

## PRODUCT DESCRIPTION

TOMLINSON ASSOCIATES

**TITLE:** Forest Fire Coverage Information Product

**REQUIRED BY:** Santa Fe National Forest Headquarters/Fire & Aviation **PRODUCT #:** 12

**NAME:** Robert Morales

## SUMMARY

Firefighters and rangers will use the information generated by satellites and sensors to determine strategies to fight the fire. The emergency team requires a map containing the road network, the route to the part of the fire where it originated, the route to the part of the fire where is going, heat sensors activated, the detected humidity by sensors, and the wind direction of different weather stations. This map will be based on last Fire Risk Index (Based on NDVI), vegetation cover and hydrological network. The second map will be a Fire Dispersion Velocity Map. This map will have the index propagation that is calculated with the type of vegetation and fire risk. The output format will be in paper map and will be sent to electronic tablet. In addition, they also require a map with aerial images taken from a drone and the images captured by the security cameras of the watchtowers.

Two products

- 1.- Map of actual conditions (delivered by paper and digital format)
- 2.- Map of fire velocity dispersion (delivered by paper and digital format)
- 3.- Map of photo views (delivered by paper and digital format)

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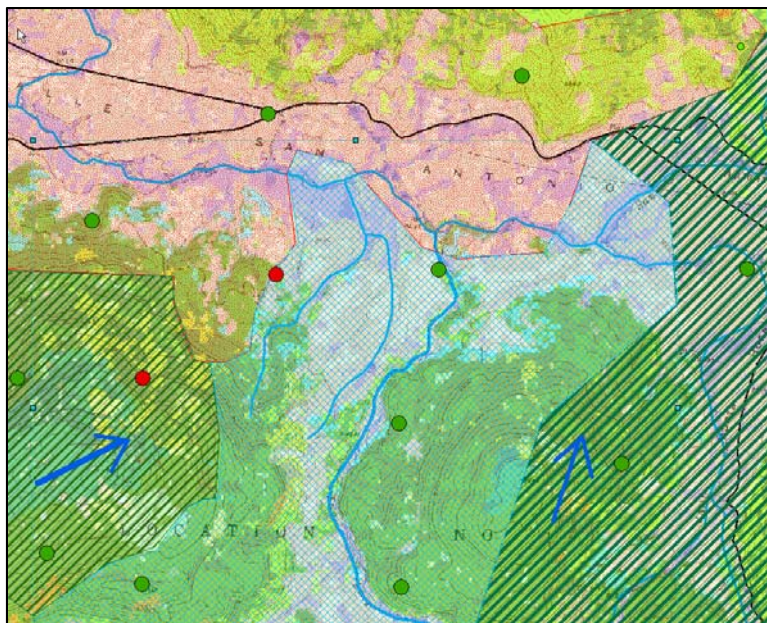
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**MAP # 1**

**SCALE:** 1 map at fire extent. (1:25,000) Maps as needed to complete a mosaic



**Legend**

- Roads
- Streams
- Rivers
- Water Body

**Vegetation**

- Aspen Forest and Woodland (Dry Mesic)
- Aspen Forest and Woodland (Moist Mesic)
- Blue Spruce Fringe Forest
- Felsenmeer Rock Field
- Forest Meadow
- Gambel Oak Mixed Montane Shrubland
- Lower Montane Grassland
- Mixed Conifer Forest and Woodland (Dry Mesic)
- Mixed Conifer Forest and Woodland (Moist Mesic)
- Montane Riparian Shrubland
- Open Water
- Ponderosa Pine Forest
- Post-Fire Bare Ground
- Roads-Disturbed Ground
- Sparsely Vegetated Rock Outcrop
- Spruce-Fir Forest and Woodland (Dry Mesic)
- Spruce-Fir Forest and Woodland (Moist Mesic)
- Upper Montane Grassland
- Wet Meadow
- Wetland

The arrows will include temperature and air velocity  
This map will contain North arrow, scale, and a locator map

- High Risk Fire
- Medium Risk Fire
- Low Risk Fire
- Wind direction
- Heat sensor activated
- Heat sensor Not-activated

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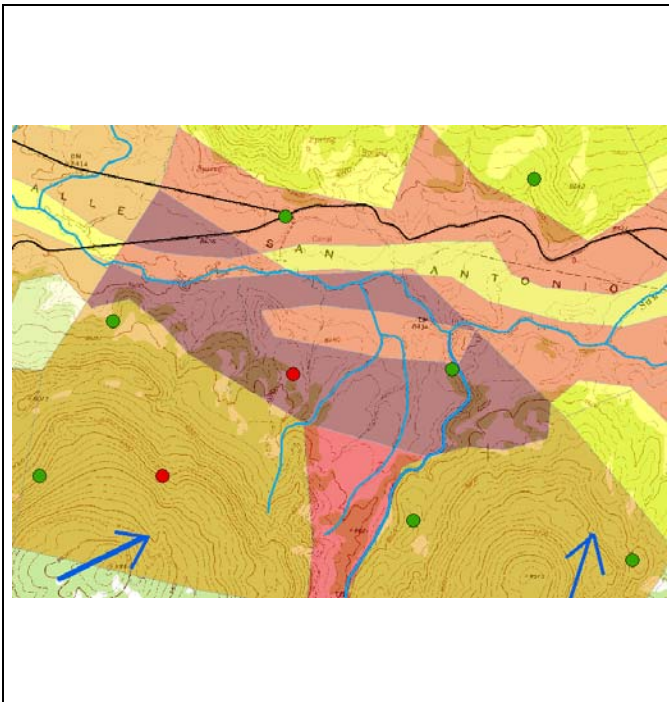
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**MAP # 2**

