Prioritizing Well Inspections in Colorado: A Risk-Based Approach

February 23, 2016
COGCC Operator Guidance Meeting
&
February 25, 2016
GWPC 2016 UIC Annual Conference

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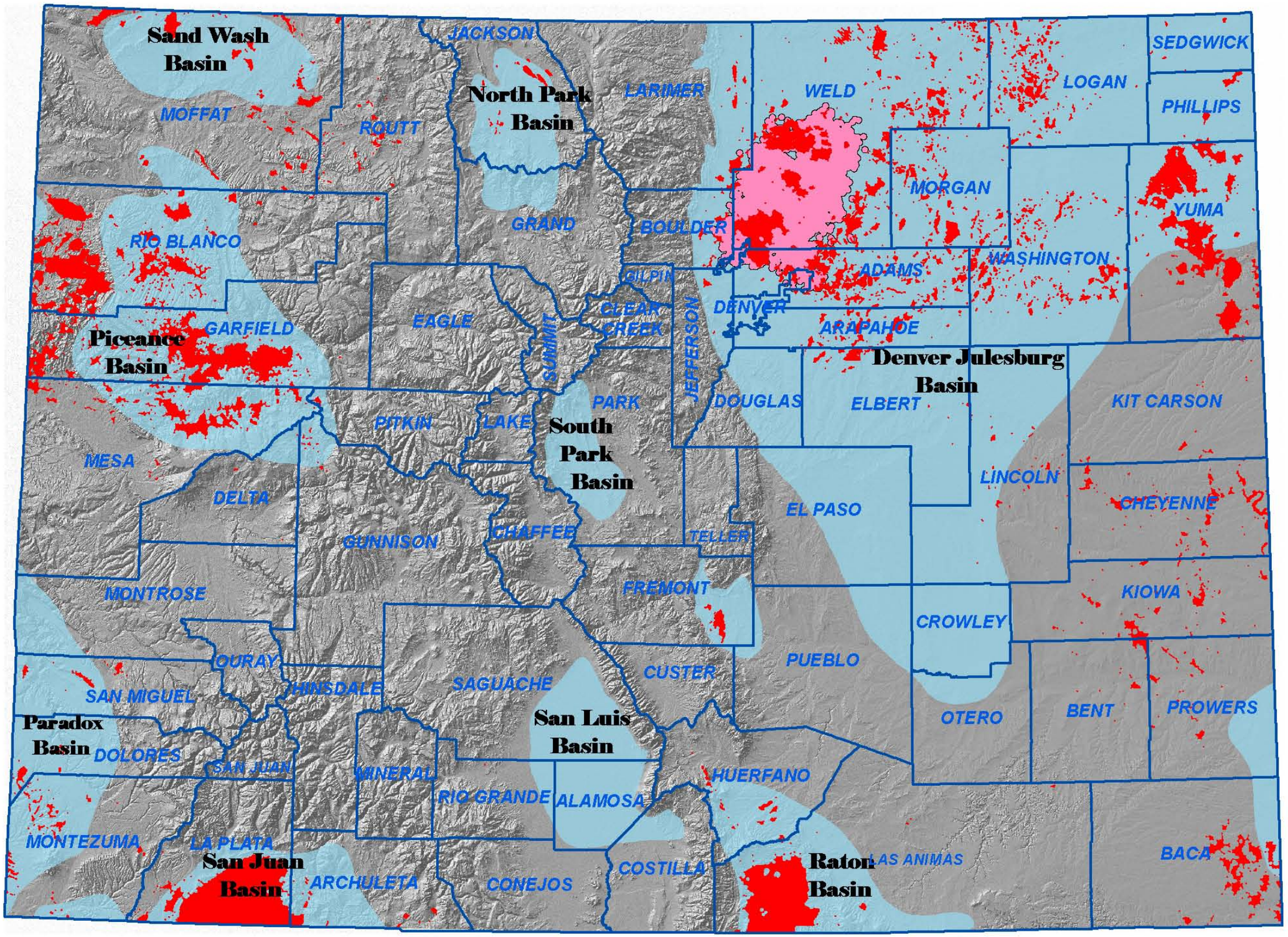
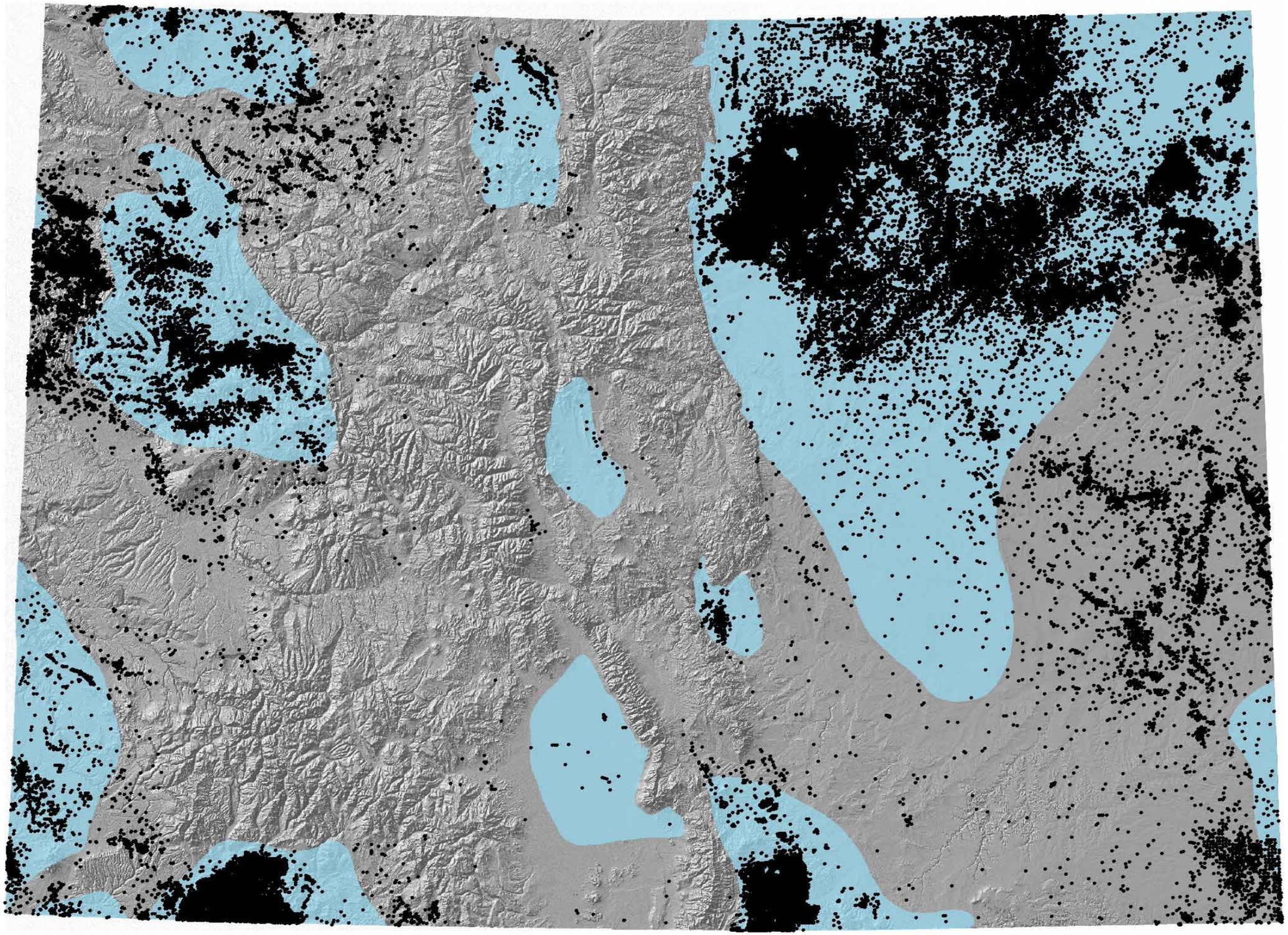
COLORADO
Oil & Gas Conservation Commission
Department of Natural Resources

