O&G EMISSIONS INVENTORY PROJECT: GREATER SAN JUAN AND PERMIAN BASIN

John Grant, Rajashi Parikh, Amnon Bar-Ilan
Ramboll Environ

Tom Moore, Mary Uhl
Western Regional Air Partnership

Lee Gribovicz
Airstar Consulting

Charis Tuers
U.S. Bureau of Land Management

RAMBOLL ENVIRON

NATIONAL SYSTEM OF PUBLIC LANDS
U.S. DEPARTMENT OF THE INTERIOR
BUREAU OF LAND MANAGEMENT

WRAP
Western Regional Air Partnership

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OUTLINE

- Greater San Juan Basin (GSJB)
  - Overview
  - O&G Activity
  - Point (midstream) source inputs
  - Nonpoint (well-site) source inputs
- Permian Basin
  - Overview
  - O&G Activity
  - Point (midstream) source inputs
  - Nonpoint (well-site) source inputs

GREATER SAN JUAN BASIN: OVERVIEW

Objective: Develop inputs for 2014 O&G emission inventory for criteria pollutants and greenhouse gases for the Greater San Juan Basin in southern Colorado and Northern New Mexico.

Input	Source
• **O&G activity data** by county, well type, and mineral designation	**IHS Enerdeq Database**
• **Point (midstream) source emissions** by facility	**Federal / State / Local / Tribal Agency Permit Databases**
• **Well-site source input factors**	**Operator survey, Subpart W GHGRP, EPA O&G Tool, CARMMS O&G Inventory**

