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FINAL

Evaluation of Existing Fire Tracking Systems

PREPARED FOR:

WESTERN GOVERNORS' ASSOCIATION
WESTERN REGIONAL AIR PARTNERSHIP
FIRE EMISSIONS JOINT FORUM

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SECTION 1

INTRODUCTION

The Western Regional Air Partnership (WRAP) Policy/Fire Tracking System Executive Summary states that the WRAP is charged with developing technical and policy tools to assist states and Tribes with implementing the Regional Haze Rule. The WRAP policy on Fire Tracking Systems (FTS) was developed through a stakeholder-based consensus process to assist the WRAP region's states and Tribes in addressing emissions from fire sources. It is the position of the WRAP FTS Policy that it is necessary to track fire activity information in the WRAP region using a fire tracking system, which will also provide the information essential to create fire emissions inventories to be used for various applications.

The Fire Tracking System Task Team (Task Team) is looking for a fire tracking system that meets the WRAP's minimum needs yet is flexible enough to allow for modifications to accommodate expansions to include additional options. The Task Team is not looking for a "brilliant, new design." The evaluation of existing fire tracking systems project is a thorough analysis to assess existing systems and determine the feasibility of and costs associated with modification of existing systems to meet the WRAP's requirements identified in the WRAP's Fire Tracking System Policy. The Work Plan for this project describes the methods to evaluate existing fire tracking systems to determine if an existing system, with few or minor modifications, will satisfy the WRAP's requirements. Both web-based and historical systems (e.g., wildfire systems) may be listed as candidate systems for evaluation. However, the primary emphasis of this project is on real-time data import and export capabilities.

It is intended that the Fire Emissions Tracking System (FETS) be a platform for consistently tracking fire activity and fire emissions across all jurisdictions within the WRAP. Data from the FETS, which will be made available to states/Tribes for use in Regional Haze planning, include but are not necessarily limited to:

- Real-time reviews of planned prescribed (Rx) fires to support the Enhanced Smoke Management Program (ESMP) decision-making and facilitate regional coordination between ESMP programs.
- Output of fire emissions data for state or regional modeling purposes.
- Output of annual fire emissions data for National Emission Inventory (NEI) reporting purposes.
- "Seed data" for the Calculation Tool to build planning emission inventories (projections).
- Information on the application of Emission Reduction Techniques (ERTs) to support demonstration of meeting Annual Emission Goal (AEG) commitments.

The ultimate goal of this evaluation is to determine and document the most effective way to develop an effective WRAP FTS that meets these requirements.

SECTION 2

PROJECT GOALS AND DELIVERABLES

The project team of Air Sciences and EC/R (Project Team) has reviewed the WRAP Policy – Fire Tracking System (April 2, 2003), the "Needs Assessment for Evaluating and Design of an Emission Data Reporting, Management, and Tracking System" (July 25, 2003 – in particular those sections pertaining to fire tracking), the "Fire Tracking System" presentation from the Coeur d'Alene, Idaho meeting on May 15 through 17, 2001, and the WRAP Emissions Data Management System (EDMS) design information.

The stated goal of this project is to evaluate existing fire tracking systems and provide the following:

- A feasibility assessment of each evaluated existing system (i.e., how well does each system, as-is, meet the WRAP's requirements for an FTS).
- An analysis of modifying each system to include WRAP needs (i.e., what needs to be done to make the system fit the WRAP's needs).
- An estimate of resources needed to modify the system to meet the required elements for tracking prescribed fires. The cost estimate should include development hours, any additional hardware costs, and ongoing system costs. The estimate should be itemized and should include some of the optional elements of a WRAP FTS that have been identified such as: provide for regional coordination and transfer of data to the WRAP's EDMS system.

The following operational existing fire tracking systems have been evaluated:

1. San Joaquin Valley Smoke Management System - California
2. Airshed Management System (formerly RAZU) - Montana/Idaho
3. Smoke Management Database - New Mexico
4. Nez Perce Tracking System
5. South Carolina
6. Florida
7. USDA Smoke Management System

The Project Team has evaluated all of the listed fire tracking systems per the contents of the Evaluation Chart described in Section 3, Task 2 of the Final Work Plan – Evaluation of Existing Fire Tracking Systems (November 18, 2005, at http://www.wrapair.org/forums/fejf/documents/fts/fts.html). Per the Work Plan, two (2) existing fire tracking systems were selected for further evaluation and assessment (systems 3 and

7). In addition, the Project Team recommended, and the Task Team approved, that a third system (system 2) be included on the short-list for further evaluation and assessment. Each of the short-listed FTS have been evaluated for necessary modifications to meet the WRAP's required elements for tracking prescribed fires and to provide estimates of the resources that would be necessary to modify an existing system to meet the WRAP's requirements and maintain the WRAP's FTS.