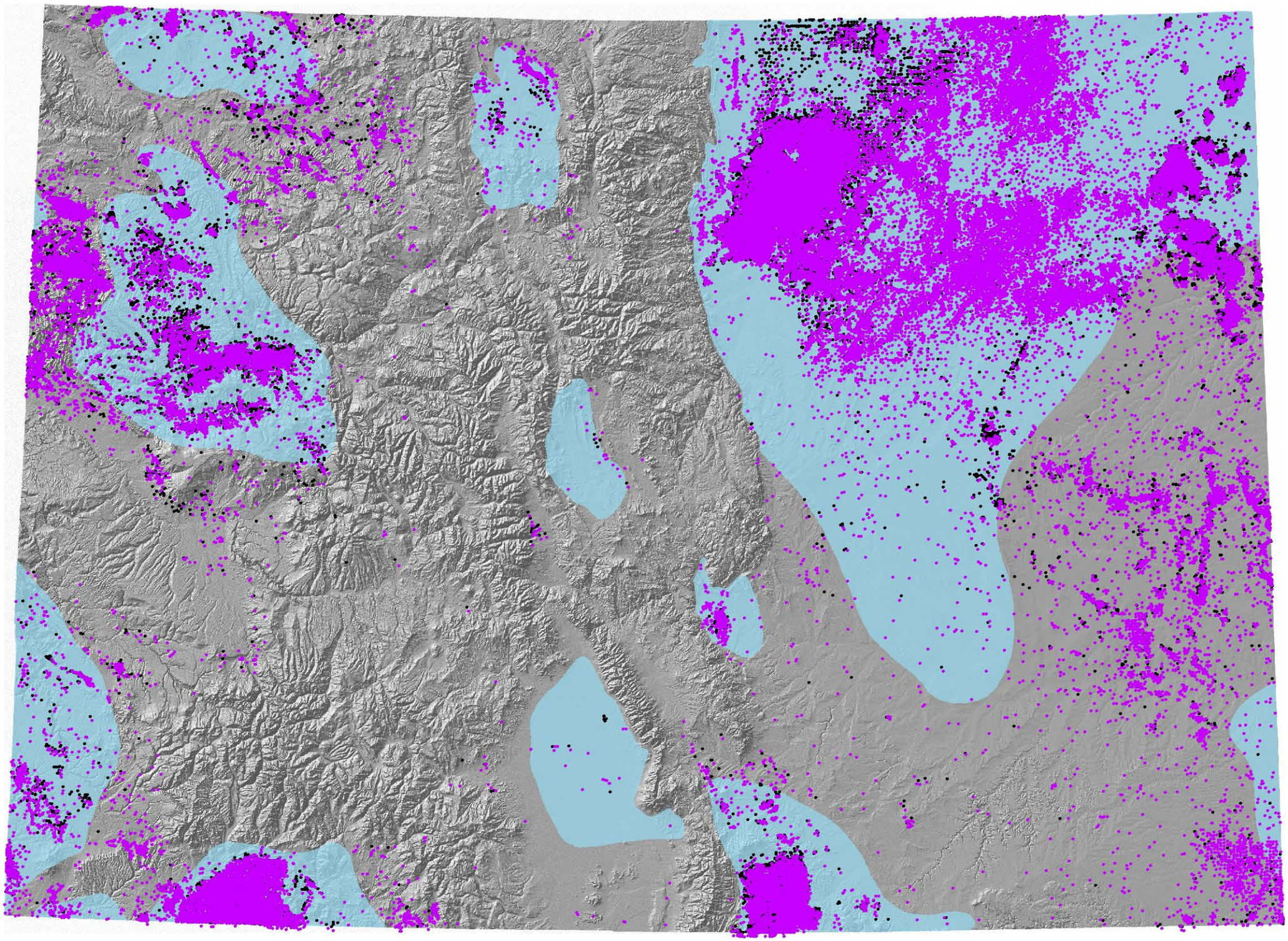


Oil & Gas Fields in Colorado



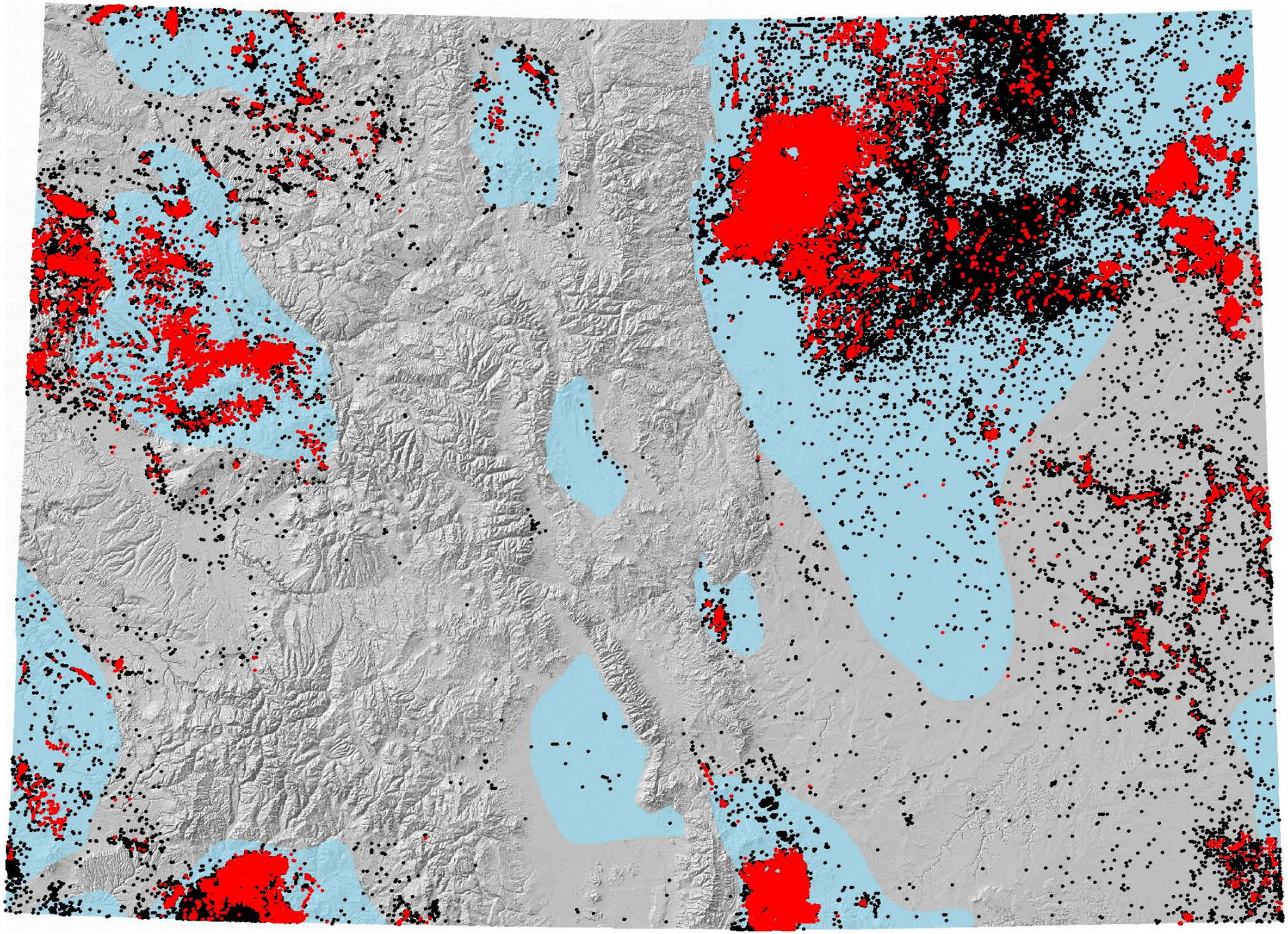
As of 2/21/2016:

109,296 total APIs in COGCC database



As of 2/21/2016:

~89,477 wells (purple) have been drilled in Colorado



As of 2/21/2016: **~52,174 active wells (red) for inspection prioritization**

Background

Senate Bill 13-202

An Act

34-60-106. Additional powers of commission - rules - repeal.

(15.5) THE COMMISSION SHALL USE A RISK-BASED STRATEGY FOR INSPECTING OIL AND GAS LOCATIONS THAT TARGETS THE OPERATIONAL PHASES THAT ARE MOST LIKELY TO EXPERIENCE SPILLS, EXCESS EMISSIONS, AND OTHER TYPES OF VIOLATIONS AND THAT PRIORITIZES MORE IN-DEPTH INSPECTIONS.

- ✓ **Use a risk-based strategy for inspections of oil and gas locations**
- ✓ **Prioritize more in-depth inspections**
- ✓ **Improve the frequency and timing of inspections**

Background

- **Detect spills before they worsen**
- **Increase the public's trust in the Commission's oversight of O & G operations**
- **Better protect public HSWE**

Agency Benefits

- *Systematic, repeatable, less subjective method*
- *Accountability*
- *Leveraging data we collect as part of the regulatory process*

Background

Addressed by risk-based approach presented here

Risk-Based Inspections: Strategies to Address Environmental Risk Associated with Oil and Gas Operations, Final Report, February, 2014, OGCC-2014-PROJECT #7948.

