Adventures with IFTDSS on the Kenai Peninsula, Alaska

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December 2014
Fire Modeling and Analysis Committee Webinar

IFTDSS: Interagency Fuel Treatment Decision Support System

- Built by Fuels Managers for Fuels Managers
- Not another model, it is a web-based collaborative platform
- One interface – consistent with WFDSS
- Facilitates models talking to each other
- Does the file transformations for you
- Shifts focus from how a model works to “why should I do this”

Outline of Presentation

- Kenai National Wildlife Refuge fuel treatment planning
  - Burn probability
  - Hazard analysis
  - MTT
  - Risk Assessment
  - Treatment effects

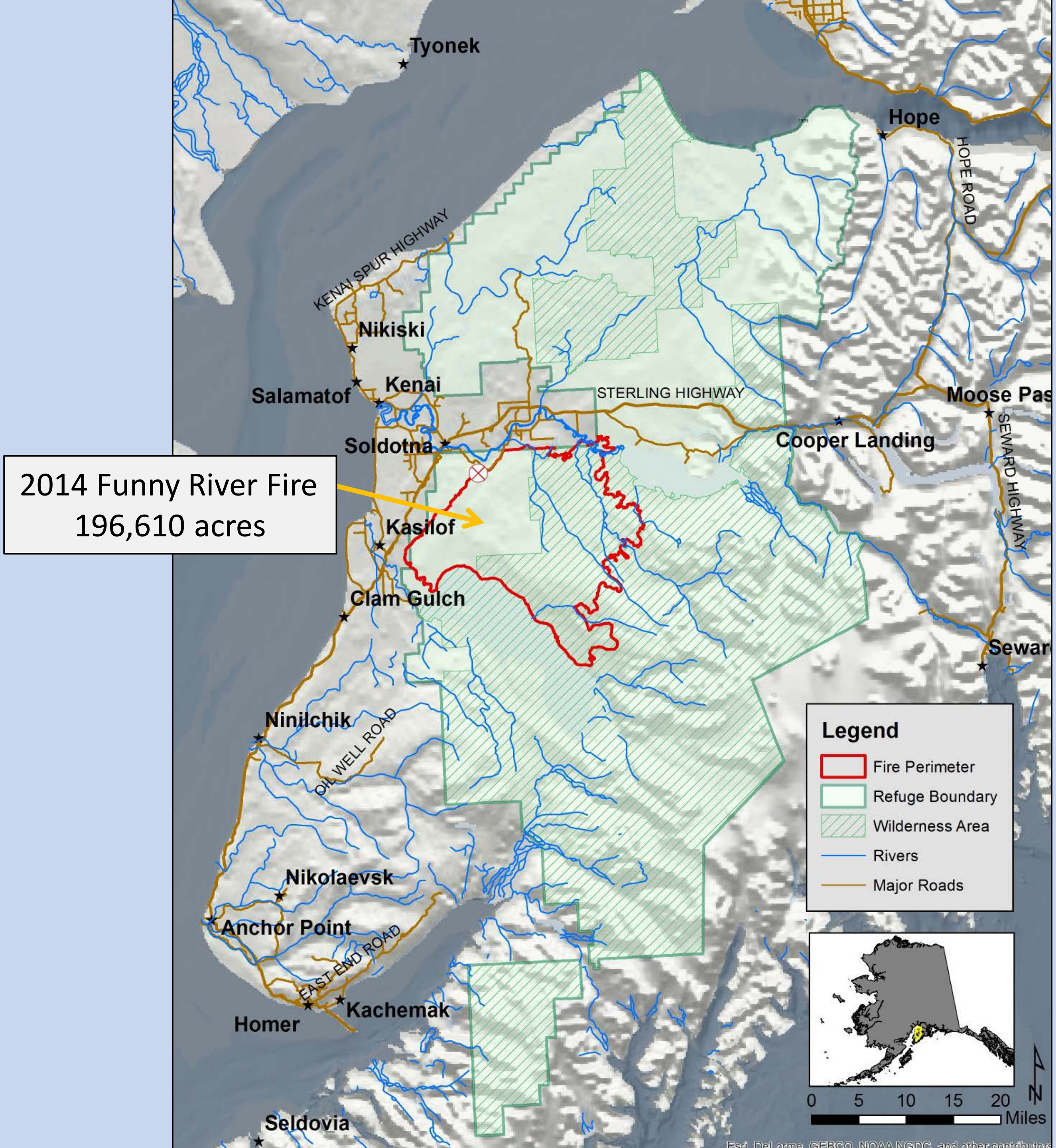
- Funny River Fire example

Fuel Treatment Planning

"Policy: The Fuels Management Program is revised to ***focus on a risk-based approach*** that supports the National Cohesive Wildland Fire Management Strategy and focuses on three strategic issues:

- The nature and extent of the fuels problem in terms of risk of wildfire to key values
- ***Determination of treatment and funding priorities based on those risks***
- ***Measurement of accomplishment and program success in terms of reduction of these risks."***

- Policy memo: Risk-based DOI fuels management program: Strategic approach and outcomes. 10/28/2013

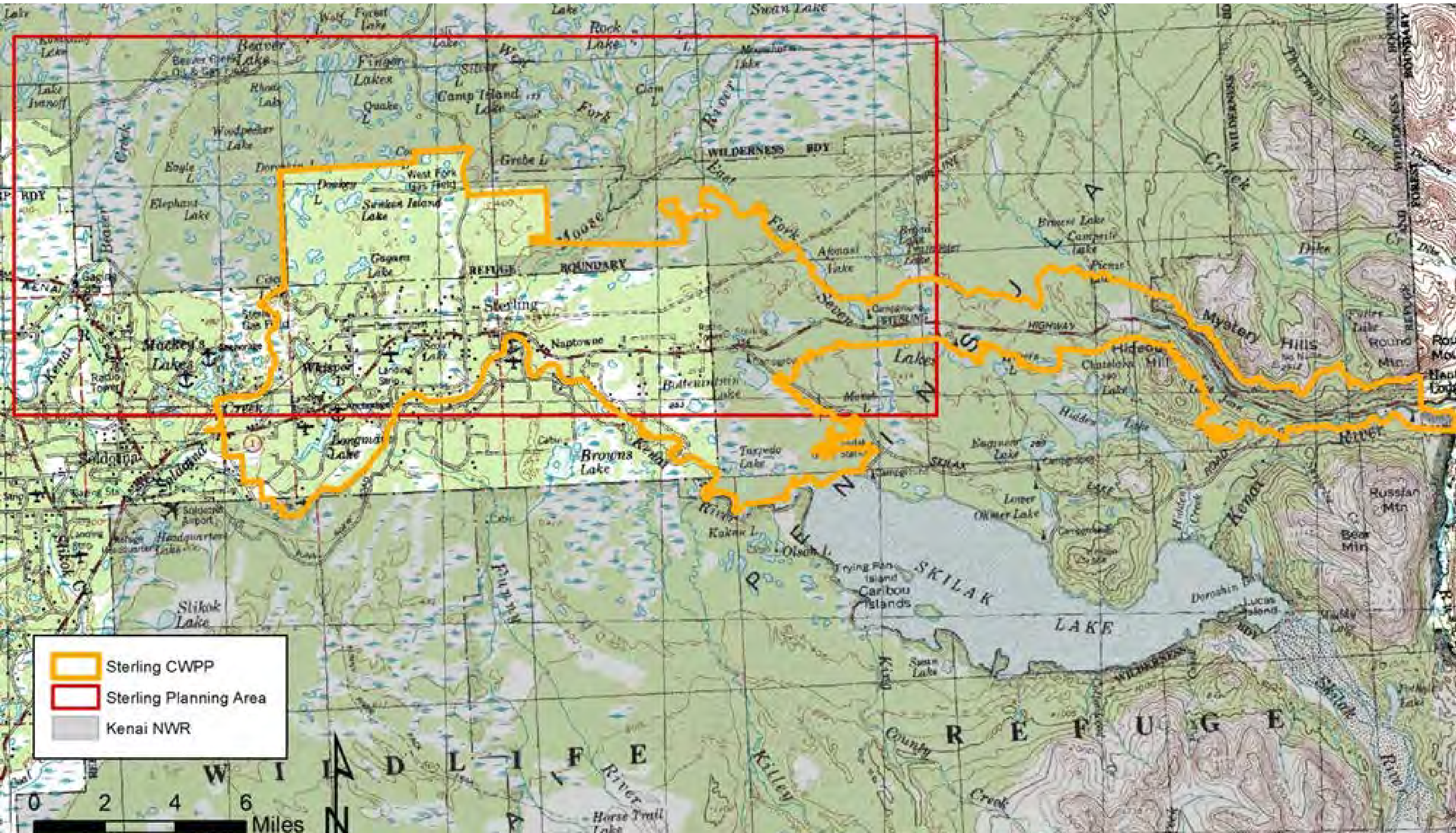


2014 Funny River Fire
196,610 acres
Tyonek
Hope
HOPE ROAD
KENAI SPUR HIGHWAY
Nikiski
Salamatof
Kenai
STERLING HIGHWAY
Moose Pas
SEWARD HIGHWAY
Cooper Landing
Soldotna
Kasilof
Clam Gulch
Sewar
Ninilchik
OIL WELL ROAD
Nikolaevsk
Anchor Point
EAST END ROAD
Kachemak
Homer
Seldovia
Legend
Fire Perimeter
Refuge Boundary
Wilderness Area
Rivers
Major Roads
0 5 10 15 20
Miles
N

Sterling Community Wildfire Protection Plan: Rated High Risk by Kenai Borough

Worst case scenario: fire moving south from Refuge into populated area (north frontal winds)

Planning area: 156,246 acres (current IFTDSS limit 250,000 acre lcp)



IFTDSS Workflows Used

Landscape Hazard Analysis: Fire Behavior Across a Landscape (IFT-FlamMap)

Minimum Travel Time (IFT-MTT)

Risk Assessment (IFT-FlamMap, IFT-RANDIG)

Manual Treatment Locations- user defined treatments (IFT-FlamMap)

IFTDSS Pros/Cons

Pros:
- Easy to learn and use: good educational/help material
- Consistent interface between different workflows
- Sonomatech very responsive to questions and problems
- Display changes (value change, % change) in fire behavior on landscape following treatment

Cons :
- Cannot download results as shapefiles (export to .kml, but not from .kml to .shp). Had to use screenshots *
- No metrics available for results - just images*
- People can readily obtain output without understanding model assumptions, limitations
- Alaska only: Can’t load LANDFIRE landscape from within IFTDSS*

* On list to be addressed

Kenai Fuel Treatment Analysis Inputs- All Analyses

LANDFIRE 2010 landscape, no blanket fuel model changes

Scott and Reinhardt Method used for crown fire calculation

Wind direction set at 360° (worst case)

Fuel moisture set at 97, 90, and 80 percentile levels

Analyses were run on two wind speeds, 22 and 5 mph

22 mph winds rare but, do occur. 5 mph represents average winds at the Kenai NWR and Swanson River RAWS.

Inputs: Fuel Moisture

Derived from Fire Family Plus, June 1 – August 31

Several potential RAWS: Kenai RAWS had lowest fuel moistures at each percentile; used this for 90 and 80 percentiles

	Kenai NWR RAWS Fuel Moisture				
Percentile	1 hour	10 hour	100 hour	Herbaceous	Woody
97	4	6	10	33	75
90	6	7	11	74	95
80	7	8	12	90	108

97 percentile: deviated from RAWS, wanted extremely dry/worst case

3%, 4%, and 5% for 1-hr, 10 hr, and 100 hr fuels

Herbaceous fuel entered as 30% (cured)

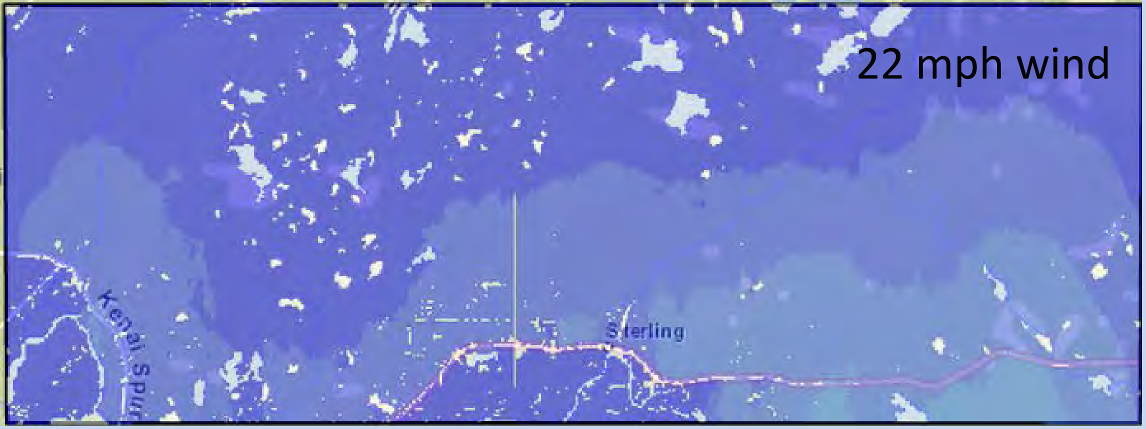
Woody fuel 70% (following Stratton 2009 early July analysis)

Keeping Track of Analyses: Project currently has 46 analyses

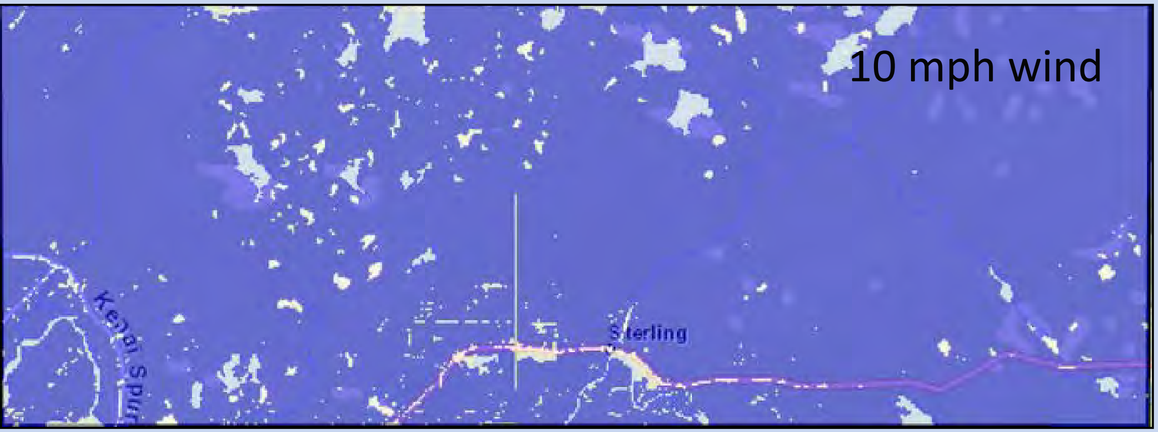
		Fuel Inputs					Wind Inputs				
Run#	Run Name	1 hr	10 hr	100 hr	Live Herb	Live Woody	Deg	mph	Spotting	Dur. (min)	Notes
2	FireBehavior_97 percentile	3	4	5	30	70	360	22	NA	360	
2.2	FireBehavior_97 percentile fuel model changes	3	4	5	30	70	360	22	NA	360	Changed fuel model from TU4 – TU1 in 2009 Lily Lake treatment
2.3	FireBehavior_90 percentile	6	7	11	74	95	360	22	NA	360	
2.4	FireBehavior_80 percentile	7	8	12	90	108	360	22	NA	360	
3	MTT_97percentile_0.25Spotting	3	4	5	30	70	360	22	0.25	360	Ignitions subjectively placed in spruce stands
3.1	MTT_97percentile_NoSpotting	3	4	5	30	70	360	22	0.0	360	
3.2	MTT_97Percentile_LongLineIgnition_0Spotting	3	4	5	30	70	360	22	0.0	360	Single line ignition across planning area

