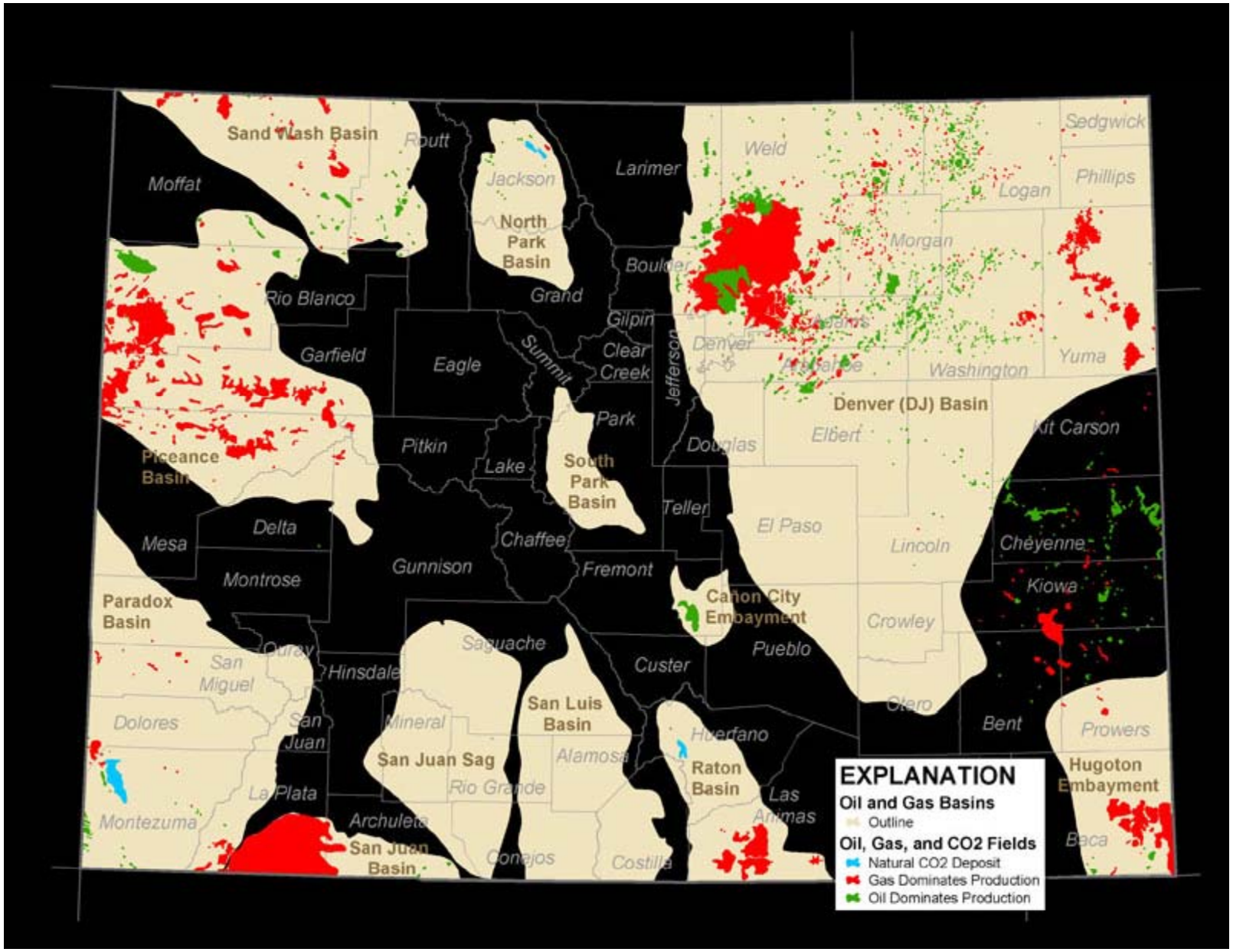
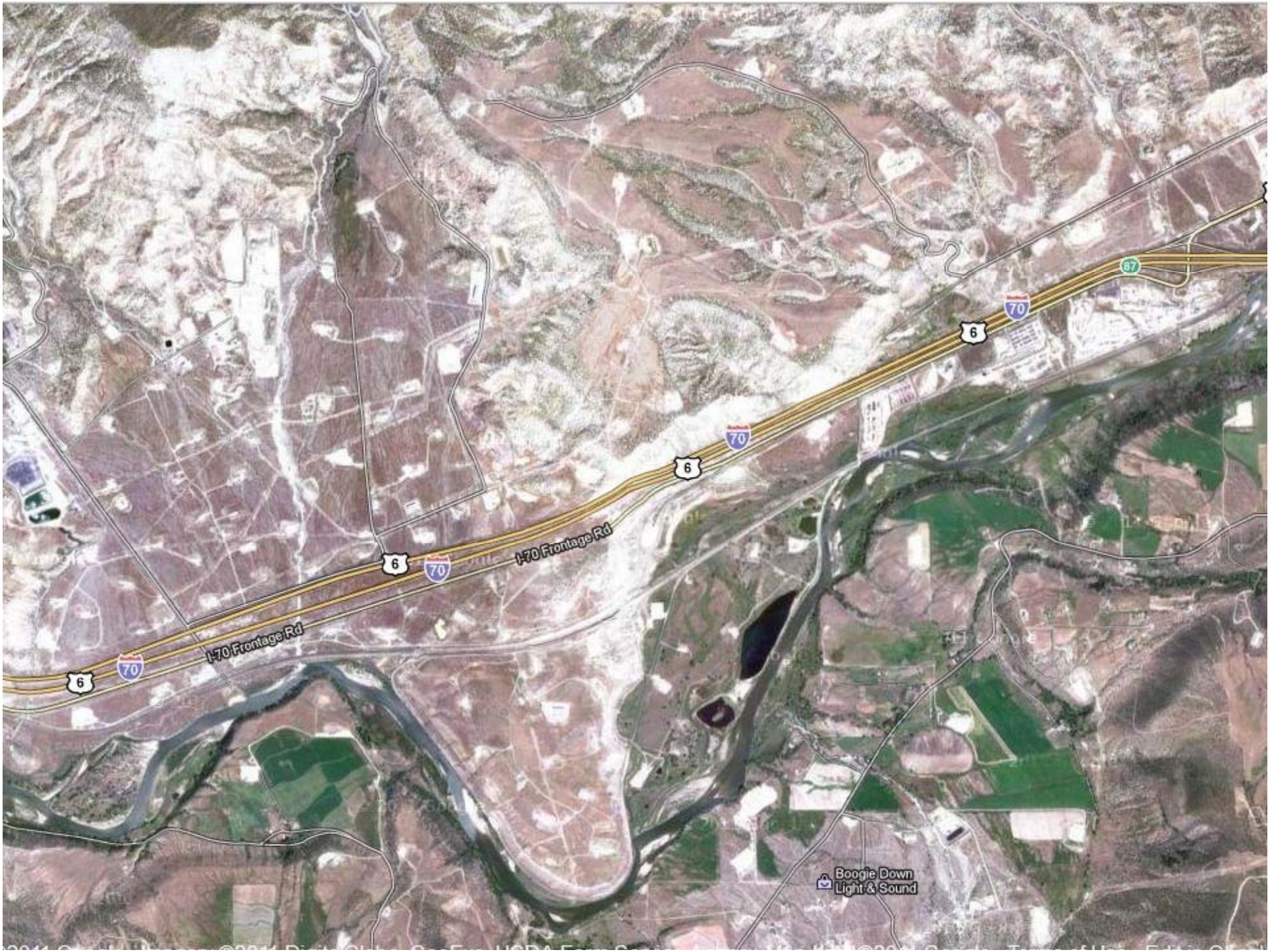
Oil & Gas-Related Vehicle Traffic and Emissions Inventories