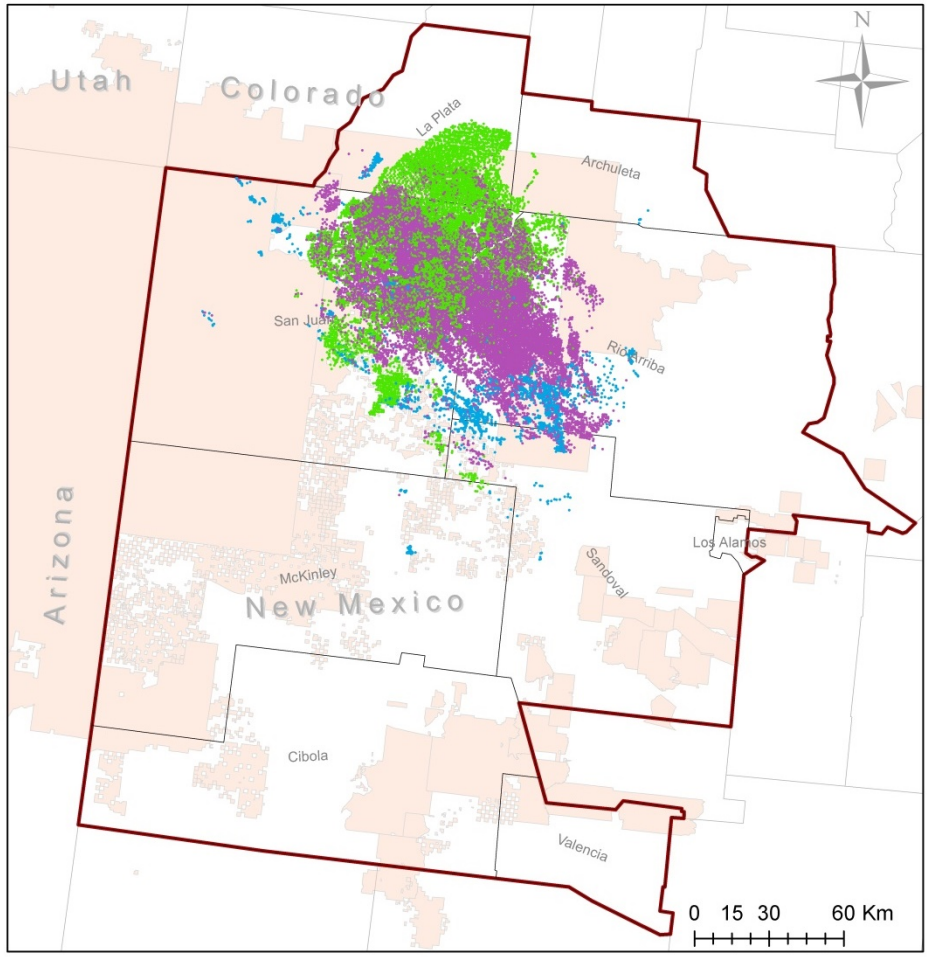
GREATER SAN JUAN BASIN: O&G ACTIVITY

- Gas and CBM well dominant
- Colorado:
  - Primarily CBM wells
- New Mexico
  - Mix of gas, oil, and CBM wells
- GSJB accounted for about 3% of US-wide on-shore natural gas production in 2014

Activity Metric		Basin-wide Totals	Percent of Greater San Juan Basin O&G Activity in each State	
			Colorado	New Mexico
Active Well Count	Gas	16,047	5%	95%
	Oil	1,725	5%	95%
	CBM	7,098	32%	68%
	Total	**24,870**	13%	87%
Liquid Hydrocarbon Production	Condensate	1,653	0%	100%
	Oil	4,413	1%	99%
	Total	**6,066**	1%	100%
Gas Production (MMCF/yr)	Natural Gas	426,789	6%	94%
	Associated Gas	23,833	0%	100%
	Coalbed Methane	609,777	53%	47%
	Total	**1,060,399**	33%	67%
Spuds		122	16%	84%