Burn Probability:

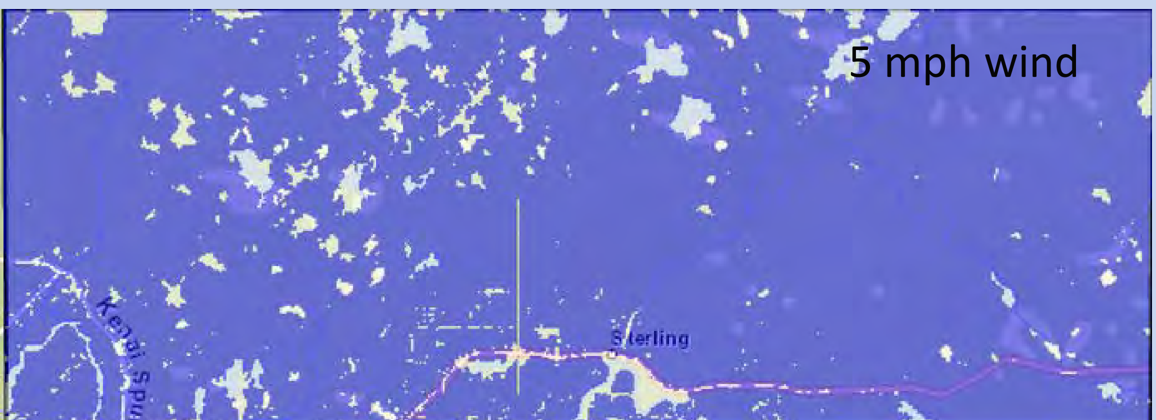
The likelihood that a pixel will burn given a random ignition across the area of interest for a specific set of environmental conditions



97 Percentile fuel moisture



Stand-alone analysis
or
Included in risk assessment



Burn Probability

- 0
- 0.00 to 0.050
- 0.0500 to 0.1
- 0.10 to 0.15
- 0.15 to 0.20

1. Landscape Hazard Analysis: Fire Behavior Across a Landscape

Outputs:

Standard: Results based on moisture, wind inputs and landscape

- Flame length in feet
- Chains/hr for ROS
- Crown fire: No Fire, Surface Fire, Torching, Canopy Fire

Classified: Low, medium, high, very high

- Requires analyst to set thresholds between classes
- Eg., flame length classes matching Haul chart
- Default class separations used for Sterling Planning Area

Relative Output: Lowest, Low, Medium, High, Highest

- Bins output values into 5 relative classes
- Bins defined as percentages set by analyst- must add to 100%
- Default is 20% in each bin
- Sterling example: Lowest=50%, Low=25%, Medium=5%, High=10%, Highest-10%. Focus on most extreme values.

Run 2.0.FireBehavior_97percentile - Calculate fire behavior across a landscape (IFT-F... Help Tools

Properties

Crown Fire Calculation Method: Scott & Reinhardt Method

Fuel Moisture

Parameter	Unit	Simulation #1
1-hr Fuel Moisture	percent	3
10-hr Fuel Moisture	percent	4
100-hr Fuel Moisture	percent	5
Live Herbaceous Fuel Moisture	percent	30
Live Woody Fuel Moisture	percent	70

Weather

Parameter	Unit	Simulation #1
Wind Direction	deg	360
20-ft Wind Speed	mi/h	22.00

< Back | Edit | Next > | US Customary Units | Change Units

Run 2.0.FireBehavior_97percentile - Calculate fire behavior

Specify the MINIMUM value for each class of each parameter. The mi

Classify Parameters

Parameter	Unit	Simulation #1
Medium Flame Length	ft	4.00
High Flame Length	ft	8.00
Very High Flame Length	ft	11.00
Medium Rate of Spread	chains/hr	20.00
High Rate of Spread	chains/hr	90.00
Very High Rate of Spread	chains/hr	150.00
Medium Fireline Intensity	Btu/ft/s	100.00
High Fireline Intensity	Btu/ft/s	500.00
Very High Fireline Intensity	Btu/ft/s	1,000.00
Medium Heat Per Unit Area	Btu/ft²	100.00
High Heat Per Unit Area	Btu/ft²	500.00

Relative Flame Length Category Percentage

Lowest Flame Length	50
Low Flame Length	25
Medium Flame Length	5
High Flame Length	10
Highest Flame Length	10

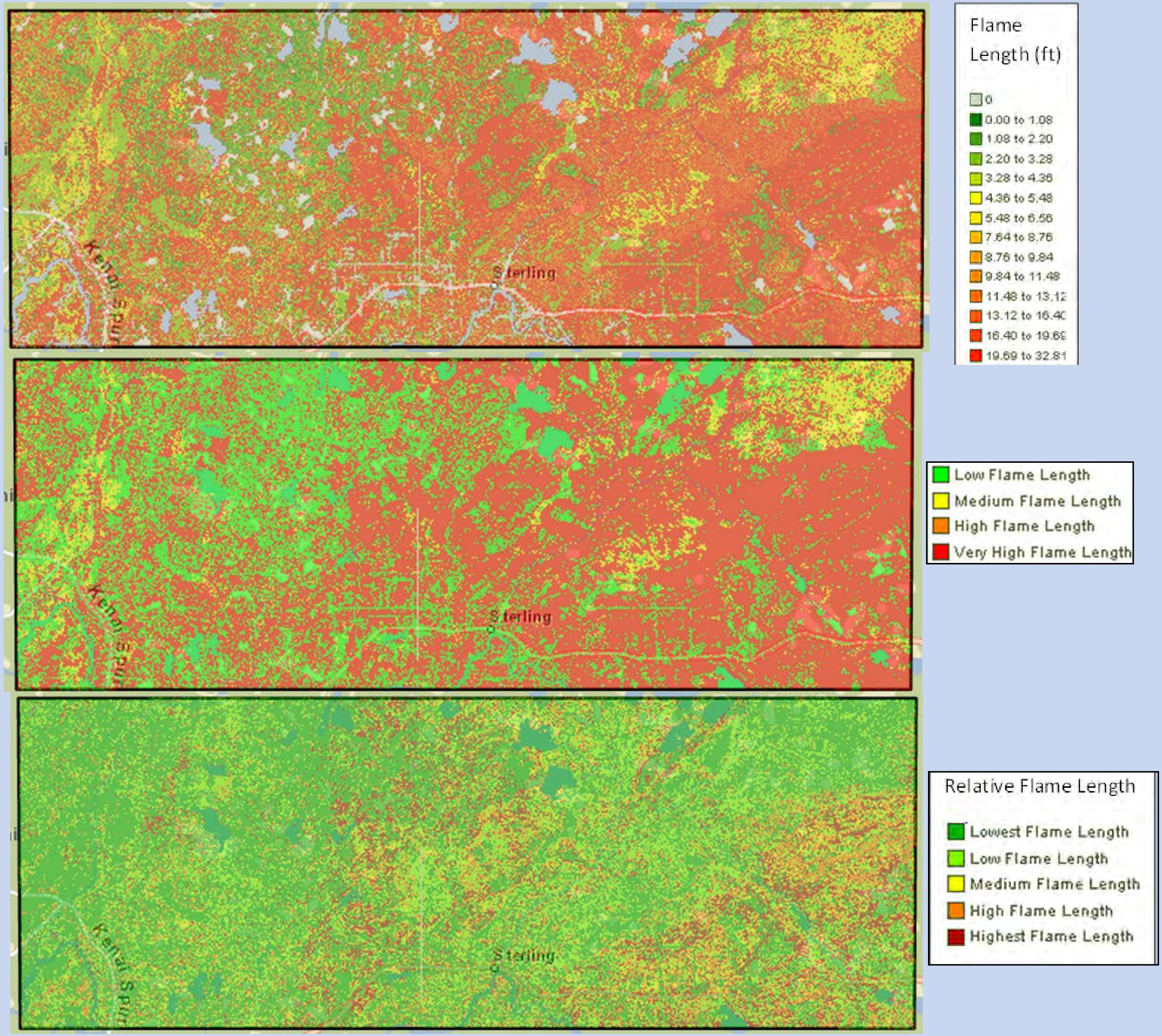
Relative Rate of Spread Category Percentage

Lowest Rate of Spread	50
Low Rate of Spread	25
Medium Rate of Spread	5
High Rate of Spread	10
Highest Rate of Spread	10

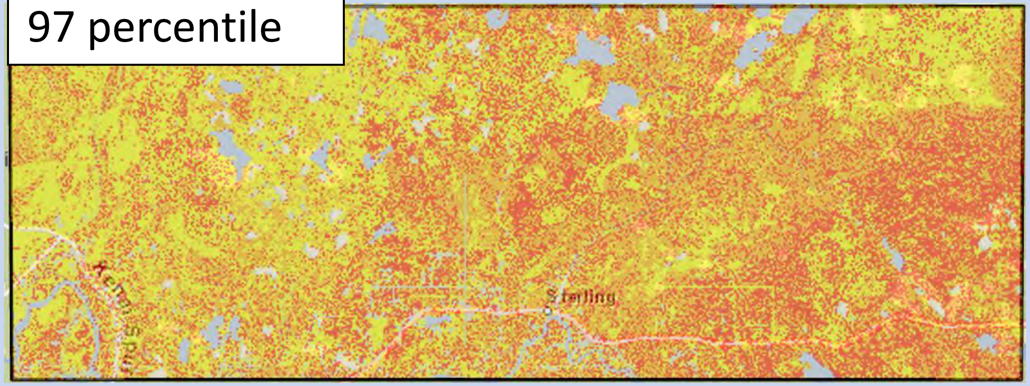
Relative Fireline Intensity Category Percentage

Lowest Fireline Intensity	50

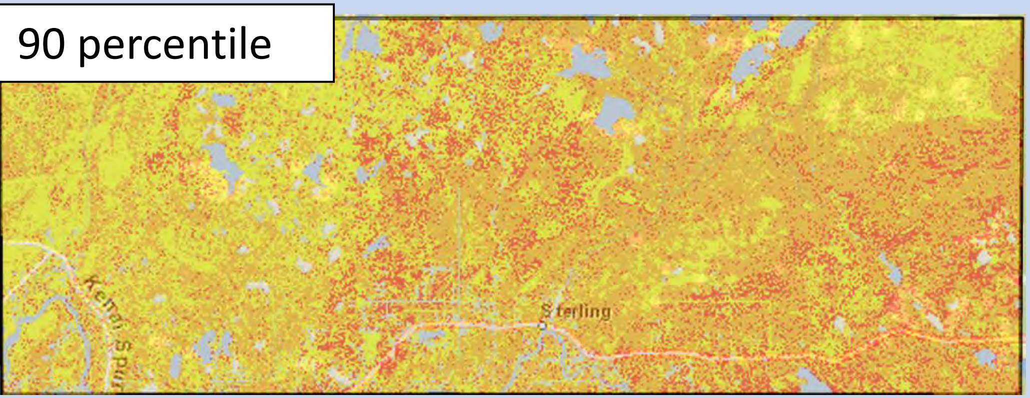
97 percentile fuel moistures, 22 mph wind



