June 2019

LANDFIRE Capable Fuels - changes to the fuels assignment process for LF Remap

The LANDFIRE (LF) process to assign Fire Behavior Fuel Models (FBFM) to recently disturbed vegetation has been refined as part of the LF Remap production. These refinements provide a better understanding of how vegetation regrows, and fuel transitions are assigned. The objective was to improve, clarify, and simplify fuel transitions and regrowth following disturbances, such as mechanical treatments, prescribed burning, and wildfire. By synchronizing Time Since Disturbance (TSD), these refinements improve performance of fire behavior modeling and reduce the need for LF users to update the vegetation and fuel conditions to represent effective year conditions for their area of interest. LF Remap fuels are delivered as "capable" information in that the fuel transitions and regrowth following a disturbance is accounted for in the products, making the fuels products capable for an effective year. For example, disturbed areas within the fuels products now represent contemporary year conditions, in this case the products are capable for the 2019 effective year.

The differences between the fuel assignment process for LF 2014 and LF Remap are as follows:

Disturbance

LF 2014: Fuel Disturbance (FDist) provided the information required to update fuel products, but it did not provide a full history of disturbance on the landscape for the user to understand how disturbances were assigned to each of the 5 disturbance categories (Fire, Mechanical Add, Mechanical Remove, Windthrow, Insects-Disease). Also, disturbances were only represented in FDist for the last 10-year period, so disturbances older than 10 years were not visible to the user. Disturbances more than 10 years old were tracked by State and Transition models as part of the vegetation update process. In the table below, the first digit indicates the type of disturbance (1 = Fire, 2 = Mechanical Add, 3 = Mechanical Add, 4 = Windthrow, 5 = Insects-Disease). The second digit indicates Severity (1 = Low, 2= Medium, 3 = High). The third digit indicates TSD (1 = One Year, 2 = Two to Five Years, 3 = Six to Ten Years) into these 3 categories TSD1, TSD2, and TSD3.

Table 1: LANDFIRE 2014 FDist codes

Disturbance	Type	SEVERITY	Time Since Disturbance
0	No Disturbance	NA	NA
111	Fire	Low	One Year
112	Fire	Low	Two to Five Years

Disturbance	Type	SEVERITY	Time Since Disturbance
113	Fire	Low	Six to Ten Years
121	Fire	Moderate	One Year
122	Fire	Moderate	Two to Five Years
123	Fire	Moderate	Six to Ten Years
131	Fire	High	One Year
132	Fire	High	Two to Five Years
133	Fire	High	Six to Ten Years
211	Mechanical Add	Low	One Year
212	Mechanical Add	Low	Two to Five Years
213	Mechanical Add	Low	Six to Ten Years
221	Mechanical Add	Moderate	One Year
222	Mechanical Add	Moderate	Two to Five Years
223	Mechanical Add	Moderate	Six to Ten Years
231	Mechanical Add	High	One Year
232	Mechanical Add	High	Two to Five Years
233	Mechanical Add	High	Six to Ten Years
311	Mechanical Remove	Low	One Year
312	Mechanical Remove	Low	Two to Five Years
313	Mechanical Remove	Low	Six to Ten Years
321	Mechanical Remove	Moderate	One Year
322	Mechanical Remove	Moderate	Two to Five Years
323	Mechanical Remove	Moderate	Six to Ten Years
331	Mechanical Remove	High	One Year
332	Mechanical Remove	High	Two to Five Years
333	Mechanical Remove	High	Six to Ten Years
411	Windthrow	Low	One Year
412	Windthrow	Low	Two to Five Years
413	Windthrow	Low	Six to Ten Years
421	Windthrow	Moderate	One Year
422	Windthrow	Moderate	Two to Five Years
423	Windthrow	Moderate	Six to Ten Years
431	Windthrow	High	One Year
432	Windthrow	High	Two to Five Years
433	Windthrow	High	Six to Ten Years
511	Insects-Disease	Low	One Year
512	Insects-Disease	Low	Two to Five Years
513	Insects-Disease	Low	Six to Ten Years
521	Insects-Disease	Moderate	One Year
522	Insects-Disease	Moderate	Two to Five Years

Disturbance	Type	SEVERITY	Time Since Disturbance
523	Insects-Disease	Moderate	Six to Ten Years
531	Insects-Disease	High	One Year
532	Insects-Disease	High	Two to Five Years
533	Insects-Disease	High	Six to Ten Years

LF Remap: New with LF Remap, Historical Disturbance (HDist) links the year and disturbance source code together so that the user can see the type, severity, and year of disturbance. This linked value, represented in the value field of the grid, is aggregated into the 5 original disturbance categories and 1 additional category called “Mechanical Unknown.” Mechanical Unknown was added to describe mechanical disturbances where there is not enough information to distinguish between the “Mechanical Add” or “Mechanical Remove” categories. Most Mechanical Unknown disturbances are treated as Mechanical Remove in LF Remap.

This new product (HDist) is used in the development of both vegetation and fuels. Disturbances older than 10 years are given an HDist code of “0,” meaning non-disturbed. Changes in these areas (beyond 10 years) are tracked by State and Transition models. The HDist Table below includes a field heading and column to track the year of the disturbance. The coding scheme is the same as LF 2014 except a sixth type of disturbance is added for Mechanical Unknown.

Table 2: LF Remap HDist codes.

Disturbance	Type	SEVERITY	Time Since Disturbance
0	No Disturbance	NA	NA
111	Fire	Low	One Year
112	Fire	Low	Two to Five Years
113	Fire	Low	Six to Ten Years
121	Fire	Moderate	One Year
122	Fire	Moderate	Two to Five Years
123	Fire	Moderate	Six to Ten Years
131	Fire	High	One Year
132	Fire	High	Two to Five Years
133	Fire	High	Six to Ten Years
211	Mechanical Add	Low	One Year
212	Mechanical Add	Low	Two to Five Years
213	Mechanical Add	Low	Six to Ten Years
221	Mechanical Add	Moderate	One Year
222	Mechanical Add	Moderate	Two to Five Years
223	Mechanical Add	Moderate	Six to Ten Years
231	Mechanical Add	High	One Year