**SCALE:** : 1 map at fire extent. (1:25,000) Maps as needed to complete a mosaic



**Legend**

- Roads
- Streams
- Rivers
- Water Body

**Velocity Risk Index**

- 2
- 4
- 6
- 7
- 9
- 10
- 12

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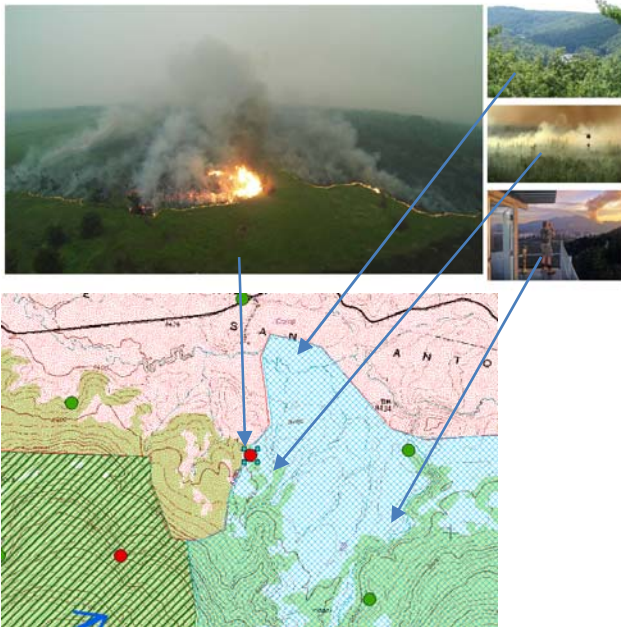
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**MAP # 3**



**SCALE:** 1:25,000

This map will contain North arrow, scale, and a locator map

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**STEPS REQUIRED TO MAKE PRODUCT**

**DATA NEEDED:**

**STEPS TO MAKE PRODUCT:  
(Using System Functions)**

Hydrology. Streams (VallesCalderaData\hydrology.mdb/hydrology_vc100km/ stream)	Used as is. Streams (Color: RGB (53,187,235) width: 3)
Hydrology. Rivers (VallesCalderaData\hydrology.mdb/ hydrology_vc100km/ major_rivers)	Used as is. Rivers (Color: RGB (86,147,238) width: 4)
Hydrology. Water Bodies (VallesCalderaData\hydrology.mdb/ hydrology_vc100km/ water_body)	Used as is. Water Bodies (Color: RGB (0,197,255), outline: RGB (191,179,175), Width: .5)
Hydrology. Wetlands (VallesCalderaData\hydrology.mdb/ hydrology_vc100km/wetlands)	Used as is. Water Bodies (Color: RGB (208,144,247), outline: RGB (191,179,175), Width: .5)
Roads (VallesCalderaData\VallesCalderaData\VC_Data.gdb/Transportation/open_roads_Nov2007)	Used as is. Roads (Color: RGB (26,26,26,), Width: 2)
Vegetation (VallesCalderaData\VallesCalderaData\ VC_Data.gdb/vegetation20m)	Used as is. Vegetation. Color ramp/classification attached to the grid data.
Topomaps (VallesCalderaData\VallesCalderaData\ baselinedata.gdb/topomap)	Used as is. Raster map with topographic data.
Climate Stations Feature (VallesCalderaData\VallesCalderaData\ VC_Data.gdb/ Weather station)	Used as is. Point replaced by an arrow depending of wind direction
Heat and humidity sensors features (VallesCalderaData\VallesCalderaData\ VC_Data.gdb/ sensors)	Used as is. Point feature
Fire Risk Map (latest, produced twice in a month extracted from NDVI, raster, VallesCalderaData\hydrology.mdb/ hydrology_vc100km/ FireRisk)	Shapefile map with Fire Risk index <ul style="list-style-type: none"> <li>• Maximum Risk = 6</li> <li>• Medium Risk = 3</li> <li>• Low Risk = 1</li> </ul>
Climate stations data (remote sensed in real time, data text file log)	Search by Attribute: <ul style="list-style-type: none"> <li>• Station Id</li> <li>• Environmental temperature (F)</li> <li>• Air Velocity (mi/hr)</li> <li>• Air Direction (mi/hr)</li> </ul>
Heat and humidity sensors data(remote sensed in real time, data text file log)	Search by Attribute: <ul style="list-style-type: none"> <li>• Sensor ID</li> <li>• Temperature (F)</li> <li>• Humidity (%)</li> </ul>

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**STEPS REQUIRED TO MAKE PRODUCT**

**DATA NEEDED:**

**STEPS TO MAKE PRODUCT:  
(Using System Functions)**

This classification is already done that is not included in the database. Do this process once a year if there are changes in vegetation.

