

## MEMORANDUM

Date: **October 8, 2020**

To: **Tom Moore, WESTAR-WRAP**

From: **Tejas Shah, John Grant and Amnon Bar-Ilan**

Subject: **WESTAR-WRAP Region Oil and Gas Emission Inventory Refinement:  
Task 2. Spatial allocation of O&G emissions by Mineral Ownership**

### INTRODUCTION

Oil and gas (O&G) emission inventories developed by Ramboll for the WRAP OGWG distinguish emissions by county and Tribal/non-Tribal surface land. Gridding surrogates are used to allocate total emissions for a geo-political area (e.g., county) to air quality model grid cells that intersect that area. Ramboll developed O&G gridding surrogates to allocate county level emissions to modeling grid cells for air quality modeling. Current gridding surrogates are by well type (oil, gas, coalbed methane) and O&G activity parameter (spuds, active well count, oil production, gas production). Per the request of the Bureau of Land Management (BLM), under this task, we expanded the level of detail in the O&G surrogates by adding mineral designation (Federal, non-Federal, and Tribal).

### BACKGROUND

For the WRAP Regional Haze air quality modeling, Ramboll developed 12-km spatial resolution gridding surrogates for processing the WRAP O&G inventories. Spatial surrogates are developed using GIS by overlaying modeling domain on maps of O&G wells. The surrogates were based on 2014 O&G activity data from IHS that provides production data for individual wells. Table 1 shows a list of O&G gridding surrogates created for the WRAP Regional Haze modeling. The WRAP O&G surrogates are the basis of gridding surrogates for each mineral ownership as described below.

**Table 1. List of O&G spatial surrogates**

Surrogate	Surrogate Desc
688	Gas production at oil wells
689	Gas production at all wells
690	Oil production at all wells
691	Well count - CBM wells
692	Spud count
693	Well count - all wells
694	Oil production at Oil wells
695	Well count - oil wells
696	Gas production at gas wells
697	Oil production at gas wells
698	Well count - gas wells
699	Gas production at CBM wells

## METHODOLOGY

BLM and Ramboll staff collaborated to develop a “Data Request Workbook” to facilitate data exchange for the purpose of defining oil and gas spatial surrogates by mineral designation. Ramboll populated the “Data Request Workbook” with the following data:

- i. 12-kilometer grid cells identification numbers and coordinates (latitude and longitude) for each oil and gas basin within the modeling domain.
- ii. For each grid cell, the O&G spatial surrogate that is currently being applied for distributing the total (regardless of ownership) O&G emissions for circa-2014 baseline. The same spatial surrogates are being used for the circa-2014 baseline and future year inventory, therefore, only a single set of surrogates was provided.

BLM modified the workbook to include spatial surrogate fractions that have been split by mineral designation (Federal, non-Federal and Tribal) for each 12-kilometer grid cell for each basin. BLM provided the workbook including spatial surrogate fractions by mineral designation across all WRAP O&G basins. The basis of the O&G spatial allocation by mineral designation was provided by BLM<sup>1</sup> and is available for review as an attachment to the associated memorandum on the subject of apportionment of county-level O&G emissions to mineral designation<sup>2</sup>.

Ramboll transformed the BLM-provided surrogate fractions that includes mineral designation details into a format required by the Sparse Matrix Operator Kernel Emissions (SMOKE) Modeling System<sup>3</sup>. Each spatial surrogate is output to a separate surrogate file with SMOKE-required descriptive header information. We produced O&G surrogates listed in Table 2. The surrogate files are ready to be used in SMOKE as AGPRO files. We also created cross-reference files in SMOKE-ready format to apply appropriate surrogate to each inventory source along with surrogate description file required by SMOKE. BLM provided spatial allocation fractions by mineral designation will be applied to spatially distribute future year emissions.

We produced the following files for surrogate cross-reference and description in SMOKE-ready format<sup>4</sup>.

- `srg_desc.oag.WRAP_2014.Federal.txt` – provides surrogate description for Federal O&G surrogate
- `srg_desc.oag.WRAP_2014.tribal.txt` – provides surrogate description for tribal O&G surrogate
- `srg_desc.oag.WRAP_2014.non-Federal.txt` – provides surrogate description for non-Federal O&G surrogate
- `gref.oag.WRAP_2014.Federal.txt` – surrogate cross-reference (GREF) file for Federal O&G emissions
- `gref.oag.WRAP_2014.tribal.txt` – surrogate cross-reference (GREF) file for tribal O&G emissions
- `gref.oag.WRAP_2014.non-Federal.txt` – surrogate cross-reference (GREF) file for non-Federal O&G emissions

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<sup>1</sup> Email from Bureau of Land Management, Colorado (Forrest Cook). May 27, 2020

