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TECHNICAL MEMORANDUM

STRAWMAN – APPROACH FOR TECHNICAL REFINEMENTS OF LARGE FIRES AND FIRE COMPLEXES FOR WRAP PHASE I FIRE EMISSIONS INVENTORY

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This memo summarizes the proposed technical approaches to refine the wildfire activity data represented in the Western Regional Air Partnership (WRAP) Phase I emission inventory (Phase I EI). The technical approaches for the three following tasks are discussed in this Strawman document:

- Complex fire identification;
- Identification of blackened versus perimeter acres;
- Refinements of spatial, temporal and fuel loading data for large fires.

In order to address these tasks, the largest 28 wildfires in the Phase I EI (all near or above 50,000 acres) were examined for availability of more refined spatial data. This information was obtained through internet searches combined with follow up phone calls with the appropriate Federal Land Manager (FLM). The type of fire-event-specific information included Burned Area Emergency Response reports (BAER reports), Environmental Impact Statements, GIS-files provided by the national forests or obtained through the internet, as well as other web-based fire event information. Availability of these resources varied from fire to fire. Table 1 presents the list of large fires for which the availability of fire-specific digital information was researched. The list of fire complexes researched includes those in Table 1, as well as several smaller fire complexes.

Table 1: Summary of available data for large wildland fires in Phase I Emission Inventory. "---" indicates no data available or located.

Fire Name	State	Perimeter Acres	Fuels information	Fire Severity Information	GIS-based Fire Perimeter
Biscuit	OR	499,570	Tabular[1]/GIS	Tabular	GIS[4]
Rodeo/Chediski	AZ	468,638	Tabular[1]/GIS	Tabular/GIS[3]	GIS[3]
Geskamina Lake	AK	257,258	GIS	---	Fire history GIS
Reindeer	AK	227,800	GIS	---	Fire history GIS
Minunchima Group	AK	196,584	GIS	---	Fire history GIS
Yetna River	AK	152,962	GIS	---	Fire history GIS
McNalley	CA	150,696	Tabular[1]/GIS	Tabular/GIS[3]	GIS[3]
Hayman	CO	137,760	Tabular[2]/GIS	Tabular/GIS[3]	GIS[3]
Sischu	AK	128,983	GIS	---	Fire history GIS
Tool Box	OR	120,085	Tabular[1]/GIS	GIS[4]	GIS[4]
Moose Lake	AK	117,648	GIS	---	Fire history&GIS[3]
MP 78	AK	115,328	GIS	---	Fire history GIS
Rattle	UT	94,519	GIS	Tabular/GIS[4]	GIS[4]
Ponil Complex	NM	92,194	GIS	GIS[4]	GIS[4]
Vinasale	AK	92,000	GIS	---	Fire history GIS
Long Creek	AK	74,931	GIS	---	Fire history GIS
Galatea Creek	AK	74,511	GIS	---	Fire history GIS
Kraft Springs	MT	69,900	Tabular[1]	Tabular	---
Windy	AK	69,523	GIS	---	Fire history GIS
Tiller Complex	OR	68,775	GIS	GIS[4]	GIS[4]
Missionary Ridge	CO	66,534	GIS	Tabular/GIS[3]	GIS[3]
Sanford	UT	64,972	Tabular[1]/GIS	Tabular/GIS[4]	GIS[4]
Spurs	AK	64,834	GIS	---	Fire history GIS
Bear Creek	AK	63,634	GIS	---	Fire history GIS
Pines	*CA*	*61,705*	---	---	---
Khotol Riv	AK	50,811	GIS	---	Fire history GIS
Boulder	*OR*	*48,080*	---	---	---
Kraft Complex	*ND*	*48,000*	---	---	---
Acres Researched		**3,678,235 (58 % of Phase I WF EI)**			
GIS Acres (potential)		**3,512,255 (55 % of Phase I WF EI)**			

Notes: [1]Tabular fuel model distribution derived from vegetation descriptions (hardcopy); [2]Tabular fuel model provided by source (hardcopy); Digital GIS fire perimeter data was either downloaded from the internet (GIS [3]) or obtained from the US Forest Service (GIS [4])

Complex Fire Identification

Analysis and Results

The goal of this analysis is to identify potential duplicate fire entries that might be present in the database. A fires event could occur more than once in the emission inventory database if, for example, the fire name was changed over the course of time. This can occur when multiple fires are merged into a single fire complex. In this situation the initial fire names are generally dropped and all fires get assigned a common name. The Alaska fires could not be checked for the potential of duplicates since information on individual fires that might make up these fires was not available (Personal communication, Sue Christensen, Alaska Fire Service). Of the fire complexes in the WRAP states in the lower 48 the following fires were examined:

1) Wildfires (including WFU) above approximately 50 thousand acres, regardless of fire name

2) Wildfires (including WFU) between 6 and 50 thousand acres with names ending in "Complex".