Report to Colorado Legislature in early 2014 had eight findings:

- **Spills and releases are most likely to occur during the production phase of oil and gas operations in Colorado.**
- **Spills and releases that occur subsurface may not be identified during the normal inspection process.**
- **The Commission does not routinely review production facility maintenance records.**
- **The Commission should monitor the installation and operation of flowlines.**
- **Historic spills from oil and gas operations must be identified and remediated during facility site closure review.**
- **The Commission should receive notice of construction, reclamation, and drilling activities.**
- **The Commission could rebalance inspection resources to provide additional inspections of hydraulic fracturing operations.**
- **The Commission's Form 19 will be revised to standardize data entry and reporting requirements.**

And four recommendations:

1) **The Commission should review integrity test results and inspect production facilities more frequently.**
2) **The Commission should increase inspections during production facility closures.**
3) **The Commission should conduct more time-specific inspections of construction, reclamation, and drilling activities using improved notice from operators.**

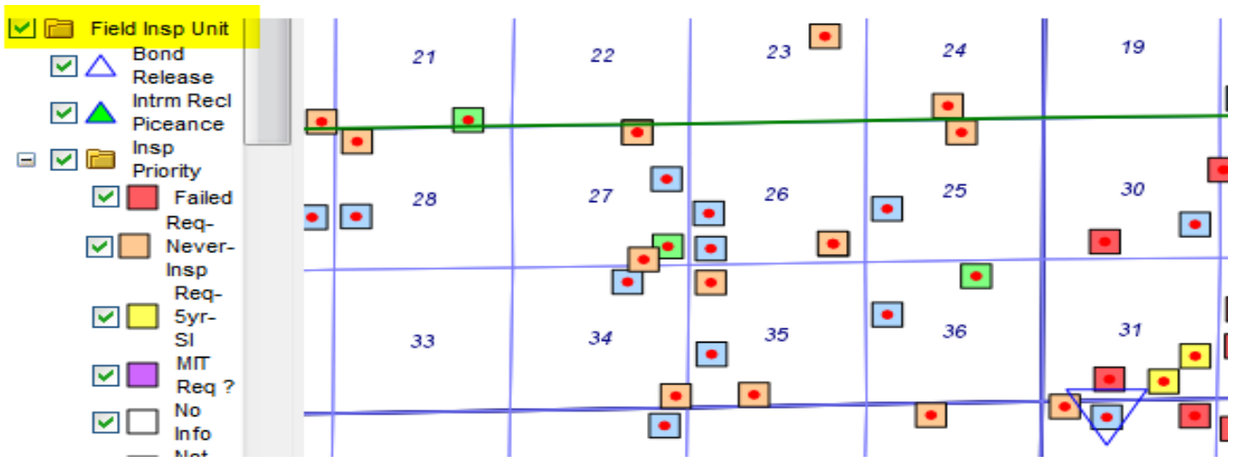
Partial

4) **The Commission should increase its inspection frequency of hydraulic fracturing operations.**

Background

Historically, inspections prioritized through agency policies based on:

- Well status
- Time *(5 or more years since last inspection)*
- Notices of operator activity
- Conditions of Approval (COAs)
- Complaints & incidents
- Institutional knowledge



"Required Inspections" by Inspector's Area

Go to:Inspection Index

Choose an inspector's area: CENTRAL SOUTH FIELD OPERATIONS (MIKE LEONARD)

Qtrqtr: Sec: Twp: Range:

Sort by:

submit

- Inspection Priority
- Location
- Inspection Area
- Operator
- Status Date
- Unsorted

Inspection Priority	Count	Explanation
Orange	40	INSPECTION PROBABLY REQUIRED
Purple	1	MIT PROBABLY REQUIRED
Red	111	UNSATISFACTORY OR FAILED INSPECTION
White	430	PA, AL or INSPECTION REQUIREMENTS UNKNOWN
Yellow	5	INSPECTION OLDER THAN 5 YEARS

Approach

- Use systematic, automated, simple GIS/statistical workflow
- Commission staff identified risk-factor areas based on:

  (1) recommendations in report to Colorado Legislature

  (2) availability of data

  (3) institutional experience

- Establish relative risk:
  - classify individual data parameters on a 1-5 scale
  - combine parameter values to get risk-factor area scores
  - further combine weighted area scores to calculate an overall risk score
- Assessment currently at the well level (not location)

Risk Factor Areas

		Higher (5)	(4)	(3)	(2)	Lower (1)	RF Weight
1	*Population Density & Urbanization*	>25 p/mi2 Within Municipal Boundary	6-25 p/mi2 Within Municipal Boundary	1-6 p/mi2	0.5 -1 p/mi2	<0.5 p/mi2	10%
2	*Environment (Wildlife & Water)*	Multiple Criteria	Multiple Criteria	Multiple Criteria	Multiple Criteria	Multiple Criteria	20%
3	*Time Since Last Inspection*	>5 yrs	3-5	2-3	1-2	<1	15%
4	*Years In Service*	>20 yrs	10-20	3-10	0-3	0	30%
5	*Reported Spills (Location)*	>4	3-4	2	1	0	10%
6	*Corrective Actions (Location)*	>3		1-3		0	15%

People

Environment

Time

History (Site-specific)

Approach

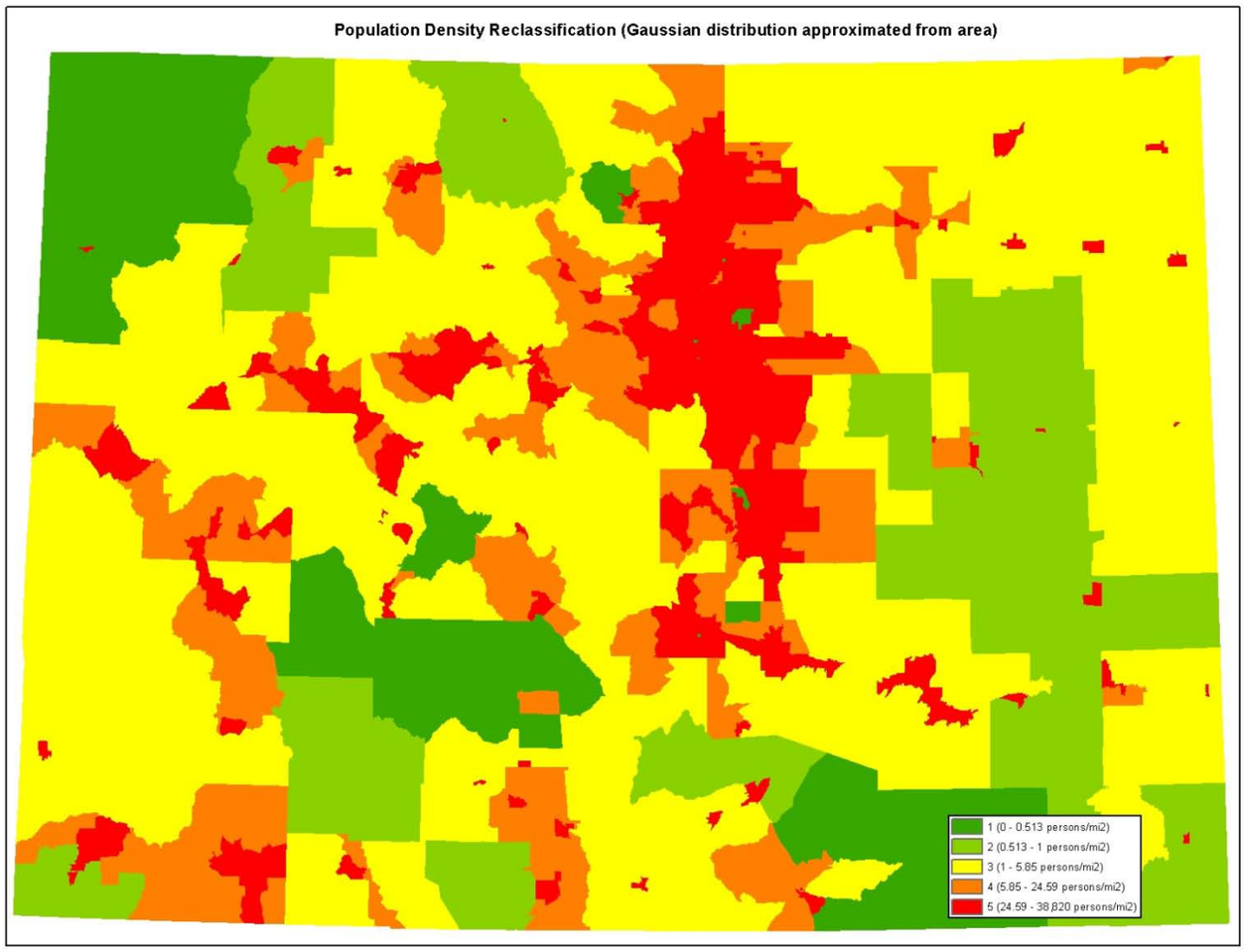
- Agency implementation of this model on March 1st, 2016.
- 3 – 6 month trial period during which feedback and modifications will be expected.