Disturbance	Type	SEVERITY	Time Since Disturbance
232	Mechanical Add	High	Two to Five Years
233	Mechanical Add	High	Six to Ten Years
311	Mechanical Remove	Low	One Year
312	Mechanical Remove	Low	Two to Five Years
313	Mechanical Remove	Low	Six to Ten Years
321	Mechanical Remove	Moderate	One Year
322	Mechanical Remove	Moderate	Two to Five Years
323	Mechanical Remove	Moderate	Six to Ten Years
331	Mechanical Remove	High	One Year
332	Mechanical Remove	High	Two to Five Years
333	Mechanical Remove	High	Six to Ten Years
411	Windthrow	Low	One Year
412	Windthrow	Low	Two to Five Years
413	Windthrow	Low	Six to Ten Years
421	Windthrow	Moderate	One Year
422	Windthrow	Moderate	Two to Five Years
423	Windthrow	Moderate	Six to Ten Years
431	Windthrow	High	One Year
432	Windthrow	High	Two to Five Years
433	Windthrow	High	Six to Ten Years
511	Insects-Disease	Low	One Year
512	Insects-Disease	Low	Two to Five Years
513	Insects-Disease	Low	Six to Ten Years
521	Insects-Disease	Moderate	One Year
522	Insects-Disease	Moderate	Two to Five Years
523	Insects-Disease	Moderate	Six to Ten Years
531	Insects-Disease	High	One Year
532	Insects-Disease	High	Two to Five Years
533	Insects-Disease	High	Six to Ten Years
611	Mechanical Unknown	Low	One Year
612	Mechanical Unknown	Low	Two to Five Years
613	Mechanical Unknown	Low	Six to Ten Years
621	Mechanical Unknown	Moderate	One Year
622	Mechanical Unknown	Moderate	Two to Five Years
623	Mechanical Unknown	Moderate	Six to Ten Years
631	Mechanical Unknown	High	One Year
632	Mechanical Unknown	High	Two to Five Years
633	Mechanical Unknown	High	Six to Ten Years

Vegetation

LF 2014: Existing Vegetation Type, Cover, and Height (EVT, EVC, EVH) represented vegetation conditions as of the last year of disturbance for both non-disturbed and disturbed areas. For example, LF 2014 represented vegetation conditions that would have been expected during the year 2014 even though the products were not available until 2016. In LF 2014 and earlier updates, EVT, EVC, and EVH informed fuel product creation. For areas that had experienced disturbance within the last 10 years, EVT, EVC, and EVH codes were adjusted to represent the existing vegetation conditions to what would be expected immediately after the disturbance occurred. “EVT_Fuel” was an attribute of the EVT product used to designate the original 2000 series EVT codes, instead of the split and reclassified 3000 series codes. EVC were classified in 10% classes that reached a maximum of 90 to 100%. EVH were depicted using meters and were classified into 3 herb, 4 shrub, and 5 tree classes.

Table 3: 2000 vs 3000 series EVT split

3000 Series	3000 Series Name	2000 Series	2000 Series Name
3162	Western Great Plains Floodplain Forest and Woodland	2162	Tr Western Great Plains Floodplain Systems
3253	Western Great Plains Floodplain Shrubland	2162	Tr Western Great Plains Floodplain Systems
3254	Western Great Plains Floodplain Herbaceous	2162	Tr Western Great Plains Floodplain Systems

Table 4: LF 2014 EVH Attribute Data Dictionary

Attribute Value	Description: EVH layer represents the average height of the dominant vegetation for a 30-m grid cell and is binned separately for each life form.
11	Open Water
12	Snow/Ice
13	Developed-Upland Deciduous Forest
14	Developed-Upland Evergreen Forest
15	Developed-Upland Mixed Forest
16	Developed-Upland Herbaceous
17	Developed-Upland Shrubland
18	Developed-Herbaceous Wetland Vegetation
19	Developed-Woody Wetland Vegetation
20	Developed - General
21	Developed - Open Space
22	Developed - Low Intensity
23	Developed - Medium Intensity
24	Developed - High Intensity

Attribute Value	Description: EVH layer represents the average height of the dominant vegetation for a 30-m grid cell and is binned separately for each life form.
25	Developed-Roads
31	Barren
32	Quarries-Strip Mines-Gravel Pits
60	NASS-Orchard
61	NASS-Vineyard
62	NASS-Bush fruit and berries
63	NASS-Row Crop-Close Grown Crop
64	NASS-Row Crop
65	NASS-Close Grown Crop
66	NASS-Fallow/Idle Cropland
68	NASS-Pasture and Hayland
69	NASS-Wheat
75	NASS-Aquaculture
76	Herbaceous Semi-dry
80	Herbaceous Semi-wet
81	Recently Disturbed Forest
82	Agriculture - General
83	Pasture/Hay
84	Cultivated Crops
95	Small Grains
100	Fallow
101	Urban-Recreational Grasses
102	Herbaceous Wetlands
103	Sparse Vegetation Height
104	Herb Height 0 to 0.5 meters
105	Herb Height 0.5 to 1.0 meters
106	Herb Height > 1.0 meter
107	Shrub Height > 3.0 meters
108	Forest Height 0 to 5 meters
109	Forest Height 5 to 10 meters
110	Forest Height 10 to 25 meters
111	Forest Height 25 to 50 meters
112	Forest Height > 50 meters
150	Sparse Vegetation Height
151	Herb Height >0 and < 0.5m
152	Herb Height >= 0.5m

Attribute Value	Description: EVH layer represents the average height of the dominant vegetation for a 30-m grid cell and is binned separately for each life form.
153	Shrub Height >0 and < 0.5m
154	Shrub Height >= 0.5 and < 1.5m
155	Shrub Height >= 1.5m
156	Tree Height > 0 and < 10m
157	Tree Height >= 10m
Count	**number of pixels for the corresponding value**
Classnames	**Display attribute, EVH is represented in meters and life forms are binned separately. EV bin intervals for AK are courser than CONUS and HI.**
Open Water	NLCD class
Snow/Ice	NLCD class
Developed-Upland Deciduous Forest	NLCD class
Developed-Upland Evergreen Forest	NLCD class
Developed-Upland Mixed Forest	NLCD class
Developed-Upland Herbaceous	NLCD class
Developed-Upland Shrubland	NLCD class
Developed-Herbaceous Wetland Vege	NLCD class
Developed-Woody Wetland Vegetation	NLCD class
Developed - General	NLCD class
Developed - Open Space	NLCD class
Developed - Low Intensity	NLCD class
Developed - Medium Intensity	NLCD class
Developed - High Intensity	NLCD class
Developed-Roads	NLCD class
Barren	NLCD class
Quarries-Strip Mines-Gravel Pits	NLCD class
NASS-Orchard	NASS class
NASS-Vineyard	NASS class
NASS-Bush fruit and berries	NASS class
NASS-Row Crop-Close Grown Crop	NASS class
NASS-Row Crop	NASS class
NASS-Close Grown Crop	NASS class
NASS-Fallow/Idle Cropland	NASS class
NASS-Pasture and Hayland	NASS class
NASS-Wheat	NASS class
NASS-Aquaculture	NASS class
Herbaceous Semi-dry	LANDFIRE class
Herbaceous Semi-wet	LANDFIRE class

LF Remap: Enhancements to LF EVC and EVH products required new fuel products to be created. No longer grouped into categories, LF Remap EVC and EVH now represent the landscape with continuous data values. To better characterize the landscape from a fuels perspective, Fuel Vegetation Type, Cover, and Height (FVT, FVC, FVH.) were produced. These products depict what the vegetation is during the production year in non-disturbed and pre-disturbance areas. Pre-disturbance vegetation is represented by LF vegetation products produced prior to the year of the disturbance. FVT values are represented by the original 2000 series EVT codes. FVC are classified in 10% classes that reach a maximum of 90 to 100%. FVH are depicted using meters and are classified into 3 herb, 4 shrub, and 13 tree classes. For non-disturbed areas LF Remap existing vegetation data are used to create fuels products. If an area experienced a disturbance, existing vegetation conditions from the last update prior to a disturbance are used to inform FVT, FVH, and FVC.