Although all fires with names ending in "Complex" were identified, only those above 6 thousand acres (cumulative acres) were researched in the (online) National Fire Incident Situation Reports for 2002. The portion of fire complexes not included in the analysis contained 23 fire complexes sized from 100 to ~4,000 acres, and totaling ~26 thousand acres. The fire complexes were examined for 1) the individual fires that made up the complex, and, 2) the potential duplicate presence of these individual fires in the Phase I EI based on fire name and fire event date(s).

Table 2 summarizes the results for the fire complexes included in this research. For the total of 24 large fires and fire complexes that were researched, 18 were identified as actual fire complexes (Table 2). Out of these 18 fire complexes, 13 complexes had potential duplicate entries in the Phase I EI, based on 26 potential duplicate fires (Table 2). A total of ~260 thousand acres that potentially might have been double counted in the Phase I EI was identified (Table 2). In the second step of this quality control procedure these potential duplicates were compared by fire location. Specifically, the distance from the fire complex coordinates to the coordinates of its comprising fires was calculated. The distances varied from zero (identical coordinates) to ~57 miles. Most of the distances short enough to fall within the fire perimeter (median ~11mi, geometric mean ~9mi, Table 2).

Table 2. Summary of complex fire check based on duplicate names only. "---" indicates no duplicates found by checking fire names; "n.a." indicates not applicable.

Fire Name	State	Perimeter Acres	Fires Included in Phase I EI Event	Potential Duplicate Events Identified (acres)	Distance (mi)
Biscuit	OR	499,570	Biscuit fire	Sour biscuit (41,897 acres)	25
			Florence fire	---	---
			Sourdough fire	---	---
Rodeo/Chediski	CO	468,638	Chediski fire	---	---
			Rodeo fire	---	---
McNalley	CA	150,696	One fire name only	NA	---
Hayman	CO	137,760	One fire name only	NA	---
Tool Box	OR	120,085	Toolbox fire	---	---
			Silver fire	Silver (24,565)	8
			Winter fire	Winter (69,673; 2 duplicate sets)	21
Rattle	UT	94,519	Black Canyon fire	Black Canyon (5,970)	0
			Diamond Creek fire	Diamond Creek (1,300)	14
Ponil Complex	NM	92,194	Middle Ponil Fire	---	---
			Medcalf Fire	---	---
			Office Fire	---	---
			Turkey	Turkey (1,295)	13
Kraft Springs	MT	69,900	One fire name only	NA	---
Tiller Complex	OR	68,775	Tallow	Tallow (1,132)	7
			Acker	Acker (4,114)	3
			Boulder fire	Boulder (48,080)	3
			Buckeye	Buckeye (2,212)	5
			Big Bend	Big Bend (10,063)	6
			Ruby Red	---	---
			Buster Springs	---	---
			Digger	---	---
			Anderson	Anderson (457)	12
			Wilderness	---	---
Missionary Ridge	CO	66,534	One fire name only	NA	---
Sanford	UT	64,972	Sanford Rx burn	---	---
			Adams Rx burn	---	---
Kraft	ND	48,000	Kraft	---	---
			Bale II	Bale II (1,076)	28
			Twin II	Twin II (450)	23
			Kenel Again	---	---

Table 2. (Continued)

Fire Name	State	Perimeter Acres	Fires Included in Phase I EI Event	Potential Duplicate Events Identified (acres)	Distance (mi)
Monument-Malheur	OR	44,062	Roberts	---	---
			Easy	---	---
			Monument	---	---
Daley	WY	42,000	Daley Draw	---	---
			Hairy	Hairy (13,000)	1
Mahogany	OR	41,328	Atkins	Atkins (800)	12
			Mahogany Mountain	---	---