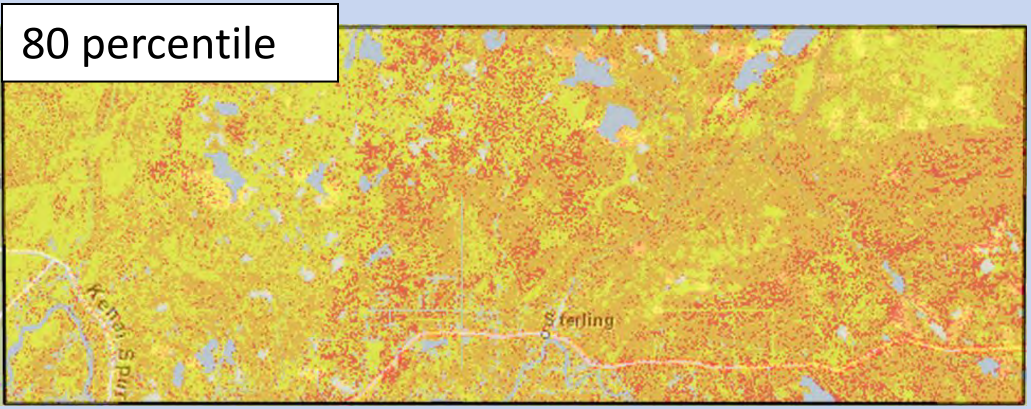
97 percentile



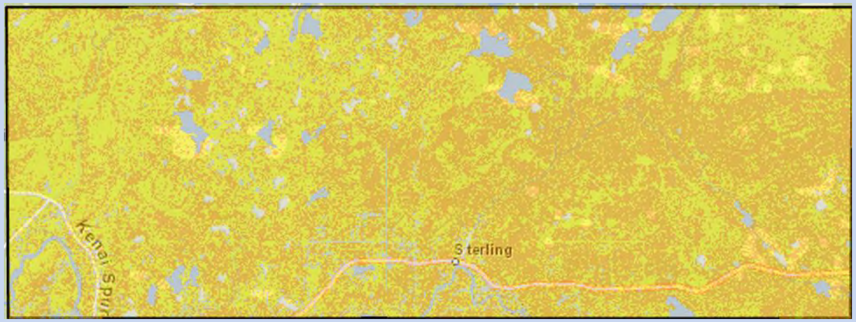
90 percentile



80 percentile



Fuel Moistures Change
Wind Constant: North, 22 mph



97 percentile fuel moisture
5 mph wind

Crown Fire

- No Fire
- Surface Fire
- Torching
- Canopy Fire

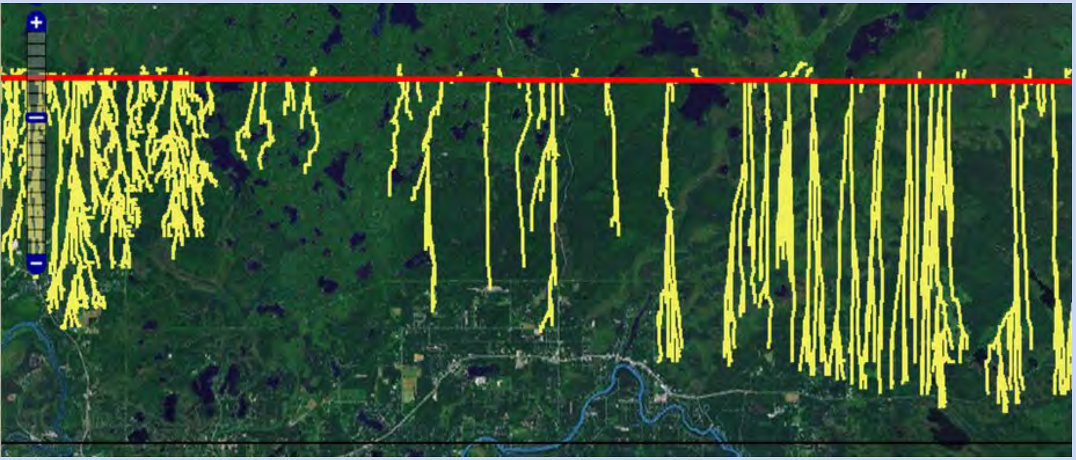
2. Minimum Travel Time

Analyses at 0 and 0.25 spotting

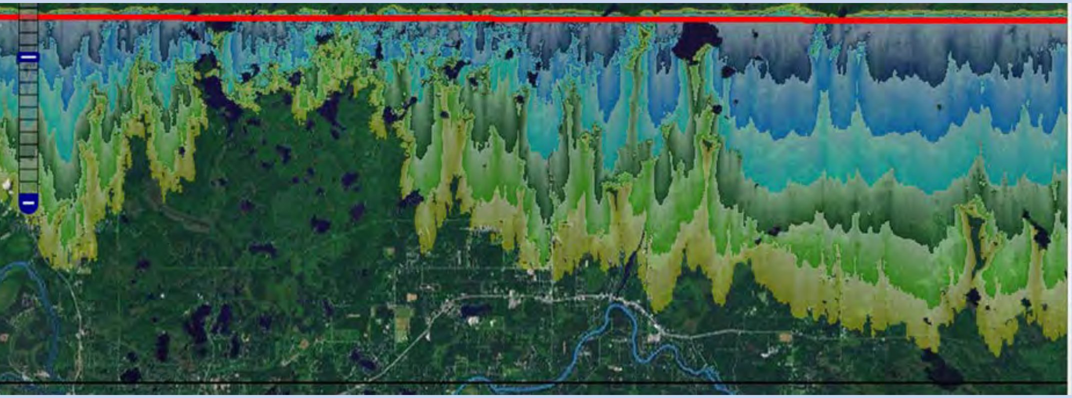
Simulation duration 6 hours

Default of 500’ path interval retained

Single long ignition line across northern planning area

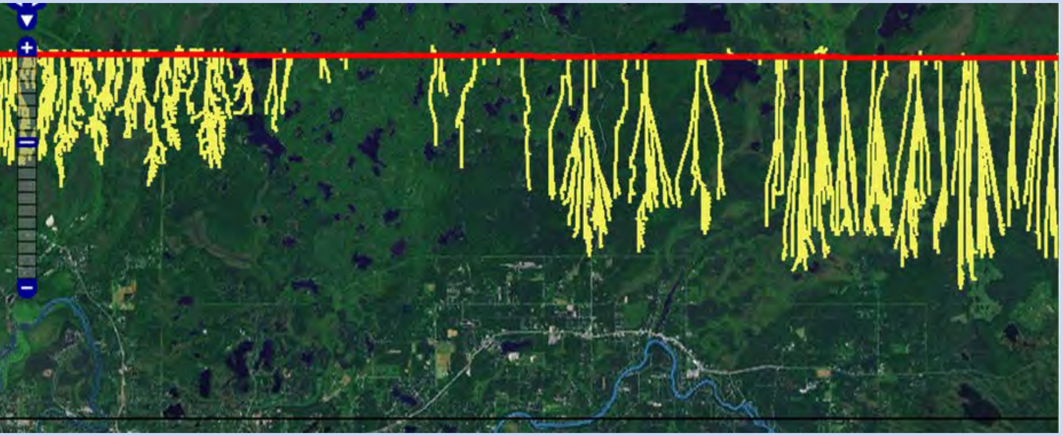


97 percentile fuel moisture,
22 mph wind, 0.25 spotting



97 percentile fuel moisture,
22 mph wind, 0.25 spotting

Fire Arrival (hr)



80 percentile fuel moisture,
22 mph wind, 0.25 spotting

Is Fire Arrival Time Reasonable?
Compare to Funny River Fire

<u>Funny River IMT Report:</u>

Detected 1608 hr, May 19.

Winds out of east 12-15 mph

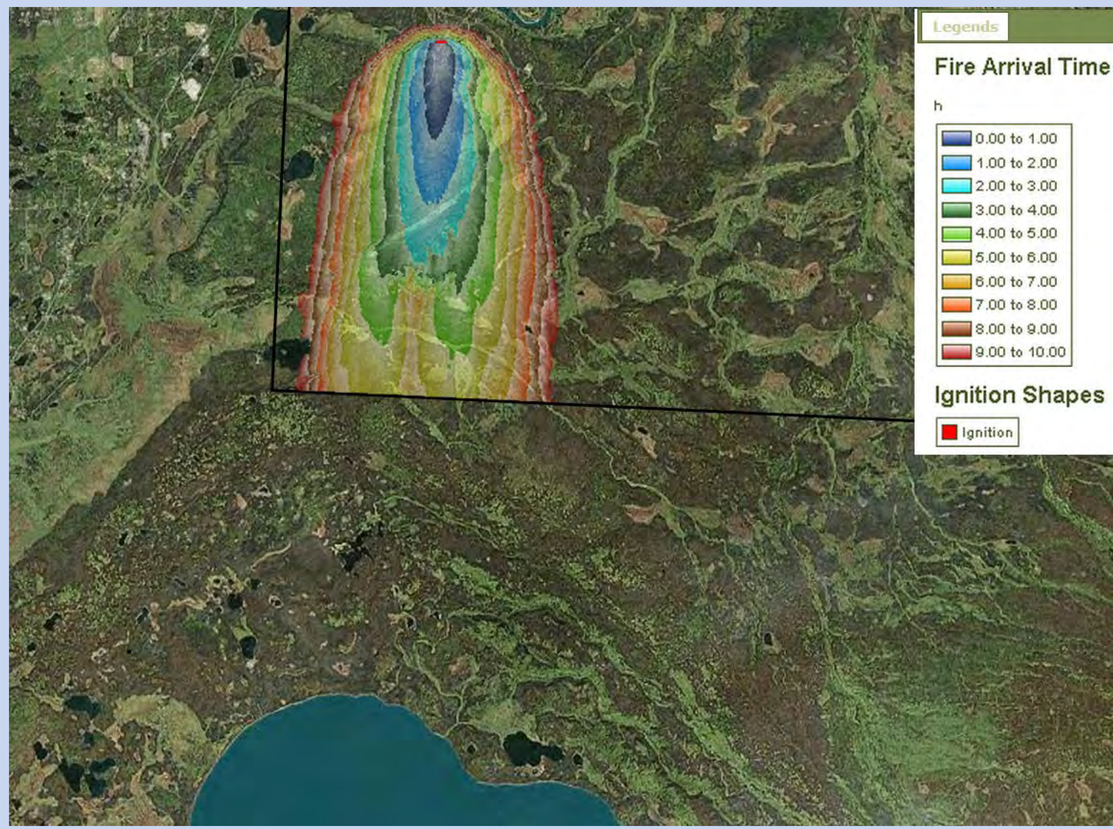
by 2000 hr, winds 25 mph from north

By 2225 hr (6 hrs, 25 min), fire was 6.9 miles long, ¾ miles wide.

<u>Funny River IFTDSS Output</u>

97 Percentile Inputs, 22 mph wind, 0.25 spotting

~ 5.9 miles in 5-6 hours



3. Risk Assessment

Requires identification of **Values at Risk (VAR)** on the analysis map

Assign **Response Function (RF)** – how VAR will respond to fire

RF reflects different combinations of fire intensity and level of loss or benefit. Loss/benefits can be ecological, financial, political.

Two Approaches:

Worst Case Flame Length Approach: each pixel assumed to burn under the worse case conditions (head fire)

or

Flame Length Probability Approach: considers likelihood of a fire burning as a backing fire, a flanking fire, or a head fire given a random ignition in the landscape

Response Function	Description
1	All fire is beneficial; strong benefit at low and moderate fire intensities and moderate benefit at high and very high intensity.
2	All fire is beneficial; moderate benefit at low fire intensity and mild benefit at higher intensity.
3	Strong benefit at low fire intensity, decreasing to a strong loss at very high fire intensity.
4	Moderate benefit at low fire intensity, decreasing to a moderate loss at very high fire intensity.
5	Slight benefit or loss at all fire intensities.
6	Mild increasing loss from slight benefit or loss at low intensity to a moderate loss at very high intensity.
7	Moderate increasing loss from mild loss at low intensity to a strong loss at very high intensity.
8	Slight benefit or loss at all fire intensities, except a moderate loss at very high intensity.
9	Slight benefit or loss at low and moderate fire intensities and a mild loss at high and very high intensities.
10	Mild loss at all fire intensities.
11	Moderate loss from fire at all fire intensities.
12	Strong loss from fire at all fire intensities.
13	Loss increases from slight loss at low intensity to strong loss at very high intensity.
14	Slight benefit or loss from fire at low and moderate intensities and a strong loss from fire at high and very high intensities.

Used statewide Fire Management Options to designate VAR

a. Critical: Highest priority areas for suppression actions, assignment of resources.

Immediate threat to human life, primary residences, inhabited property, community-dependent infrastructure, National Historic Landmarks

b. Full: Control fires at the smallest acreage reasonably possible with initial action forces.

Provides for protection of cultural sites, developed recreational facilities, administrative sites and cabins, high-value natural resources; high-value areas that do not involve protection of human life and inhabited property.

c. Limited: Broad, landscape-scale areas with low density and wide distribution of values; allows for fire to function in its ecological role.

Fire used as management tool to maintain, enhance and improve ecological conditions

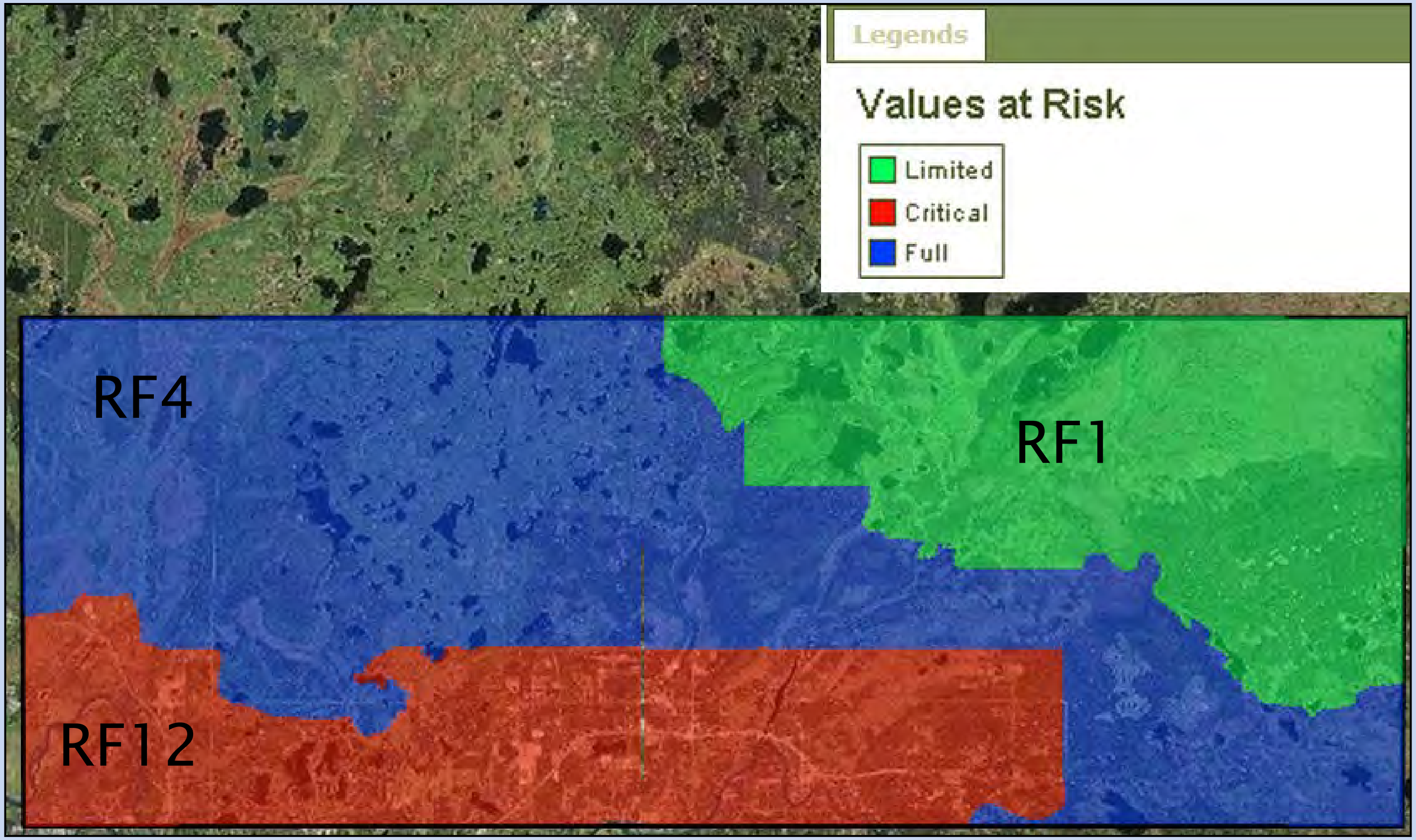
*Modified Management Option does not occur in planning area

Sterling Planning Area Response Functions

Limited=RF1 (all fire beneficial)

Full=RF4 (moderate benefit at low fire intensity, mild benefit at higher intensity); and

Critical=RF12 (strong loss at all fire intensities).



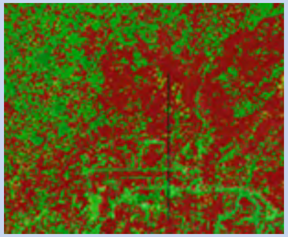
Tying values and responses to what might happen on the ground: Net Value Change

Each RF has a Net Value Change Multiplier associated with different flame length classes

- Multiplier can range between -80 to +80; lower values have more negative response to fire

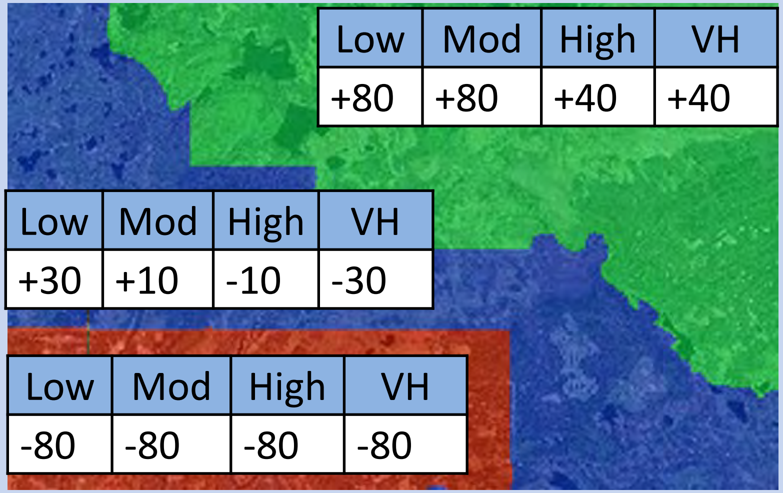
		Net Value Change Multiplier By Flame Length Class			
Response Function	Description	Low	Mod	High	Very High
1	All fire is beneficial; strong benefit at low and mod fire intensities. Mod benefit at high and very high intensities	+80	+80	+40	+40
4	Mod benefit at low fire intensity. Decreasing to mod loss at higher fire intensities	+30	+10	-10	-30
12	Strong loss from fire at all fire intensities	-80	-80	-80	-80