Table 5: LANDFIRE Fuel Vegetation Type Attribute Data Dictionary

Attribute	Description
Value	The LF assigned code identifying fuel vegetation and land cover types.
11 - 2969	Numerical code for FVT.
Count	The number of pixels for the corresponding value
EVT_Fuel	The LF assigned code identifying fuel vegetation and land cover types.
EVT_Fuel_N	Fuels Vegetation Type (FVT) represents the name of the terrestrial ecological systems classification developed by NatureServe for the western Hemisphere and is an important input to LF fuel mapping.

Table 6: LANDFIRE Fuel Vegetation Cover Attribute Data Dictionary

Attribute Value	**Description: 2-3-digit code representing the land cover type or depicts percent canopy cover by life form. FVC has a potential range of 0 - 100 percent canopy cover. Values are binned into discrete classes (up to 10 bins at 10 percent intervals for tree, shrub, and herbaceous canopy cover).**
-9999	NoData
11	Open Water
12	Snow/Ice
13	Developed-Upland Deciduous Forest
14	Developed-Upland Evergreen Forest
15	Developed-Upland Mixed Forest
16	Developed-Upland Herbaceous
17	Developed-Upland Shrubland
18	Developed-Herbaceous Wetland Vegetation
19	Developed-Woody Wetland Vegetation
20	Developed - General

Attribute Value	Description: 2-3-digit code representing the land cover type or depicts percent canopy cover by life form. FVC has a potential range of 0 - 100 percent canopy cover. Values are binned into discrete classes (up to 10 bins at 10 percent intervals for tree, shrub, and herbaceous canopy cover).
21	Developed - Open Space
22	Developed - Low Intensity
23	Developed - Medium Intensity
24	Developed - High Intensity
25	Developed-Roads
31	Barren
32	Quarries-Strip Mines-Gravel Pits
60	NASS-Orchard
61	NASS-Vineyard
62	NASS-Bush fruit and berries
63	NASS-Row Crop-Close Grown Crop
64	NASS-Row Crop
65	NASS-Close Grown Crop
66	NASS-Fallow/Idle Cropland
67	NASS-Pasture and Hayland
68	NASS-Wheat
69	NASS-Aquaculture
75	Herbaceous Semi-dry
76	Herbaceous Semi-wet
78	Recently Disturbed Forest
80	Agriculture - General
81	Pasture/Hay
82	Cultivated Crops
83	Small Grains
84	Fallow
85	Urban-Recreational Grasses
95	Herbaceous Wetlands
100	Sparse Vegetation Canopy
101	Tree Cover >= 10 and < 20%
102	Tree Cover >= 20 and < 30%
103	Tree Cover >= 30 and < 40%
104	Tree Cover >= 40 and < 50%
105	Tree Cover >= 50 and < 60%
106	Tree Cover >= 60 and < 70%
107	Tree Cover >= 70 and < 80%

Attribute Value	Description: 2-3-digit code representing the land cover type or depicts percent canopy cover by life form. FVC has a potential range of 0 - 100 percent canopy cover. Values are binned into discrete classes (up to 10 bins at 10 percent intervals for tree, shrub, and herbaceous canopy cover).
108	Tree Cover >= 80 and < 90%
109	Tree Cover >= 90 and <= 100%
111	Shrub Cover >= 10 and < 20%
112	Shrub Cover >= 20 and < 30%
113	Shrub Cover >= 30 and < 40%
114	Shrub Cover >= 40 and < 50%
115	Shrub Cover >= 50 and < 60%
116	Shrub Cover >= 60 and < 70%
117	Shrub Cover >= 70 and < 80%
118	Shrub Cover >= 80 and < 90%
119	Shrub Cover >= 90 and <= 100%
121	Herb Cover >= 10 and < 20%
122	Herb Cover >= 20 and < 30%
123	Herb Cover >= 30 and < 40%
124	Herb Cover >= 40 and < 50%
125	Herb Cover >= 50 and < 60%
126	Herb Cover >= 60 and < 70%
127	Herb Cover >= 70 and < 80%
128	Herb Cover >= 80 and < 90%
129	Herb Cover >= 90 and <= 100%
150	Sparse Vegetation Canopy
151	Tree Canopy >= 10 and < 25%
152	Tree Canopy >= 25 and < 60%
153	Tree Canopy >= 60 and <= 100%
161	Shrub Canopy >= 10 and < 25%
162	Shrub Canopy >= 25 and < 60%
163	Shrub Canopy >= 60 and <= 100%
171	Herb Canopy >= 10 and < 60%
172	Herb Canopy >= 60 and <= 100%
Count	The number of pixels for the corresponding value
CLASSNAMES	Display attribute. FVC is EVC that has been binned to facilitate fuel rule assignment.
NoData	No data background value
Open Water	LANDFIRE Mapped
Snow/Ice	NLCD 2011 Snow/Ice
Developed-Upland Deciduous Forest	LANDFIRE Mapped