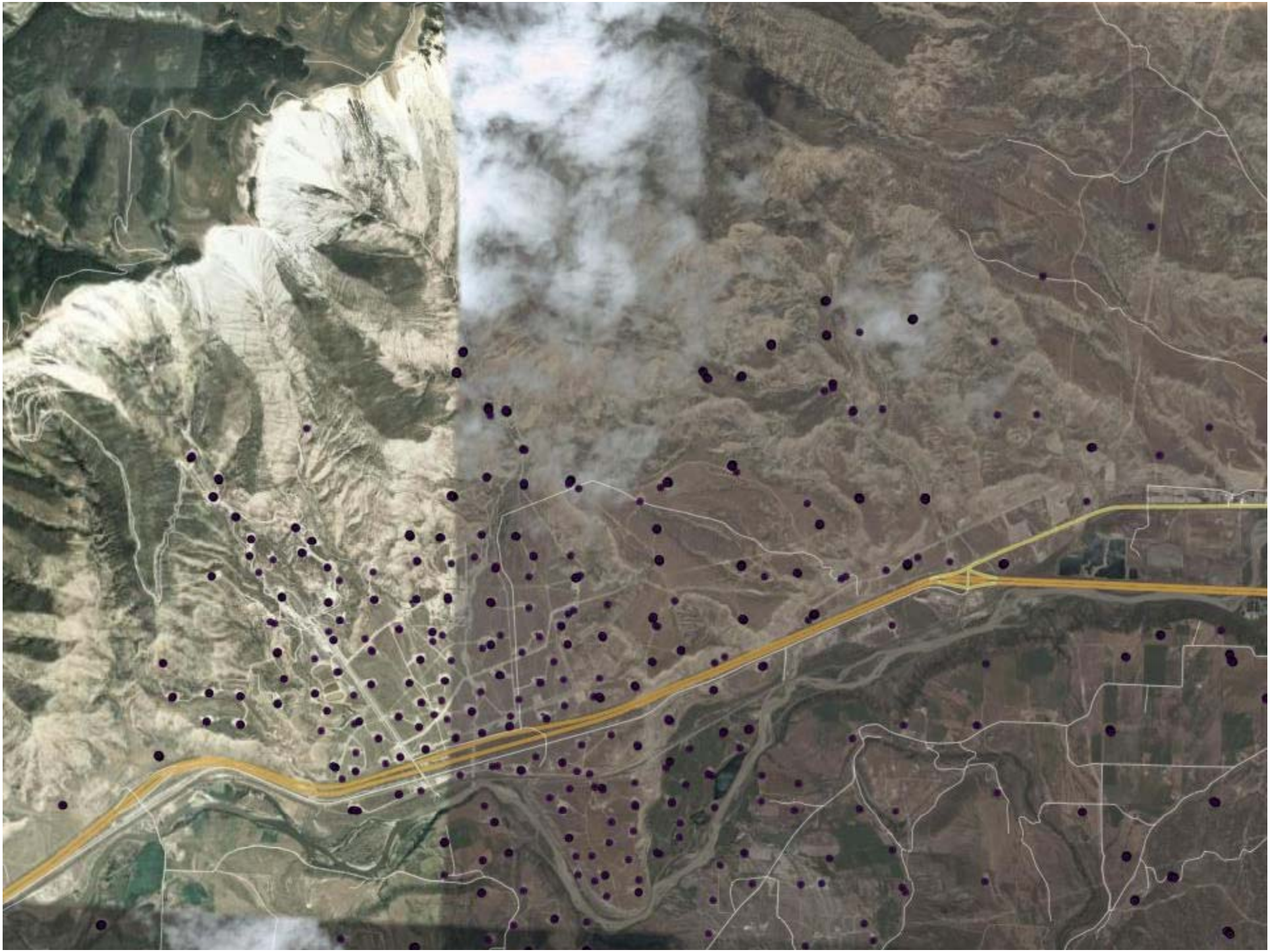
By Lisa Silva and Rose Waldman

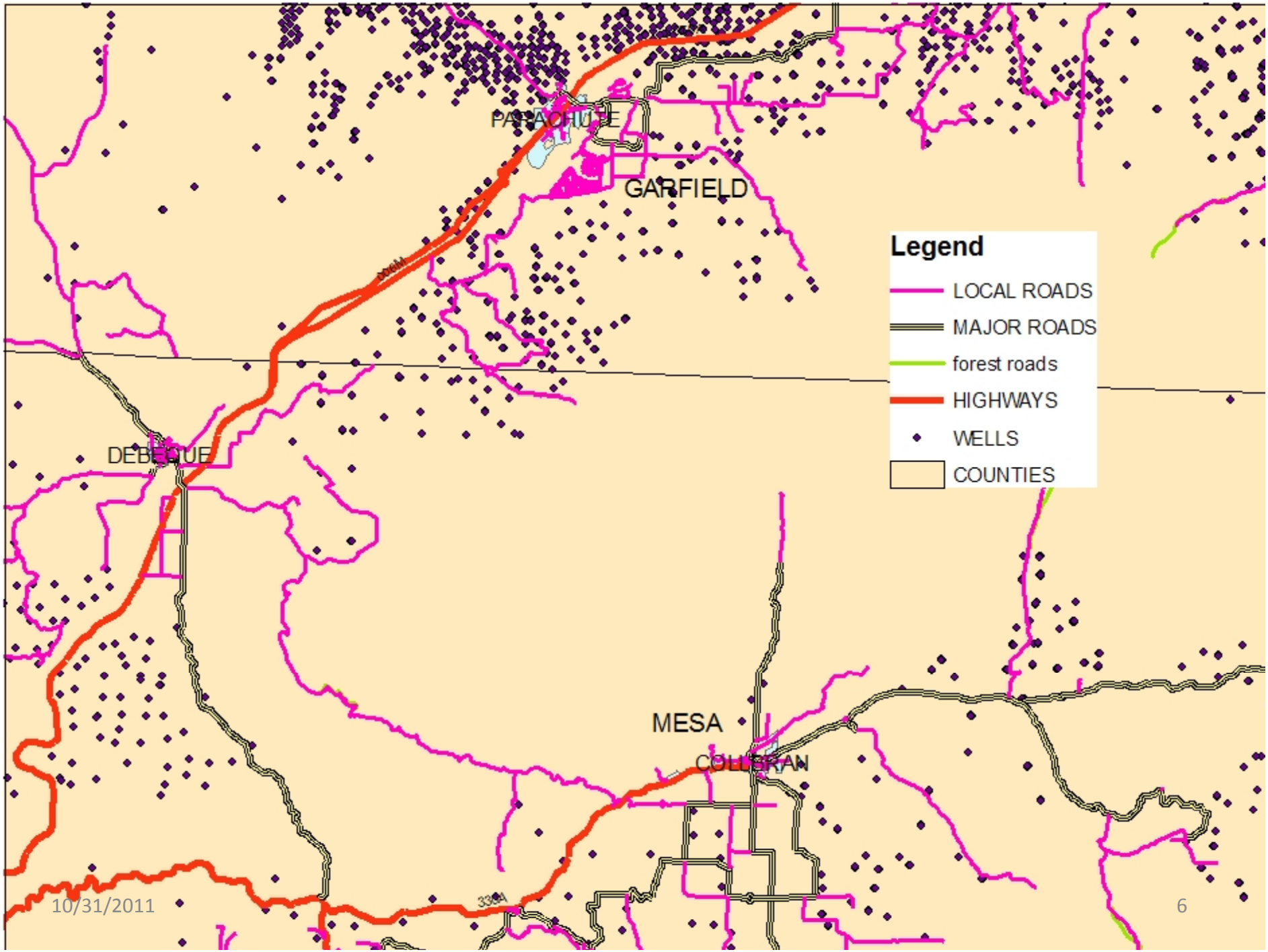
Roadway Emission Inventories

- APCD captures O&G traffic on: highways, county roads, other public streets, but does not disaggregate from other traffic
- Traffic on private land and leased public lands (BLM, USFS) not captured by APCD/EPA – likely a significant omission in inventories
- Satellite photos show extensive roadway networks in O&G patches.