  COGCC inspectors will balance their inspection workload between (1) higher-risk active wells as identified by model AND (2) inspections required by Rule 316C (noticed activities), incidents, complaints, and corrective actions.

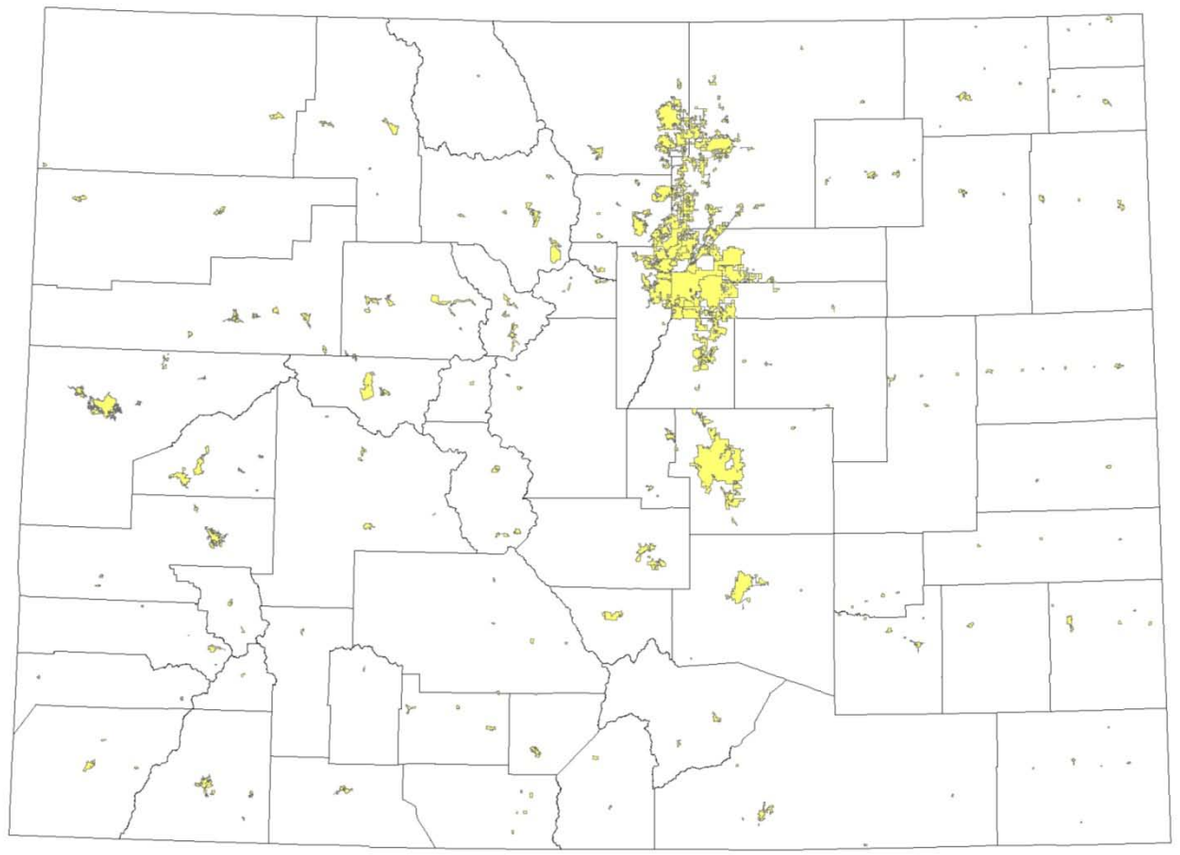
NoticeCount	Notice_type	insp_
2	BLOW OUT PREVENTER TEST	conk
4	HYDRAULIC FRACTURING TREATMENT	binsc
1	HYDRAULIC FRACTURING TREATMENT	gome
5	HYDRAULIC FRACTURING TREATMENT	mont
2	HYDRAULIC FRACTURING TREATMENT	murra
1	MECHANICAL INTEGRITY TEST	carlil
2	MECHANICAL INTEGRITY TEST	conk
2	MECHANICAL INTEGRITY TEST	helge
1	MECHANICAL INTEGRITY TEST	labov
2	MECHANICAL INTEGRITY TEST	longv
2	MECHANICAL INTEGRITY TEST	macl
3	MECHANICAL INTEGRITY TEST	mont
1	MECHANICAL INTEGRITY TEST	pesic
2	MECHANICAL INTEGRITY TEST - UIC	brow
1	RUN AND CEMENT CASING - INTERMEDIATE	waldr
1	RUN AND CEMENT CASING - PRODUCTION	conk
2	RUN AND CEMENT CASING - PRODUCTION	longv
2	RUN AND CEMENT CASING - PRODUCTION	murra
1	RUN AND CEMENT CASING - SURFACE	longv
1	SPUD	binsc
1	SPUD	helge
4	SPUD	longv
3	SPUD	murra
5	START OF PLUGGING OPERATIONS	carlil
6	START OF PLUGGING OPERATIONS	helge
6	START OF PLUGGING OPERATIONS	mont
21	START OF PLUGGING OPERATIONS	peter
1	START OF PLUGGING OPERATIONS	ricka

January, 2016 notice count by type and inspector

Risk Factor #1: Population Density & Urbanization (RF Weight 10%)