Attribute Value	Description: 2-3-digit code representing the land cover type or depicts percent canopy cover by life form. FVC has a potential range of 0 - 100 percent canopy cover. Values are binned into discrete classes (up to 10 bins at 10 percent intervals for tree, shrub, and herbaceous canopy cover).
Developed-Upland Evergreen Forest	LANDFIRE Mapped
Developed-Upland Mixed Forest	LANDFIRE Mapped
Developed-Upland Herbaceous	LANDFIRE Mapped
Developed-Upland Shrubland	LANDFIRE Mapped
Developed-Herbaceous Wetland Vegetation	LANDFIRE Mapped
Developed-Woody Wetland Vegetation	LANDFIRE Mapped
Developed - General	LANDFIRE Mapped
Developed - Open Space	LANDFIRE Mapped
Developed - Low Intensity	LANDFIRE Mapped
Developed - Medium Intensity	LANDFIRE Mapped
Developed - High Intensity	LANDFIRE Mapped
Developed-Roads	LANDFIRE Mapped
Barren	LANDFIRE Mapped
Quarries-Strip Mines-Gravel Pits	LANDFIRE Mapped using information from multiple sources
NASS-Orchard	Agricultural mapping from NASS and local sources if available
NASS-Vineyard	Agricultural mapping from NASS and local sources if available
NASS-Bush fruit and berries	Agricultural mapping from NASS and local sources if available
NASS-Row Crop-Close Grown Crop	Agricultural mapping from NASS and local sources if available
NASS-Row Crop	Agricultural mapping from NASS and local sources if available
NASS-Close Grown Crop	Agricultural mapping from NASS and local sources if available
NASS-Fallow/Idle Cropland	Agricultural mapping from NASS and local sources if available
NASS-Pasture and Hayland	Agricultural mapping from NASS and local sources if available
NASS-Wheat	Agricultural mapping from NASS and local sources if available
NASS-Aquaculture	Agricultural mapping from NASS and local sources if available
Herbaceous Semi-dry	LANDFIRE Mapped
Herbaceous Semi-wet	LANDFIRE Mapped
Recently Disturbed Forest	LANDFIRE Mapped
Agriculture - General	Agricultural mapping from NASS and local sources if available
Pasture/Hay	Agricultural mapping from NASS and local sources if available
Cultivated Crops	Agricultural mapping from NASS and local sources if available
Small Grains	Agricultural mapping from NASS and local sources if available
Fallow	Agricultural mapping from NASS and local sources if available
Urban-Recreational Grasses	LANDFIRE Mapped
Herbaceous Wetlands	LANDFIRE Mapped
Sparse Vegetation Canopy	LANDFIRE continuous EVC < 10%

Attribute Value	Description: 2-3-digit code representing the land cover type or depicts percent canopy cover by life form. FVC has a potential range of 0 - 100 percent canopy cover. Values are binned into discrete classes (up to 10 bins at 10 percent intervals for tree, shrub, and herbaceous canopy cover).
Tree Cover >= 10 and < 20%	LANDFIRE continuous EVC binned to Tree Cover >= 10 and < 20%
Tree Cover >= 20 and < 30%	LANDFIRE continuous EVC binned to Tree Cover >= 20 and < 30%
Tree Cover >= 30 and < 40%	LANDFIRE continuous EVC binned to Tree Cover >= 30 and < 40%
Tree Cover >= 40 and < 50%	LANDFIRE continuous EVC binned to Tree Cover >= 40 and < 50%
Tree Cover >= 50 and < 60%	LANDFIRE continuous EVC binned to Tree Cover >= 50 and < 60%
Tree Cover >= 60 and < 70%	LANDFIRE continuous EVC binned to Tree Cover >= 60 and < 70%
Tree Cover >= 70 and < 80%	LANDFIRE continuous EVC binned to Tree Cover >= 70 and < 80%
Tree Cover >= 80 and < 90%	LANDFIRE continuous EVC binned to Tree Cover >= 80 and < 90%
Tree Cover >= 90 and <= 100%	LANDFIRE continuous EVC binned to Tree Cover >= 90 and <= 100%
Shrub Cover >= 10 and < 20%	LANDFIRE continuous EVC binned to Shrub Cover >= 10 and < 20%
Shrub Cover >= 20 and < 30%	LANDFIRE continuous EVC binned to Shrub Cover >= 20 and < 30%
Shrub Cover >= 30 and < 40%	LANDFIRE continuous EVC binned to Shrub Cover >= 30 and < 40%
Shrub Cover >= 40 and < 50%	LANDFIRE continuous EVC binned to Shrub Cover >= 40 and < 50%
Shrub Cover >= 50 and < 60%	LANDFIRE continuous EVC binned to Shrub Cover >= 50 and < 60%
Shrub Cover >= 60 and < 70%	LANDFIRE continuous EVC binned to Shrub Cover >= 60 and < 70%
Shrub Cover >= 70 and < 80%	LANDFIRE continuous EVC binned to Shrub Cover >= 70 and < 80%
Shrub Cover >= 80 and < 90%	LANDFIRE continuous EVC binned to Shrub Cover >= 80 and < 90%
Shrub Cover >= 90 and <= 100%	LANDFIRE continuous EVC binned to Shrub Cover >= 90 and <= 100%
Herb Cover >= 10 and < 20%	LANDFIRE continuous EVC binned to Herb Cover >= 10 and < 20%
Herb Cover >= 20 and < 30%	LANDFIRE continuous EVC binned to Herb Cover >= 20 and < 30%
Herb Cover >= 30 and < 40%	LANDFIRE continuous EVC binned to Herb Cover >= 30 and < 40%
Herb Cover >= 40 and < 50%	LANDFIRE continuous EVC binned to Herb Cover >= 40 and < 50%
Herb Cover >= 50 and < 60%	LANDFIRE continuous EVC binned to Herb Cover >= 50 and < 60%
Herb Cover >= 60 and < 70%	LANDFIRE continuous EVC binned to Herb Cover >= 60 and < 70%
Herb Cover >= 70 and < 80%	LANDFIRE continuous EVC binned to Herb Cover >= 70 and < 80%
Herb Cover >= 80 and < 90%	LANDFIRE continuous EVC binned to Herb Cover >= 80 and < 90%
Herb Cover >= 90 and <= 100%	LANDFIRE continuous EVC binned to Herb Cover >= 90 and <= 100%
Sparse Vegetation Canopy	LANDFIRE continuous EVC < 10%
Tree Canopy >= 10 and < 25%	LANDFIRE continuous EVC binned to Tree Canopy >= 10 and < 25%
Tree Canopy >= 25 and < 60%	LANDFIRE continuous EVC binned to Tree Canopy >= 25 and < 60%
Tree Canopy >= 60 and <= 100%	LANDFIRE continuous EVC binned to Tree Canopy >= 60 and <= 100%

Shrub Canopy >= 10 and < 25%	LANDFIRE continuous EVC binned to Shrub Canopy >= 10 and < 25%
Shrub Canopy >= 25 and < 60%	LANDFIRE continuous EVC binned to Shrub Canopy >= 25 and < 60%
Shrub Canopy >= 60 and <= 100%	LANDFIRE continuous EVC binned to Shrub Canopy >= 60 and <= 100%
Herb Canopy >= 10 and < 60%	LANDFIRE continuous EVC binned to Herb Canopy >= 10 and < 60%
Herb Canopy >= 60 and <= 100%	LANDFIRE continuous EVC binned to Herb Canopy >= 60 and <= 100%

