

Obvious And Relevant Points

■ Dust definition implementation feasible

- No "one-size-fits all" approach
- Wide variety of information resources available
- Key challenges
 - Reconciling different emission estimates
 - Partitioning Category 3 sources and identifying reference areas / time periods
 - Quantifying impact of natural disturbances

■ Dust Definition provides a process (and a tool – Conceptual Model) for integrating WRAP tools/projects during SIP development: (see also the NM SIP Pilot Project)

■ Case Studies provide a useful step-by-step template for agencies implementing the dust definition during SIP development.

■ Feasibility Assessment Report provides useful background information and data resources matrix.

■ Implementing the Dust Definition, and in particular, developing a Conceptual Model, can provide important feedback to emissions modelers and inventory developers, improving the robustness of SIP inventories and control strategy assessments.

Research / Information Needs

There is active research in the field of dust emissions and impacts at all spatial scales, from the very smallest (e.g., mechanisms of production and entrainment) to the very largest (e.g., global dust budgets and the impact of climate change.)

We Recommend:

- ⇒ The results of these studies should be incorporated to a database of identified data resources.
- ⇒ The research be reviewed for use in inputs and enhanced tools to quantify dust emissions.
- ⇒ Further research on the role of burrowing animals in soil disturbance and production of "entrainable" soils.



Future Work / Next Steps

- The feasibility assessment study of the WRAP DEJF Dust Definition is complete.
- Next steps will be the implementation of the dust definition for SIPs in other Class I areas.
- To facilitate that implementation, we suggest:
 - ⇒ Outreach to the Bureau of Land Management to assess the status of Standard Indicator Evaluation Matrix development. WRAP and its member agencies may wish to work with BLM to identify key source areas.
 - ⇒ Refinements to emission partitioning methodologies for windblown sources.

Contact Information and Additional Resources

Feasibility Assessment and Case Studies:
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Feasibility Assessment and Case Studies
<http://www.wrapair.org/forums/dejf/documents/defdust/index.html>

DUST DEFINITION IMPLEMENTATION

A Feasibility Assessment Protocol was developed for the WRAP's draft dust definition (see schematic below). It is important for Regional Haze Rule (RHR) State Implementation Plan (SIP) control strategy development that the anthropogenic contribution of dust from disturbed natural dust sources be identified. For example, current or previous grazing activities could alter the soil or vegetation in a way that increases the dust emissions beyond those emitted from the undisturbed land. The Protocol was used in two case studies.

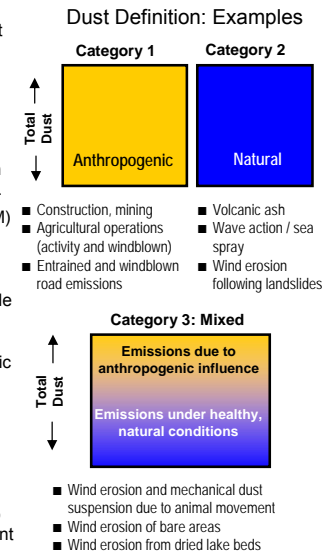
Key results from the study include:

- a **Feasibility Assessment Protocol**
- a **"conceptual model" approach** using multiple WRAP resources and tools
- A **novel approach to partitioning emissions from grazing land** using the Bureau of Land Management's rangeland health indicator matrix (Salt Creek Wilderness Case Study)

Background

In the western US, dust is a significant component in visibility degradation.

- Only visibility impairments from man-made pollution must be prevented and/or remedied.
- Dust sources, particularly fugitive dust sources, can result from both man-made and natural conditions.
- Historically, particulate matter (PM) issues and related visibility issues have focused on anthropogenic sources. Most PM and visibility modeling does not explicitly include "natural" sources of PM and inventories do not discriminate between natural and anthropogenic PM.
- As planners and policy makers formulate and communicate their plans, there is an increasing need to discriminate between uncontrollable and controllable sources in emission inventories to better assess visibility improvement strategies.



PM Inventory Developers and Modelers

"Conceptual Model" to assist in the identification of available inventory and modeling data resources.

Identify major mixed natural / anthropogenic sources and what data resources are available.

Case studies for data-poor (Saguaro West) and data-rich (Salt Creek Wilderness) Class I areas.

SIP Developers

"Conceptual Model" useful for introductory and background sections of Regional Haze SIPs.

Partitioning of major mixed emission sources important in formulating and assessing control strategies.

Policy Makers and the Public

"Conceptual Model" an important communication tool.

Describe quantitatively anthropogenic dust sources (controllable) and natural dust sources.