O&G activity data from IHS Enerdeq Database

GREATER SAN JUAN BASIN: WELL LOCATIONS BY TYPE



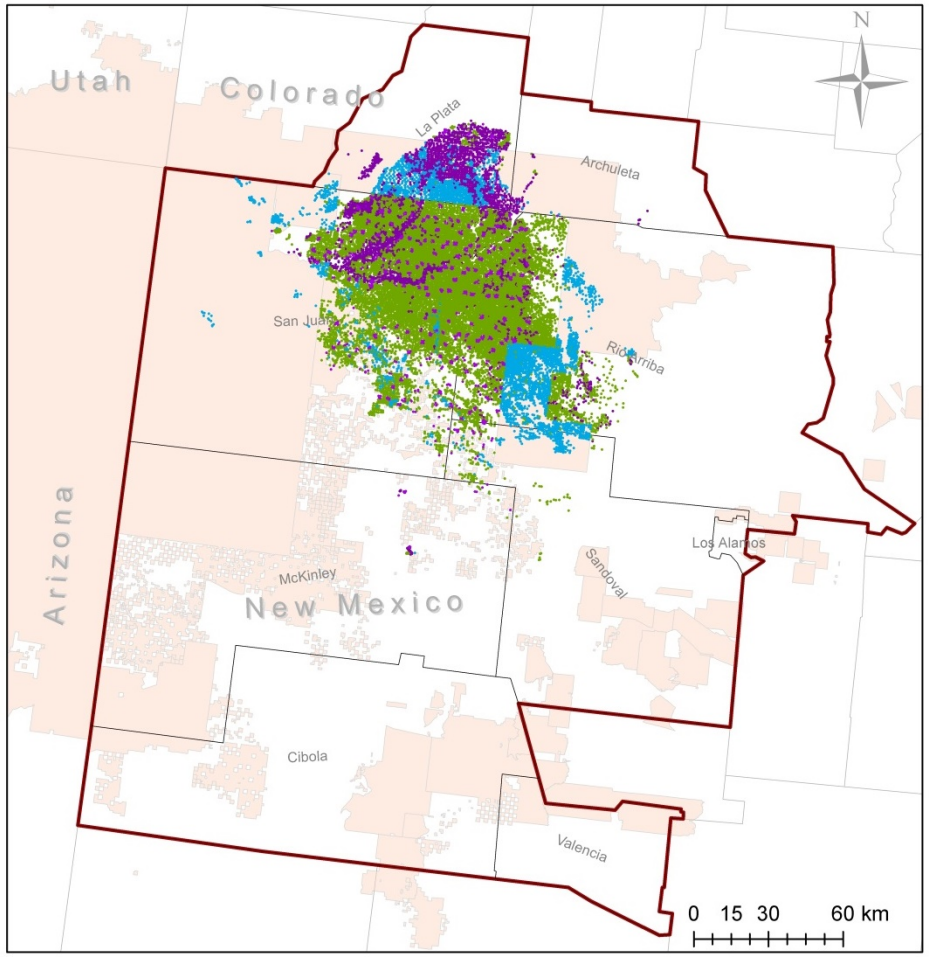
Legend

- Greater San Juan Basin (consistent with GHGRP Subpart W definition)
- Tribal Lands

Well Type

- Oil
- CBM
- Gas

GREATER SAN JUAN BASIN: WELL LOCATION BY MINERAL OWNERSHIP



Legend

Greater San Juan Basin (consistent with GHGRP Subpart W definition)

Tribal Lands

Mineral Ownership (2014 Wells)

- Private/State
- Tribal
- Federal

GREATER SAN JUAN BASIN: MIDSTREAM EMISSIONS OVERVIEW

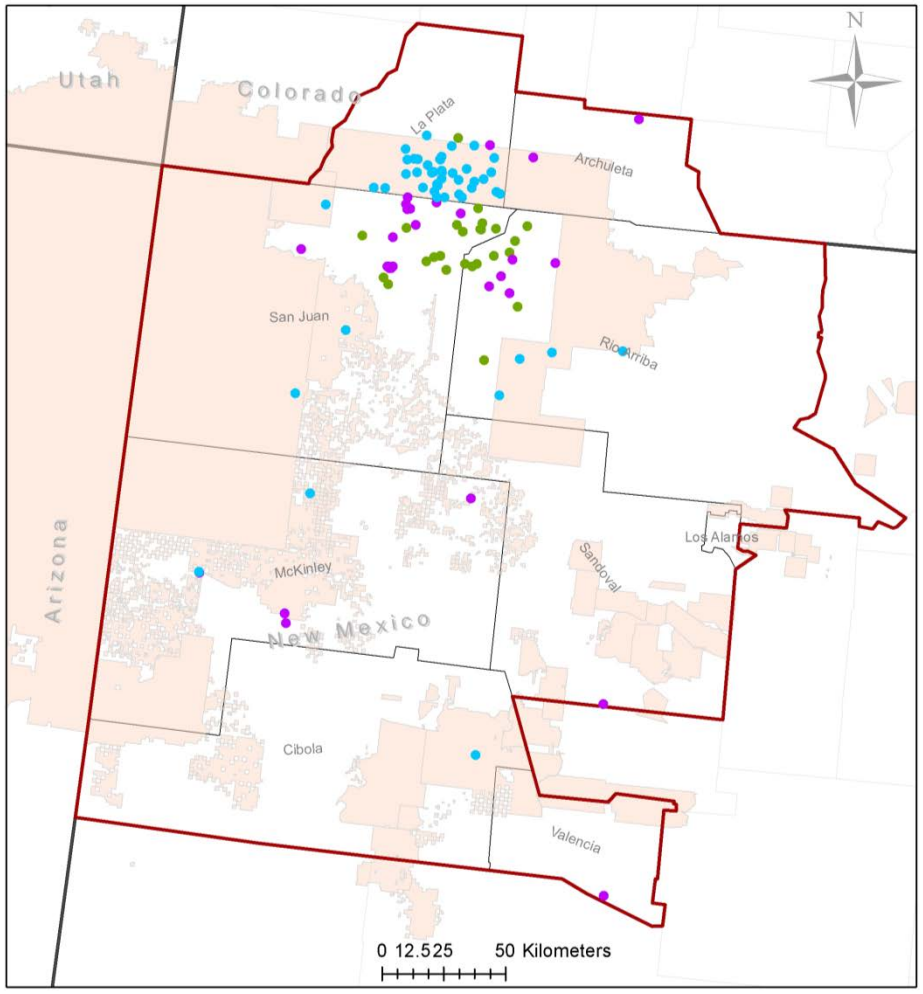
- Facilities: large gas processing plants, major compressor stations, and other smaller facilities
- Data sources:
  - Title V or major sources in use in midstream, gas gathering applications from NMED permit data;
  - Major and minor sources in use in midstream applications from CDPHE permit data;
  - Title V and Tribal Minor New Source Review major sources on tribal land from 2014 NEI v1 and US EPA Regions 6, 8, & 9;