Sand Wash Basin
Routt
Moffat
Jackson
Larimer
Weld
Sedgwick
Logan
Phillips
North Park Basin
Morgan
Boulder
Rio Blanco
Grand
Gilpin
Garfield
Eagle
Summit
Clear Creek
Jefferson
Denver
Adams
Washington
Yuma
Denver (DJ) Basin
Park
Pitkin
Douglas
Elbert
Kit Carson
Piceance Basin
Lake
South Park Basin
Teller
Delta
Mesa
Chaffee
El Paso
Lincoln
Cheyenne
Gunnison
Fremont
Montrose
Kiowa
Canon City Embayment
Paradox Basin
Saguache
Crowley
Ouray
Custer
Pueblo
San Miguel
Hinsdale
Otero
San Luis Basin
Dolores
San Juan
Mineral
Huerfano
Bent
Prowers
San Juan Sag
Alamosa
Raton Basin
Hugoton Embayment
La Plata
Rio Grande
Las Animas
Montezuma
Archuleta
Baca
San Juan Basin
Conejos
Costilla
EXPLANATION
Oil and Gas Basins
Outline
Oil, Gas, and CO2 Fields
Natural CO2 Deposit
Gas Dominates Production
Oil Dominates Production

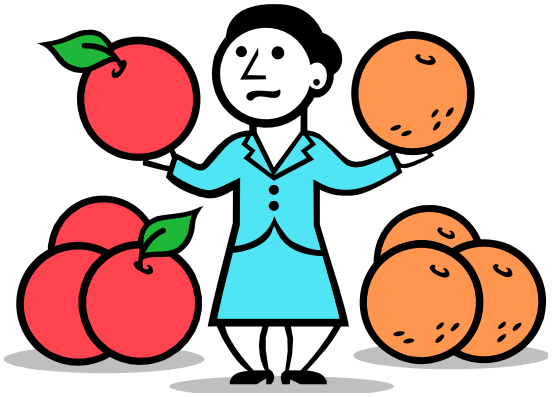

I-70 Frontage Rd
I-70 Frontage Rd
Boogie Down
Light & Sound




PARACHUTE
GARFIELD
DEBEQUE
MESA
COLLBRAN
Legend
LOCAL ROADS
MAJOR ROADS
forest roads
HIGHWAYS
WELLS
COUNTIES

Studies indicate significant traffic

- Studies indicate significant traffic, but specifics are not directly comparable (apples to oranges)
  - UDOT On-Highway study (2006) *apples*
  - CDOT On-Highway counts (2008) *crabapples*
  - Piceance Basin Pilot (2011) *oranges*
- We will discuss these 3 studies and what they contribute to our knowledge
- We'll also recommend areas for future study.



Apples, oranges

- UDOT and CDOT study interest: documenting increased O&G traffic and roadway damage, establishing infrastructure needs
  - UDOT looked at HDD traffic on state and federal highways
  - CDOT looked at all types of vehicle traffic on state and federal highways
- Piceance Basin Pilot Project (P3) interest: traffic and air pollutant emissions associated w/ O&G development.

UDOT Study: "Highway Freight Traffic Associated with the Development of Oil and Gas Wells"

Found range of 375 to 1,375 HDD truck trips per well under development.

Load	Number of HDD truck trips
Construction equipment	10 to 45
Drilling rig	30
Fresh water	100 – 1,000
Drill mud	10-20
Frac sand, frac tanks	26
Cement powder	2-5
Completion rig water	100
Completion rig equipment	30-35
Explosives	1

UDOT Study: "Highway Freight Traffic Associated with the Development of Oil and Gas Wells"

- Post -completion HDD truck trips for general maintenance: Between 24 and 40 HDD truck trips every 3 to 5 years.

- Smaller (light duty) trucks that also visit/maintain wells (in-field traffic) were *not i*ncluded in the study.

CDOT Study 2008

- O&G-related trips (all vehicle types) in NE Colorado
  - (I-70, U.S. 40 and State Highways 64, 13, 6, 65, 139, 330, 92, 133, 141)
- Road damage from HDD/oversize, overweight
  - Severe rutting, e.g.
- Safety issues (no shoulders on many roads)
- Greatly increased congestion
- Used average of 900 trips per well.