Table 7: LANDFIRE Fuel Vegetation Height Attribute Data Dictionary

Attribute Value	Description: 2-3-digit code representing the land cover type or depicts canopy height by life form. FVH product represents the average height of the dominant vegetation for a 30-m grid cell and is binned separately for each life form.
-9999	NoData
11	Open Water
12	Snow/Ice
13	Developed-Upland Deciduous Forest
14	Developed-Upland Evergreen Forest
15	Developed-Upland Mixed Forest
16	Developed-Upland Herbaceous
17	Developed-Upland Shrubland
18	Developed-Herbaceous Wetland Vegetation
19	Developed-Woody Wetland Vegetation
20	Developed-General
21	Developed-Open
22	Developed -Low Intensity
23	Developed -Medium Intensity
24	Developed -High Intensity
25	Developed-Roads
31	Barren
32	Quarries-Strip Mines-Gravel Pits
60	Orchard
61	NASS-Vineyard
62	Bush fruit
63	NASS-Row Crop-Close Grown Crop
64	NASS-Row Crop
65	NASS-Close Grown Crop
66	Fallow/Idle
68	NASS-Wheat
69	NASS-Aquaculture
75	Herbaceous Semi-dry

76	Herbaceous Semi-wet
80	Agriculture-General
81	Pasture/Hay
82	Cultivated Crops
83	Small Grains
84	Fallow Idle Crop
95	Herbaceous Wetlands
100	Sparse Vegetation Height
425	Herb Height 0 to 0.5 meters
475	Herb Height 0.5 to 1.0 meters
499	Herb Height > 1.0 meter
502	Shrub Height 0 to 0.5 meters
507	Shrub Height 0.5 to 1.0 meter
520	Shrub Height 1.0 to 3.0 meters
530	Shrub Height > 3.0 meters
603	Forest Height 1.8 to 5 meters
607	Forest Height 5 to 9 meters
611	Forest Height 9 to 13 meters
615	Forest Height 13 to 17 meters
619	Forest Height 17 to 21 meters
623	Forest Height 21 to 25 meters
627	Forest Height 25 to 29 meters
631	Forest Height 29 to 33 meters
635	Forest Height 33 to 37 meters
639	Forest Height 37 to 41 meters
643	Forest Height 41 to 45 meters
647	Forest Height 45 to 49 meters
651	Forest Height >49 meters

Biophysical Settings

LF 2014: The same Biophysical Settings (BPS) was used since LF 2010 production.

LF Remap: Currently, LF Remap BPS is the same as LF 2010 except it has been updated to reflect the barren and water pixels mapped in LF Remap vegetation products. With the final release of LF Remap for CONUS in mid to late 2020, the LF Remap BPS product will receive an updated numbering scheme and will also include Mean Fire Return Interval (MFRI), Percent of Low-severity Fire (PLS), Percent of Mixed-severity Fire (PMS), Percent of Replacement-severity Fire (PRS), and Fire Regime Groups (FRG) as attributes, so that the linkage of these characteristics to BPS is maintained.

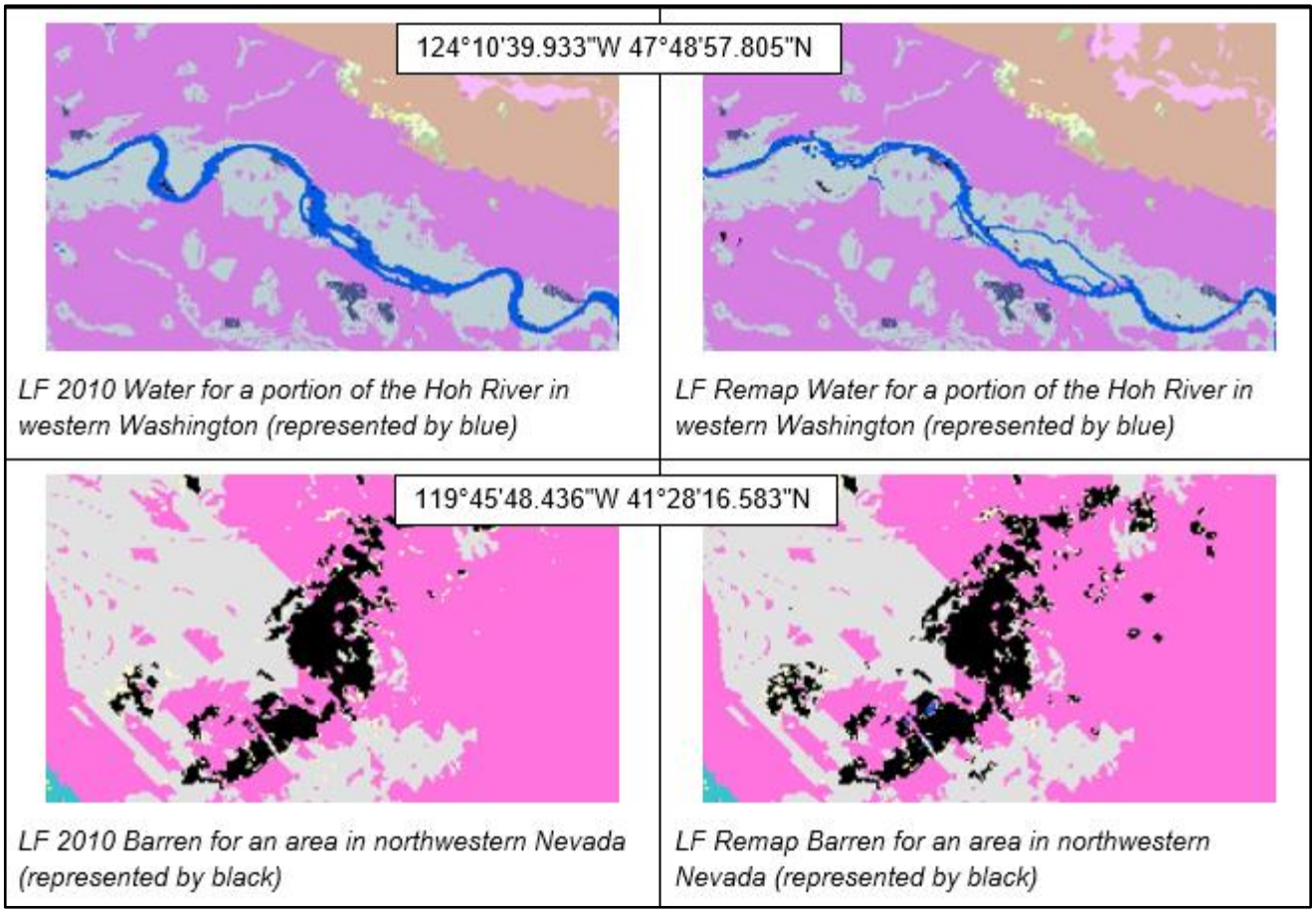

Figure 1: Comparison of LF 2010 and LF Remap Water and Barren.

Fire Behavior Fuel Models (FBFM)13 and 40

LF 2014: LF surface fuel models were assigned using the LF calibrated rulesets (https://landfire.gov/fuel_rulesets_db.php) applied to EVT, EVC, EVH, BPS, and FDist. All surface fuel models that were classified as FDist TSD1 (Time Since Disturbance 1 year) were assumed to be the same as TSD2 (Time Since Disturbance 2-5 years). The release year of LF Update products was typically 2 to 3 years after the year of the update (circa year). For example, LF 2014 was released in 2016 with a 2014 effective year. Since there was a difference between the circa year of the update products and the year of release, disturbances were assigned TSD2 for the creation of Surface Fuels so that disturbances did not remain in TSD1 (0 -1 years) until the next update and the products were one step closer to being used in the future.