Trinidad	CO	33,000	Spring	---	---
			James John	---	---
Mt. Zirkel	CO	31,016	Burn Ridge	Burn Ridge (8,260)	0
			Hinman	Hinman (10,176)	7
Quartz Mt.	WA	12,144	Quartz Mountain	---	---
			Middle Mountain	Middle Mountain (7,858)	5
			Lake	---	---
			Beauty Peak Action #344	---	---
Lincoln County	CO	10,000	One fire name only	NA	NA
Canyons	UT	9,800	Hang Dog	---	---
			Hammond	---	---
Inyo	CA	6,550	Fuller	Fuller (6,400)	7
			Piper	Piper (150)	1
Frank Church	ID	6,341	Parker Mountain	Parker Mountain (301)	32
			Little Horse	---	---
			Little Soldier	Little Soldier (303)	57
			Bobtail	---	---
			Waterfall	Waterfall (36)	23
			Big Hill	---	---
Grizzly	OR	6,050	Grizzly	---	---
			Bare	Bare (35)	16
			Logan	---	---
El Paso County	CO	6,000	One fire name only	NA	NA
Acres Researched		**2,129,934 (33% of Phase I WF EI)**		**259,603 (4% of Phase I WF EI)**	

Action Items

- The potential duplicate fires were identified by 1) the same name as reported in the individual daily fire reports, 2) overlapping fire date, and, 3) similarity of geographical coordinates. Based on these similarities it is recommended that all potential duplicate fires recorded in Table 2 be removed from the emission inventory, and considered duplicate fire entries.

Blackened versus Perimeter Fire Acres

Based on the fire event specific information obtained, the percentage of the acreage within the fire perimeter that did not burn was extracted. From 4 to 54 percent of the acreage within the analyzed fire perimeters did not burn resulting in the removal of from 2,800 to 115,000 acres from the Phase I fire event data (Table 3). These adjustments will be incorporated in the refined emission inventory. Although not yet included in Table 3, similar information is available for the Tool Box- and the Tiller Complex fires (GIS format). Blackened acres cannot be calculated for the Alaska fires since burn severity data were not collected for these fire events (Personal communication, Sue Christensen, Alaska Fire Service). In this case it is assumed that the blackened acres and the perimeter acreage is the same for the large Alaska fire events. This is a reasonable assumption, given that most of these fires occurred in the interior of Alaska, and generally were characterized as intense, stand replacing wildfires (Personal communication, Sue Christensen, Alaska Fire Service).

As a follow up to these blackened acres refinements, selected Phase I EI fires were analyzed to detect any trends in this data based on NFDRS fuel model. The goal of this analysis was to see if there was a relationship between the proportion of blackened acres and the NFDRS fuel model, which potentially could be used to estimate blackened acres for smaller fires in the Phase I EI, as well as for fires in future emission inventories. The data were summarized as the proportions of unburned acreage and blackened acres (low-, moderate-, and high fire severity combined) for six fires and fire complexes (Table 4). Fire severity data were available in the form of GIS layers (Ponil and Sanford), or (hardcopy) reported fire intensities by vegetation type or NFDRS (Biscuit, Kraft, McNally, Rodeo-Chediski). The results indicate that the blackened acres within a perimeter varied considerably between NFDRS fuel models (average blackened acres 25 to almost 100 percent of perimeter). Moreover, blackened acres within a perimeter varied considerably within NFDRS fuel models as well, as indicated by the fairly high standard deviation in some cases (Table 4).

Table 3. Summary of blackened versus perimeter fire acres for large wildfire events ("SD" stands for standard deviation).

Fire Name	State	Perimeter Acres	Unburned Acres (%)	Blacked Acres	Reduction of Acres in EI
Biscuit	OR	499,570	23%	384,669	114,901
Rodeo/Chediski	AZ	468,638	15%	398,342	70,296
McNalley	CA	150,696	10%	135,626	15,070
Hayman	CO	137,760	20%	110,208	27,552
Rattle	UT	94,519	54%	43,479	51,040
Ponil Complex	NM	92,194	16%	77,443	14,751
Kraft Springs	MT	69,900	4%	67,104	2,796
Missionary Ridge	CO	66,534	20%	53,227	13,307
Sanford	UT	64,972	50%	32,486	32,486
Overall Acres		**1,644,783**	24% ± 17% (SD)	**1,302,584**	**342,199**
% WF EI Acres		**26%**		**21%**	**5%**

A further refinement could consist of expressing the blacked acreage as their proportion distributed over three fire severity categories typically used in BAER reporting, low, moderate and high fire severity, respectively. For the six fires in this analysis the distribution of blackened acres over the three fire severity classes did vary considerably, both between NFDRS fuel models, as well as within each NFDRS fuel model (Table 5). The latter is demonstrated by the high standard deviation in comparison with the mean percentages. This variation makes it difficult to generalize this categorization to other fires in the WRAP region.