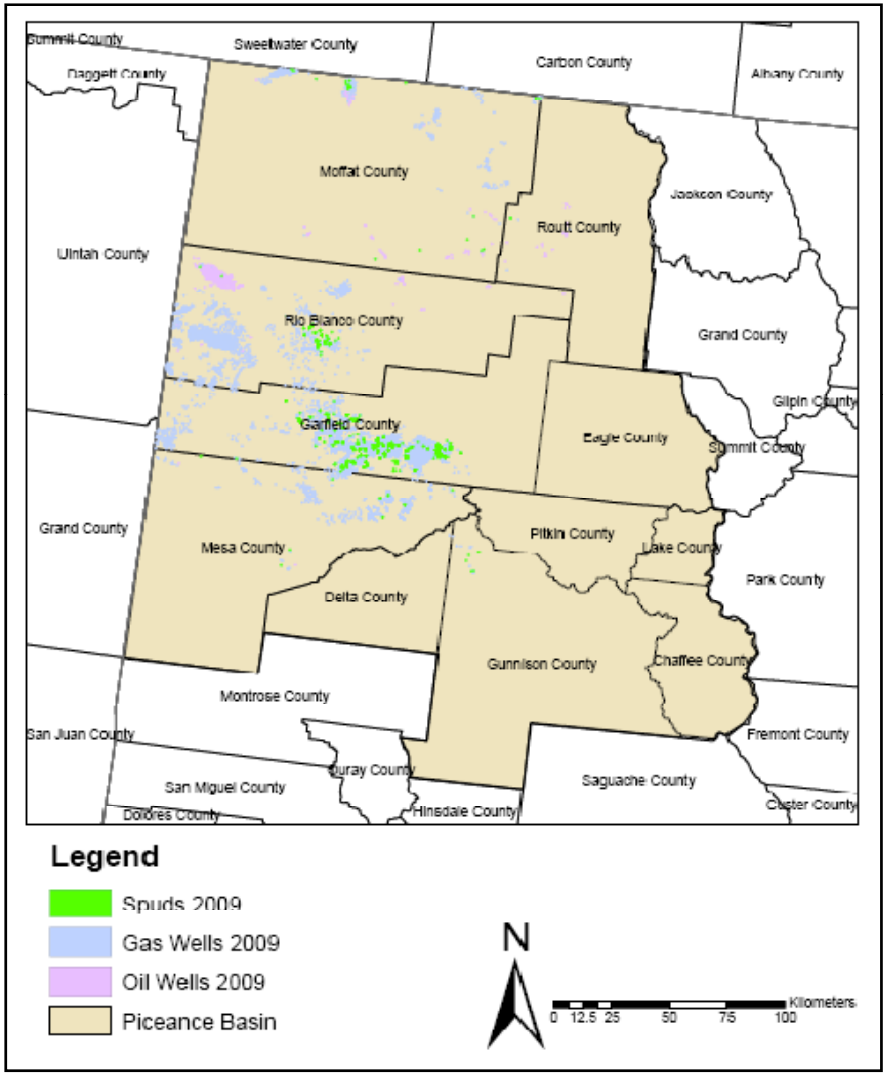

OVER SIZE LOAD

Severe Rutting due to heavy loads

Piceance Pilot Project (P3) Study 2011 Overview

- Primary purpose to develop oil and gas mobile source emission inventory for Piceance Basin
- Unit-level emission factors developed that may be applicable to other basins
- Major on-road and non-road mobile source activity associated with well pad construction, drilling, completion, production, and maintenance activities
- Focused on in-field activities

P3 Study – Geographic and Temporal Scope

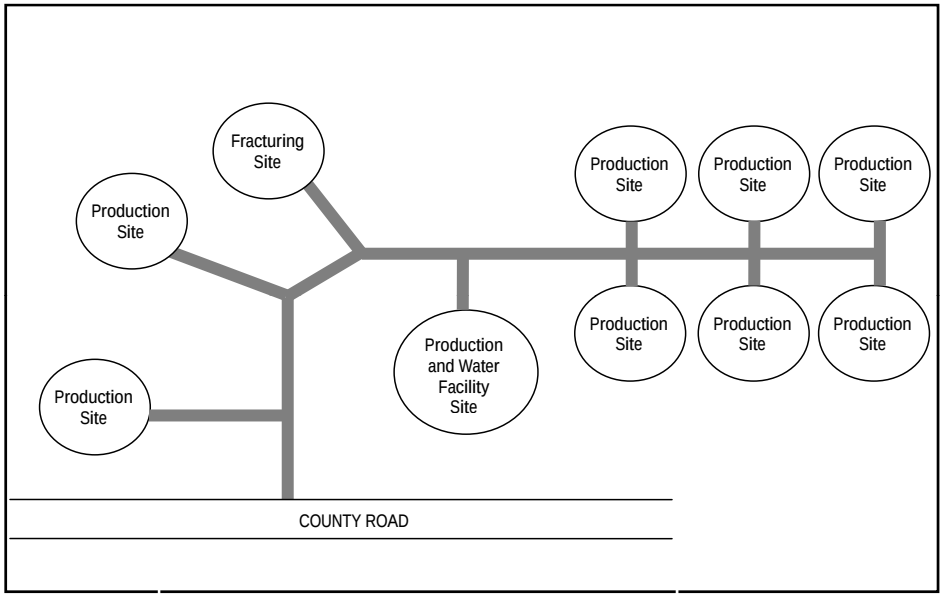


- Study focuses on Piceance Basin in NW Colorado including Chaffee, Delta, Eagle, Garfield, Gunnison, Lake, Mesa, Moffat, Pitkin, Rio Blanco and Routt Counties
- Basin contains primarily conventional gas and conventional oil production in 2009
- Gas production focused on Garfield County; oil production focused on Rio Blanco County
- P3 study considers activities in calendar year 2009 – latest year for which detailed data was available