What the Dust Emission Joint Forum (DEJF) Did

The DEJF devised and oversaw several projects to support RHR SIP development in the western US. These include:

- Dust Emission Inventory Summary
- Windblown Dust Emissions from Vacant Lands
- Dust Tools and Resources
- Dust Definition Implementation (this project)
- New Mexico Pilot SIP Project

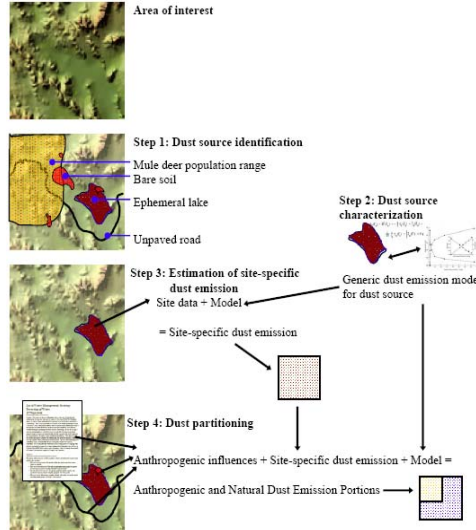
The Dust Definition project used results, tools, and methodologies from all of these related studies in developing the Feasibility Assessment Protocol and/or performing the case studies. On-going feedback from the DEJF was crucial. For example, DEJF comments led to the development and use of a "Conceptual Model" for assessing the role of dust sources in visibility impairment at a Class I area. The construction of a "Conceptual Model" is a key early step in determining the feasibility of implementing the dust definition.

FEASIBILITY ASSESSMENT AND PROTOCOL

Feasibility Assessment Approach

- How do you approach such varied sources? Approach: Constructed 3 different dust source categories:
 - Category 1: Purely anthropogenic
 - Category 2: Purely natural
 - Category 3: Mixed
- How to partition Category 3 emissions? Approach: Compare Category 3 actual or created "natural" reference sites.
- Can the partitioning be quantified? Approach: Identify metrics that may have related tools and/or databases, such as:
 - Reference areas
 - Reference time periods
 - Measures of *ecosystem health* as opposed to disturbance ranges
 - Modeling sensitivity exercises

Emission Estimation and Partitioning



Feasibility Assessment Approach (Continued)

- Are such **tools, models, and databases** available? Approach: Appendix A of the Feasibility Assessment Report identifies over 62 resources, with Web location, cost, "owner," description, spatial extent, user interface & input, data format, spatial resolution, data export, user requirements, and WRAP dust definition applicability score.

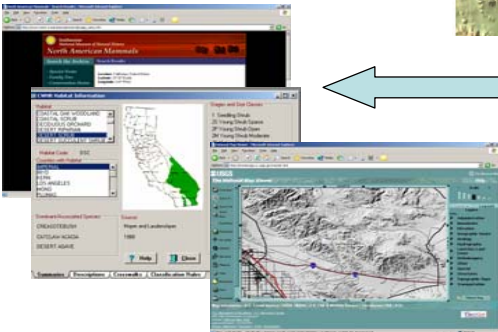
Feasibility Assessment Protocol

1. Identify the **purpose and goals** of the analysis
2. **Conceptual Model:** Initial rank ordering of sources using certain WRAP resources. (**Conceptual Model** based on feedback from the DEJF)
3. Identify **major Category 3 sources**
4. Identify **controls/mitigations**, if desired
5. For major Category 3 sources, are existing methods/databases available to characterize, estimate, and/or partition the emissions?
6. If not, can the necessary methods/databases be developed and at what cost?
 - If the answers to 5 and/or 6 are yes, definition can be implemented.

Related Efforts and Approaches

- Local and Air Basin: PM₁₀ SIPS/Natural Events Action Plans
- Regional / Interstate [National Acid Precipitation Assessment Program; WRAP Projects; regional scientific studies]
- Global: Zender et al. (2004), United States Geological Service conference, (2004) at <http://esp.cr.usgs.gov/info/dust/>

Participants at the USGS 2004 Conference noted that western North America is historically significant because human intervention and land management practices have dramatically altered the landscape and related dust emissions.



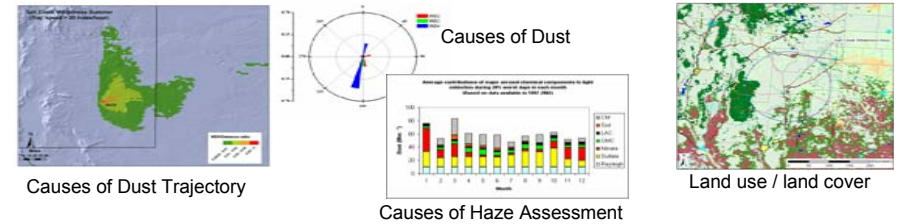
CASE STUDIES

STEP 1: Purpose and Goals

Item	Full-scale Study	Saguaro West Study	Salt Creek Wilderness Study
Analysis area	All source areas	South quadrant, 20-km radius	100 km radius circle
Resource identification	All	As in full study	As in full study
Dust source identification	Comprehensive, GIS, long-range sources	Limited	GIS spatially-resolved where possible
Dust source characterization	All <u>significant</u> sources	Most <u>significant</u> source	All <u>significant</u> sources
Emissions Inventory	All <u>significant</u> sources	Most <u>significant</u>	All <u>significant</u> sources
Inventory partitioning	All <u>significant</u> Cat. 3 sources	Most <u>significant</u> (with data)	All <u>significant</u> Cat. 3 sources