GREATER SAN JUAN BASIN: MIDSTREAM PERMITTED EMISSION SUMMARY

- Majority of emissions from NMED permitted facilities
- Sources under Title V thresholds (minor sources):
  - Not available from NMED
  - Included from CDPHE and tribal minor sources reported by EPA

Emission Data Source	Emissions (tons/yr)				
	NOx	VOC	CO	PM_{10}	SO_2
NMED	7,651	3,000	5,114	270	186
CDPHE	89	26	88	2	0
EPA Region 6	618	377	257	4	0
EPA Region 8	3,368	1,698	2,094	81	52
EPA Region 9	9	8	7	0	0
Total	**11,735**	**5,109**	**7,560**	**357**	**238**

GREATER SAN JUAN BASIN: MIDSTREAM FACILITIES BY SURFACE OWNERSHIP



Legend

- Greater San Juan Basin (consistent with GHGRP Subpart W definition)
- Tribal Lands

Ownership

- Federal
- Private/State
- Tribal

GREATER SAN JUAN BASIN: WELL-SITE SOURCE INPUTS OVERVIEW

- **Primary Source:** Operator Well-site Surveys
  - Representing 53% of well ownership, 58% of gas production, and 53% of oil production
- **Secondary Source:** GHGRP Subpart W
  - Company specific GHGRP data
- **Primary + Secondary Source** Representation:
  - 65% of well ownership, 72% of gas production ownership, and 81% of oil production ownership
- **Gapfill Sources:** EPA O&G Tool, Colorado Air Resources Management Modeling Study (CARMMS) O&G inventory

GREATER SAN JUAN BASIN: SURVEY OVERVIEW

- Leveraged data collected/submitted as part Subpart W GHGRP
- Survey requested for the following
  - GHGRP Subpart W Submission by well type
  - GHGRP Subpart W Supplemental Information
  - Supporting Data (lab analyses, model input/output)
  - Survey Data (for source categories where Subpart W data is not sufficient/available to estimate criteria pollutant emissions)
- Input factor compilation
  - Operator average weighted by O&G activity surrogate most closely linked to the associated source category (e.g. condensate tank emission factor average is weighted by condensate production)
- Output: Input factors by source category and well type

GREATER SAN JUAN BASIN: SELECT INPUT FACTORS

Wellsite Emission Inventory Input Parameter		Units	Input Factor		
			Oil Wells	Gas Wells	CBM Wells
Lateral Compressor Engines					
Number of Wells per Typical Lateral Compressor Engine			NA	111	111
Rated Horsepower		hp		444	670
Load Factor		unitless		0.7	0.7
Hours of Operation		hours/engine/year		7,776	7,828
Emission Factors	NOx	g/bhp-hr		5.4	5
Wellhead Compressor Engines					
Percentage of wells that have a wellhead compressor engine		%	NA	94%	94%
Rated Horsepower		hp		110	109
Load Factor		unitless		0.75	0.75
Hours of Operation		hours/engine/year		8,262	8,288
Emission Factors	NOx	g/bhp-hr		7.4	7.1