Deliverables from the FTS Evaluation Project include a Work Plan, a Feasibility Assessment (Section 4) of existing FTS, a Technical Analysis of short-listed FTS, and a Cost Analysis (Section 5) of modifying an existing FTS to meet the WRAP's requirements. The Feasibility Assessment includes an objective tabular and written analysis comparing each FTS to the WRAP's requirements, with a scoring system to identify the short-listed FTS. The technical and cost analyses explicitly identify the modifications necessary to adapt each FTS to meet the required elements for a WRAP FTS. Costs associated with three levels of adaptation—Essential, Preferred, and Optional—are presented in detail. Based on these results, Section 6 provides recommendations on moving forward with developing a WRAP FTS.

SECTION 3

PROJECT TASKS AND METHODOLOGY

3.1 Work Plan

The Work Plan for the project identifies the methods and deliverables for the project to evaluate existing fire tracking systems. The draft Work Plan was prepared by the Project Team, reviewed by the Task Team, and revised as necessary to prepare the Final Work Plan. The Final Work Plan was approved by the Task Team and Contract Officer.

The Work Plan carefully defines the technical scope of work and deliverables in as many areas as possible. Some aspects of the Work Plan are presented in a way that maintains more flexibility for the Fire Emissions Joint Forum (FEJF) to investigate technical aspects of the work and provide input to final methodologies and products.

3.2 Participation in Conference Calls and Meetings

Critical and appropriate members of the Project Team participated in several Task Team conference calls and two FEJF meetings. Participation included:

- At the November 30 through December 1, 2005, FEJF meeting in Seattle, Washington, the Project Team presented a brief (45-minute) overview of the Work Plan (including the timeline for the project) and a project status report.
- A Task Team conference call to review the Draft Work Plan and suggest revisions necessary for the Final Work Plan.
- A Task Team conference call (January 17, 2006, at 1300 Mountain Standard Time) to approve the short-list of two (2) fire tracking systems and one (1) additional FTS selected for assessment of necessary modifications and the costs associated with moving the existing FTS into the WRAP FTS.
- At the March 7 through March 8, 2006, FEJF meeting, the Project Team presented a brief (90-minute) presentation of the findings and recommendations for the project. The wrap-up included a presentation of the findings of the fire tracking system evaluation and recommendations to the FEJF/WRAP about fire tracking system selection and modification (including the estimated effort to modify an existing system) for the WRAP's FTS.

- A series of conference calls (March 2006) with the FEJF/WRAP coordinator (Tom Moore) to develop the scope of the WRAP FTS project and develop the WRAP FTS white paper in addition to a discussion of the structure and costs associated with a commodity-based system (alternative to an existing system).

3.3 Information Gathering and Obtaining User Access to Existing FTS

The Project Team in consultation with the Task Team identified seven (7) existing systems to include in the feasibility assessment. The initial list was developed to include a variety of unknown, functioning FTS to which some level of access for the Project Team could be obtained by the WRAP. This list and the feasibility assessment are not intended to be exhaustive. The Project Team and the Task Team acknowledge that other, unique, and functional FTS exist both within the WRAP and across the country. Inclusion of any of the systems not in the initial list for the FTS Evaluation Project would have added to the completeness of the study and the usefulness of the recommendations. For the purpose of defining the scope of work for the project and keeping the expenditures of time and resources to within known constraints, the Project Team contacted existing FTS managers to acquire Users Manuals, field definitions, and user access to the listed FTS. The Project Team evaluated the existing systems at the user level (not the programmer level). The following list includes the list of primary contact(s) for each listed FTS:

1. San Joaquin Valley Smoke Management System.
2. Airshed Management System (formerly, RAZU): Dave Grace, USDA – Forest Service
3. Smoke Management Database – New Mexico: Lisa Bye, USDOI – BLM, NPS, FWS in New Mexico.
4. Nez Perce Tracking System: Julie Simpson/Andrea Boyer, Nez Perce Tribe
5. South Carolina Tracking System: Ken Cabe, South Caroline Department of Forestry
6. Florida Tracking System: Jim Brenner, Florida Division of Forestry
7. USDA Smoke Management System: Dale Guenther, USDA – Forest Service

The Project Team conducted interviews with each of these contacts (or others as appropriate) as part of the process of evaluating each existing FTS. In addition, the Project Team conducted follow-up interviews with the contact for each short-listed FTS.

SECTION 4

FEASIBILITY ASSESSMENT OF EXISTING SYSTEMS

4.1 Feasibility Assessment Table

The Project Team has developed a table that lists the basic data elements contained in an FTS and important system-related functions of an FTS. This table has been used by the Project Team for the initial evaluation of all listed fire tracking systems.