Table 4: Summary of unburned vs. blackened acres for six fires. "SD" indicates one standard deviation, and "---" not calculated due to a sample size of one. "*" indicates a statistically significant difference between unburned and blackened acres (Kruskal-Wallis test; $P<0.05$).

		Percent of Perimeter		
NFDRS	Sample Size	Unburned	Blackened	SD
A	3	7	93	6
B	2	3	97	4
C*	5	23	77	20
F*	4	26	74	27
G	1	75	25	---
H	5	29	71	26
L	1	0	100	---
R	3	34	66	53
T	1	60	40	---
U*	4	4	96	3
ALL*	**29**	**23**	**77**	**27**

Action Items

- Accounting for the unburned sections within fire perimeters decreased fire acreage between 4 to over 50 percent for a subset of large fires. Therefore it is recommended that adjusted blackened acres for these large fires be implemented in the Phase II EI.
- The proportion of blackened acres relative top the perimeter acres did vary considerably, was based on a very small number of fires, and did not represent all NFDRS fuel models present in the Phase I EI. Therefore, it is not recommended that these proportions be applied to adjust acreage of other fires in the Phase I EI, or be applied to future emission inventories. However, this data will be useful to refine the uncertainty analysis of the Phase II EI.
- The variation in fire severity by NFDRS fuel model is too high to derive a general approach to adjust other fires in the Phase I EI, or future emission inventories.

Table 5: Relative distribution of blackened acres by fire severity category. "SD" indicates one standard deviation, and "---" not calculated due to a sample size of one.

		Severity Class (Percent of Blackened Acres ± SD)		
NFDRS	Sample Size	Low	Moderate	High
A	3	21 ± 18	36 ± 31	43 ± 49
B	2	26 ± 29	31 ± 14	43 ± 43
C	5	25 ± 22	31 ± 29	44 ± 31
F	4	36 ± 27	34 ± 25	30 ± 19
G	1	15 ± ---	74 ± ---	11 ± ---
H	5	33 ± 24	38 ± 21	29 ± 16
L	1	2 ± ---	17 ± ---	81 ± ---
R	3	14 ± 25	18 ± 15	68 ± 36
T	1	14 ± ---	68 ± ---	18 ± ---
U	4	27 ± 18	36 ± 12	37 ± 28
ALL	**29**	**25 ± 21**	**35 ± 22**	**40 ± 29**

Spatial, Temporal and Fuel Model Refinements

Spatial Refinements

Based on the information gathered on the large fire events, as summarized in Table 1, several refinements potentially can be applied. A spatial check will be performed for the largest fires and fire complexes for which digital, GIS-based, fire perimeters were available. The fire locations of these fires in the Phase I EI (Table 1) will be plotted on the same map as the GIS-based final fire perimeters, and checked for accuracy. If the fire location in the Phase I EI is located outside of the perimeter, a new location will be assigned to the fire (complex). One option would be to assign the new fire location to the centroid of the fire perimeter.

An additional spatial refinement of large fires consists of assigning a unique location for each day that a fire burns, as the location and size of the actively burning area of a wildfire event can change on a daily basis. To assign a unique new location for each day of a fire

event in the emission inventory, digital, GIS-based, data on the daily progress of the fire perimeter is required. However, the data gathering effort only yielded final fire perimeters, i.e., the perimeter after fires were fully contained. Thus, the data needed to refine the spatial distribution of the fire locations over the course of the fire were not available, and the location of the large fires was kept constant over time for each fire event.

Temporal Refinements

The data gathered in the form of reports generally provided the total (perimeter) acreage and the start and end date for each fire, only, while the GIS data provided the final fire perimeters only. Generally, the data already present in Phase I EI had much higher temporal resolution, with the total acreage distributed daily over the course of the fire's duration. Thus, since the Phase I EI was more specific in its temporal attributes, the additional fire data were not suitable for further temporal refinements.