GREATER SAN JUAN BASIN: SELECT INPUT FACTORS

Wellsite Emission Inventory Input Parameter		Units	Input Factor		
			Oil Wells	Gas Wells	CBM Wells
Pneumatic Controllers					
Number of Devices per Well	High Bleed Devices		0.1	0.2	0.05
	Intermittent Devices		1.1	2.7	2.2
	Low Bleed Device		1.4	2.5	0.1
Device Rate	High Bleed Devices	scf/hr	37.3	37.3	37.3
	Intermittent Devices		13.5	13.5	13.5
	Low Bleed Device		1.4	1.4	1.4
Annual Hours of Operation		hrs/yr	8,760	8,760	8,760

GREATER SAN JUAN BASIN: SELECT INPUT FACTORS

Wellsite Emission Inventory Input Parameter	Units	Input Factor		
		Oil Wells	Gas Wells	CBM Wells
Liquid Unloading				
Percentage of Wells Vented for Liquid Unloading		1%	45%	9%
Fraction of Liquid Unloading controlled	%	0%	0%	0%
Average Natural Gas Volume per Event	MCF/event	59	3,209	617
Annual Number of Unloading Vented to the Atmosphere per well	no.of events per well	1	31.9	2.1

PERMIAN BASIN

PERMIAN BASIN: OVERVIEW

Objective: Develop inputs for 2014 O&G emission inventory for criteria pollutants and greenhouse gases for the portion of the Permian basin in New Mexico.

Input	Source
• **O&G activity data** by county, well type, and mineral designation	**IHS Enerdeq Database**
• **Point (midstream) source emissions** by facility	**Federal / State / Local / Tribal Agency Permit Databases**
• **Well-site source input factors**	**Literature Review**