Table 1: Basic Data Elements of the WRAP's Fire Tracking System

1. Actual date of burn (please indicate whether the system records multiple days for the same event)
   a. Start date
      i. Day 1 start hour (start at 0000 hrs)
      ii. Day 2 start hour (start at 0000 hrs)
      iii. Day 3 start hour (start at 0000 hrs)
   b. End date
      i. Day 1 end hour (if over 1 day, end at 2359 hrs)
      ii. Day 2 end hour (if over 2 days, end at 2359 hrs)
      iii. Day 3 end hour (if over 3 days, end at 2359 hrs)
2. Burn location
   a. Burn name
   b. Burn number
   c. Latitude/longitude at center of proposed burn
   d. County/Borough/tribal land/Reservation
   e. Name of closest town
   f. Miles to closest town
3. Area of burn
   a. Size of burn (total acres)
   b. Day 1 area burned (blackened) in acres
   c. Day 2 area burned (blackened) in acres
   d. Day 3 area burned (blackened) in acres
4. Fuel type (predominant cover)
5. Fuel loading (tons/acre)
6. Type of burn (broadcast, pile, etc.)
7. Classification of burn (anthropogenic or natural)
8. Additional components to support the development and implementation of annual emission goals
   a. Regional coordination (pre-burn information)
      i. Burn location
      ii. Proposed burn size (acres)
      iii. Burn classification (e.g., prescribed, wildfire, WFU, etc.)
      iv. Fuel loading (tons)

Table 1: Basic Data Elements of the WRAP's Fire Tracking System – continued

8. Additional components to support the development and implementation of annual emission goals
v. Proposed burn date
b. Emissions from fire (or FTS program calculates from data provided)
i. Emission factors used
ii. Daily emissions for $PM_{2.5}$, PM_{10}, total PM, CO, VOC, NOx, SO_2, NH_3
iii. Yearly emissions for $PM_{2.5}$, PM_{10}, total PM, CO, VOC, NOx, SO_2, NH_3
c. Coordination/tracking information
i. Agency responsible for burn
ii. Point of contact for burn
iii. Address of agency responsible for burn
iv. Phone number for agency/point of contact
v. County code
vi. Tribal code
vii. State and County FIPS code
viii. SCC code
ix. Pollutant code
d. Emission Reduction Techniques (ERTs) for the use with Annual Emission Goals (AEG)
i. ERTs emission factors by fuel type
ii. Estimate total emissions without using ERTs
iii. Estimated total emissions with ERTs

4.2 Feasibility Assessment

The "raw" findings based on interviews with FTS managers, review of FTS Users Manuals, and/or review of FTS systems is included in Attachment 1

The Project Team developed a point system (maximum 100 points) to rank the evaluated FTS (Table 2). The maximum points possible for each category of elements/features reflects the Project Team's approximate measure of the importance of the category to a well functioning FTS. Many categories included what the Project Team regarded as "critical elements" (shown in bold in the evaluation table in Attachment 1). Inclusion of these "critical elements" in the FTS contributed to a higher point assignment for the category. Two bonus point assignments were also included in the ranking system.

1. Two (2) bonus points per each Basic Elements category were assigned if the majority of listed elements were included in the FTS and/or if all critical elements were included.

2. Five (5) bonus points were assigned to the overall score for an FTS if the Project Team identified some unique flexibility, an apparent ease in transfer of the FTS to the future WRAP system , and/or an expressed willingness of the current FTS host to support transfer to the WRAP system.

Overall, the maximum possible points for Basic Elements is 55; the maximum for System-Related Features is 45.

Table 2: FTS Evaluation Point System

Data Elements	Critical Elements Evaluated	Max Possible Points
Task 2.A. Basic Data Elements		
Burn Date	Start date; end date	10
Burn Location	Latitude/longitude	10
Burn Area	Size of burn (acres); fuel type	10
Components related to Annual Emission Goals		15
Emission Reduction Techniques	Any ERT element	5
Bonus Ranking		5
Total for Basic Data Elements		**55**
Task 2.B. System Information	Web-based, exporting capabilities	15
Task 2.C. Back-End and Front-End Applications		10
Task 2.D. Indexing and Reporting		10
Task 2.E. Optional Modules		5
Task 2.F. Interface and/or Data Exchange		5
Total for System-Related Features		**45**
Total Maximum Possible Score		**100**

Table 3 presents the points assigned for each category to each evaluated FTS. The Project Team assigned points using a two-step method:

1. Each individual element listed in the evaluation table was objectively scored (0 = not included; 1 = included; 3 = critical elements included) and an overall bonus for the category was scored (0 = few if any elements are included; 2 = most and/or critical elements included). The following example presents the criteria used to evaluate each FTS and presents hypothetical results to demonstrate how the scoring criteria are applied.

   Example: For the Burn Date category, there are eight listed elements (start date, start hour, multi-day start date,; multi-day start hour, end date, end hour, multi-day end dates, multi-day end hour) two of which are "critical elements" (start date, end date). Maximum possible

objective points for the Burn Date category is 14: two critical elements (3 points each), six other listed elements (1 point each), and 2 bonus points for the category if the majority of elements or all critical elements are present in the FTS.

FTS#1 includes both critical elements (start date, end date) for the Burn Date category and none of the other listed elements. FTS#1 receives an objective total score of 8 (of a possible 14): 3 points for each critical element plus 2 bonus points for the category.

FTS#2 includes one critical element (start date) and three other listed elements (start hour, multi-day start dates, multi-day end dates). FTS#2 receives an objective total score of 6 (of a possible 14): 3 points for one critical element plus 1 point each for 3 other listed elements plus no bonus points for the category.