Fuel Model Refinements

For a selection of the larger fires in the lower 48 states, the GIS-based final fire perimeters were used to extract the distribution of fuel models within the final perimeters. The fuel consumption was then recalculated based on the blackened acres, thereby taking into account the unburned portion within the fire perimeter. The fire perimeters were intersected with two fuel model maps, the NFDRS fuel model layer and a more detailed fuel characteristics class (FCC) layer (Personal Communication, Donald McKenzie, USFS, 6/25/04; http://duet.cfr.washington.edu/~dmck/feradata/fcc_west2004b2.zip). The comparison results indicate that the total consumption based on the more refined GIS-based methodology can be either higher or lower than the consumption in the Phase I EI (Table 6). Generally, the more spatially resolved fuel consumption yielded lower total consumption in the Phase I EI (Table 6). The two exceptions were fires with fuel model C (open ponderosa pine), coinciding with a fairly low fuel model loading in the Phase I EI (Table 6). Thus, higher spatial resolution increased consumption for these fires by incorporating acreage with higher fuel loadings within the fire perimeter (Table 6). These calculations were based on the default NFDRS fuel consumption percentages as defined by the WRAP for the Phase I EI (Table 8). A separate, new (draft) default set of consumption percentages was developed for the FCC categories (Table 9). Note that the FCC estimates do not include the consumption of duff, since the duff variable in the FCC dataset was provided in terms of thickness (inches) rather than loading (tons per acre). Also, it is not clear from the FCC data if the crown mass is included in the loading, and if so, how to account for the specific crown consumptions as was done for the NFDRS fuel consumption tables.

Table 6. Sensitivity of estimated fuel consumption to adjustment for blackened acres in combination with fuel loading based on GIS-derived NFDRS- and FCC-fuel layers. Fuel consumption was based on default (WRAP) consumption percentages by fuel size class and held constant for each fire severity class.

	Phase I	Total Fuel Consumption (10^6 tons)			Delta Consumption (%)	
Fire Name	**NFDRS**	**Phase I EI**	**NFDRS**	**FCC**	**NFDRS**	**FCC**
Biscuit	G	21.73	11.07	7.68	-49%	-65%
Hayman	C	0.65	2.23	1.34	+244%	+107%
McNalley	B	2.94	2.67	0.72	-9%	-75%
Sanford	K	0.93	0.41	0.51	-56%	-45%
Ponil Complex	H	2.54	0.45	0.17	-82%	-93%
Missionary Ridge	C	0.31	0.97	0.40	+211%	+28%
Rattle	G	4.11	0.95	0.34	-77%	-92

Additional Fuel Consumption Refinements

In addition to fire perimeter information, fire severity information was available for a subset of wildfire and fire complexes (either based on reports or GIS-layers). Potentially, this information can be used to further refine fuel consumption estimates by defining variable fuel consumption percentages by fuel size class for each reported fire severity category (low-, moderate-, and high severity) (Tables 8 and 9). Based on the FCC overlay, this additional refinement decreased the total fuel consumption somewhat compared to the process where all burned acres receive a default consumption percentage (Tables 6 and 7). Based on the NFDRS overlay this additional refinement had variable effects, varying from a decrease to an increase of the estimated consumption compared to application of default consumption percentages (Tables 6 and 7). However, overall the additional refinement of adding fire severity levels did not lead to statistically different changes in consumption (Paired T-test, t_{13}=0.465, P=0.650).

Table 7. Sensitivity of estimated fuel consumption to adjustment for blackened acres in combination with fuel loading based on GIS-derived NFDRS- and FCC-fuel layers. Fuel consumption was based on variable consumption percentages by fuel size class and fire severity class.

	Phase I	Total Fuel Consumption (10^6 tons)			Delta Consumption (%)	
Fire Name	**NFDRS**	**Phase I EI**	**NFDRS**	**FCC**	**NFDRS**	**FCC**
Biscuit	G	21.73	6.22	4.78	-71%	-78%
Hayman	C	0.65	1.82	1.07	+181%	+65%
McNalley	B	2.94	2.26	0.60	+23%	-80%
Sanford	K	0.93	0.35	0.39	+62%	-58%
Ponil Complex	H	2.54	0.29	0.09	-89%	-96%
Missionary Ridge	C	0.31	0.82	0.39	+163%	+25%
Rattle	G	4.11	0.82	0.26	-80%	-94%

Action Items

- The data available did not allow for spatial improvement over the temporal course of the fire, nor for data quality improvements of daily acres. However, the spatial accuracy will be checked for those wildfires for which GIS-based fire perimeters are available.
- Refinement of fuel model information for the large fires will be performed for those fires with available GIS-based fire perimeters (Table 1), by overlaying the perimeters with either the NFDRS- or the FCC fuel model layer.
    - For the Phase II inventory, the NFDRS fuel model layer was used to refine the fuel model information. Additional information would need to be developed in order to apply the FCC fuel model layer.[1]
- Refinement of fuel model adjustments by distinguishing different fuel consumption levels by fire severity category is not recommended.