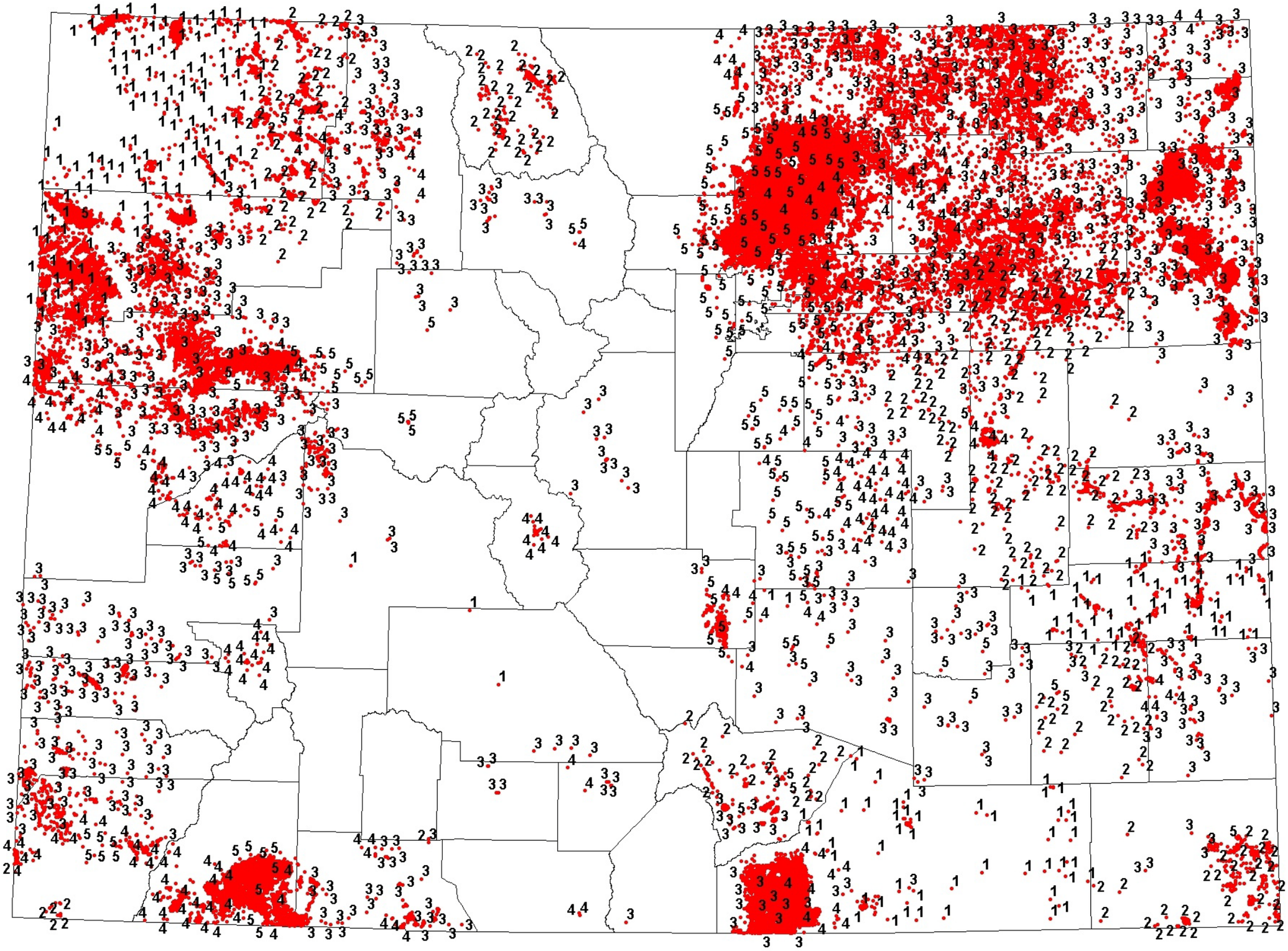
Population Density



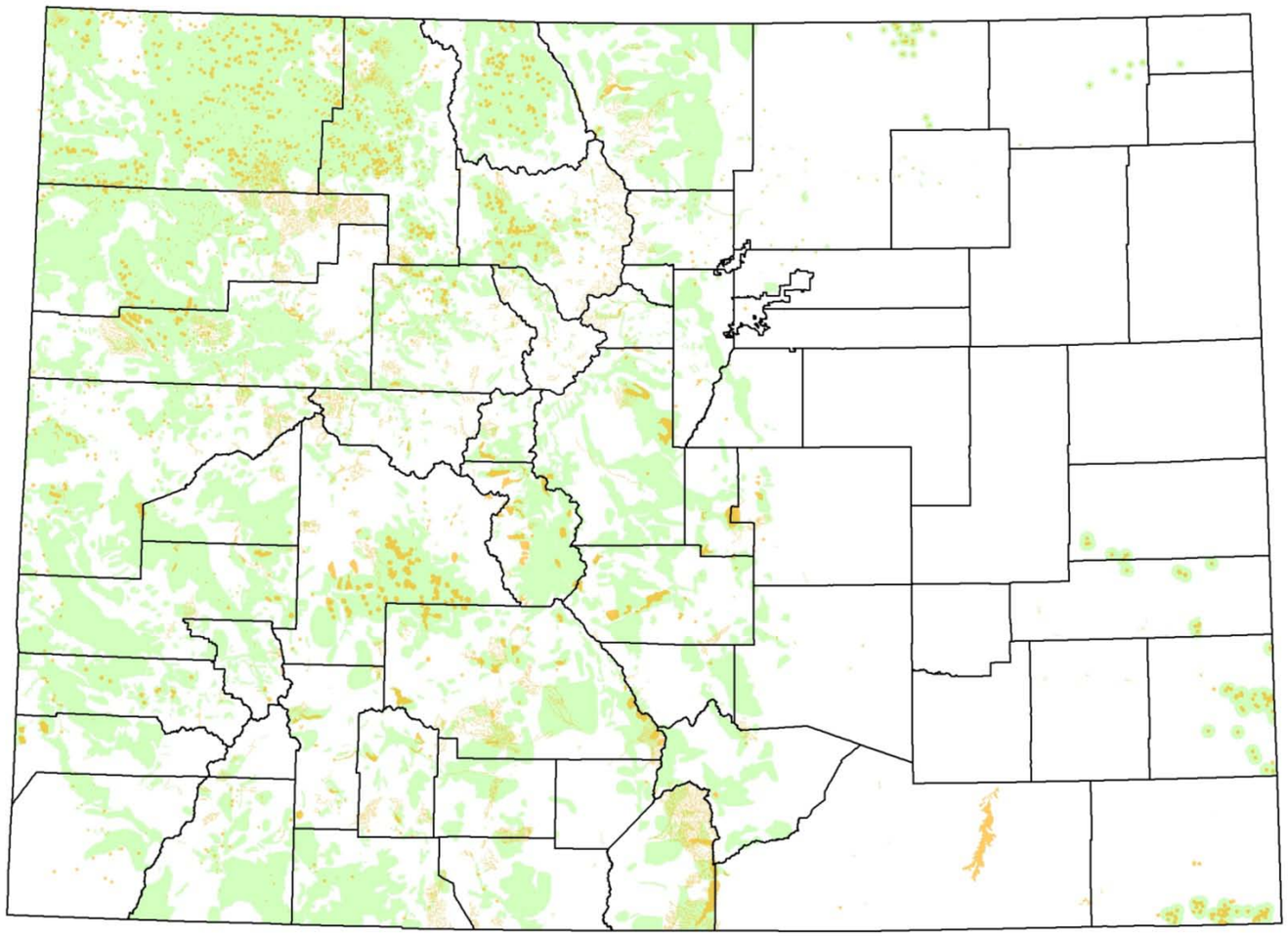
Municipalities

Data Sources: US 2010 Census
Colorado Department of Local Affairs
COGCC

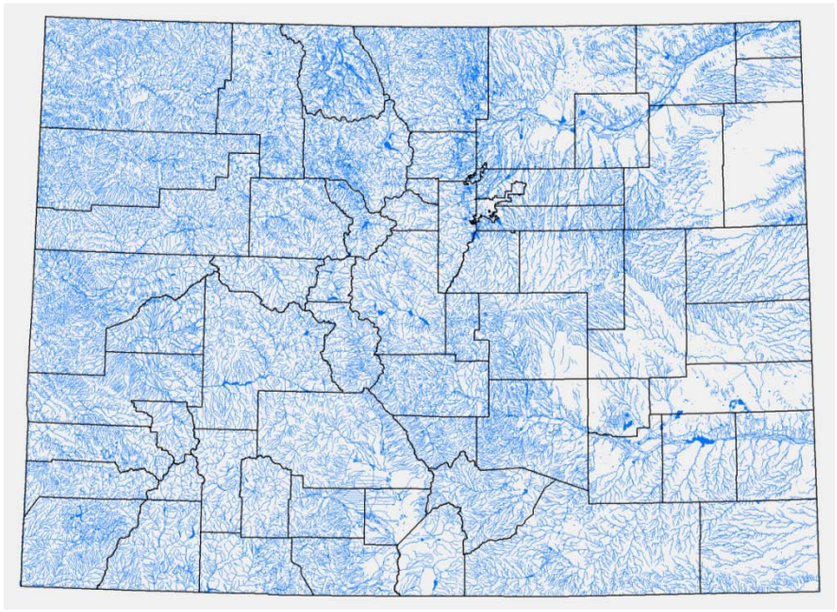
Risk Factor #1: Population Density & Urbanization



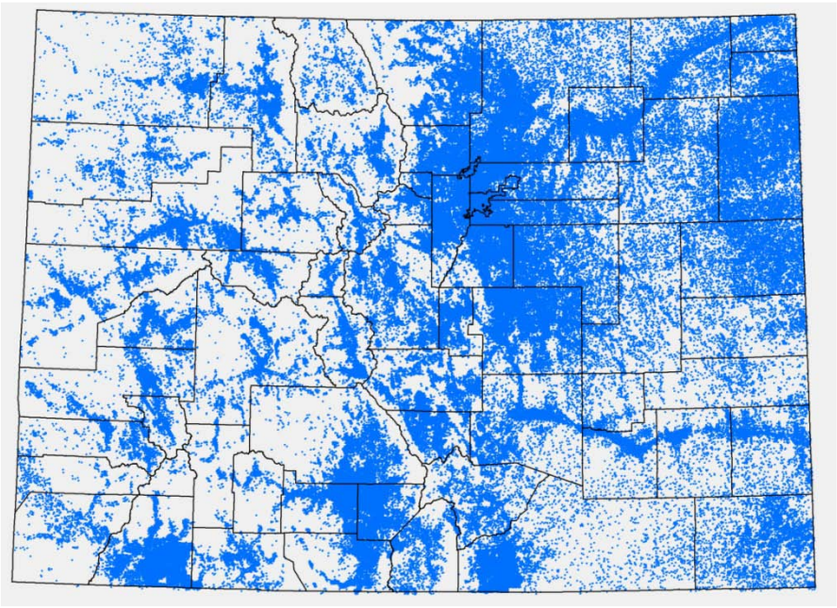
Risk Factor #2: Environment
(RF Weight 20%)