FTS#3 includes all listed elements and receives the maximum of 14 points.

2. Based on the objective scores in Step 1, each FTS was assigned a score for the category based on the maximum possible points for the category. Within a category, the relative points assigned to an FTS accurately reflect how well the FTS was evaluated vis-à-vis all of the other FTS. Below is a continuation of the example scoring and hypothetical results presented in Step 1.

   Example (continuing the example above for the Burn Date category): Total possible points for the Burn Date category is 10. FTS#1 is assigned a 7 (all critical elements, no additional listed elements). FTS#2 is assigned a 5 (one critical element, two of four other listed elements). FTS#3 is assigned a 10 (all listed elements)

.

Table 3: FTS Evaluations

Data Elements	Critical Elements Evaluated	Max Possible Points	San Joaquin Valley	Airshed Management System (MT/ID)	Smoke Management Database (NM)	Nez Perce Tracking System	South Carolina Tracking System	Florida Tracking System	USDA Smoke Management System
Task 2.A. Basic Data Elements									
Burn Date	Start date; end date	10	5	3	5	10	5	5	5
Burn Location	Latitude/longitude	10	7	8	8	2	9	10	8
Burn Area	Size of burn (acres); fuel type	10	9	9	9	6	9	7	7
Components related to Annual Emission Goals		15	12	4	13	10	10	10	10
Emission Reduction Techniques	Any ERT element	5	0	0	0	0	0	0	0
Bonus Ranking		5	0	5	5	0	0	0	5
Total for Basic Data Elements		**55**	33	29	40	28	33	32	35
Task 2.B. System Information	Web-based, exporting capabilities	15	6	10	12	4	4	4	12
Task 2.C. Back-End and Front-End Applications		10	3	6	8	10	5	3	10
Task 2.D. Indexing and Reporting		10	4	4	8	0	4	4	10
Task 2.E. Optional Modules		5	0	0	3	5	0	0	0
Task 2.F. Interface and/or Data Exchange		5	0	0	0	0	0	0	0
Total for System-Related Features		**45**	13	20	31	19	13	11	32
Total Maximum Possible Score		**100**	46	49	71	47	46	43	67

4.3 Short-Listed FTS

The Final Work Plan for the project stipulates that two of the evaluated seven FTS be recommended for the short-list of FTS to assess for necessary modifications and costs associated with moving the existing FTS to the WRAP FTS. Based upon the results presented in Table 2, the Project Team recommended the following two FTS for the short-list:

1. State of New Mexico Smoke Management Database (total score 71)
2. USDA Smoke Management System (total score 67)

Both of these FTS include most of the critical elements of an FTS. Both received the five bonus points for apparent flexibility, ease in transfer, and/or willingness of host support to transfer the FTS to the WRAP FTS. Both of these systems scored well in the Indexing and Reporting category, and there were no obvious incompatibilities with transferring over either system to the WRAP FTS.

As noted in the Final Work Plan, the FTS Task Team may elect to include additional FTS on the short-list for an additional $2,250 per system. The Project Team requested that the FTS Task Team consider inclusion of two additional FTS on the short-list.

1. San Joaquin Valley Smoke Management System. A couple of unique features of this FTS merit consideration for the WRAP FTS: data is entered into the system via telephone, making the system comparatively automatic and real-time compared to other FTS evaluated. Also, this system has been rigorously tested with large amounts of fire events.
2. Airshed Management System (MT/ID). This unique aspects of this FTS include a standard and rigorous architecture, an interactive mapping website, and features that promote regional coordination.

After consideration of the characteristics of these two additional FTS, the Task Team approved inclusion of the Airshed Management System (MT/ID) on the short-list for further assessment of technical modifications and costs.

SECTION 5

ASSESSMENT OF SHORT-LISTED FTS MODIFICATIONS AND COSTS

Each of the short-listed FTS have been evaluated for the modifications needed to each system to satisfy WRAP requirements and the associated resources necessary to accomplish varying degrees of modification. The four-step process of the evaluation included:

- An inter-comparison of WRAP FTS requirements met by short-listed FTS.
- An inter-comparison of short-listed FTS system characteristics.
- An estimate of resources needed to modify the system to meet the required elements for tracking prescribed fires.
- A post-modification analysis evaluating the relative merits of each short-listed FTS.

5.1 Technical Modifications

As a starting point for this assessment, the Project Team prepared a list of essential elements for a functional and usable FTS for the FEJF, WRAP, states, and Tribes. This list was developed from review of several documents:

- WRAP Policy – Fire Tracking System (April 2, 2003).
- "Needs Assessment for Evaluating and Design of an Emission Data Reporting, Management, and Tracking System" (July 25, 2003 – in particular those sections pertaining to fire tracking).
- "Fire Tracking System" presentation from the Coeur d'Alene, Idaho meeting on May 15 through 17, 2001, and the WRAP Emissions Data Management System (EDMS) design information.
- The detailed list of basic and system elements for an FTS as presented in the Request for Proposal for the Fire Tracking System Evaluation Project and the Final Work Plan for this project.
- Materials prepared by the Regional Coordination Task Team of the FEJF.