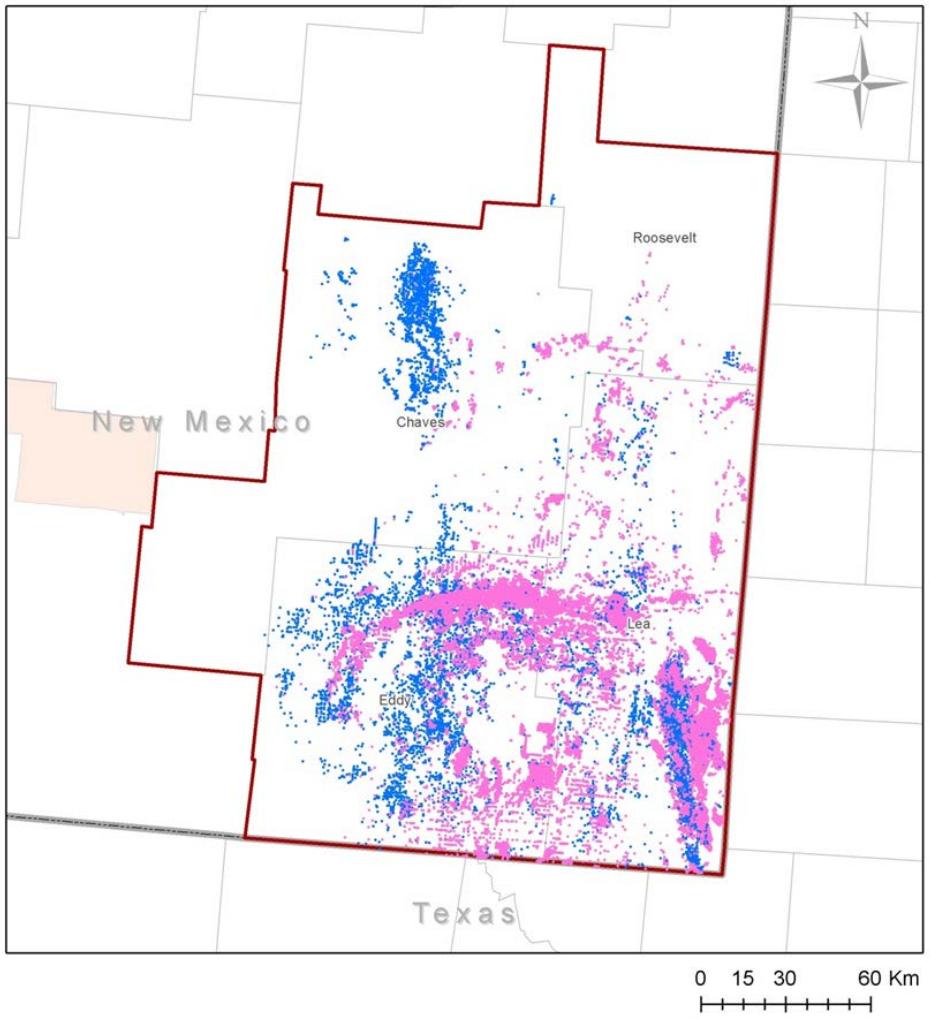
PERMIAN BASIN: O&G ACTIVITY

- New Mexico activity only
- Oil well dominant
- Permian Basin (New Mexico only) accounted for about 4% of US-wide on-shore oil production in 2014

Activity Metric		Totals for Permian Basin in New Mexico
Active Well Count	Gas	5,957
	Oil	22,611
	Total	**28,568**
Liquid Hydrocarbon Production (Mbbl/yr)	Condensate	2,644
	Oil	114,613
	Total	**117,257**
Gas Production (MMCF/yr)	Natural Gas	118,006
	Associated Gas	387,858
	Total	**505,864**
Spuds		1,089