<sup>2</sup> Memorandum: WESTAR-WRAP Region Oil and Gas Emission Inventory Refinement: Task 1. Apportion Oil and Gas Emissions by “Federal”, “Non-Federal” and “Tribal” Mineral Ownership. October 2, 2020. From: John Grant, Rajashi Parikh, Amnon Bar-Ilan (Ramboll). To: Tom Moore (WESTAR-WRAP)

<sup>3</sup> <https://www.cmascenter.org/smoke/>

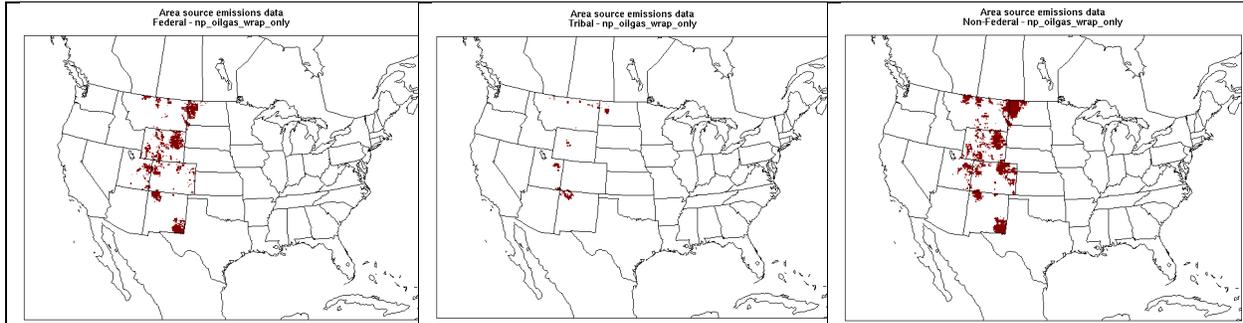
<sup>4</sup> Surrogate cross-reference and description files in SMOKE-ready format are available for review in the companion archive submitted with this memorandum, “WRAP\_MinDes\_SpatSurr.zip”

**Table 2. List of new O&G spatial surrogates by mineral designation**

Surrogate	Surrogate Desc
6881	Gas production at oil wells on Federal lands
6891	Gas production at all wells on Federal lands
6901	Oil production at all wells on Federal lands
6911	Well Counts - CBM Wells on Federal lands
6921	Spud Count - All Wells on Federal lands
6931	Well Count - All Wells on Federal lands
6941	Oil Production at Oil Wells on Federal lands
6951	Well Count - Oil Wells on Federal lands
6961	Gas Production at Gas Wells on Federal lands
6971	Oil Production at Gas Wells on Federal lands
6981	Well Count - Gas Wells on Federal lands
6991	Gas Production at CBM Wells on Federal lands
6882	Gas production at oil wells on tribal lands
6892	Gas production at all wells on tribal lands
6902	Oil production at all wells on tribal lands
6912	Well Counts - CBM Wells on tribal lands
6922	Spud Count - All Wells on tribal lands
6932	Well Count - All Wells on tribal lands
6942	Oil Production at Oil Wells on tribal lands
6952	Well Count - Oil Wells on tribal lands
6962	Gas Production at Gas Wells on tribal lands
6972	Oil Production at Gas Wells on tribal lands
6982	Well Count - Gas Wells on tribal lands
6992	Gas Production at CBM Wells on tribal lands
6883	Gas production at oil wells on non-Federal lands
6893	Gas production at all wells on non-Federal lands
6903	Oil production at all wells on non-Federal lands
6913	Well Counts - CBM Wells on non-Federal lands
6923	Spud Count - All Wells on non-Federal lands
6933	Well Count - All Wells on non-Federal lands
6943	Oil Production at Oil Wells on non-Federal lands
6953	Well Count - Oil Wells on non-Federal lands
6963	Gas Production at Gas Wells on non-Federal lands
6973	Oil Production at Gas Wells on non-Federal lands
6983	Well Count - Gas Wells on non-Federal lands
6993	Gas Production at CBM Wells on non-Federal lands

## RESULTS

To test and quality assure our products, we ran SMOKE with WRAP O&G emission inventory files to visualize the new surrogates. Figure 1 shows emission maps created with the new gridding surrogates by mineral ownership. Major O&G basins (example, Williston, Great Plains, Permian, San Juan etc.) are clearly visible on the emissions maps and confirm correct spatial allocation of oil and gas emissions.



**Figure 1. Spatial distribution of oil and gas emissions on Federal (left), tribal (middle) and non-Federal lands (right).**

## NEXT STEPS

Upon response to comments, Ramboll will finalize this technical memorandum and gridding surrogates for SMOKE processing.