The list of essential features of a WRAP FTS is presented in Table 4. This list is the primary consideration for the assessment of technical modifications that would be necessary to move a short-listed FTS over to the WRAP FTS.

Table 4: Essential Features of WRAP FTS

		More Specific Information on Features:			
Elements	***Date of Burn***				
	Burn Location				
	Area of Burn	Blackened acres			
	Fuel Type	Predominant fuel or cover type			
	Pre-Burn Fuel Loading				
	Type of Burn				
	Nat/Anth				
	Annual Emission Goal Info	ERT Used	emission reduction achieved	fuel moisture	
	AEG (addl)	responsible agency	point of contact		
	Projections	surveys	growth factors	multipliers	
	Emissions	Daily	Annual	PM2.5;PM10;PM;CO;VOC;Nox;SO2;NH3	Emission Factors
	Emissions (addl)	Emissions calculator			
System Features	Real time data import and export				
	Web based				
	Can info easily be shared between states				
	GIS/mapping capabilities				
	Conventional system language & design				
Important Characteristics	Straightforward queries				
	Straightforward reporting				
		Important Elements for Regional Coordination			
	Italic, Indented Text	**Basic Elements of FTS Policy**			

The features of Table 4 were broken into two parts: Elements and System Features. Keeping in mind the intention to create an FTS with all essential elements and key system characteristics, a system was devised to evaluate merits of one FTS in relationship to the other FTS:

- -1 or –2: system deficient compared to other FTS
- 0: system essentially as proficient as other FTS
- +1 or +2: system more proficient compared to other FTS

Evaluating each FTS with respect to one another helps to identify the best "as-is" system. Table 5 applies the rating system to the Elements portion of Table 4, with cumulative scores at the top of table. The Existing FTS were evaluated to be very similar in terms of meeting the WRAP FTS Requirements. NM FTS scored higher due to the ability to calculate PM emissions and track multi-day burns.

Table 6 applies the rating system to System Features and Characteristics. There is a larger discrepancy between FTS in this evaluation. MT/ID and USDA FTS are built using SQL Server, which provides enhanced security and permission controls but requires extensive knowledge of the SQL programming language. In contrast, NM FTS, built with Microsoft Access, is relatively easy to modify, but has limited database size (2GB) and does not readily support automated scheduled tasks such as data backup or aggregation. A unique feature of the MT/ID FTS is a planned interactive web GIS mapping tool, but to date this has not been fully implemented.

Table 5: WRAP FTS Requirements Evaluation

	FTS Requirements Total Points:	**2**		**1**			**1**
Element	**New Mexico**		**MT/ID**		**USDA**		
What required fields are missing?	Burn hour, location of closest town, burn agency info., blackened acres, ERT emission factors, emission reductions, responsible agency	**0**	Burn hour, location of closest town, emissions, emission factors, ERT, burn agency info., blackened acres, ERT emission factors, emission reductions, responsible agency	**0**	Burn hour, location of closest town, emissions, emission factors, ERT, burn agency info., blackened acres, ERT emission factors, emission reductions, responsible agency	**0**	
Is the system web-based?	Yes with limitations (see Table 2)	**0**	Yes	**0**	Yes*	**0**	
Can the system perform emissions calculations?	PM10 emissions are estimated by means of emission factors, acreage, and tonnage.	**1**	No emissions.	**0**	Currently developing a link to CONSUME.	**0**	
Is there ERT support?	ERTÕs are recorded but no emission reduction information	**0**	No ERT information.	**0**	No ERT information.	**0**	
Is there a GIS capability?	Predetermined map images	**0**	Currently developing a web-based interactive ArcGIS server application to display burn locations and associated database information.	**0**	Currently developing a system that uses Google Earth to display burn locations and associated database information.	**0**	
Is there multi-day burn support?	Yes	**1**	No	**0**	No	**0**	
Is there support for Importing from or exporting to other systems?	No	**0**	No	**0**	No	**0**	
Is there ad-hoc query support?	Queries must be created by user with access to the application server	**0**	Queries must be created by user with access to the application server	**0**	Queries must be created by user with access to the application server	**0**	
Is there an ability to assign different user permissions?	Yes, only at the database level	**0**	Yes, per record, table, or view	**1**	Yes, per record, table, or view	**1**	
Is there Annual Emission Goal support?	No	**0**	No	**0**	No	**0**	