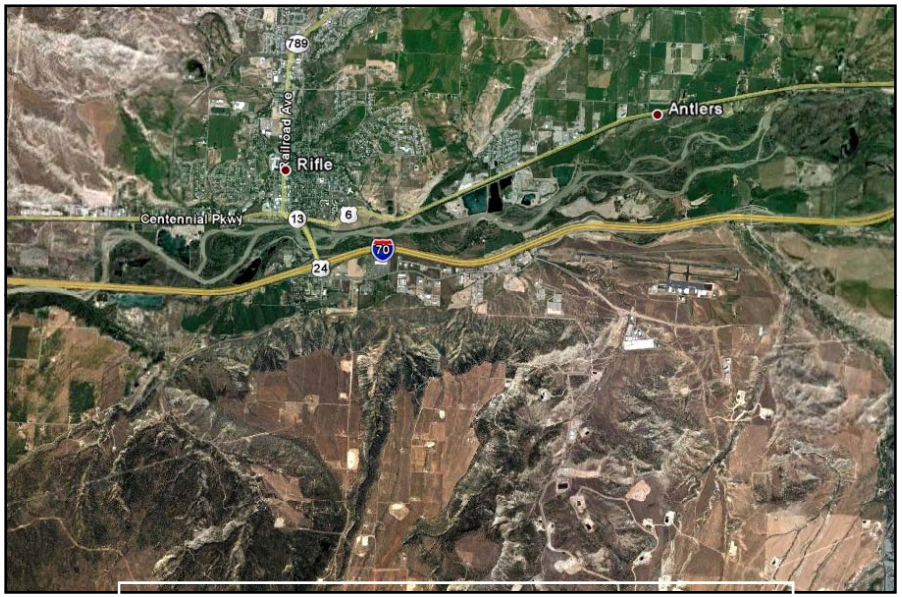
ENVIRON

P3 Study – Geographic Scope

In-Field vs. Total Trip



Example of in-field activity



Example of public roadway network

- In-field refers to travel on mostly unpaved roadways within oil and gas fields (majority are not public roadways)
- Restriction to in-field in P3 due to difficulty in reconciling mobile source activity and emissions with existing traffic counts and county-level mobile source inventory in CO

ENVIRON

P3 Study Progression

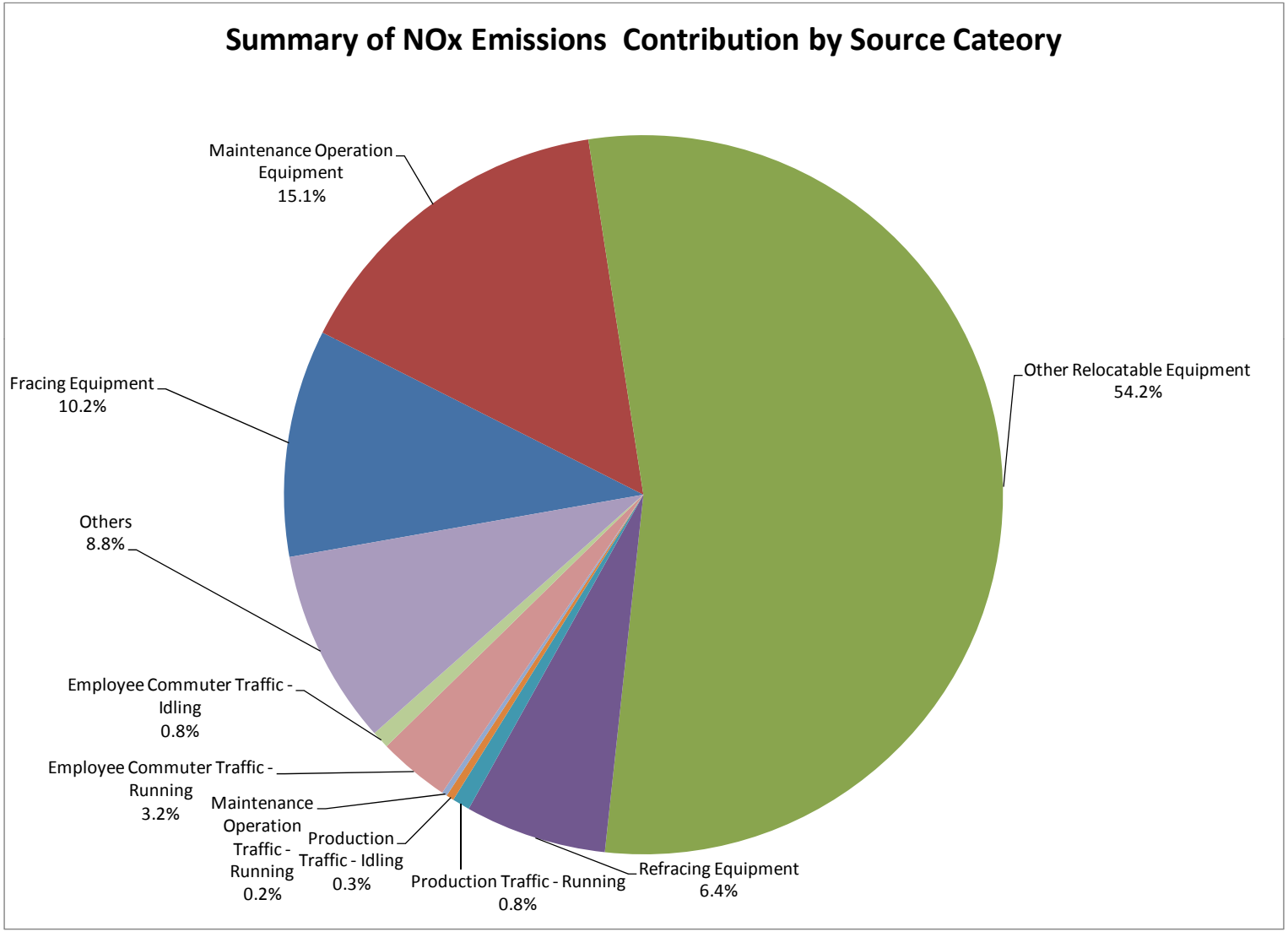
- Surveys completed by 3 major oil and gas producers in Piceance Basin
- Field verification
- Survey data aggregated to determine inventory in Piceance
- Emission factors derived using models to apply survey results to other basins