Net Value Change = Burn Probability x Net Value Change Multiplier



Flame Length Class

Response Function



Low	Mod	High	VH
+80	+80	+40	+40

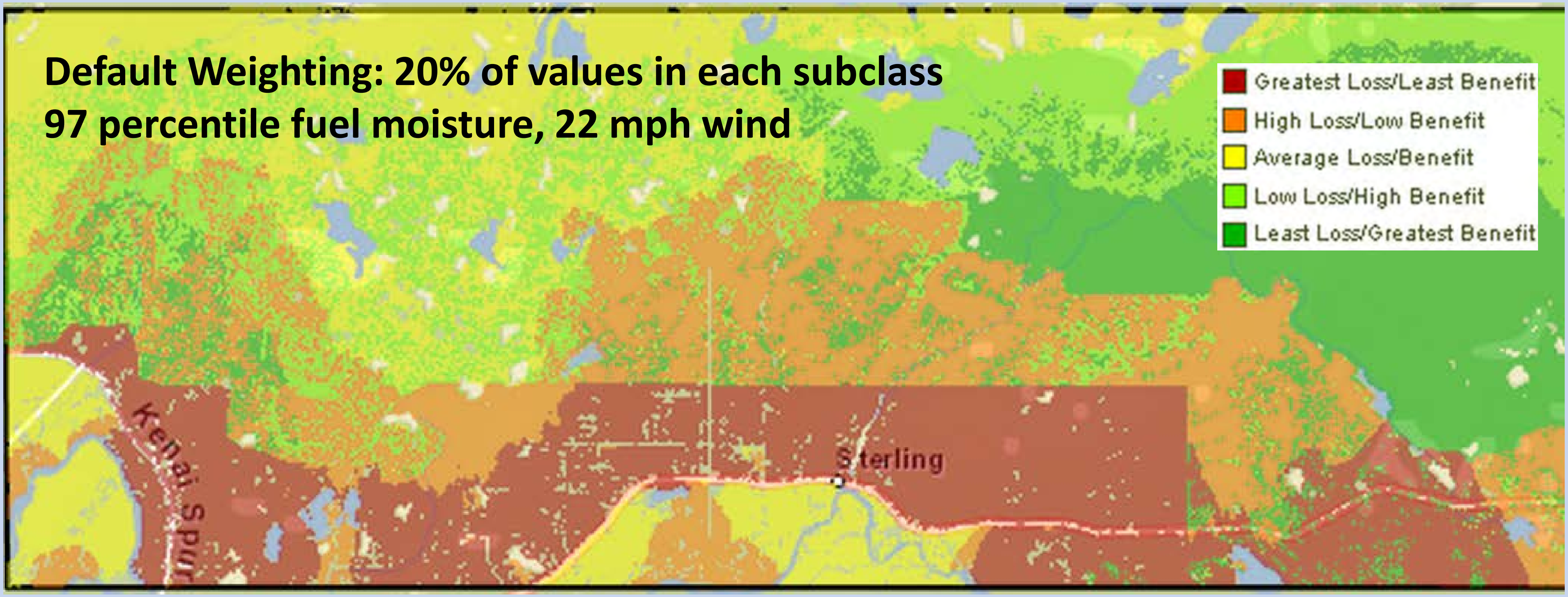
Low	Mod	High	VH
+30	+10	-10	-30

Low	Mod	High	VH
-80	-80	-80	-80

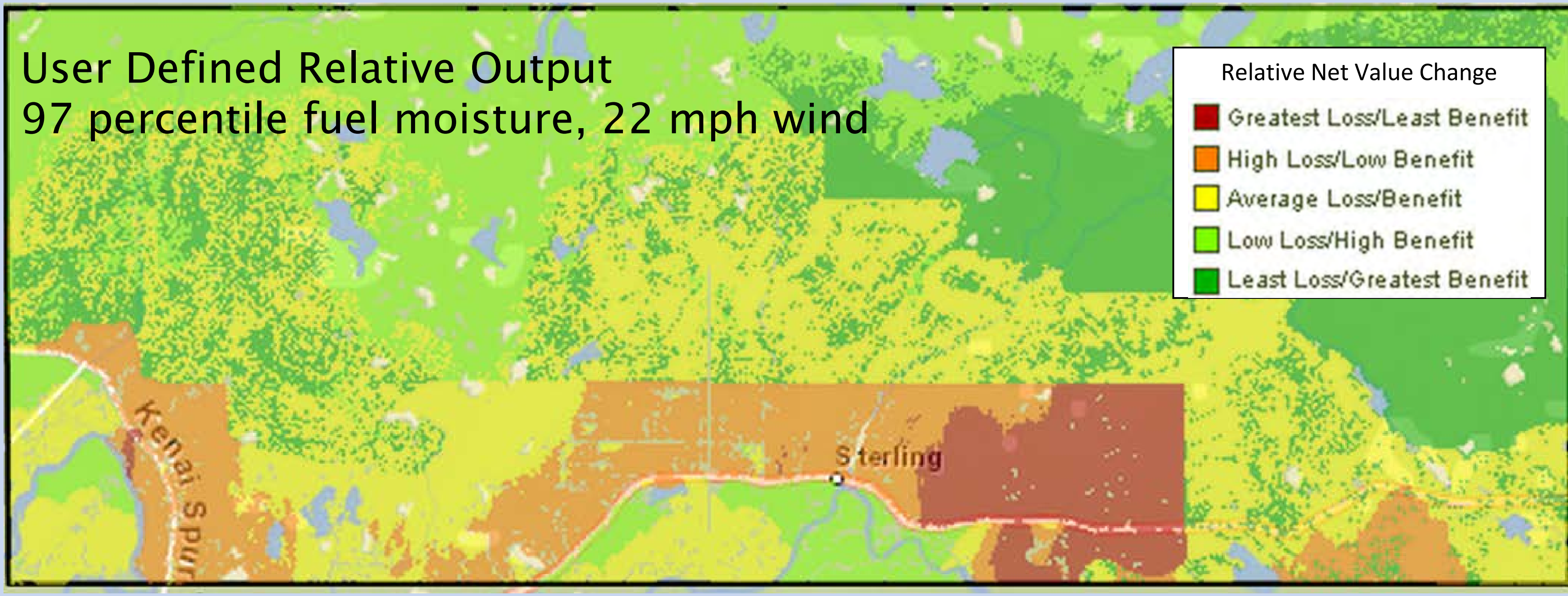
RF/Net Value Change Multiplier

Burn Probability

Net Value Change = 0.0230 x -80 =Net Value Change = -1.84



Not very useful for prioritizing fuel treatment locations; too much In Greatest Loss/Least Benefit category



User defined weighting :

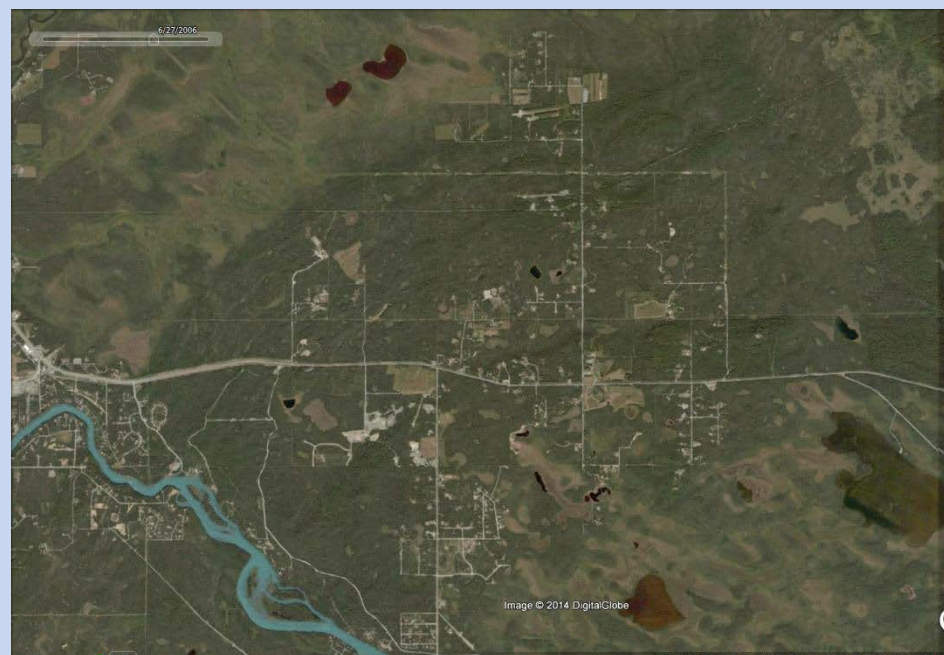
5% Greatest Loss/Least Benefit

10% High Loss/Low Benefit

30% Average Loss/Average Benefit

25% Low Loss/High Benefit

30% Least Loss/Greatest Benefit

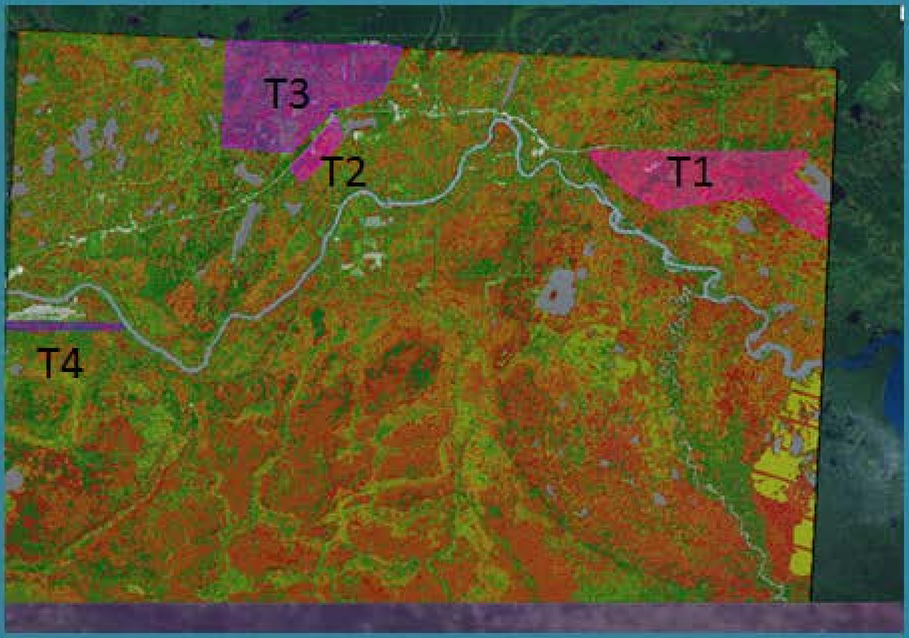


Next Steps

Refuge staff review inputs and analyses; adjust as needed

Refuge staff determine potential treatment areas, treatment type

*At some point, need to field verify fuel models and canopy characteristics



Example Treatment Objectives:

T1: Reduce flame length, crown fire, and ROS by an average of 40% using mechanical means to protect subdivision

T2: Reduce flame length, crown fire, and ROS by an average of 50% to enhance suppression capability along road and prevent fire from crossing into subdivision

T3: Reduce flame length, crown fire, and ROS by an average of 40% in subdivsion

T4: Change fuel model to grass to reduce flame length and fireline intensity by 40-50% for airport protection

Next Steps, cont'd

- Change fuel parameters in proposed treatment areas, run analyses
- Compare treated to untreated results

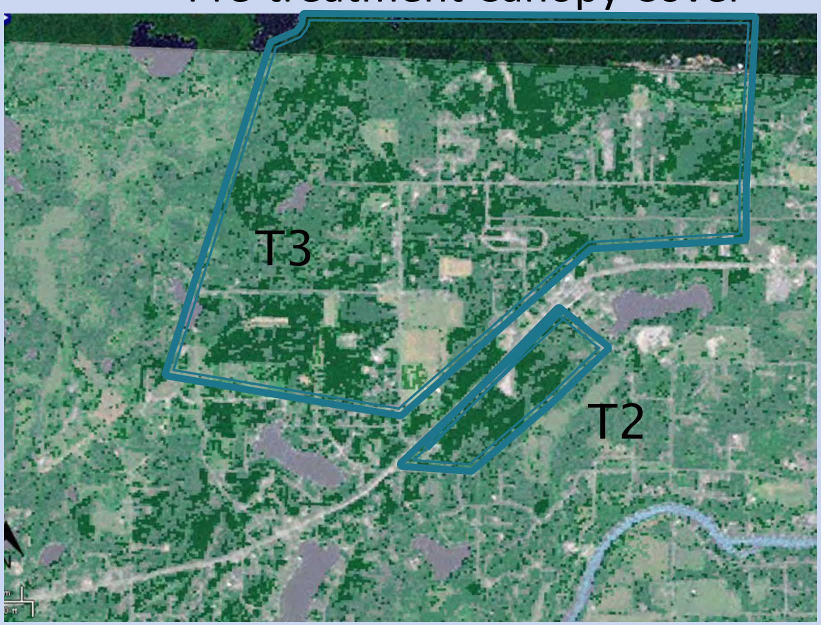
Prescriptions:

T2: If canopy cover in TU1, TU3, TU4 and TU5 (black and white spruce forest) >=15%, reduced it to 15%. Increased canopy base height to 6 feet

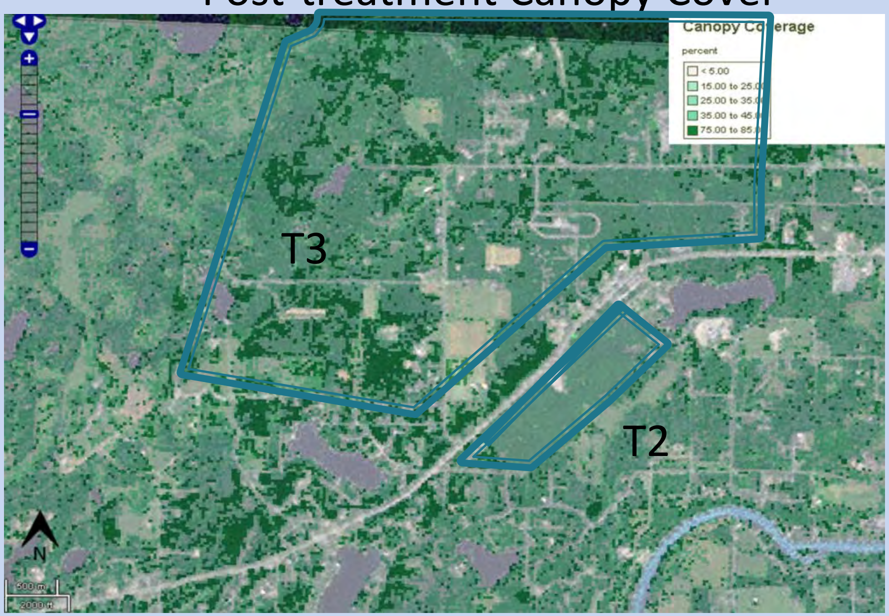
T3: If canopy cover in TU1, TU3, TU4 and TU5 >30%, set canopy cover to 30% and increase canopy base height to 6 feet