Table 6: FTS System Characteristics and Requirements Evaluation

	FTS Requirements Total Points:	0		4		4
	New Mexico		**Montana/Idaho**		**USDA**	4
Ease of use of web interface	Easy button navigation and plenty of help. Use of acronyms provides some confusion of web page organization.	1	Not clear that you can indicate type of fuel. Relationship between preseason and proposed burn is not clear.	0	Easy button navigation with clear labels. Latest version of the interface is in beta form and not currently available for testing by the Project Team. Some of the new features are not yet available.	-1
System Characteristics						
Permission	Can only set-up permissions at the file level.	0	Can set-up permissions by table, view, or record.	1	Can set-up permissions by table, view, or record.	1
Users	Limited to approximately 10 concurrent users in a web environment.	-1	Able to support hundreds of concurrent users	1	Able to support hundreds of concurrent users	1
Automatic Scheduled Jobs	Difficult to create automatic scheduled jobs such as back-ups or data aggregation.	0	Built-in ability to set-up scheduled jobs that run automatically.	1	Built-in ability to set-up scheduled jobs that run automatically.	1
Robust Queries	Database can become corrupt if client query fails to complete.	-1	Use of transaction logs prevent database from becoming corrupted because of incomplete queries.	1	Use of transaction logs prevent database from becoming corrupted because of incomplete queries.	1
System Storage Capacities	2 GB database size limit. Includes data, queries, and forms	-1	More than 1,000,000 TB	1	More than 1,000,000 TB	1
Database Record Limits	One database will hold approximately 2,000,000 fire records	0	Limited by server storage.	1	Limited by server storage.	1
Ease of Use of System	Easy to set-up database and develop queries and forms.	1	Somewhat complex to set-up and manage database. Requires good knowledge of SQL language.	-1	Somewhat complex to set-up and manage database. Requires good knowledge of SQL language.	-1
Hardware and software requirements						
Software	MS Access 2000 (~ $230)	1	SQL Server 2000 standard edition for single processor (~ $6,000)	0	SQL Server 2000 standard edition for single processor (~ $6,000)	0
Web/GIS Server	ArcView desktop software (~ $1,500) required to generate maps.	0	No Web/GIS server currenlty required. With development of user-based GIS capabilities, ArcGIS Server ($30,000 for one server with 2 processors)* would be required.	-1	Cold Fusion Server (~ $1,300)	0
Database Server	Server with 1 GB RAM, 120 GB hard drive, and 1.0 GHz processor (~ $1,100)	0	Server with 1 GB RAM, 120 GB hard drive, and 1.0 GHz processor (~ $1,100)	0	Server with 1 GB RAM, 120 GB hard drive, and 1.0 GHz processor (~ $1,100)	0

*Used for interactive GIS system that is currently being developed

5.2 Resource Assessment

The resource estimates will be approximate and based on input received from managers/users of the existing FTS systems and input from the Project Team based upon our companies' related experience. These estimates should be considered approximate and not "fixed-price" costs to be used by the WRAP for future contracting purposes. The cost estimates will include:

- Development hours,
- Additional hardware costs, and
- Ongoing system costs.

The Project Team expects that the cost estimates will be most meaningful when related to one another (e.g., "the cost to modify and host System 1 will be twice the cost to modify and host System 2"). In addition to the itemized cost estimates, the Project Team will attempt to include cost estimates for some of the additional optional elements, to specifically provide for regional coordination and inter-state/Tribe data sharing, and transfer of data to the WRAP's EDMS system.

Also, the current manager of each short-listed FTS will be asked a few questions during the evaluation/interview process pertaining to the manager's assessment of the suitability of the existing system to become the WRAP's FTS. The Project Team will attempt to provide a preliminary and qualitative description of the manager's willingness to modify the existing system and host the WRAP FTS, given an acceptable contractual relationship with the Western Regional Air Partnership/Western Governors' Association. The primary objective of these questions will be to identify any FTS managers that would be unwilling to modify the existing FTS and host the WRAP FTS.

Table 7 uses the results of Table 5 and Table 6 to estimate the resources required—including development hours and additional hardware costs—to modify each FTS system for the WRAP. Integrating all possible modifications into a WRAP FTS, including development of interactive GIS mapping, a link to an emissions calculator such as CONSUME, and enhancement of other user-end features, is ideal but not essential to create an FTS to meet WRAP's minimum requirements. Therefore, modifications were tiered into three designations: Essential (E), Preferred (P), and Optional (O). This way, a more thorough picture of the costs associated with FTS configurations is available for consideration. The provided cost estimates provided are primarily based on input from FTS managers, should be considered approximate, and are most useful as an assessment of *relative* costs to modify the evaluated FTS.

Table 8 represents a consolidation of the modification/cost tables, presenting estimates of overall cost for each tier of modification. From this, some basic conclusions can be drawn:

- To create a WRAP FTS with essential elements and system characteristics, NM FTS can be most efficiently transferred (580 hours).
- Similar effort required to modify any of the three FTS to include preferred elements and system characteristics (1300 – 1340 hours).
- Similar effort required to modify any of the three FTS to build WRAP FTS with all bells and whistles (1400 – 1500 hours).

Also included in Table 8 is the rating system from Table 5 and Table 6 applied to each modification tier in a "post-modification" analysis, showing the relative merits of each system after Essential, Preferred, and Optional modification. Both total points from the post-modification analysis and associated costs are considered in making final recommendations.