STEP 2: Conceptual Model (CM)

Construct a Conceptual Model from available resources (see below) and prepare an initial ranking of dust sources



STEP 3: Identify Major Category 3 Sources

Windblown dust from shrublands (and to a lesser extent, grasslands) was the dominant dust source and dominant Category 3 source.

STEP 5: Can Category 3 sources be characterized, estimated, and/or partitioned?

- Saguaro West:** Identified impacted areas and a "natural" reference area; emissions not updated.
- Salt Creek Wilderness:** A more extensive analysis:
 - Inventory refinement based on dust source ranking through the Conceptual Model.
 - County-specific emissions for anthropogenic sources were re-calculated using information.
 - Revised Windblown PM₁₀ dust emissions were developed based on local data.
 - A novel method to partition emissions from grazed vacant lands using Bureau of Land Management Standard Indicator Evaluation Matrix.

STEP 4: Identify Possible Controls and Mitigations

Standard Indicator Evaluation Matrix

Indicator	Extent	Degree of Departure from the Ecological Reference Area	Ecological Description and/or Ecological Reference Area(s)	Notes for Significance	
1. Wildflower dependent	Wildflower is sparse and well defined throughout most of the area.	Wildflower is moderately active and well defined throughout most of the area.	Active wildflower is sparse at adjacent intervals, mostly in exposed areas.	No recent formation of hills, all hills have flat-tops or no hills.	Current site formation of hills as expected for the site.
2. Underflow channels	Extensive and numerous, variable with active season, usually connected (perennial).	More numerous than expected, moderate to active season, occasionally connected.	Extensive in minor with some irregularly and irregularly connected.	Healthy riparian what is expected for the site, some evidence of minor erosion. Flow channels are visible and shrub.	Matches what is expected for the site, some evidence of past or current soil deposition or erosion.
3. Perennial and/or herbaceous plants or rocks	Abundant active herbaceous plants or rocks (usually in a result of being soil by wind or water erosion). Perennial herbaceous plants or soil deposition caused by water flow events.	Abundant active herbaceous plants or rocks common. Many rocks and plants are scattered with occasional exposed rocks.	Slight active herbaceous plants or rocks are in the path and a herbaceous plant is exposed. Occasional herbaceous plants.	Active herbaceous plants or rocks are in the path and a herbaceous plant is exposed. Occasional herbaceous plants.	Current or past evidence of herbaceous plants or rocks as expected for the site. Perennial herbaceous plants or soil deposition or erosion.
4. Bare ground (annual grass)	Percent bare ground is moderate to the upper range of the EIS (i.e., Loamy 10-15 bare ground 10-15%).	Percent bare ground exceeds the upper range of the EIS (i.e., Loamy 10-15 bare ground exceeds 10%).	Percent bare ground approaches the upper range of the EIS (i.e., Loamy 10-15 bare ground approaches 10%).	Percent bare ground is moderate to the upper range of the EIS (i.e., Loamy 10-15 bare ground approaches 10%).	Percent bare ground is moderate to the upper range of the EIS (i.e., Loamy 10-15 bare ground approaches 10%).
5. Soil texture	Common with indications of active erosion and channeling vegetation is abundant on slopes and in the path.	Common with indications of active erosion, vegetation is abundant on slopes and in the path. Headcuts are active, headcuts are not present.	Moderate to common with indications of active erosion, vegetation is abundant on slopes and in the path. Headcuts are active, headcuts are not present.	Moderate to common with indications of active erosion, vegetation is abundant on slopes and in the path. Headcuts are active, headcuts are not present.	Headcuts are represented on map, some channels, no signs of erosion with vegetation cover.
6. Wind-blown	Blowable and Deposition (absence of soil crust)	Active.	Common.	Occasionally present.	Blowable and fine. Matches what is expected for the site.
7. Litter	Abundant annual or winter litter (fall and spring) is present from 10-15%.	Litter is moderately abundant and well distributed. Litter has been deposited.	Litter is moderately abundant and well distributed. Litter has been deposited.	Litter is moderately abundant and well distributed. Litter has been deposited.	Matches what is expected for the site with a fair distribution of litter.