Examples

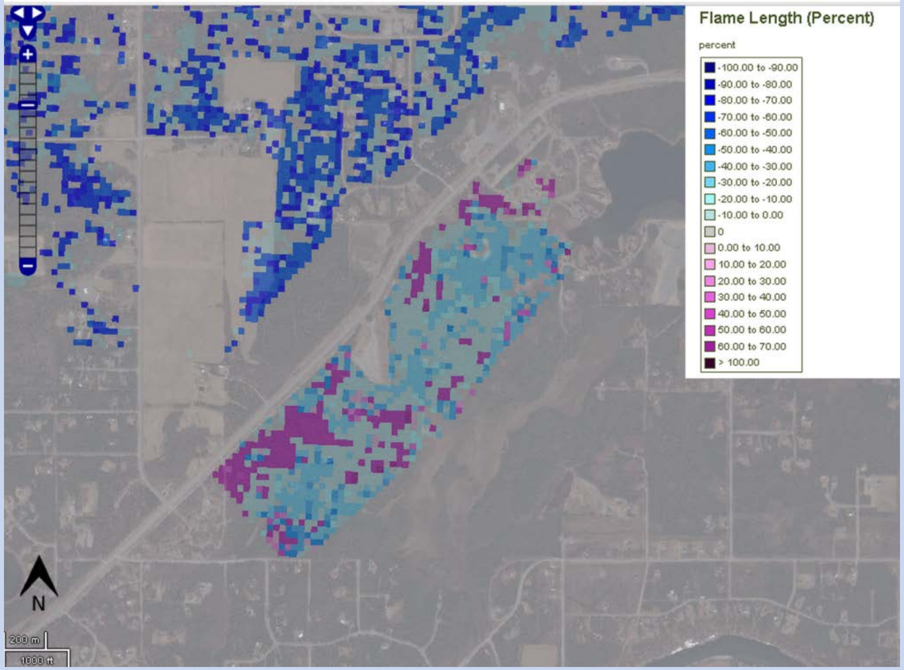
Pre-treatment Canopy Cover

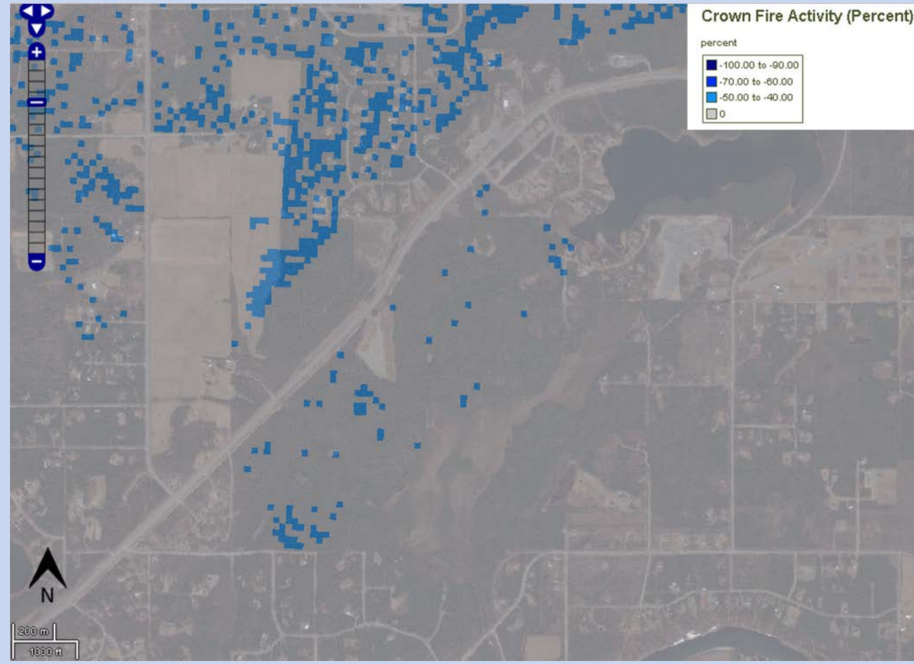


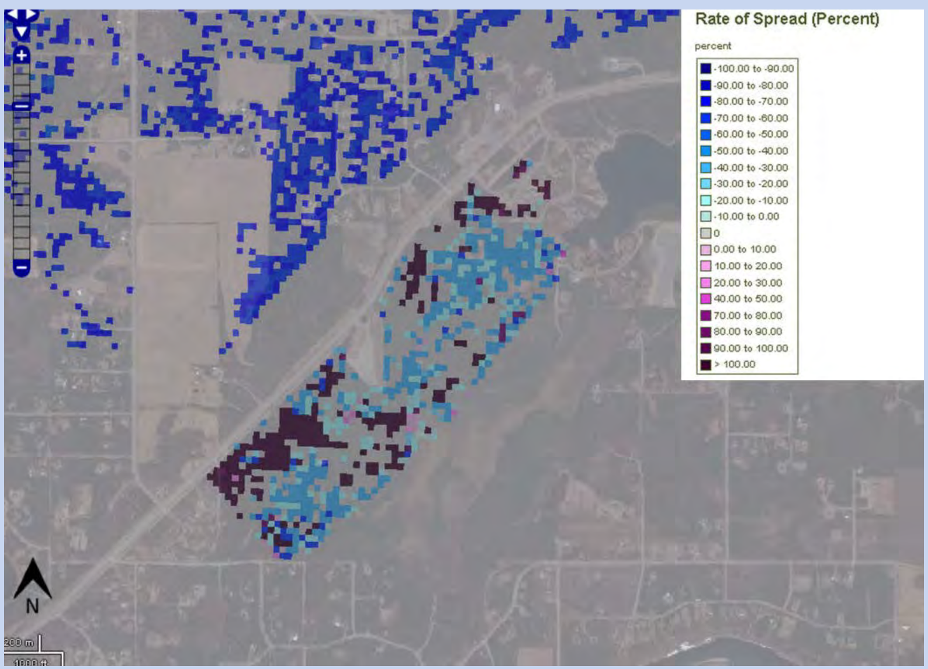
Post-treatment Canopy Cover

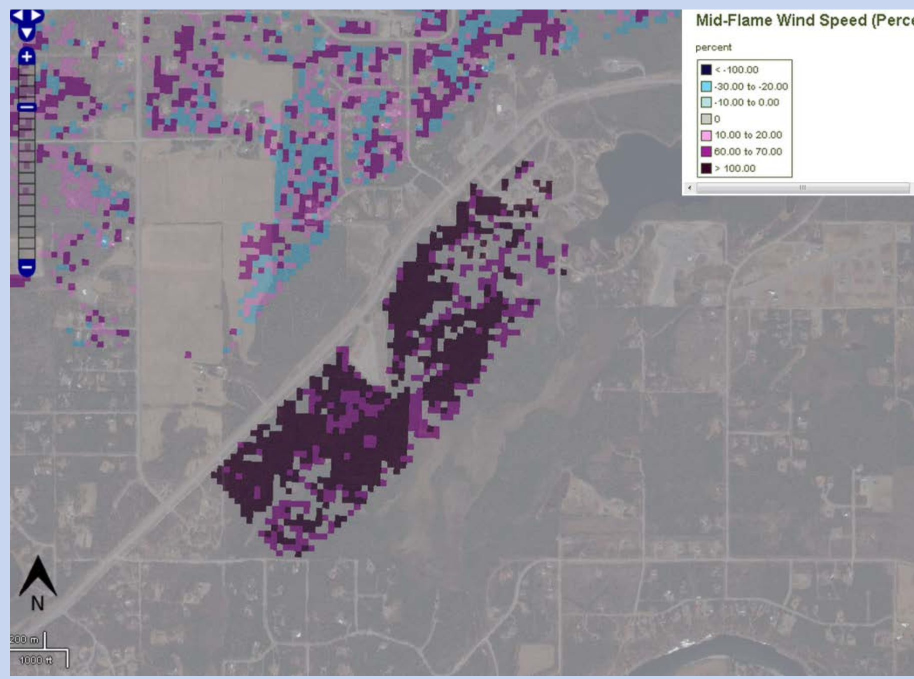


Examples (wind from southwest)

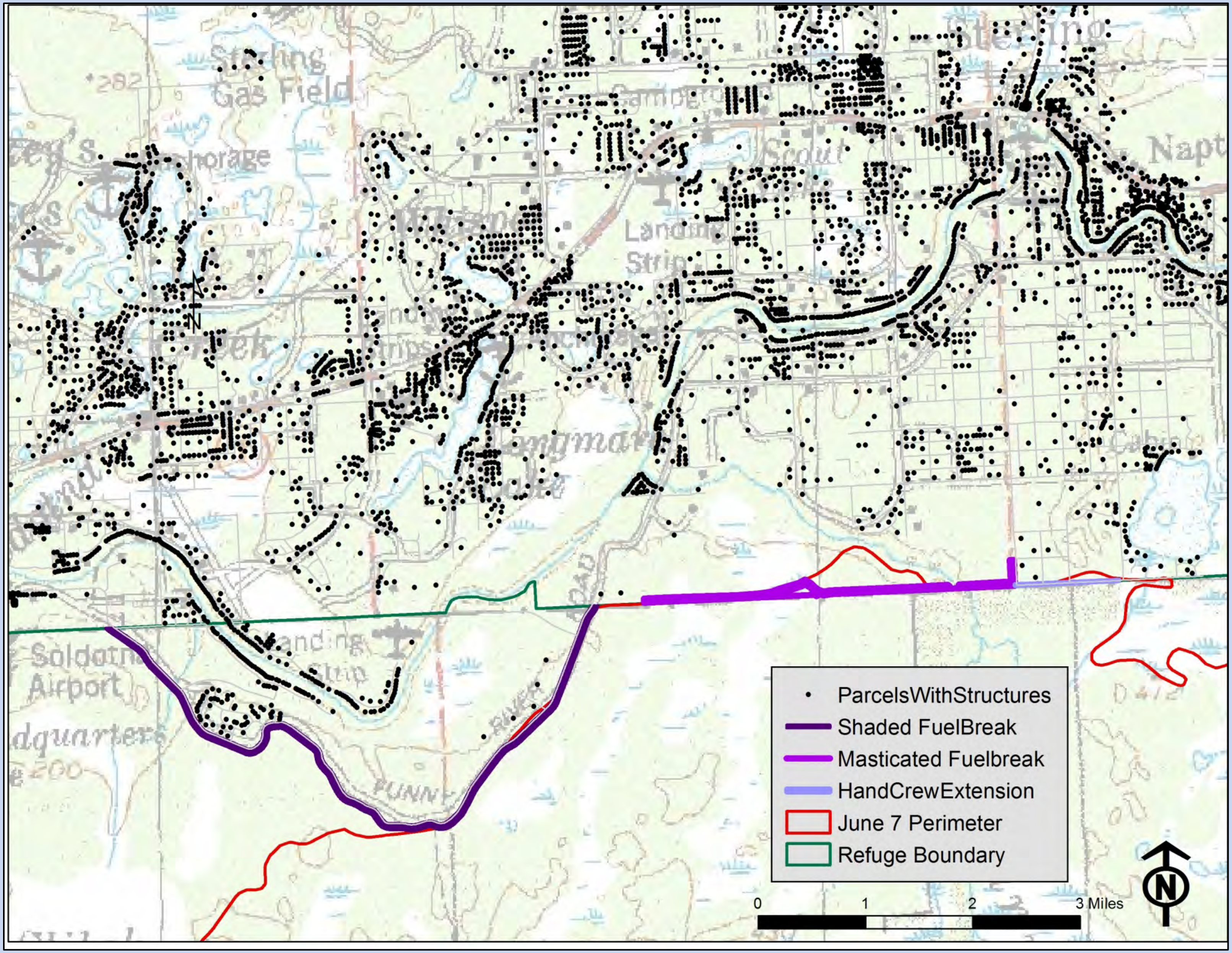






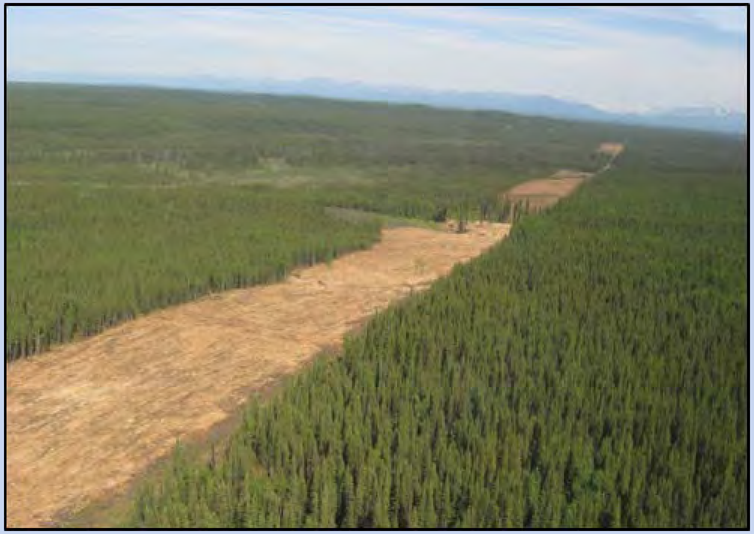


Funny River Fire Example



ParcelsWithStructures
Shaded FuelBreak
Masticated Fuelbreak
HandCrewExtension
June 7 Perimeter
Refuge Boundary
0
1
2
3 Miles
N


Shaded Fuel Break
6.5 miles/150-200 ft wide (variable)



Masticated fuelbreak: 3.5 miles/200 ft wide

Handline extension: 1 mile/60 ft wide

What would have happened without the fuelbreaks?
Were treatments good, or were we just lucky?
Can modeling be used to answer this?

- FSPro pulls from broader climatology rather than set, specific conditions. Lot of variation in FSPro results; that's what it was designed to do. Not what we want for this analysis.
- MTT results okay to show potential for spread from perimeter, but be careful of how reported
- Randomness incorporated into spotting. No way to directly compare fire spread with and without treatments if spotting is turned on
- Fuel model for masticated fuelbreaks? Non-burnable will *always* stop a fire. TL1 (181) has been used in past.
- Effect of suppression efforts difficult to incorporate

Why IFFTDS?

- Don’t know how to run in stand-alone Flammap.
  -Can tell spot origins in Flammap, not in IFTDSS or WFDSS; could provide useful information.
- Started with WFDSS short term
- Like IFTDSS’s ability to highlight changes pre- and post treatment
- Good opportunity to tie in with fuel treatment planning

Fuel Inputs

Overall landscape: LANDFIRE 2010, with global changes in fuel models (per modeling by FBAN assigned to fire).

- TU4 changed to SH5
- TU1, TL1, TL3 changed to TU3

Shaded fuelbreak:

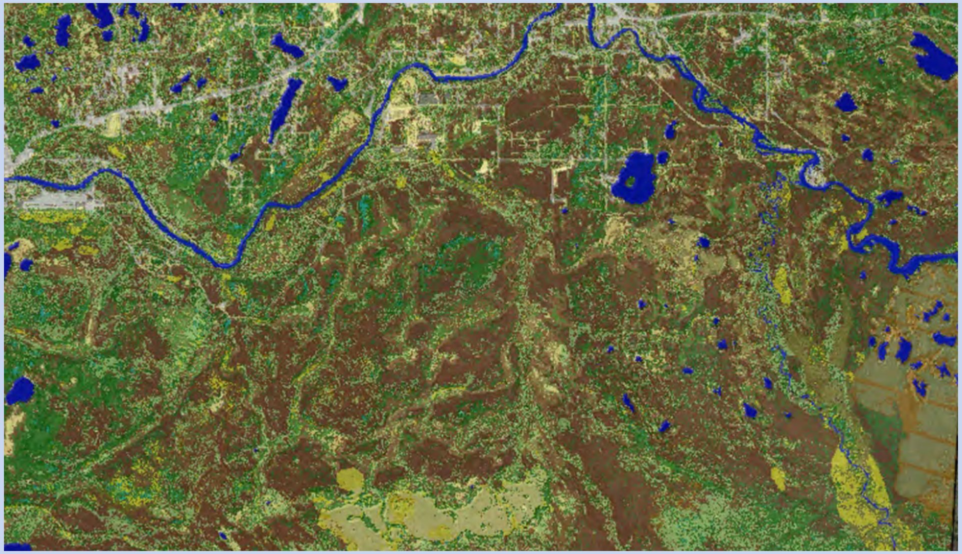
- All fuel models representing spruce forest (SH5 and TU models) changed to the TL2
- Canopy covers greater than 25% set at 25%
- CBH for trees taller than 12’ and CBH < 6’ set to 6’

Masticated fuelbreak:

- All fuel models changed to SB1

Hand treatment extension

- All fuel models changed to TL1
- Canopy cover set to 0%

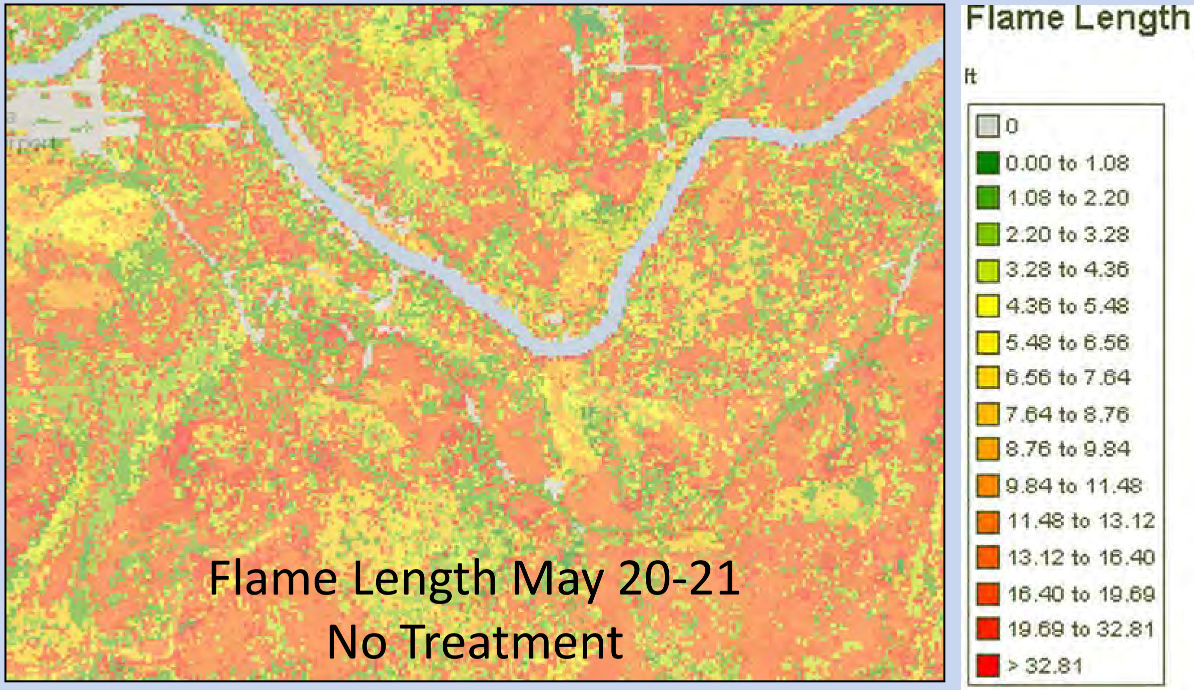


Fire behavior, weather, and fuel moisture[1] inputs for IFTDSS models

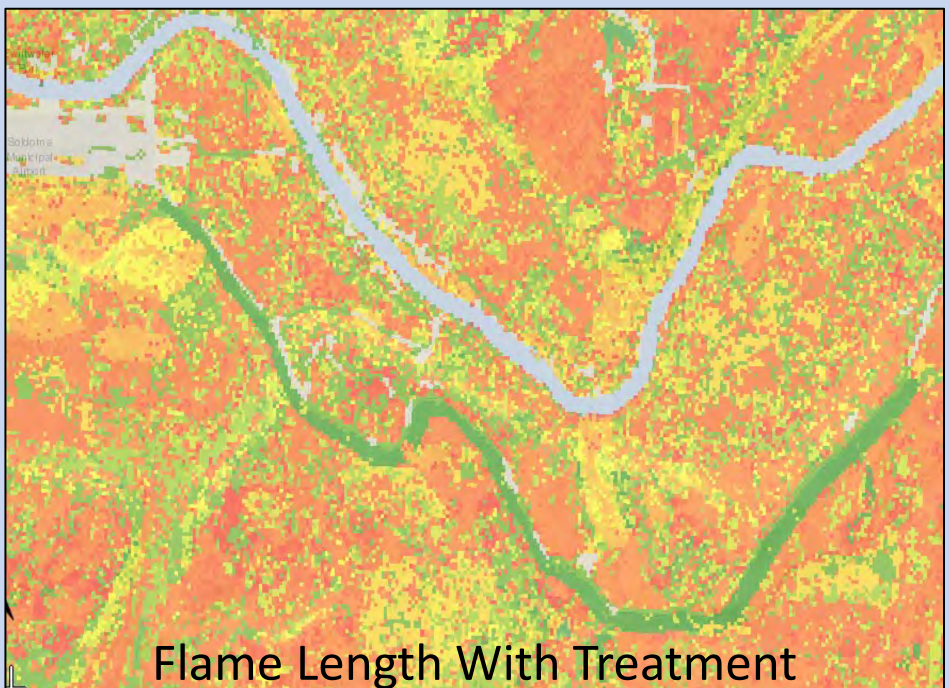
	Fire Engages Shaded Fuelbreak	Fire Engages Masticated Fuelbreak
Date and Time[2]	May 20, 2200 hr – May 21, 0400 hr	May 24, 000h hr – May 25, 2300 hr
Crown Fire Calculation Method	Scott & Reinhardt	Scott & Reinhardt
1 Hour Fuel Moisture	8	8
10 Hour Fuel Moisture	8	8
100 Hour Fuel Moisture	8	8
Live Herbaceous Fuel Moisture	30	40
Woody Fuel Moisture	60	70
Wind Speed	9.0	16.0
Wind Direction	180	225
Duration of Simulation (minutes)	600	720
Travel Path Interval (feet)	250	250
Spot Fire Probability	0 and 0.2	0 and 0.2

[1] Fuel moisture derived from Short Term Fire Behavior analyses in WFDSS

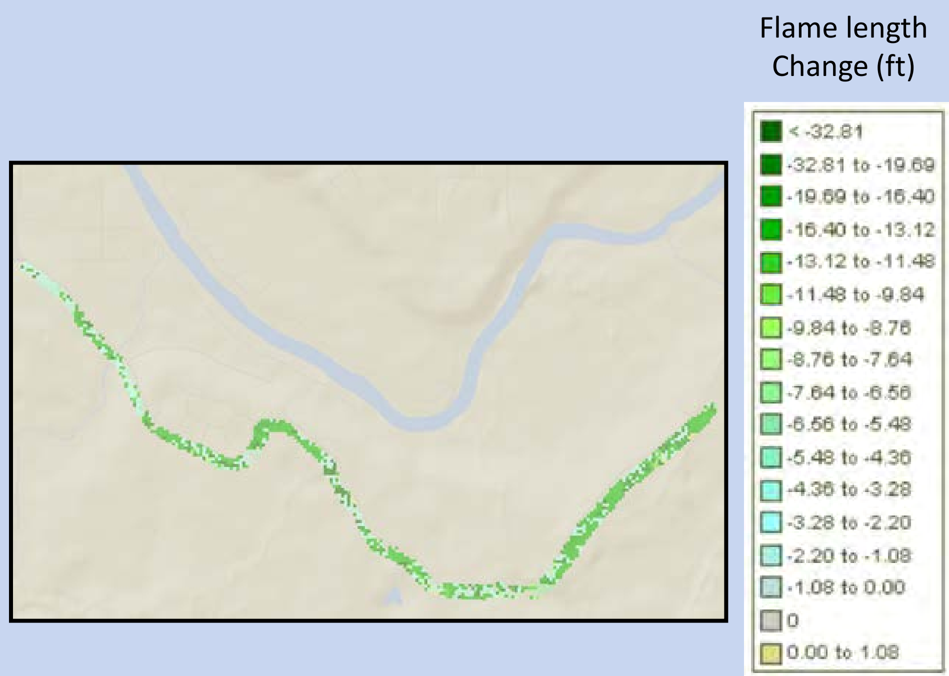
[2] Date and time used for general wind speed and direction from weather station



Flame Length May 20-21
No Treatment
Flame Length
ft
0
0.00 to 1.08
1.08 to 2.20
2.20 to 3.28
3.28 to 4.36
4.36 to 5.48
5.48 to 6.56
6.56 to 7.64
7.64 to 8.76
8.76 to 9.84
9.84 to 11.48
11.48 to 13.12
13.12 to 16.40
16.40 to 19.69
19.69 to 32.81
> 32.81

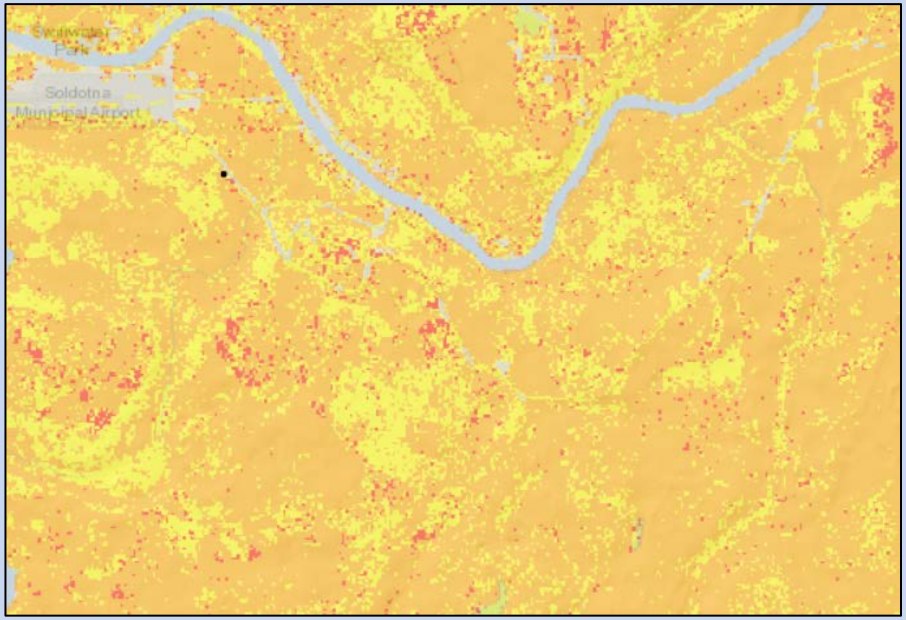


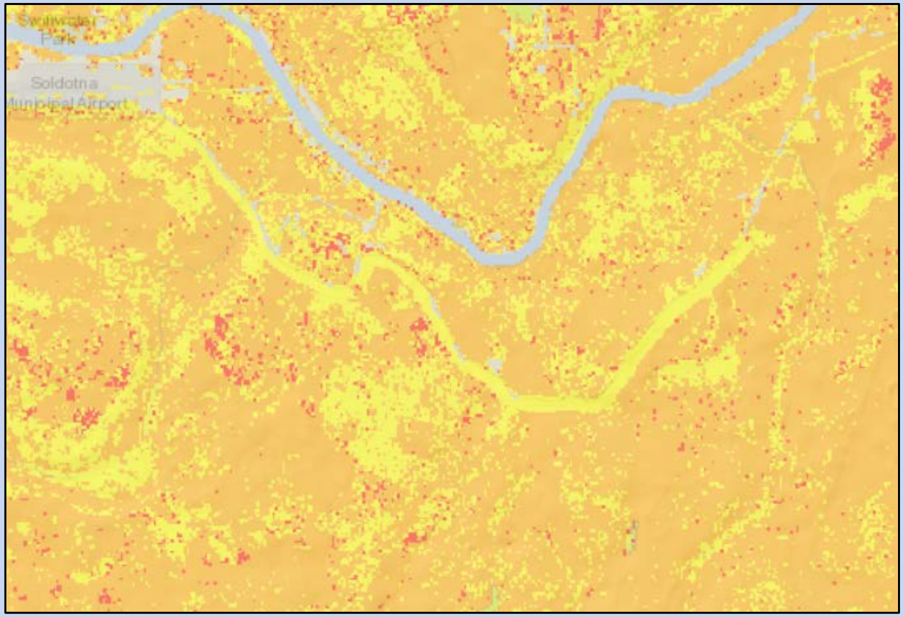
Flame Length With Treatment



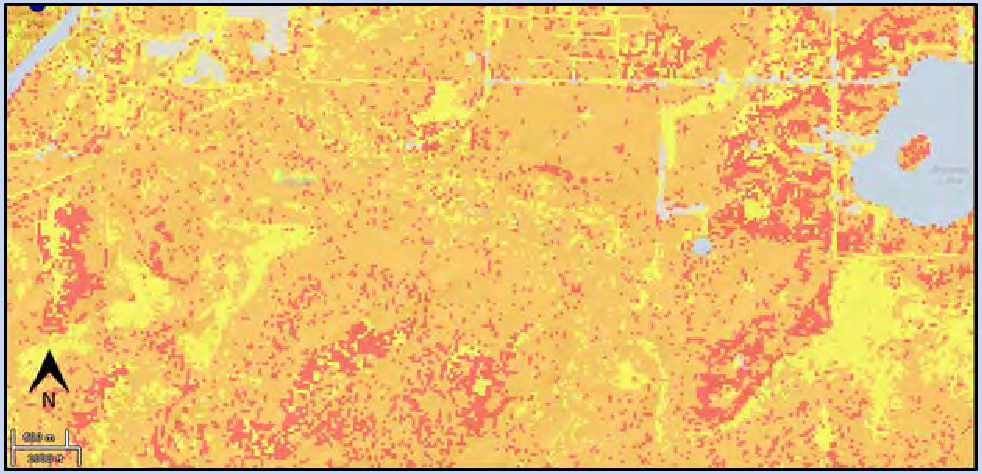
Flame length
Change (ft)
< -32.81
-32.81 to -19.69
-19.69 to -16.40
-16.40 to -13.12
-13.12 to -11.48
-11.48 to -9.84
-9.84 to -8.76
-8.76 to -7.64
-7.64 to -6.56
-6.56 to -5.48
-5.48 to -4.36
-4.36 to -3.28
-3.28 to -2.20
-2.20 to -1.08
-1.08 to 0.00
0
0.00 to 1.08