Table 8: LF 2014 surface and canopy fuel assignment out of sync, by TSD for the 2014 effective year (2014-2005)

Fuel Type	**TSD1**	**TSD2**	**TSD3**
Surface	None	0-5 yrs. (2014-2009)	6-10 yrs. (2008-2005)
Canopy	0-1 yrs. (2014-2013)	2-5 yrs. (2012-2009)	6-10 yrs. (2008-2005)

LF Remap: Surface fuel models are assigned using the LF calibrated rulesets applied to FVT, FVC, FVH, BPS, and FDist. Pre-disturbance vegetation is now used to inform fuel product creation, instead of existing vegetation products. The pre-disturbance scenario is represented by the vegetation that existed before the disturbance occurred. Accounting for pre-disturbance vegetation assists with fuel model assignment by informing vegetation type, cover and height acted on by the disturbance. All surface fuel models classified as FDist TSD1 are assumed to be the same as TSD2. This was done, so that disturbances do not remain in TSD1 (0 -1 years) until the next update.

Table 9: LF Remap (circa 2016) surface and canopy fuel assignment in sync, by TSD for the 2019 effective year (2018-2009)

Fuel Type	**TSD1 (2019-2018)**	**TSD2 (2017-2014)**	**TSD3 (2013-2009)**
Surface	None	2-5 yrs.	6-10 yrs.
Canopy	None	2-5 yrs.	6-10 yrs.

Canopy Cover (CC)

LF 2014: CC was assigned the midpoint of the EVC forested classes in non-disturbed locations and post disturbance adjusted EVC midpoint at disturbed locations. All TSD1 disturbances were based on the vegetation midpoint value and couldn't be set to TSD2 until a vegetation update occurred. As a result, surface fuel models and canopy fuel products could be out of sync.

LF Remap: CC is assigned the midpoint of the EVC forested classes at non-disturbed locations. For disturbed areas, FDist, pre-disturbance vegetation FVT, FVC, and FVH are used to calculate CC, via linear equations derived from Forest Vegetation Simulator (FVS) scenario outputs by informing vegetation type, cover, and height acted on by the disturbance. All TSD1 disturbances are calculated as TSD2 so that CC does not remain in TSD1 until the next update. This is possible in LF Remap because canopy fuels are calculated, not assigned by the midpoint of the vegetation.

Table 10: Percent Canopy Cover

Forest Cover (%)	Canopy Cover Midpoint (%)
10 <= CC < 20	15
20 <= CC < 30	25
30 <= CC < 40	35
40 <= CC < 50	45
50 <= CC < 60	55
60 <= CC < 70	65
70 <= CC < 80	75
80 <= CC < 90	85
90 <= CC <= 100	95

Canopy Height (CH)

LF 2014: CH was assigned the midpoint of the EVC forested classes at non-disturbed locations and the post disturbance adjusted EVC midpoint at disturbed locations. All TSD1 disturbances were based on the vegetation midpoint value and couldn't be set to TSD2 until a vegetation update occurred. As a result, surface fuel models and canopy fuel products could be slightly out of sync.

LF Remap: CH is assigned the midpoint of the EVC forested classes at non-disturbed locations. For disturbances, FDist, pre-disturbance vegetation FVT, FVC, and FVH are used to calculate CH, via linear equations derived from FVS scenario outputs, by informing vegetation type, cover, and height acted on by the disturbance. All TSD1 disturbances are calculated as TSD2 so that CH does not remain in TSD1 until the next update. This is possible in LF Remap because canopy fuels are calculated, not assigned by the midpoint of the vegetation.

The table below shows the 5 height classes for LF 2014 in comparison to LF Remap's 13 height classes.

Table 11: CH comparison for treed lifeform.

LF 2014 (m)	CH Midpoint	LF Remap (m)	CH Midpoint
0 - 5	2.5	1.8m- 4.9	3
5 - 10	7.5	5m- 8.9	7
10 - 25	17.5	9m- 12.9	11
10 - 25	17.5	13m- 16.9	15
10 - 25	17.5	17m- 20.9	19
10 - 25	17.5	21m- 24.9	23
25 - 50	37.5	25m- 28.9	27
25 - 50	37.5	29m- 32.9	31
25 - 50	37.5	33m- 36.9	35
25 - 50	37.5	37m- 40.9	39
25 - 50	37.5	41m- 44.9	43
25 - 50	37.5	45m- 48.9	47
50 - max	50	49m- Max	51

Canopy Base Height (CBH)

LF 2014: CBH was assigned using regression trees and non-disturbed or post disturbance EVT, CC, and CH. All TSD1 disturbances were based on the vegetation midpoint value and couldn't be set to TSD2 until the next vegetation update. As a result, surface fuel models and canopy fuel products could be slightly out of sync.

LF Remap: CBH is calculated using a linear equation with FVT, CC, and CH as inputs. The fuel vegetation products are pre-disturbance at disturbance locations and existing vegetation at non-disturbance locations. The pre-disturbance scenario is represented by vegetation that existed before the disturbance occurred. A combination of pre-disturbance and non-disturbance vegetation conditions are used to calculate CBH by informing vegetation type, cover, and height acted on by a disturbance. Linear equations for these calculations are derived from FVS scenario outputs. All TSD1 disturbances have CC and CH calculated as TSD2allowing CBH to be calculated on TSD2 inputs, preventing the vegetation from being depicted in a fire behavior state represented by a recent disturbance until the next update. This is possible in LF Remap because canopy fuels are calculated, not assigned by the midpoint of the vegetation.

Table 12: LANDFIRE Forest Canopy Base Height Data Dictionary

Value (cbh_m_x_10)	Description
0	Non-forested Value is 0.
1 – 99	0.1 – 9.9 meters
100	CBH > 100 Value is 100 = 10 meters

Canopy Bulk Density

LF 2014: CBD was assigned using general linear model (Reeves et al, 2009) and non-disturbed or post disturbance EVT, CC, and CH. All TSD1 disturbances were based on the vegetation midpoint value and couldn't be set to TSD2 until the next vegetation update. As a result, the surface fuel models and canopy fuel products could be slightly out of sync.