[1] Additional information includes: a Strawman fuel consumption table for the FCC fuel categories; conversion of the duff depth (inches) in the FCCs to loading units (ton/acre); verification of if/how crown biomass consumption is incorporated in the FCCs.

Table 8. Summary of fuel consumption percentages applied to model variable consumption by fire severity class, NFDRS fuel models. Default percentages applied in Phase I EI.

Fuel Size Class	Default Consumption	Low Fire Severity	Moderate Fire Severity	High Fire Severity
1-hour	100%	100%	100%	100%
10-hour	100%	100%	100%	75%
100-hour	100%	100%	75%	25%
1,000-hour	100%	100%	50%	0%
Wood	100%	100%	100%	50%
Herb	100%	100%	100%	100%
Duff	50%	100%	50%	0%
Crown	62%	100%	40%	0%

Table 9. Summary of fuel consumption percentages applied to variable consumption by fire severity class, FCC fuel models. Default percentages serve as temporary placeholder.

Fuel Size Class	Default Consumption	Low Fire Severity	Moderate Fire Severity	High Fire Severity
1-hour	100%	100%	100%	100%
10-hour	100%	75%	100%	100%
100-hour	100%	25%	75%	100%
1,000-hour	100%	0%	50%	100%
10,000-hour	50%	0%	25%	100%
>10,000-hour	25%	0%	10%	100%
Grass	100%	100%	100%	100%
Shrub	100%	50%	100%	100%
Duff *	0%	0%	0%	0%

* Duff consumption set to zero for all fire categories, since data provided in terms duff depth and not in actual loading.

Overall Assessment of Refinements

Table 10 summarizes the potential changes to the data that would result from incorporating the refinements discussed in this strawman document. Changes are reported for the number of fire events, number of fire days, fire acres and fuel consumption. The number of fire events and the number of fire days only change based on the duplicate fire checking in the fire complexes. While the change in numbers of fire events and fire days is relatively small, this adjustment does decrease the fire acres and the fuel consumption by 4 to 5 percent. An additional reduction in fire acres and the fuel consumption is achieved by adjusting the acreage for the largest fire event from the perimeter acres to the blackened acres. Between the checking for duplicate fire entries and the blackened acreage adjustment the fuel consumption can be reduced by almost 10%. An additional 3 to 9 percent reduction could be achieved based on the fuel model refinements of those large fires for which GIS-based perimeter data were available.

Table 10. Summary of estimated adjustments to the Phase I EI (wildfire and wildland fire use) based on described quality control and data refinement procedures. The percentages refer to the change as a percent of the Phase I EI.

Adjusted records by Refinement Step	**# of Fire Events**	**# of Fire Days**	**Fire Acres**	**Fuel Consumption (10^6 tons)**
Phase I EI[1]	1,899	3,243	6,366,532	178.1
Fire complex duplicates	26 (-1.4%)	74 (-2.2%)	259,603 (-4.1%)	8.1 (-4.5%)
Blackened acres	As above	As above	342,199 (-5.4%)	8.9 (-5.0%)
NFDRS, default consumption[2]	As above	As above	As above	15.2 (-8.5%)
FCC, default consumption[2]	As above	As above	As above	21.2 (-12.0%)
NFDRS, severity class specific consumption[2]	As above	As above	As above	19.9 (-11.2%)
FCC, severity class specific consumption[2]	As above	As above	As above	23.9 (-13.4%)
Overall Adjustments	**26 (-1.4%)**	**74 (-2.2%)**	**601,802 (-9.5%)**	**23.3 to 32.0 (-13.0% to -18.0%)**

[1] References values are based on data before incomplete records are dropped from EI, and do not include smoldering. Hence, data will be somewhat different from those in the final Phase I report.
[2] These adjustments and percentages do include the correction for blackened acres as well as the fuel models.