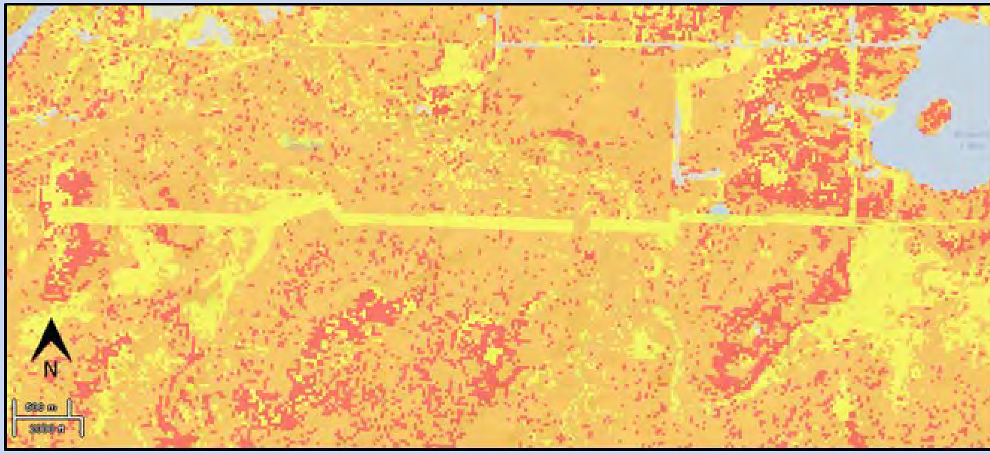
Crown Fire May 20-21
Shaded Fuelbreak



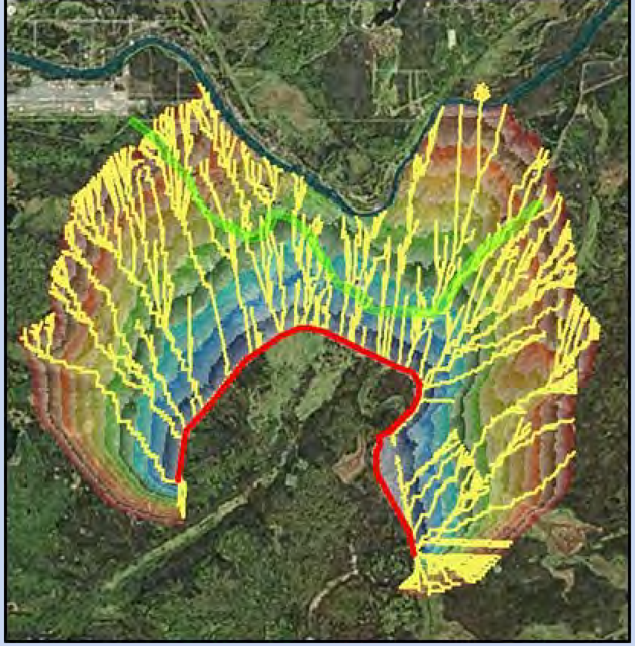


Crown Fire May 24-25
Masticated Fuelbreak

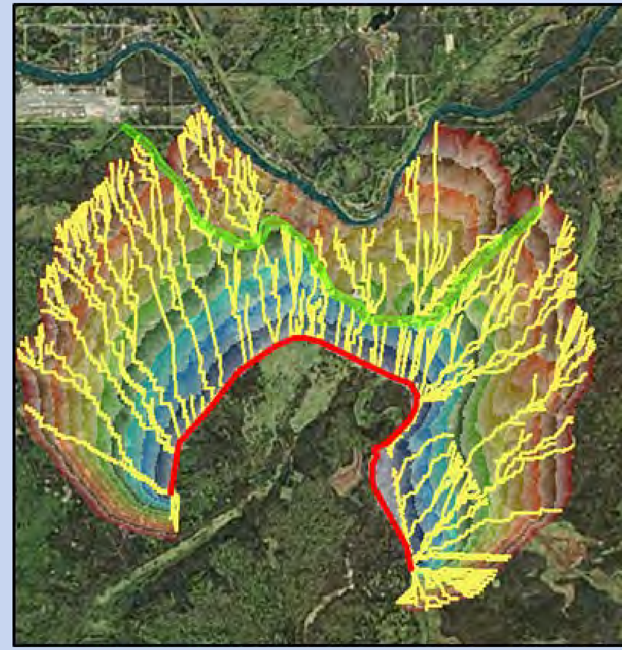




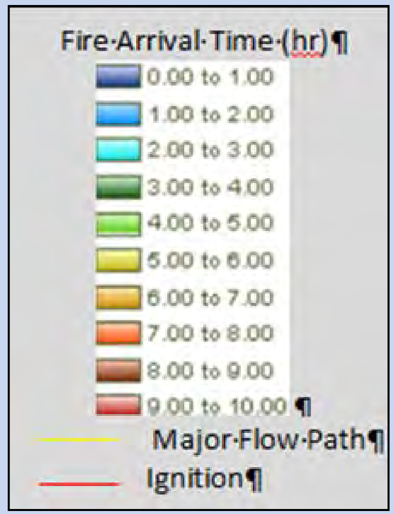
Shaded Fuelbreak

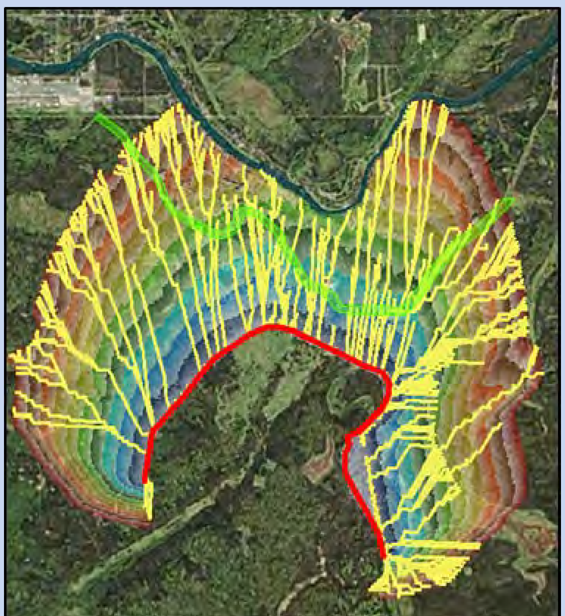


With Spotting, No Treatment

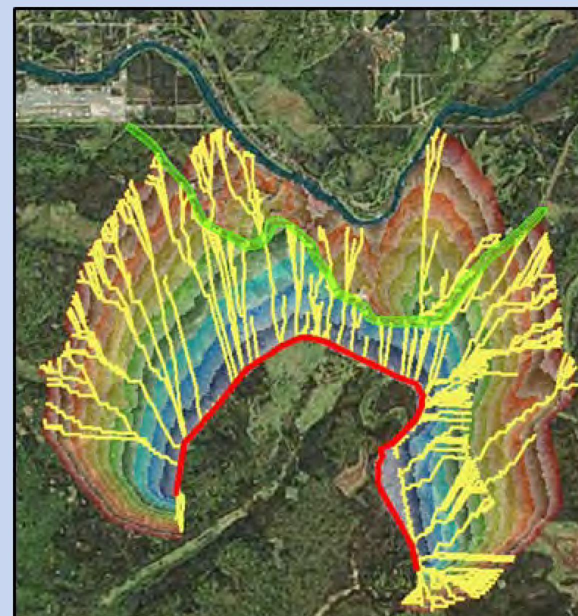


With Spotting, With Treatment





No Spotting, No Treatment

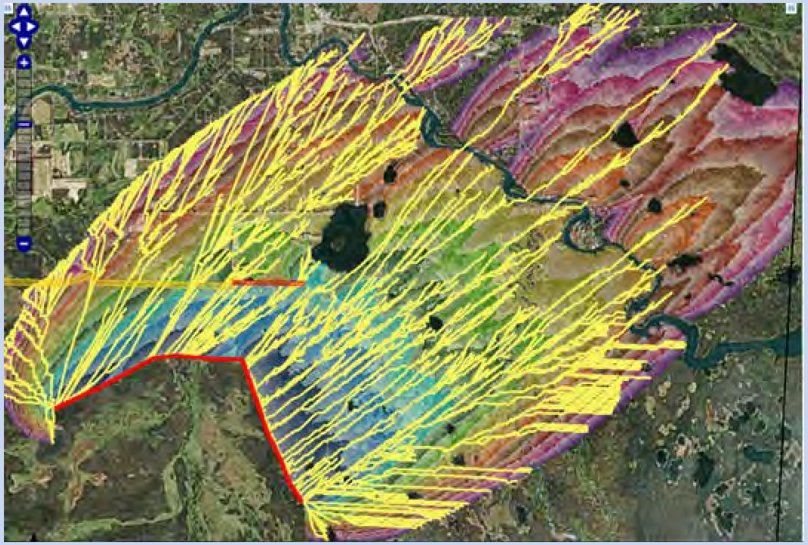


No Spotting, With Treatment

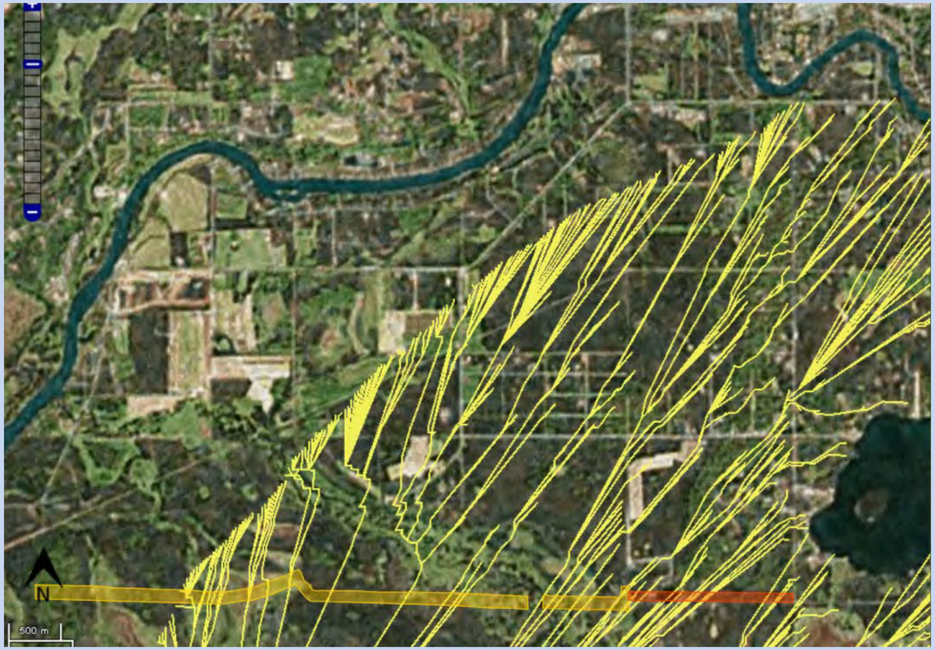
Masticated Fuelbreak

Models showed spotting across river May 24-25, with or without treatment.

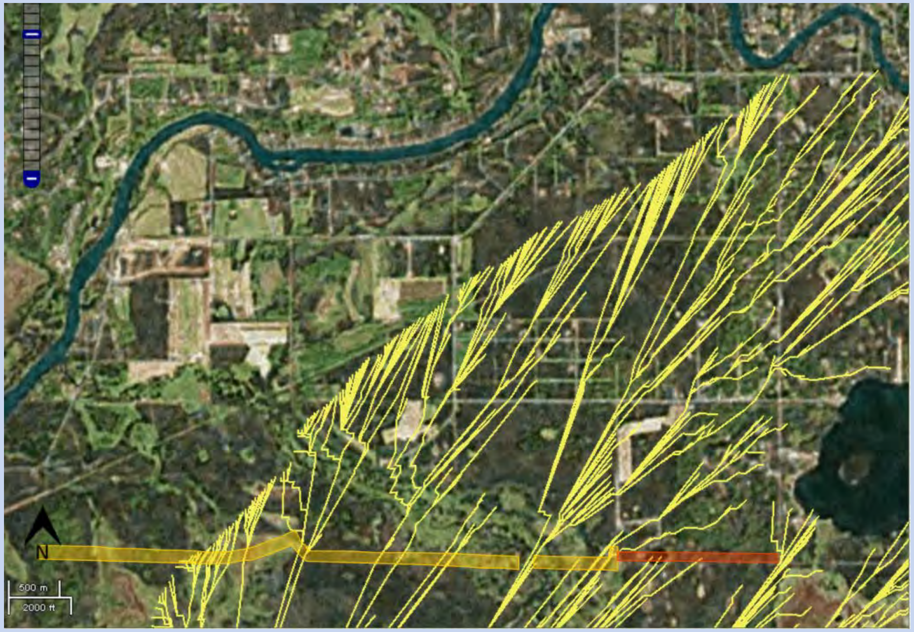
Fire actually did spot across river during this time frame.



With Spotting, With Treatment



No Spotting, No Treatment



No Spotting, With Treatment

Summary

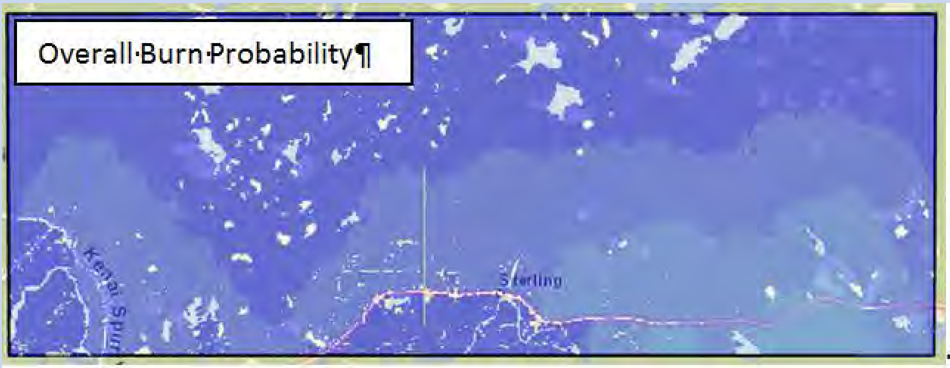
- Fuelbreaks enabled suppression resources to hold the fire south of populated areas by changing fire behavior and providing areas for firefighters to safely conduct burn outs
  - Designed to serve as anchor points, not designed to stop fire on their own
- Fuelbreaks alone could not have stopped the fire
  - Spotting distances up to 0.5 miles reported
  - Burnable material still present within fuelbreaks
- Modeling analyses supported these observations
  - Post-treatment results predicted flame lengths < 4 ft, surface fire
  - Post-treatment simulations showed reduced number of major flow paths crossing treated areas and fire excluded from some areas
- Fuelbreaks designed with average to above-average conditions in mind; FFMC and DMC exceeded previous maximum values.

Questions?


SBS
THANK YOU FIREFIGHTERS FOR ALL YOUR GOOD WORK PRAY FOR THEIR PROTECTION
KENAI NATIONAL
WILDLIFE REFUGE
VISITOR CENTER
LIMIT 35

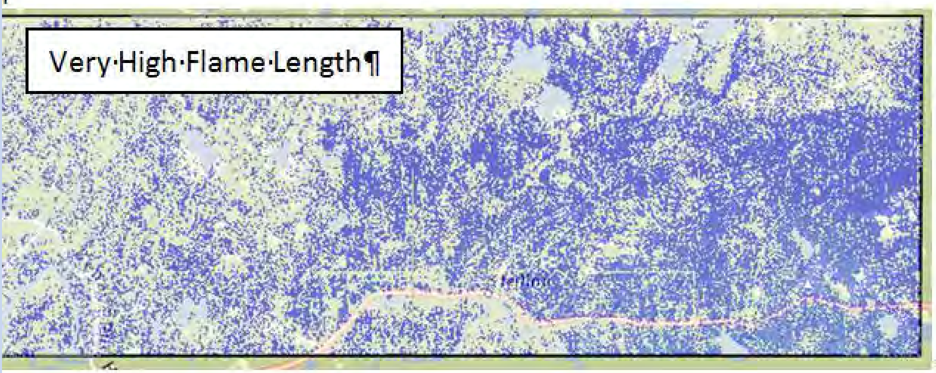
Extra Slides (not used in presentation unless to answer questions

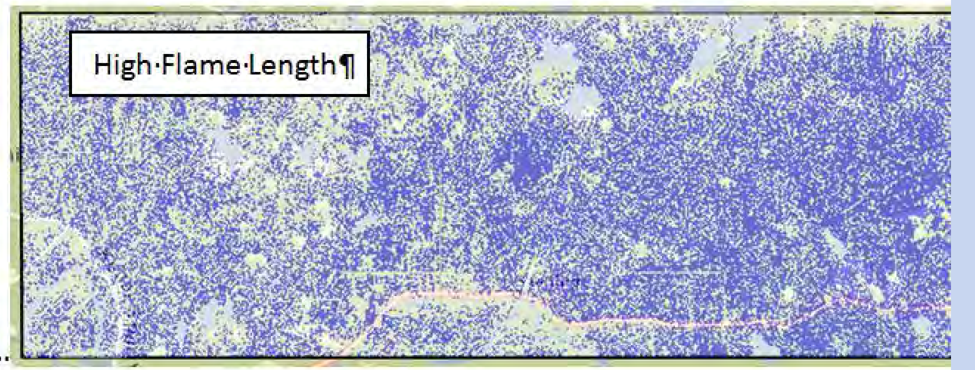
Flame Length Probability Example
90 percentile fuel moisture, 22 mph wind

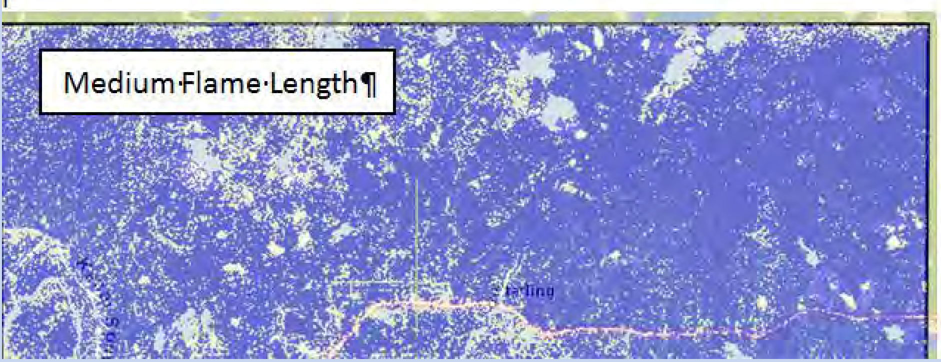


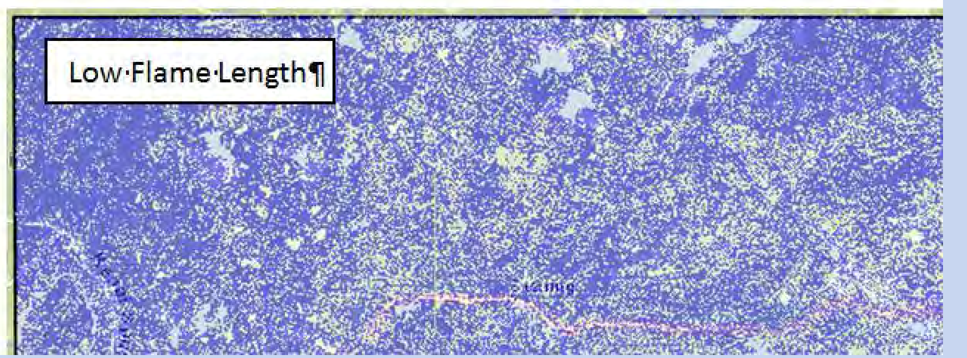
Burn Probability
0
0.00 to 0.0500
0.0500 to 0.10
0.10 to 0.15
0.15 to 0.20