Already reclassify vegetation raster data to:  
 Aspen Forest and Woodland (DryMesic) = 1  
 Aspen Forest and Woodland (Moist Mesic) = 1  
 Blue Spruce Fringe Forest = 1  
 Felsenmeer Rock Field = -1  
 Forest Meadow = 3  
 Gambel Oak-Mixed Montane Shrubland = 3  
 Lower Montane Grassland = 6  
 Mixed Conifer Forest and Woodland (Dry Mesic) = 1  
 Mixed Conifer Forest and Woodland (Moist Mesic) = 1  
 Montane Riparian Shrubland = 3  
 Open Water = -7  
 Ponderosa Pine Forest = 1  
 Post-Fire Bare Ground = 4  
 Roads-Disturbed Ground = -7  
 Sparsely Vegetated Rock Outcrop = 3  
 Spruce-Fir Forest and Woodland (Dry Mesic) = 1  
 Spruce-Fir Forest and Woodland (Moist Mesic) = 1  
 Upper Montane Grassland = 6  
 Wet Meadow = 2  
 Wetland = 1

Fire Dispersion Velocity Raster

Feature to raster conversion  
 Risk Fire Map Index shapefile to raster  
Raster Calculator  
 Sum Risk Fire Map Index Raster and Reclassified Vegetation Raster  
Reclassify  
 Fire Velocity Map  
 Prior result reclassify in color  
 12 = Purple  
 9 = Red  
 7 = Dark Orange  
 6 = Medium Orange  
 4 = Yellow Caterpillar  
 2 = Light Yellow  
 Below 0 = transparent  
Symbology Change  
 Selection Sensor temperature > (Environmental Temp +20) = Red  
 Not selected = Green  
 Map labeled by Georeferenced images

Heat Sensor feature

Pictures sent by drone ant watchtowers

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**LOGICAL LINKAGES:**

List to Graphic Entity

Heat and humidity sensors data to sensors features.

Map to Map

None

Attribute to Attribute

None

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**ERROR TOLERANCE:**

Type of error:	Possible occurrences	Result of Error	Impact on benefits	Error tolerance
<b>REFERENTIAL</b>	Wrong classification of vegetation	Adding the risk of fire (humidity in the plant), the velocity of burning is different for each type of vegetation.	It is possible to estimate time to reach risk areas to stop fire advance	No error tolerance
<b>TOPOLOGICAL</b>	not applicable			
<b>RELATIVE</b>	Not applicable			
<b>ABSOLUTE</b>	Raster dataset as Fire Risk Map and Vegetation Map can lead a poor Fire Dispersion Velocity Raster	The wrong size of pixel and the spatial error of location. (Ecological fallacy)	The rangers can locate the area that could expand the fire rapidly and they can take actions to cut the advance.	±40 meters



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**FREQUENCY:**

<b>YEAR</b>	2016	2017	2018	2019	2020	2021				
<b>MAPS</b>	6	6	6	6	6	6				

**FUNCTIONS INVOKED:**

<b>Function</b>	<b>Number</b>	<b>Function</b>	<b>Number</b>
Search by attribute	2		
Reclassify	2		
Feature to raster	1		
Raster calculator (sum)	1		
Symbology Change	1		
Labeling	1		

**WAIT TOLERANCE:**

<b>Wait Tolerance Category</b>	<b>Time</b>
Photographs from Watchtowers and drones will be delayed.	For maps 1 and 2 : 20 minutes For map 3 : 1 hour

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ASSOCIATES**

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**COSTS:**  
(to produce product using existing methods)

	<b>HOURS</b>	<b>\$ COST</b>
<b>LABOR</b>		
Professional GIS Analyst		\$ 60,000
Technical GIS Technician		\$ 38,000
<b>MATERIALS:</b>		\$ 2,000
<b>TOTAL COST:</b>		\$ 100,000

**PROGRAM/PROCESS RELATED:**

The labor cost is the same labor cost of the GIS Analyst (GIS-A) and Technician (GIS-T) in whole project Valles Caldera. This SIP is part of the duties of GIS-A and GIS-T

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### BENEFITS:

- A) **Savings:** This SIP does not provide savings in the project, but it can limit spending money with respect to combat fires by keeping limited the spread of fire.
  
- B) **Benefits to Agency:** This does help to establish a protocol for fast action and improve strategies in fighting fires.
  
- C) **Future and External:** This SIP has the potential to expand to different national parks and It will depend on the efficiency with which it will be applied