LF Remap: CBD is calculated using a general linear model (Reeves et al, 2009) with FVT, CC, and CH as inputs. The CBD Generalized Linear Model (GLM) calculations are improved due to the added FVH height classes that produce a finer resolution of CH, which is an input to the CBD GLM equations. The fuel vegetation data are pre-disturbance at disturbance locations and existing vegetation at non-disturbance locations. The pre-disturbance scenario is represented by vegetation that existed before the disturbance. A combination of pre-disturbance and non-disturbance vegetation conditions are used to calculate CBD by informing vegetation type, cover, and height acted on by a disturbance. All TSD1 disturbances have CC and CH calculated as TSD2allowing CBD to be calculated on TSD2 inputs, preventing the vegetation from being depicted in a fire behavior state represented by a recent disturbance until the next update. This is possible in LF Remap because canopy fuels are calculated, not assigned by the midpoint of the vegetation.

Table 13: LANDFIRE Forest Canopy Bulk Density Data Dictionary

Value (cbd_x_100 kg/m³)	Description
0	Non-forested Value is 0.
1 - 45	0.01 – 0.45 kg/m³
45	CBD > 45 Value is 45 = 0.45 kg/m³

Table 14: Comparison of LF 2014 and LF Remap classes

CBD classes LF 2014	CBD classes LF Remap	Description
0 to 5m CBD based on CBH of stand and CH 2.5m.	Surface fuel bed	CBD based on CBH of stand and CH of 4.9m
	0 to 1.8	CBD based on CBH of stand and CH of 4.9m
	1.8 to 4.9	CBD based on CBH of stand and CH of 4.9m
5 to 10 CBD based on CBH of stand and CH 7.5m.	5 to 8.9	CBD based on CBH of stand and CH of 8.9m

CBD classes LF 2014	CBD classes LF Remap	Description
10 to 25 CBD based on CBH of stand and CH 17.5m.	9 to 12.9	CBD based on CBH of stand and CH of 12.9m
	13 to 16.9	CBD based on CBH of stand and CH of 16.9m
	17 to 20.9	CBD based on CBH of stand and CH of 20.9m
	21 to 24.9	CBD based on CBH of stand and CH of 24.9m
25 to 50 CBD based on CBH of stand and CH of 37.5m	25 to 28.9	CBD based on CBH of stand and CH of 28.9m
	29 to 32.9	CBD based on CBH of stand and CH of 32.9m
	33 to 36.9	CBD based on CBH of stand and CH of 36.9m
	37 to 40.9	CBD based on CBH of stand and CH of 40.9m
	41 to 44.9	CBD based on CBH of stand and CH of 44.9m
	45 to 48.9	CBD based on CBH of stand and CH of 48.9m
50+	49+	CBD based on CBH of stand and CH of 49+m

Capable Fuels – Effective Year

LF 2014: LF 2014 represented vegetation conditions that would have been expected during the year 2014, including disturbances that occurred through 2014. LF 2014 was delivered in 2016 for the 2014 effective year. In order for LF 2014 products to better represent contemporary conditions, the user was required to adjust the time since disturbance to match the desired year. Using the example of LF 2014 fuels, which were based on disturbances that have a TSD for the circa year of 2014, if a disturbance occurred in year 2010, the TSD would be 2, meaning the vegetation conditions would represent a disturbance that occurred 2-5 years previously. In this instance, a disturbance that occurred in 2006 would be assigned a TSD of 3. However, to represent 2016 conditions (i.e. 2016 effective year), the 2010 disturbance would need to be adjusted to be 5-10 years old and given a TSD of 3. Disturbances that occurred before 2007 would fall outside the 10-year window and no longer be assigned a TSD.

Considering how LF mapped things in the past, all fuels assignments were based on the circa year of the product (e.g. production year – LF 2012, LF 2014). As a result, fuels products did not represent contemporary conditions for most users. To represent contemporary conditions, the user had to account for the difference between circa year of the update and the time of distribution to update the products to the desired application period.

LF Remap: With LF Remap, fuels products include a “capable” functionality, meaning fuels are created to represent an effective year (in this case 2019). For example, “2019 capable” fuels products consider all existing disturbances included in LF Remap (circa 2016) and updates the TSDs to the effective year of 2019. This makes the products ready for use in 2019 without the need for users to account for the difference in time. Disturbances that become greater than 10 years old (occurring before 2009) are removed from the FDist and replaced with more recent non-disturbed 2016 vegetation.

Important Note: LF product users will still need to add any disturbances that are not included

in the products, such as those that occurred in 2017 and 2018. All non-disturbed fuels are based on LF Remap, which is the newest fuel vegetation.

Fuels continue to be determined as described above, which includes the 2019 capable addition of updating FDist TSDs. Also note that non-disturbed vegetation is circa 2016. For many applications and locations, LF Remap vegetation for non-disturbed vegetation is a viable source on which to base non-disturbed fuels for use in 2019.

The concept of capable fuels opens new possibilities with future LF Updates and the LF team is exploring these ideas. The LF team is also considering capable fuels for other effective years (i.e. 2020, 2021, etc.). As always, the LF team welcomes feedback regarding ways to improve existing or develop new products, so we want to hear from you. Please share comments and suggestions via the LF Help Desk (https://www.landfire.gov/contactus.php) or send an e-mail directly to HelpDesk@landfire.gov. Visit https://www.landfire.gov to learn more about LF products or follow LF on social media to stay informed.

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Definitions and Frequently Asked Questions & Answers

Capable Fuels

D: A term describing the LANDFIRE (LF) Remap fuels products as having updated Time Since Disturbance (TSD) assignments that are usable for an effective year. Let's say, for example, fuels are determined based on an effective year of 2019. Capable Fuels considers all the existing disturbances included in LF Remap (circa 2016) and updates the TSDs to the effective year of 2019 growing season, making it ready to be used in 2019. Disturbances that are older than 10 years (occurred before 2010 {2019-10=2010 growing season}), at effective year 2019, follow the existing LF operations for removal from the Fuel Disturbance product. and are replaced with more recent non-disturbed LF Remap vegetation. LF users still need to add any disturbances that were not included in LF Remap products, or for those that occurred in 2017 and 2018 as they are not yet available. All non-disturbed fuel continues to be based on LF Remap, which is the newest fuel vegetation available.

Effective Year

D: In the LANDFIRE Remap Capable Fuels process, "effective year" describes the year the data would be used. For example, if the effective year (the year you will use the data) is 2019, then 2018 disturbances are TSD1; 2017 to 2014 are TSD2; 2013 to 2009 are TSD3; and 2009 and older go to the non-disturbed newest vegetation available.

Disturbance

Q: How is vegetation assessed (type / structure) once the vegetation has reached its 10-year scope?

A: LANDFIRE (LF) has always used the most recently available updated/adjusted LF vegetation to represent non-disturbed and disturbances outside their 10-year scope. For LF Remap, the vegetation used is based on new imagery and methodology, which determines type, lifeform, and lifeform structures outside of the 10-year disturbance scope.

Q: Why is a 10-year scope used?