P3 Study – Results

County	NOx (tons/yr)	CO (tons/yr)	Total VOC (tons/yr)	SOx (tons/yr)	Total PM10 (tons/yr)	Fugitive Dust PM10 (tons/yr)	Total PM2.5 (tons/yr)	Fugitive Dust PM2.5 (tons/yr)
Delta	0	0	0	0	1	1	0	0
Garfield	758	325	61	14	6,273	6,226	1,505	1,460
Gunnison	2	1	0	0	10	10	2	2
Mesa	67	30	6	1	657	652	158	154
Moffat	42	18	3	1	380	377	91	89
Rio Blanco	185	81	15	3	1,695	1,684	408	397
Routt	3	1	0	0	23	23	6	5
Totals	**1,055**	**455**	**86**	**19**	**9,039**	**8,974**	**2,171**	**2,109**

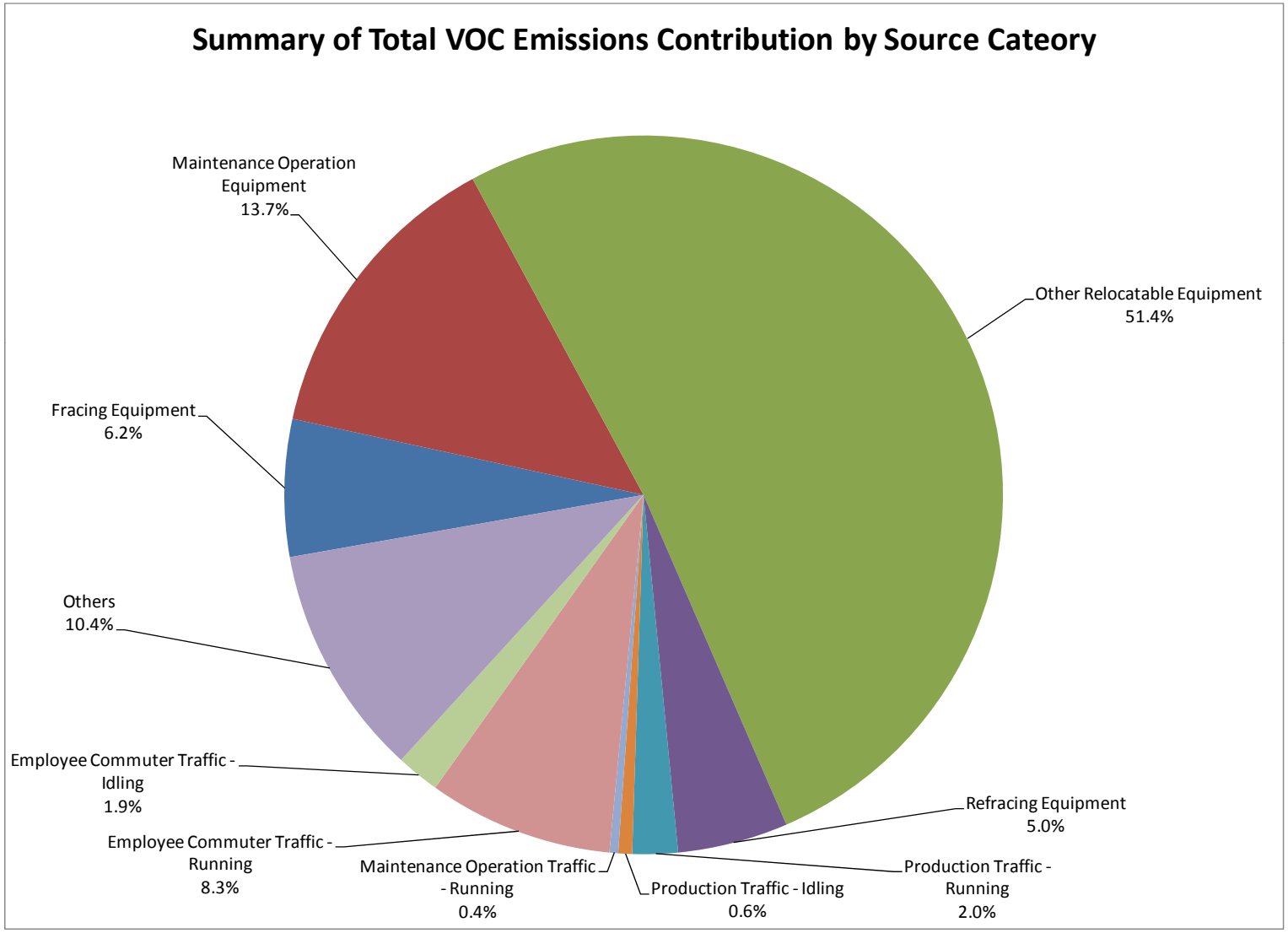
- Emissions represent within-field activities – emissions not developed for total trips for on-road vehicles
- Emissions concentrated in Garfield and Rio Blanco counties where most gas and oil production, respectively occur
- PM emissions large in magnitude and dominated by fugitive dust (not tailpipe)