O&G activity data from IHS Enerdeq Database

PERMIAN BASIN: WELL LOCATIONS BY TYPE



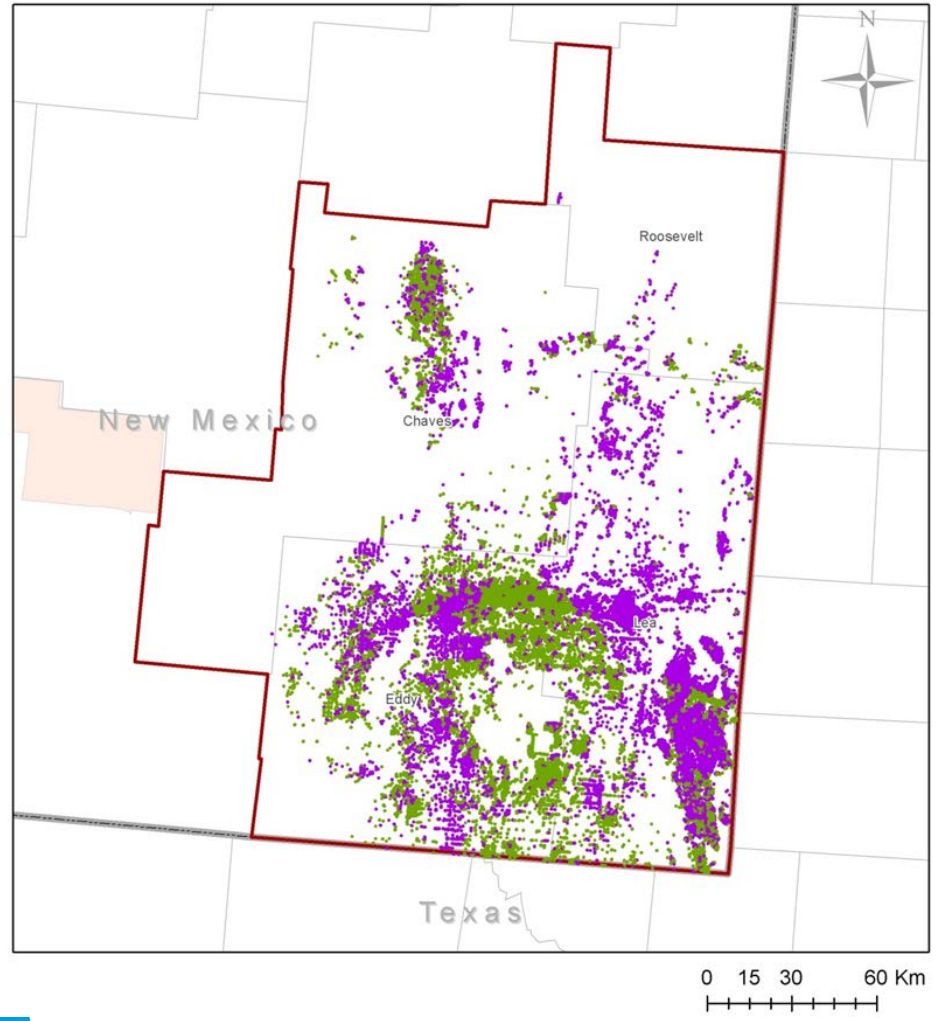
Legend

- Permian Basin
- Tribal Lands

Well Type

- Oil
- Gas

PERMIAN BASIN: WELL LOCATIONS BY MINERAL OWNERSHIP



Legend

- Permian Basin
- Tribal Lands

Mineral Ownership (2014 Wells)

- Private/State
- Federal

PERMIAN BASIN: MIDSTREAM EMISSIONS OVERVIEW

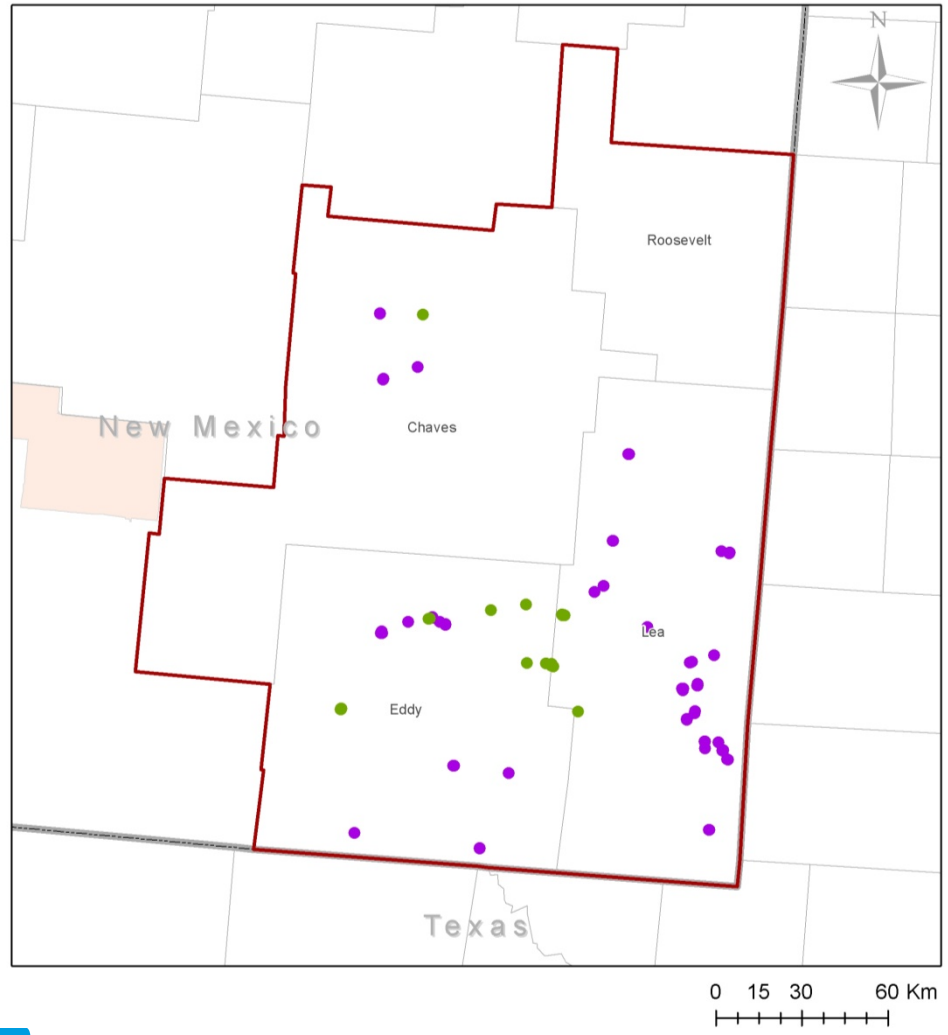
- Facilities: large gas processing plants, major compressor stations, and other smaller facilities
- Data sources:
  - Title V or major sources in use in midstream, gas gathering applications from NMED permit data;
  - No tribal ownership in Permian Basin