A: LANDFIRE has chosen to frame this for a 10-year time frame for the Time Since Disturbance (TSD) period. Based on the available literature and succession information in the Forest Vegetation Simulator (FVS), this 10-year period addresses the need to account for

vegetation succession and frames this with a scope that can reasonably be managed and executed to deliver new products that account in a general way for these successional changes.

LF recognizes that there is a wide range of variability and complexity of landscapes across the United States with timing of successional responses. The ecological succession response in some areas can take decades for regrowth/colonization to occur as vegetation changes toward a stable climax community. The succession response times vary by disturbance type and location based on the environmental conditions of the landscape. Additional research in this area would be very helpful in further refining the TSD logic.

This general scope approach provides that surface fuel models will return or are within an average range of variability of returning to the original vegetation/fuel assignment. LF recognizes that canopy fuels are on a similar trajectory during this 10-year period but are not at an original vegetation/fuel condition; however, canopy fuels would be tall enough to be included in the canopy fuel profile for the area. Based on this regrowth trajectory of the vegetation, the newest available LF data for structure and Existing Vegetation Type can then be used to inform what the vegetation is and what its structural characteristics would be.

Table 15: Examples of Effective Year for Vegetation, Disturbance, and Surface Fuel

Effective Year	**2018**	**2019**
Vegetation	2001 Structure and EVT (available pre-disturbance vegetation)	2016 Structure and EVT (most current available vegetation)
Disturbance	2008 (10 years)	Non-Disturbed
Surface Fuel	TU2	TU2-TU5 depending on the most recent vegetation available

Vegetation

Q: Why is pre-disturbance vegetation (type / structure) used in LANDFIRE (LF) Remap for disturbed areas?

A: When LF started with the circa 2001 data set, there was not enough time and funding to factor in the disturbances that had occurred prior to this time frame. As such, many disturbances were simply just incorporated as a current vegetation type which was an incorrect characterization of the landscape. For example, in the Pacific Northwest recently cut timber areas were classified as either barren or herbaceous/shrublands. Although representative for the specific time when the imagery was taken, it did not account for the successional nature of the landscapes. These areas labelled as barren or herbaceous/shrublands continued to persist in this state even though they were in a forested landscape which successionally transitioned back to forest. In these previous versions of LF,

fuels were based on existing vegetation conditions, which were post disturbance. It was difficult to know or maintain the identity of the vegetation type that existed prior to the disturbance. Fast forward to now with a program like LF that is mapping all lands and accounting for disturbances on an annual basis, which then incorporated these disturbances into a biennial updated product suite, and you have a program that has a rich data repository of undisturbed lands as well as disturbances (agency submitted and remote sensed collected) that can be used to appropriately inform what is happening across these lands. As an example, post disturbance vegetation used to reflect what the existing vegetation became after the disturbance. This caused challenges in appropriately assigning vegetation types and subsequently in assigning fuels. Looking at this type of example closer, let's consider the following: assume we are in a blowdown area. The post disturbance Existing Vegetation Cover and Height would be very low in this area and the Existing Vegetation Type (EVT) may have changed from a tree lifeform to an herb or shrub lifeform. Having knowledge of the pre-disturbance vegetation conditions better informs the fuels process regarding vegetation type and structure that was acted upon by the disturbance and then account for the successional changes in this site as the vegetation regrows over time.

When EVT and structure remain consistent, it is easier to determine the type of vegetation and amount of vegetation remaining on the landscape after the disturbance by considering the type, severity, and time since the disturbance.

Fire Behavior Fuel Models (FBFM)13 and 40

Q: How does the pre-disturbance vegetation affect surface fuel model transitions in disturbed areas?

A: Previous versions of LANDFIRE (LF) assigned disturbed surface fuel models to disturbed areas using rulesets of Existing Vegetation Type (EVT) structure and fuel model of the non-disturbed vegetation type. The idea was to change the fuel model based on the type of disturbance, severity, and time since the disturbance according to expert opinion. Once the vegetation and structure are updated to reflect expected conditions after the disturbance, the ruleset applied could be based on a changed EVT and assigned a different fuel model than intended. For LF Remap, the surface fuel model ruleset is always tied to the pre-disturbance vegetation that is carried forward for a 10-year time frame and can be assigned the intended surface fuel of the disturbance.

Table 16: Pre and post disturbance examples

Disturbances	Vegetation Type	Cover	Height	Fuel Model	Canopy
Post disturbance Vegetation (LF 2014)	Recently Burned	Herbaceous lifeform cover	Short grass	GR2 TSD2, GR2 TSD3	0 Canopy Fuel TSD1, TSD2, TSD3
Pre-disturbance Vegetation (LF Remap)	Ponderosa Pine	Treed lifeform cover	Tall Trees	GR2 TSD2, TL8 TSD3	0 Canopy Fuel TSD1 and TSD2 Regrowth vegetation is now tall enough to have canopy fuel characteristics again in TSD3

Canopy Fuels

Q: How does pre-disturbance vegetation affect canopy fuel values/assignments?

A: Previous versions of LANDFIRE (LF) based the Canopy Cover (CC) and Height (CH) assignments on the mid-points of post disturbance tree Existing Vegetation Cover (EVC) and Height (EVH). Post disturbance tree EVC and EVH were assigned by changing the density and height based on type, severity, and Time Since Disturbance (TSD). The values after the change were determined by a combination of Forest Vegetation Simulator (FVS), Environmental Site Potential, and expert opinion to add tree cover back into disturbed areas and provide possible non-disturbed growth as incorporated during the update phases (LF 2010, LF 2012, LF 2014) of LF products. Once CC and CH were determined, they were used with post disturbance Existing Vegetation Type to calculate Canopy Base Height (CBH) and Bulk Density (CBD).

LF Remap uses pre-disturbance vegetation and structure to determine canopy fuel. This is done through a series of linear models built with the relationship of Fuel Vegetation Type (FVT), CC, and CH in plot data from FVS outputs for all FVTs and Fuel Disturbance (FDist) values. The calculations can be applied to all pre-disturbance FVTs and their FDist to get assignments. Non-disturbed canopy fuel uses the mid-point of the non-disturbed most recent vegetation Fuel Vegetation Cover (FVC) and Height (FVH) as CC and CH. These CC and CH values are used in the calculations for non-disturbed CBH and CBD. This system is more flexible as it does not require an LF Update to the disturbed vegetation to make new assignments. The only steps required are to add new disturbances, if needed, and modify FDist to reflect the proper TSD code.

Q: What is the process to “grow” vegetation where the disturbance is more than 10 years old?

A: When a disturbance leaves its 10-year window, it is removed from the FDist and the pre-disturbance vegetation is replaced with the most current available vegetation (currently LF Remap). This vegetation is based on the newest, best vegetation model in LF and should give a good indication of vegetation type and structure in the current condition. Growth of vegetation may be considered in future updates and as research to add to the body of knowledge on vegetation regrowth and initial colonization post disturbance as vegetation changes toward a stable climax community is done.