Flame Length Class	Length (ft)
Low	0-4
Medium	4-8
High	8-11
Very High	>11

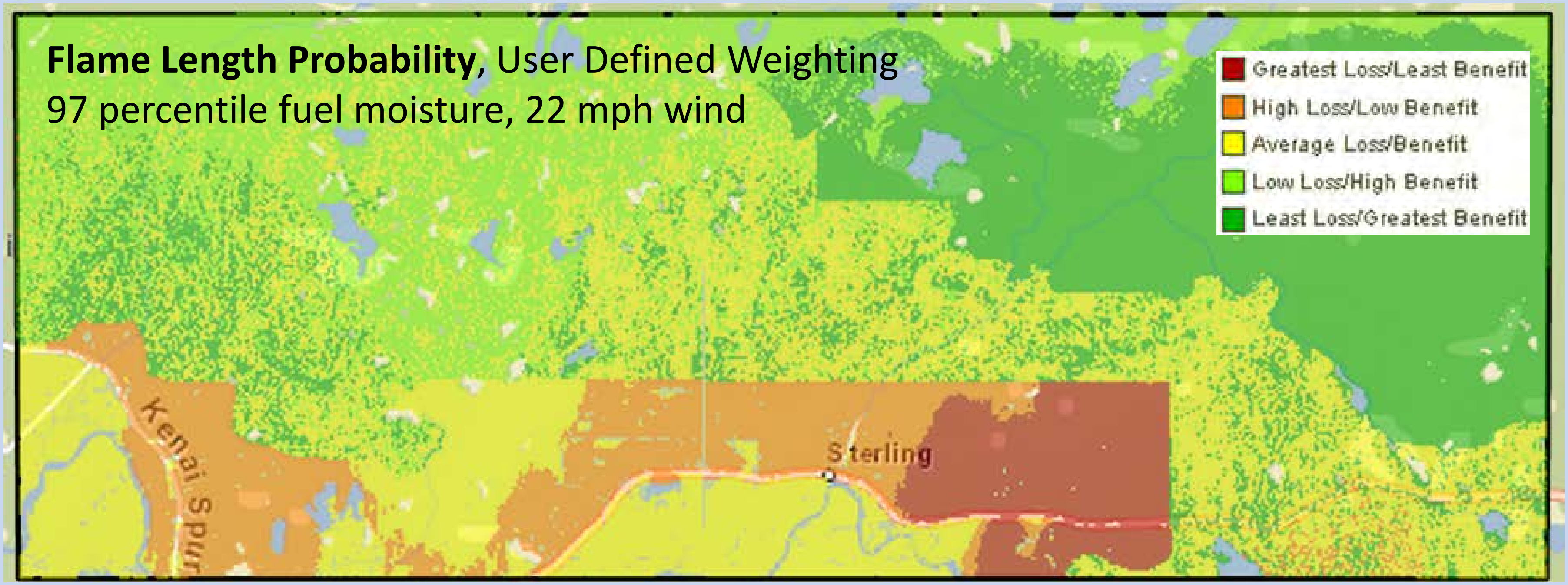


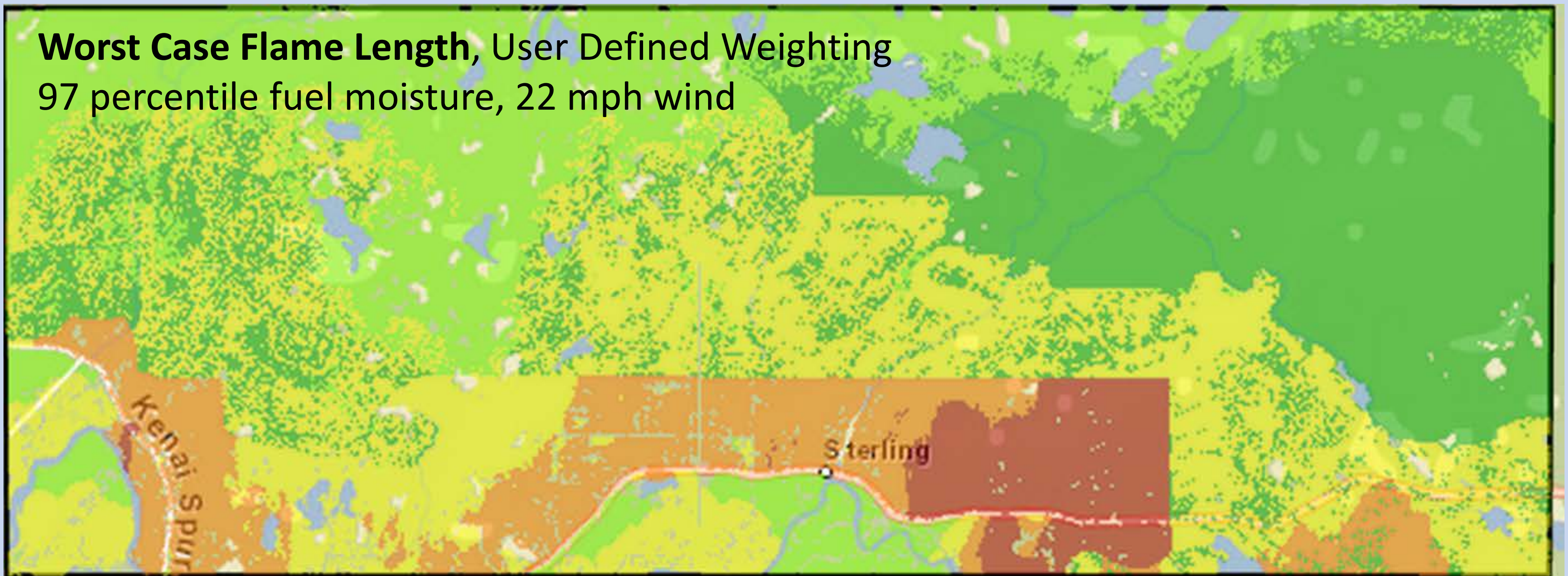




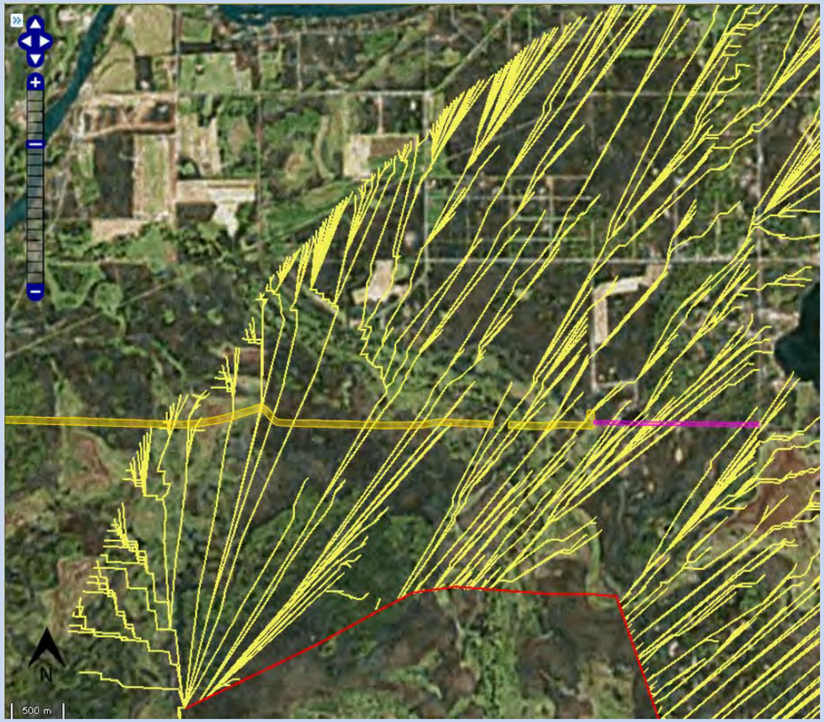


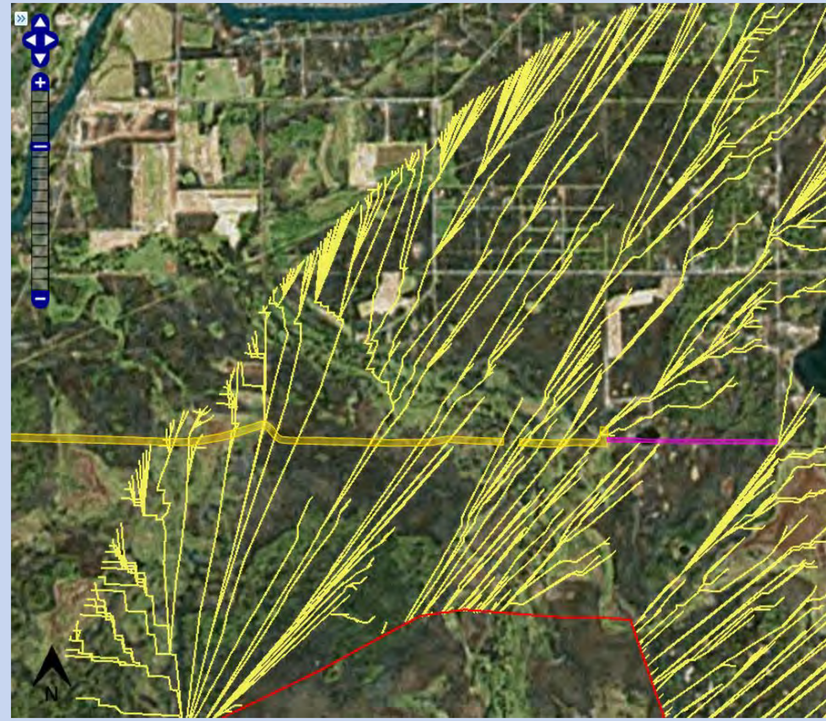
Burn probabilities will differ with each run due to random ignitions

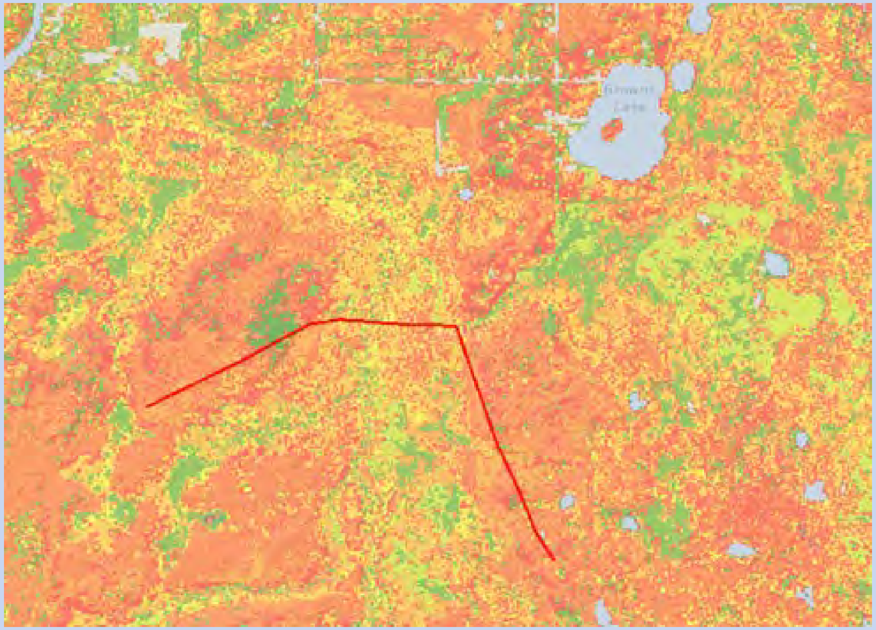

Flame Length Probability, User Defined Weighting
97 percentile fuel moisture, 22 mph wind
Greatest Loss/Least Benefit
High Loss/Low Benefit
Average Loss/Benefit
Low Loss/High Benefit
Least Loss/Greatest Benefit
Kenai Spur
Sterling


Worst Case Flame Length, User Defined Weighting
97 percentile fuel moisture, 22 mph wind
Kenai Spur
Sterling

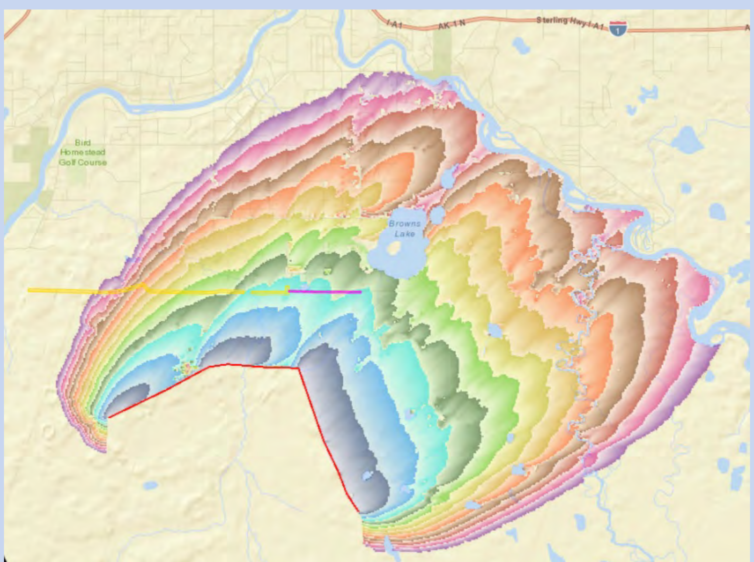
- Masticated Fuelbreak, No Spotting, Original Landscape

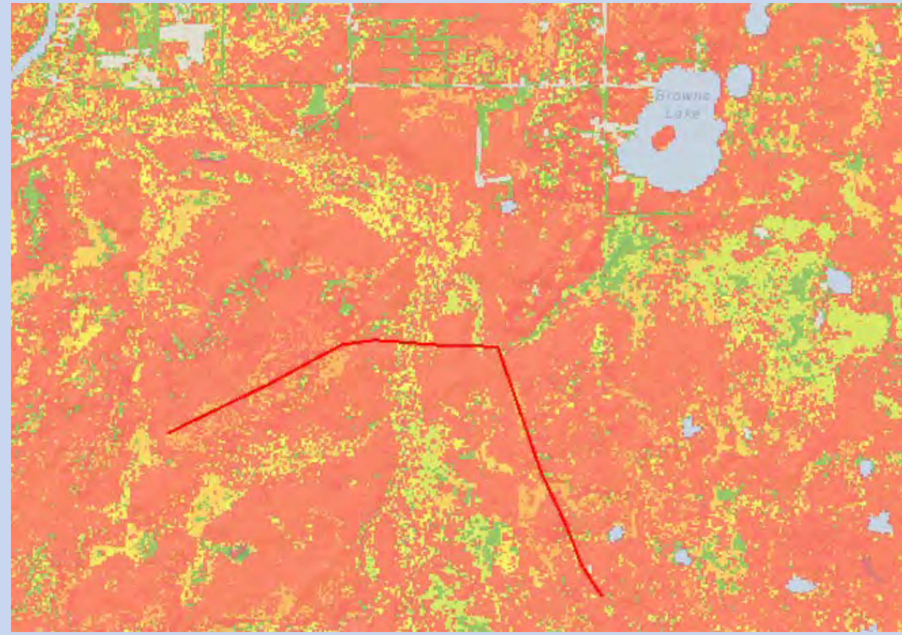






May 24 Flame length and pre-treatment fire arrival time, original landscape





May 24, with landscape changes (TU4 changed to SH5)