Table 7: FTS Modifications and Resources

(E)ssential (P)referred or (O)ptional	Modifications	New Mexico Level of Effort (hours)*	Montana/Idaho Level of Effort (hours)*	USDA Level of Effort (hours)*
	Final design of database and structure			
E	Types of records to be included, classes of users, editing protocols, and burn approvals if appropriate	60	80	80
P	Address system shortcomings: permissions; user number; automation; query limitations; size limitations.	120	0	0
E	**Add fields needed to meet WRAP requirements**	80	100	80
E	**Web interface modifications to enhance ease of use**	40	40	40
	Add features to compute emissions			
E	Develop approach	40	40	40
	Options:			
	A. WRAP Phase II/III emission inventory			
E	Develop queries to compute emissions by using look-up tables of emission factors, acreage, and tonnage	40	60	60
	B. Inter RPO (FEPS)			
O	Develop queries to compute emissions by using fuel specific emission and consumption factors and fuel moisture options	60	80	80
	C. Link to CONSUME			
O	1) Identify CONSUME inputs that can be pulled from the database	80	80	80
O	2) Create fields in the database to hold CONSUME output	20	20	20
O	3) Develop Visual .NET application to control CONSUME	100	100	100
	ERT			
E	Develop approach	40	40	40
E	Create menu of ERT's and associated emission reduction credits	20	20	20
E	Develop queries to compute ERT impacts	40	40	40
	GIS			
E	Predetermined maps	20	80	80
P	Interactive system	600	600	600
	Regional coordination features & methods			
E	Assess current protocols	40	40	40
E	Modifications to accommodate import from different federal and state systems	40	60	60
	Export data to modeling and/or projection system			
E	Assess input requirements of federal or state system such as EDMS, WFMI, FACTS, or TEISS	40	40	40
E	Create queries to output data in NIF or flat file format	20	40	40
E	Add export feature to interface	20	20	20
E	**Assign different levels of user permissions**	20	20	20
	Support for Annual Emission Goals			
E	Develop queries to report number of times ERTÕs are used	20	20	20
	Total Level of Effort (hours)	1,560	1,620	1,600

*Does not include estimate for workplan development. We estimate that 160 labor hours would be required for workplan development.

Table 8: FTS Post-Modification Analysis

FTS Post Modification Analysis	New Mexico			MT/ID			USDA		
	As-Is	After Essential Modifications	After Preferred Modifications	As-Is	After Essential Modifications	After Preferred Modifications	As-Is	After Essential Modifications	After Preferred Modifications
Total Points:	2	14	23	5	16	19	5	15	20
System Points:	0	3	10	4	5	6	4	4	7
Elements Points:	2	11	13	1	11	13	1	11	13
Estimated Hours:		580	720		740	600		720	600
Estimated Cost (not incl. maintenance):		$ 60,000	$ 72,000		$80,000 - $110,000	$ 60,000		$ 78,000	$ 60,000
Total Estimated Costs for Essential and Preferred Modifications	$130,000 - $140,000			$140,000 - $170,000			$138,000 - $150,000		
Total Estimated Costs Including Optional Modifications:	$135,000 - $160,000			$150,000 - $190,000			$145,000 - $170,000		
WRAP FTS Requirements									
What required fields are missing?	0	1	1	0	1	1	0	1	1
Is the system web-based?	0	1	2	0	1	2	0	1	2
Can the system perform emissions calculations?	1	2	2	0	2	2	0	2	2
Is there ERT support?	0	1	1	0	1	1	0	1	1
Is there a GIS capability?	0	1	2	0	1	2	0	1	2
Is there multi-day burn support?	1	1	1	0	1	1	0	1	1
Is there support for Importing from or exporting to other systems?	0	1	1	0	1	1	0	1	1
Is there ad-hoc query support?	0	1	1	0	1	1	0	1	1
Is there an ability to assign different user permissions?	0	1	1	1	1	1	1	1	1
Is there Annual Emission Goal support?	0	1	1	0	1	1	0	1	1
FTS System Characteristics and Requirements									
Ease of use of web interface	1	1	2	0	1	2	-1	-1	2
System Characteristics									
Permission	0	1	1	1	1	1	1	1	1
Users	-1	-1	1	1	1	1	1	1	1
Automatic Scheduled Jobs	0	0	1	1	1	1	1	1	1
Robust Queries	-1	0	1	1	1	1	1	1	1
System Storage Capacities	-1	0	1	1	1	1	1	1	1
Database Record Limits	0	0	1	1	1	1	1	1	1
Ease of Use of System	1	1	1	-1	-1	-1	-1	-1	-1
Hardware and software requirements									
Software	1	1	1	0	0	0	0	0	0
Web/GIS Server	0	0	0	-1	-1	-1	0	0	0
Database Server	0	0	0	0	0	0	0	0	0

SECTION 6

RECOMMENDATIONS AND DOCUMENTATION

The conclusions to the FTS Evaluation Project were developed as answers to a series of questions listed in the Work Plan for the project. The recommendations of the Project Team to the FEJF and WRAP are focused on critical aspects of the FEJF and WRAP's decisions to move toward a WRAP FTS:

1. What existing FTS would work best "as-is" for the WRAP's FTS?
2. What existing FTS would require the least amount of modification to work well as the WRAP FTS?
3. What combination of existing FTS, technical modifications, and exceptional features from other FTS would comprise a WRAP FTS with the most complete set of features and capabilities?
4. Rather than starting from an existing FTS, is there a better way for the WRAP to proceed with building the WRAP FTS?