Wildlife Habitat



Surface Water



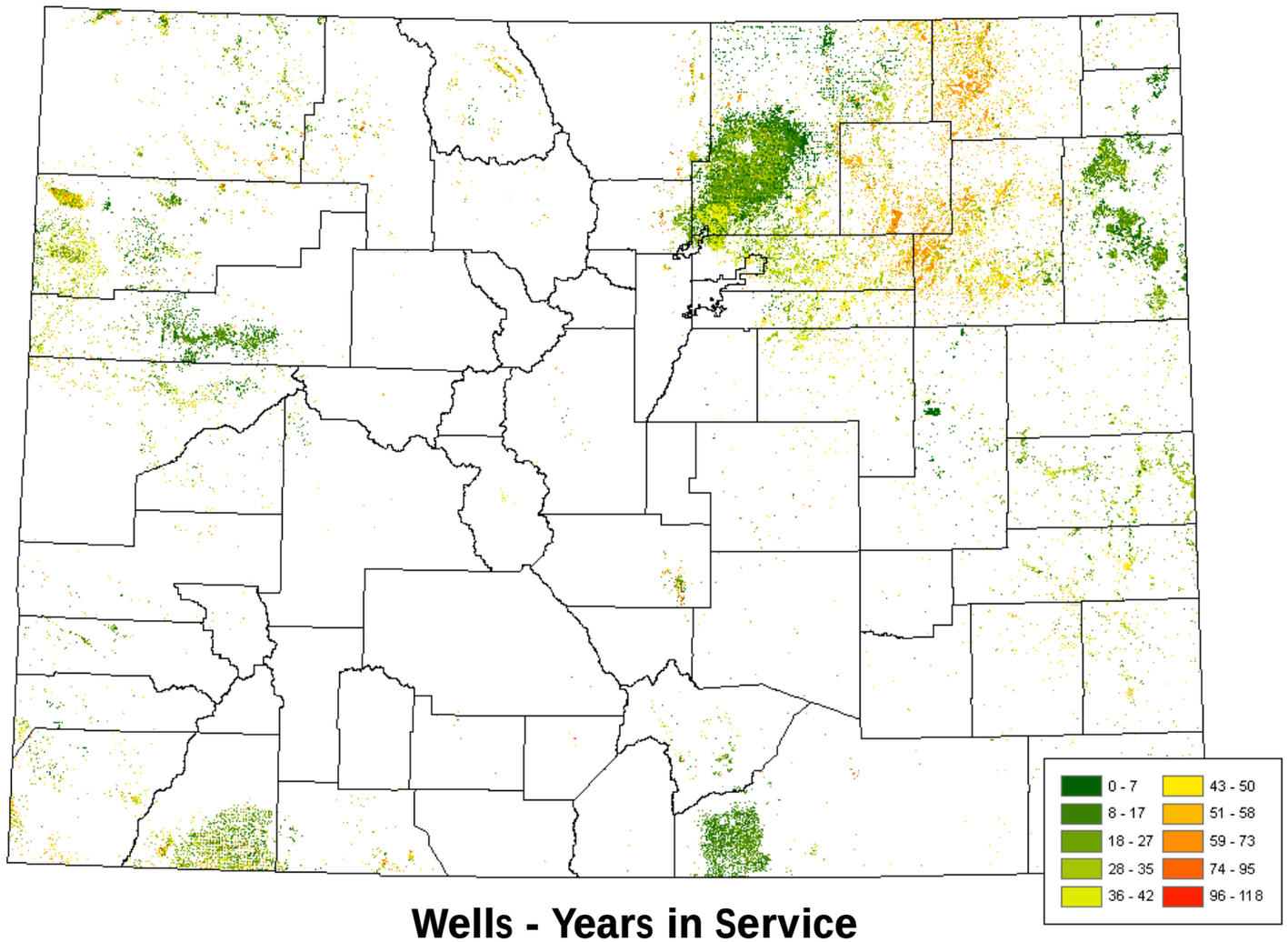
Ground Water (Water Well Data)

Data Sources: **Colorado Parks & Wildlife**
Colorado Department of Water Resources
COGCC

Risk Factor #3 & #4: Time Since Last Inspection & Years in Service (RF Weight 45%)

		Higher (5)	(4)	(3)	(2)	Lower (1)	RF Weight
3	*Time Since Last Inspection*	>5 yrs	3-5	2-3	1-2	<1	15%
4	*Years In Service*	>20 yrs	10-20	3-10	0-3	0	30%

Data Source: COGCC

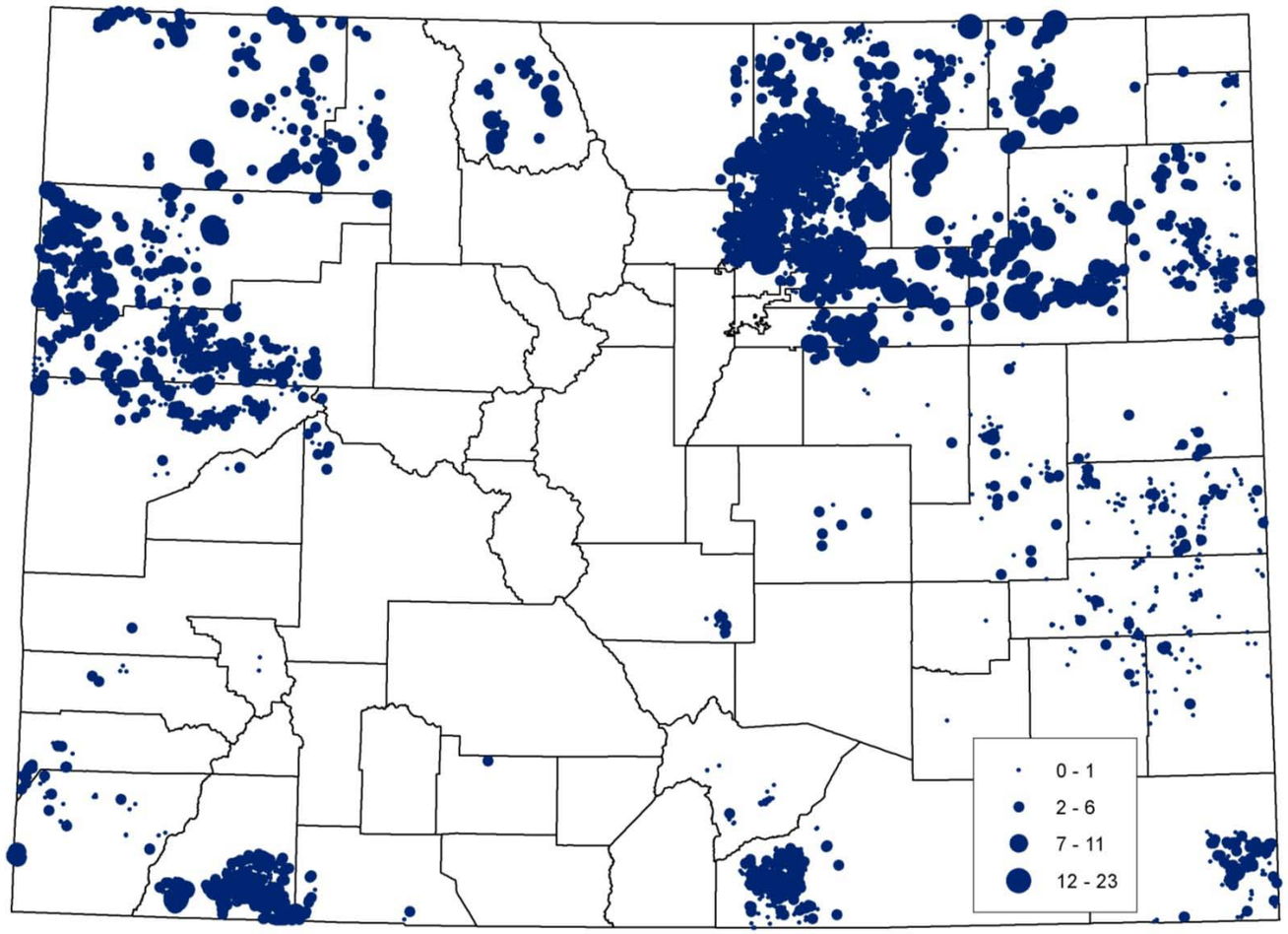


Wells - Years in Service

Risk Factor #5 & #6: Reported Spills & Corrective Actions (RF Weight 25%)

