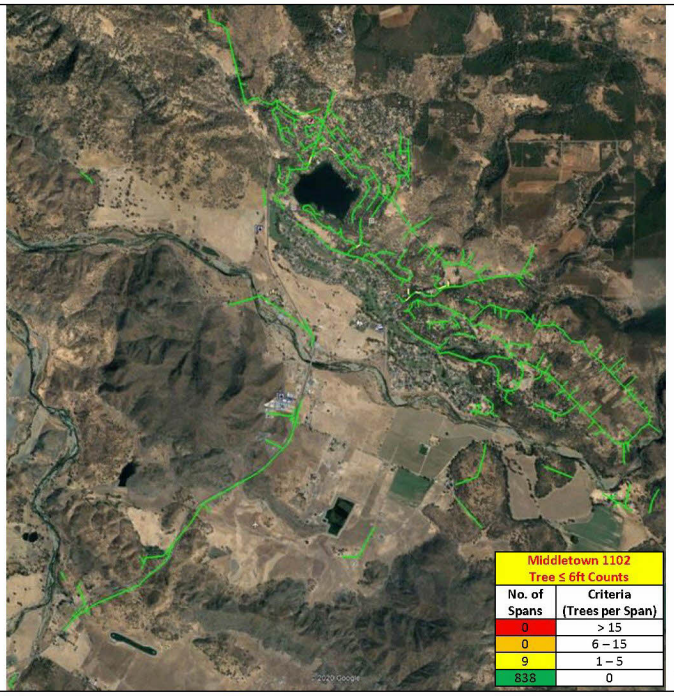
- * - Spans.kmz
- Based on 2019 LiDAR
- Trees that can touch the line
  - 4 spans have more than 15 trees in each span that can strike
  - 47 spans have 6 – 15 trees in each span that can strike
  - 325 spans have 1 – 5 trees in each span that can strike
  - 471 spans have zero tree in each span that can strike



Middletown 1102 (Non-hardened)
Tree Strike Counts

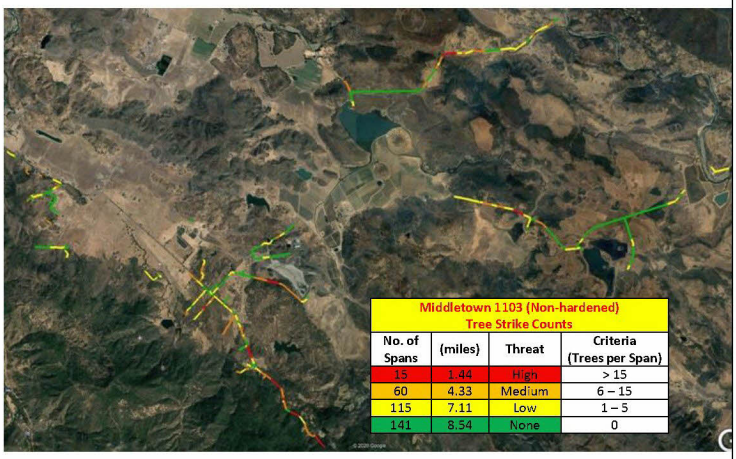
No. of Spans	(miles)	Threat	Criteria (Trees per Span)
4	0.34	High	> 15
47	2.61	Medium	6 – 15
325	14.39	Low	1 – 5
471	19.61	None	0

- * - Trees 6ft.kmz
- Trees that are within 6 ft of line
  - 0 span have more than 15 trees in each span that are within 6 ft
  - 0 span have 6 – 15 trees in each span that are within 6 ft
  - 9 spans have 1 – 5 trees in each span that are within 6 ft
  - 838 spans have zero tree in each span that are within 6 ft



Middletown 1103

- * - Spans.kmz
- Based on 2019 LiDAR
- Trees that can touch the line
  - 15 spans have more than 15 trees in each span that can strike
  - 60 spans have 6 – 15 trees in each span that can strike
  - 115 spans have 1 – 5 trees in each span that can strike
  - 141 spans have zero tree in each span that can strike

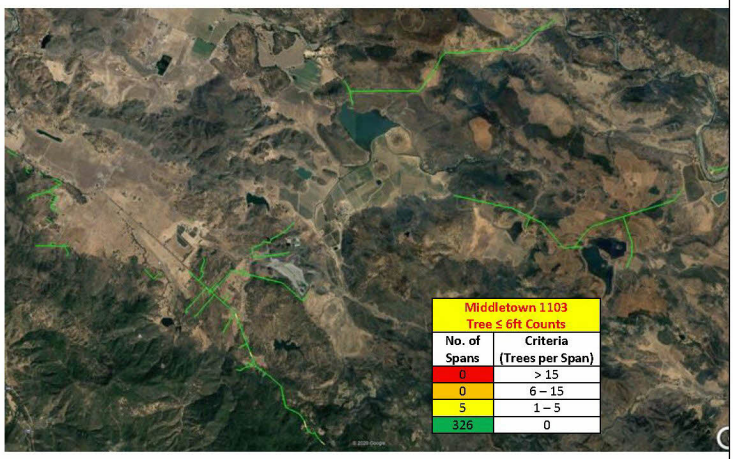


Middletown 1103 (Non-hardened)
Tree Strike Counts

No. of Spans	(miles)	Threat	Criteria (Trees per Span)
15	1.44	High	> 15
60	4.33	Medium	6 – 15
115	7.11	Low	1 – 5
141	8.54	None	0

PGE-DIXIE-NDCAL-000003949

- * - Trees 6ft.kmz
- Trees that are within 6 ft of line
  - 0 span have more than 15 trees in each span that are within 6 ft
  - 0 span have 6 – 15 trees in each span that are within 6 ft
  - 5 spans have 1 – 5 trees in each span that are within 6 ft
  - 326 spans have zero tree in each span that are within 6 ft



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