The best existing system without modification is the MT/ID FTS. The MT/ID FTS is a currently functioning system that supports burn managers in the states of Montana and Idaho. The system uses an SQL Server database that can meet the needs of the WRAP region, and the user interface is fully functional. However, the FTS requiring the least amount of modification to meet the essential elements of a WRAP FTS is the New Mexico FTS. By upgrading the Access database to SQL Server, the New Mexico FTS could become a system capable of meeting current and future WRAP needs. The Project Team has estimated that 120 labor hours would be required to perform this upgrade. NM FTS already supports limited emissions estimation (PM_{10}) and generates maps of burn locations. These features are not supported in the existing versions of the MT/ID FTS and USDA FTS, and would require approximately 140 labor hours to fully implement in the NM FTS.

A modified version of the MT/ID FTS (assuming the current manager proceeds with the planned interactive GIS upgrade) could provide the most complete set of features and capabilities for a WRAP FTS. The MT/ID FTS has the advantage over using the New Mexico FTS because it already uses an SQL Server database. The Project Team preferred the MT/ID FTS over the USDA FTS because the preferred interactive GIS system is already being designed for the MT/ID FTS, and the USDA FTS is not yet in production mode (at the time that the FTS Evaluation Project was being executed).

There are clear benefits to start developing a WRAP FTS using an existing system. Each FTS already incorporates many of the essential features. Two of the current systems will include the preferred GIS capability. Furthermore, the time and money already spent could be considered a

down payment on building the WRAP's FTS. Along those lines, there is a relative clear indication as to the resources required to develop a WRAP FTS with varying degrees of functionality. Less clear, however, are the costs associated with ongoing maintenance and support of a proprietary system.

The FTS Task Team, its contractor, and the FEJF co-chair have discussed with the WRAP and the WRAP's Technical Support System (TSS) team members the concept of building a "commodity"-based Fire Emissions Tracking System (FETS). A commodity-based approach would, to the greatest extend practicable, seek to utilize license-free software programs and utilities that enable modification with moderate knowledge of standard programming language. The concept would extend to facilitating the use of on-line or out-of-the-box utilities (such as Google Earth mapping tools) to perform the essential functions of the WRAP FTS. Also, the commodity-based approach would seek to take advantage of relatively cheap and reliable hosting services with ample storage capacity to support this WRAP FTS. This commodity-based FETS approach would be available to all WRAP states and Tribes and would integrate seamlessly with other regional haze SIP planning data and tools in the TSS. Moreover, this approach would be ready to accommodate fire data entry by July 2007. The commodity-based FETS is expected to fit within the near- and long-term budget constraints of the WRAP.

The FTS Task Team, its contractor, and the WRAP discussed the possibility of an alternative system developed independently of any existing FTS. All have agreed that a commodity-based FETS approach could be the most timely, efficient, cost-effective method to build an operable, stable, and user-friendly FETS within the WRAP's TSS. This FETS would be accessible to any of the WRAP states and Tribes and would efficiently accommodate data exchanges from any state/tribal FTS currently in operation.

Benefits for the WRAP of developing a commodity-based FETS include:

- This method is expected to require limited dollars in future WRAP grants relative to other methods and has positive effects on 2006-08 FEJF project funding, due to the expected decrease in startup and maintenance costs.
- The lessons learned in the FEJF and WRAP's fire emission inventory preparation and analysis for haze planning purposes over the past several years have shown that a move away from proprietary software-based emission inventory systems is likely to reduce development, hosting, maintenance, and system modification costs while still accomplishing critical functionality.
- A commodity-based FETS hosted within the TSS will provide states and Tribes ongoing regional technical support, as well as data access and visualization tools for their regional haze planning. The FETS would be supported by TSS, thus placing software and hardware maintenance issues in a known and tested environment.

- The FTS Task Team and WRAP expect that the FEJF FETS can be on-line and fully operational for states and Tribes to upload fire event/emissions data by July 2007 (and use real-time data for regional coordination), to access TSS functions pertaining to fire emissions by September 2007, and to download 2007 fire emissions inventory data by January 2008.

SECTION 7

REFERENCES

WRAP Policy – Fire Tracking System (April 2, 2003)

"Needs Assessment for Evaluating and Design of an Emission Data Reporting, Management, and Tracking System" (July 25, 2003 – in particular those sections pertaining to fire tracking)

"Fire Tracking System" presentation from the Coeur d'Alene, Idaho meeting on May 15-17, 2001

WRAP Emissions Data Management System (EDMS) design information.