		Higher (5)	(4)	(3)	(2)	Lower (1)	RF Weight
5	*Reported Spills (Location)*	>4	3-4	2	1	0	10%
6	*Corrective Actions (Location)*	>3		1-3		0	15%

Data Source: COGCC



# of Corrective Actions Since Last Inspection

GIS Model

RF 1: Population Density & Urbanization

RF 2: Environment

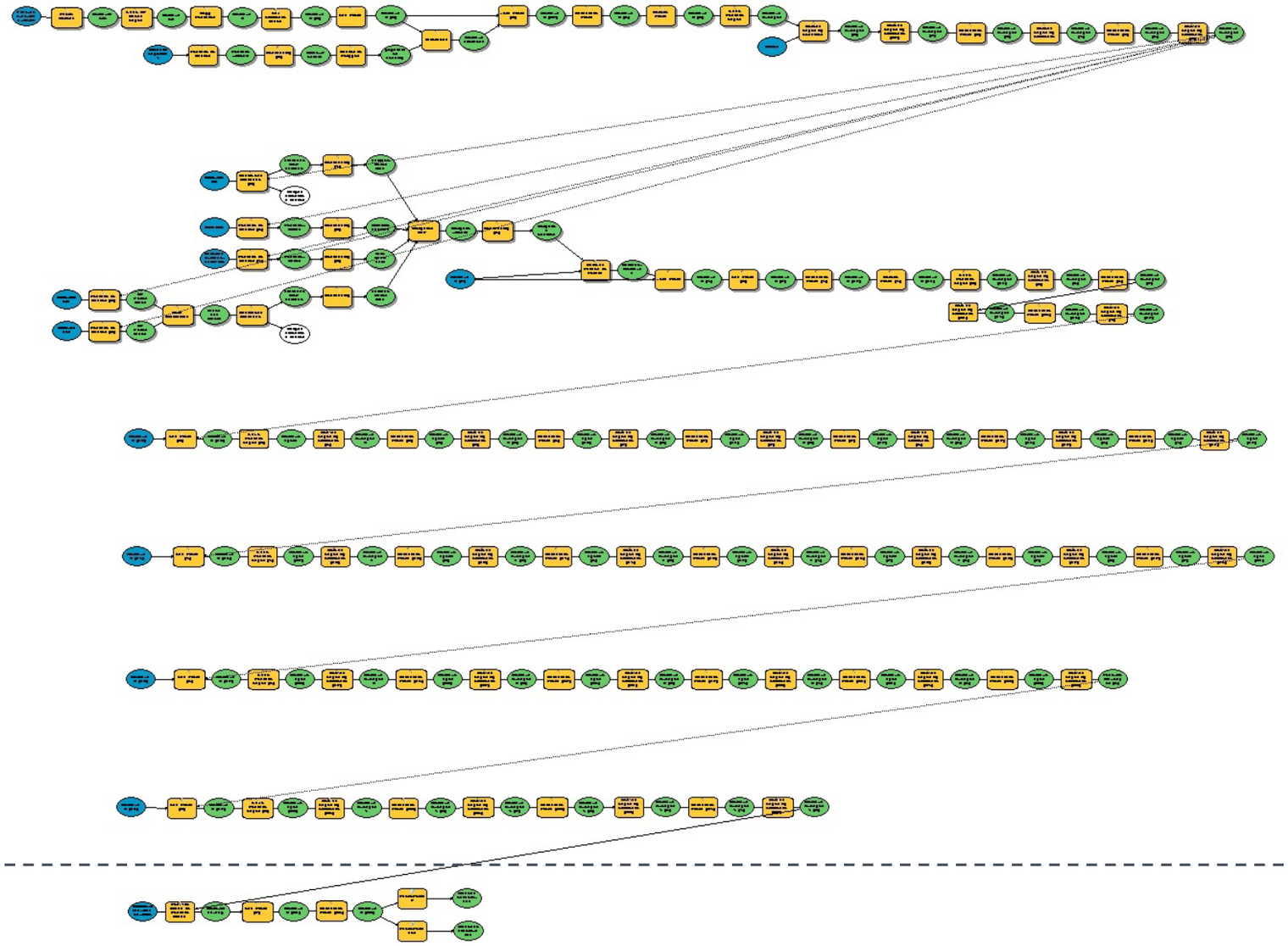
RF 3: Time Since Last Inspection

RF 4: Years In Service

RF 5: Reported Spills

RF 6: Corrective Actions

RF ALL: Combined Risk Factor



Model runs as automated Python script every night. Workflow requires 12-36 hours to update risk values and inspection priorities in network and laptop databases.

Combined Risk Factor Score

- Simple Weighting:

(([RF_01] * 0.10) + ([RF_02] * 0.20) + ([RF_03]* 0.15) +([RF_04] * 0.30) +([RF_05] * 0.10) +([RF_06] * 0.15))***15**

- Combined RF scores range between 15 – 75:
  - Higher Risk >45
  - Average Risk 40 – 45
  - Low Risk <40

- Relative risk

- **Still tweaking ranges for optimal distribution**

Model Results

As of **2/21/2016**:

52,154 active wells

Using current model parameter weightings and risk thresholds, the statewide distribution is:

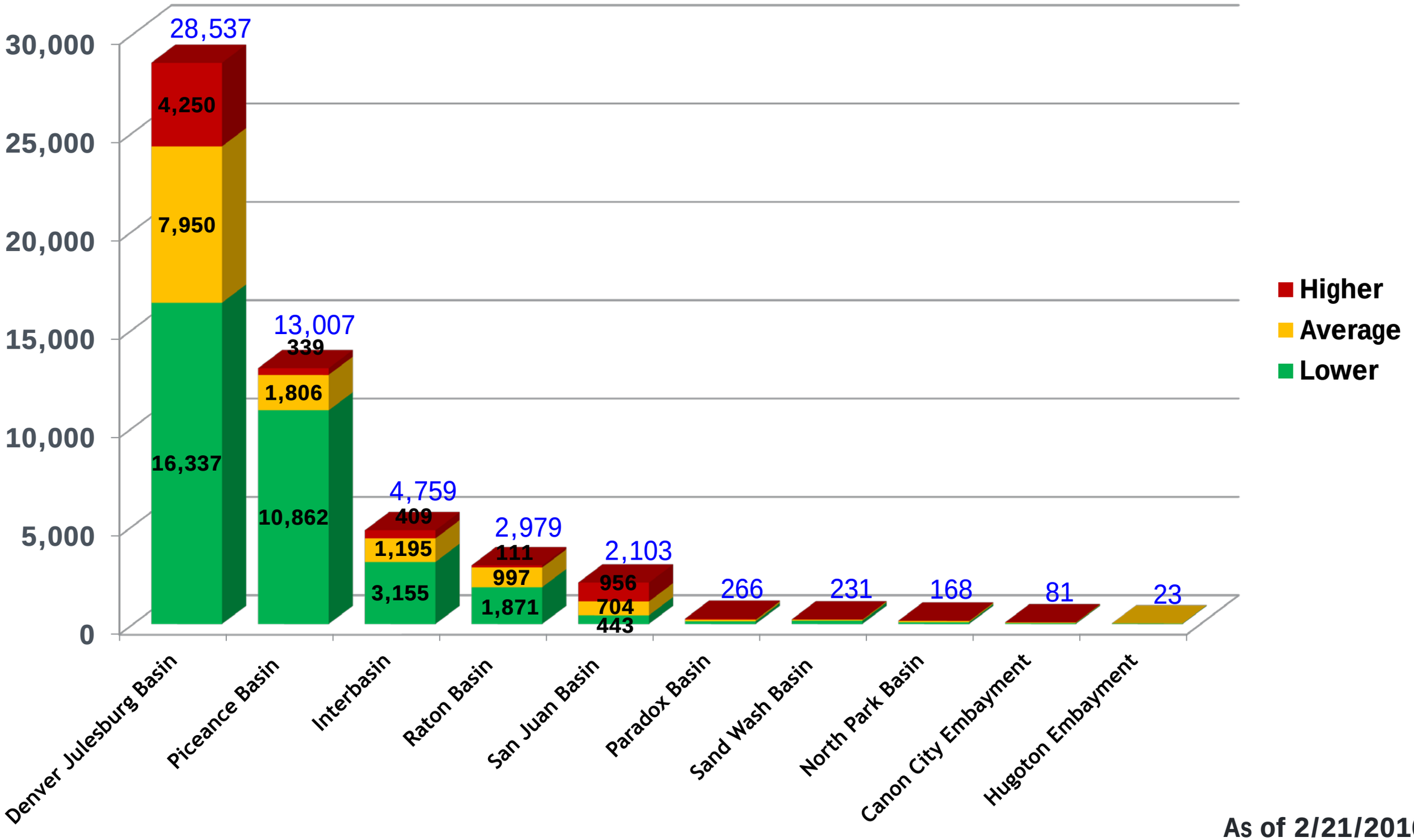
6,149 ‘Higher Risk’ (11.8%)