PERMIAN BASIN: MIDSTREAM PERMITTED EMISSION SUMMARY

- All emissions from NMED permitted facilities
- Sources under Title V thresholds (minor sources) not available from NMED

Emission Data Source	Emissions (tons/yr)				
	NOx	VOC	CO	PM_{10}	SO_2
NMED	10,578	2,678	5,230	224	6,681
Total	**10,578**	**2,678**	**5,230**	**224**	**6,681**

PERMIAN BASIN: MIDSTREAM FACILITIES BY SURFACE OWNERSHIP



Legend

- Permian Basin
- Tribal Lands

Ownership

- Federal
- Private/State

PERMIAN BASIN: WELL-SITE SOURCE INPUT DEVELOPMENT OVERVIEW

- Input factors developed based on literature review
  - Conducting a survey in the Permian Basin was not expected to yield adequate operator participation
- Literature review sources
  - EPA Subpart W reporting for wellsite sources in the Permian Basin
    - Pneumatic controllers, fugitive components, pneumatic pumps
  - TCEQ oil and gas emission inventory
    - All other well-site source categories

PERMIAN BASIN: SELECT INPUT FACTORS

Parameter	Value	Unit
Oil Tanks		
VOC Emission Factor	1.6	lb/bbl
Fraction of Production Controlled	0%	%
Condensate Tanks		
VOC Emission Factor	7.1	lb/bbl
Fraction of Production Controlled	20%	%

PERMIAN BASIN: SELECT INPUT FACTORS

Parameter		Value	Unit
Artificial Lift Engines			
Fraction of oil wells with artificial lift engines		97%	%
Fraction of artificial lift engines that are electrically operated		70%	%
Average horsepower of the engine		20.55	hp
Load factor		71%	%
Annual number of hours		4,380	hr/yr
Emission Factors	NOx	14.75	g/hp-hr

PERMIAN BASIN: SELECT INPUT FACTORS

Parameter		Value	Unit
Pneumatic Devices			
Devices counts for oil and gas wells	High Bleed	0.04	number of devices per well
	Intermittent	0.31	
	Low Bleed	0.24	
EPA default bleed rate	High Bleed	37.00	scf/hr
	Intermittent	13.50	
	Low Bleed	1.39	

GREATER SAN JUAN & PERMIAN BASIN: NEXT STEPS

- Gather comments from stakeholders on the draft report
- Publish final report
- Develop 2014 emission inventory based on the inputs developed in this study
- Develop a future year emission inventory accounting for O&G activity forecasts and controls per on-the-books regulations (e.g. NSPS OOOO, NSPS JJJJ)

QUESTIONS

John Grant
jgrant@envirocorp.com
(415) 899-0706

Amnon Bar-Ilan
abarilan@environcorp.com
(415-899-0732)

Report & other project materials available at:
http://www.wrapair2.org/SanJuanPermian.aspx