P3 Study – Results



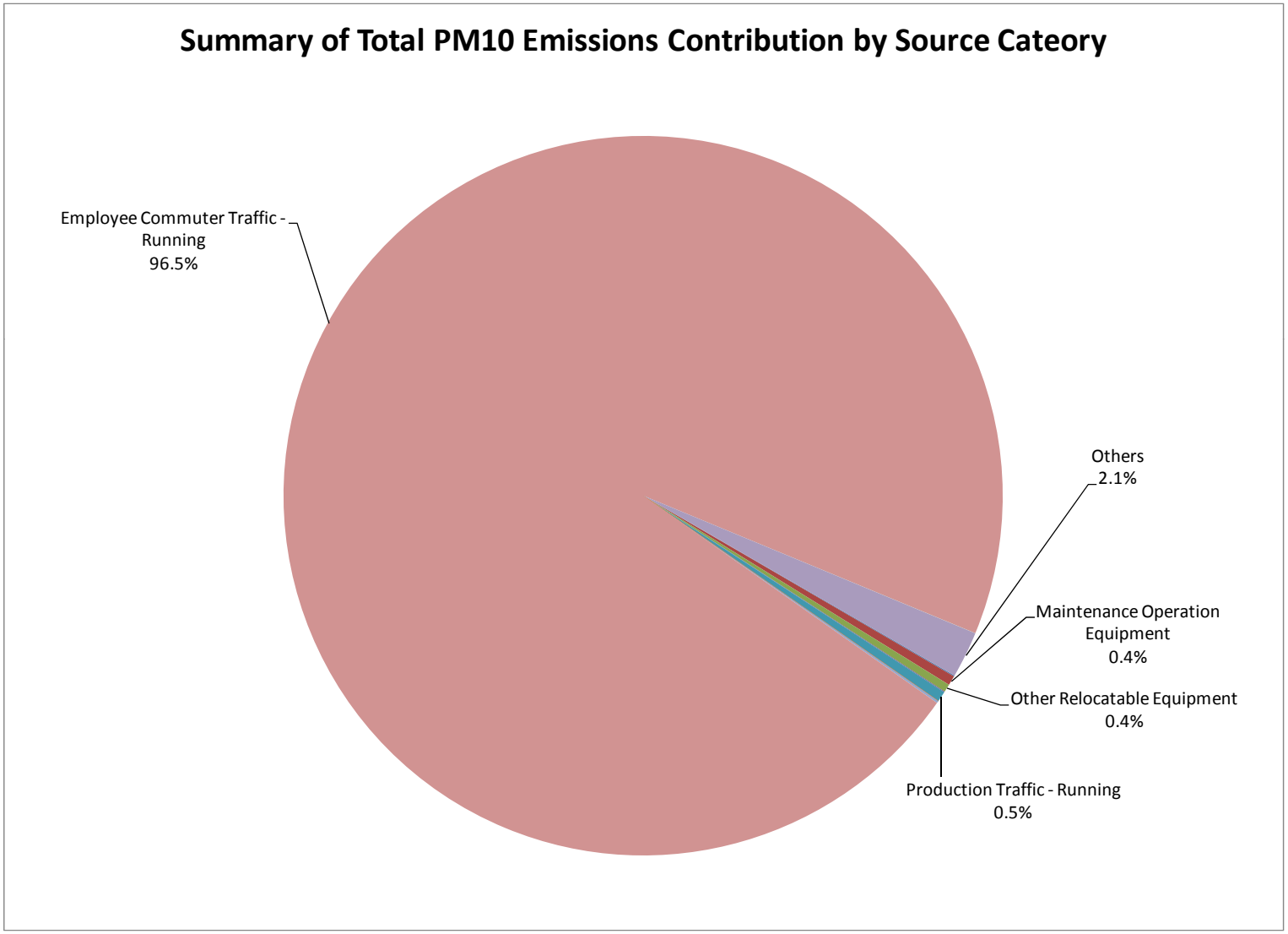
ENVIRON

P3 Study – Results



ENVIRON

P3 Study – Results



ENVIRON

P3 Study Limitations

Limited field verification

- Conducted at two sites
- Observed three activities
- Did not attend for full period of activity
- Verified each activity type only once

P3 Study Limitations (continued)

Limited in scope

- Considered only E&P activities, not mid-stream
- Limited number of survey respondents
- One basin; applicability to other basins may be limited
- Did not consider total trip emissions
- Difficult to reconcile with existing state-wide mobile source inventories

P3 Study Conclusions

- For most criteria pollutants, mobile sources are not large portion of emissions from O&G sector compared to point and area sources
  - Mobile PM10 at 91% (driven by fugitive dust)
  - Nox at 6%, CO at 4%, VOC <1%
  - Caveat: compare 2009 mobile inventory to projected 2009 point/area source inventory
- Future studies should improve on limitations from this study

Increasing Knowledge, Remaining Questions - O&G Traffic and Emissions

- On-road studies suggest considerably more trips per well than found in P3 study

- P3 Study suggests mobile source PM_{10} (reintrained road dust) significant component in overall P-Basin air pollutants.

- Unclear whether P3 emission factors can be applied beyond Piceance Basin.

Information gaps

- Mid-stream (e.g., dehydrator servicing), refining operations, truck transport of product not counted
- Need updated Utah highway information
- No in-field Uintah Basin traffic and non-road data (to compare to P3)
- Only 3 companies out of >100 operators and service providers on list participated in P3 survey
- Somewhat cursory field verification-(P3).

Recommendations (p.1)

- Follow up on UDOT highway study (same Uintah area) to discover whether trips per well have are similar to 2006 findings
- Follow up on CDOT highway study focusing on Colorado highways serving Denver/Julesburg and other Colorado Basins
- Gather *in-field* information regarding at least two additional Colorado Basins (see Slide 3 map), including Denver/Julesburg
  - » Request participation from additional companies/perhaps with different approach
  - » Improve field verification
  - » Highlight **water availability** in each case
  - » Determine number of trips per well in addition to annual VMT per well, spud, etc.

Recommendations (p.2)

- Attempt to disaggregate on-highway O&G traffic from other
- Reconcile data with actual 2009 point and area source inventory information….
- Other suggestions welcome.