12,910 ‘Average Risk’ (24.8%)

33,095 ‘Lower Risk’ (63.5%)

Results

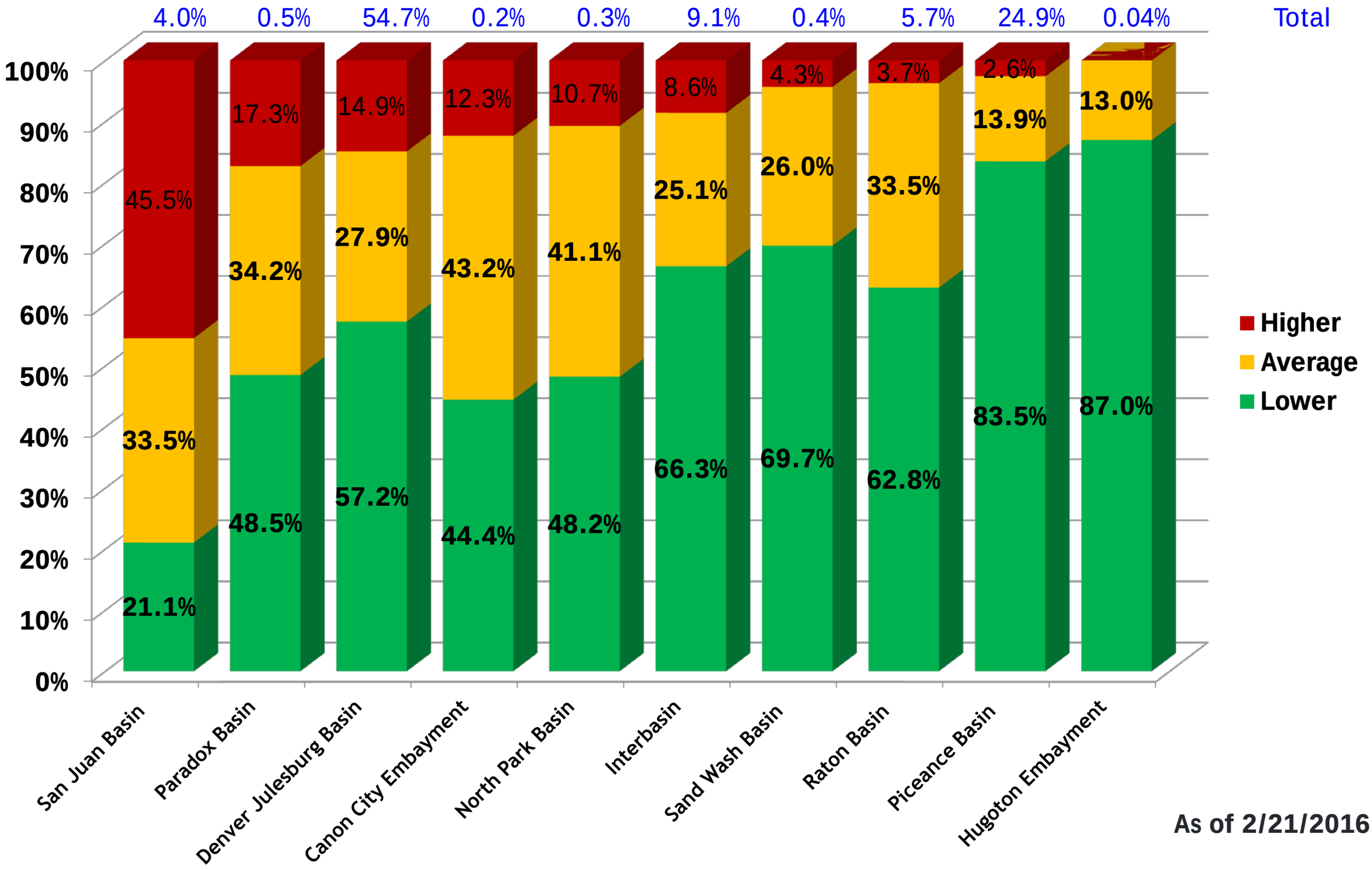
of active wells in each risk category by basin



As of 2/21/2016

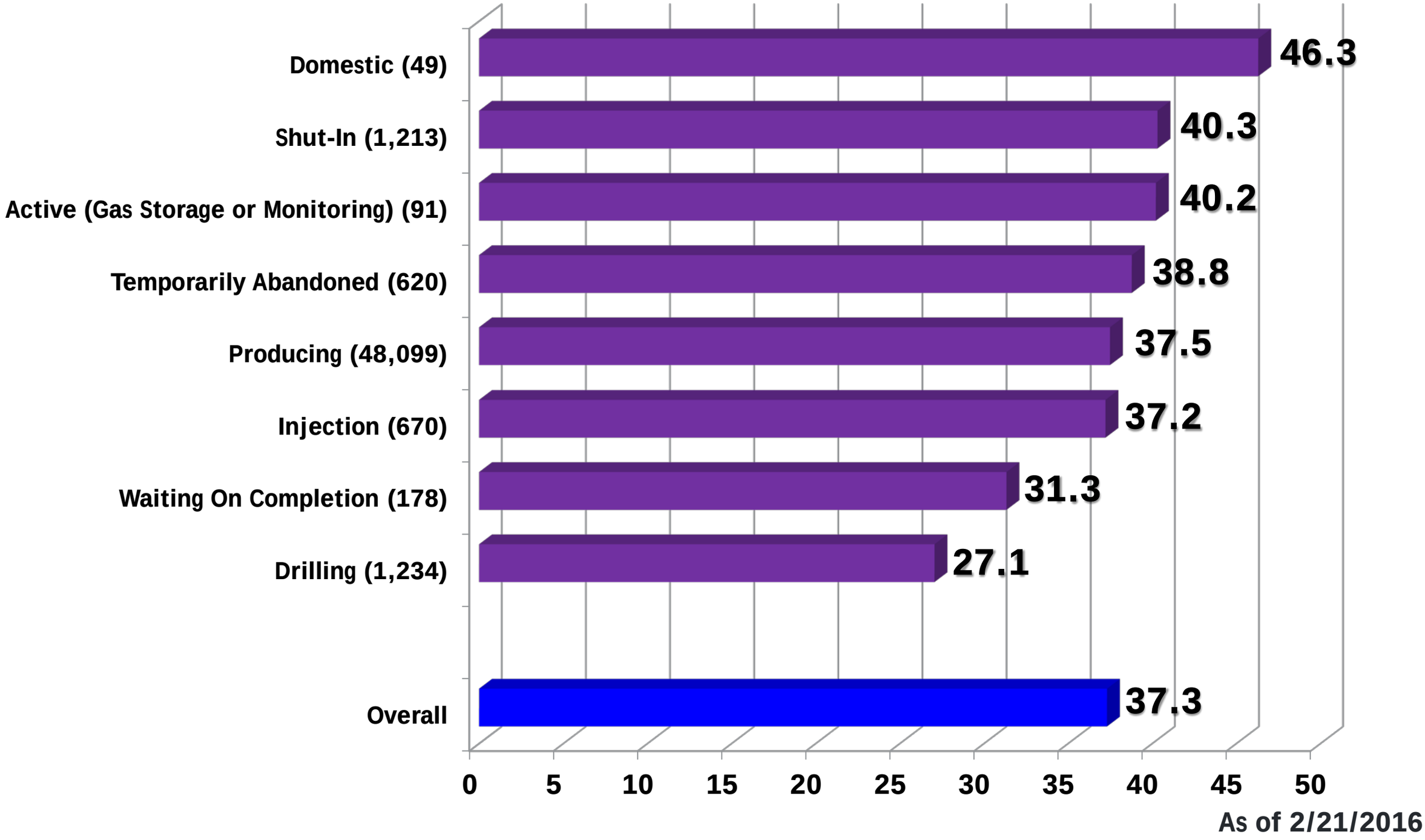
Results

% of active wells in each risk category by basin



As of 2/21/2016

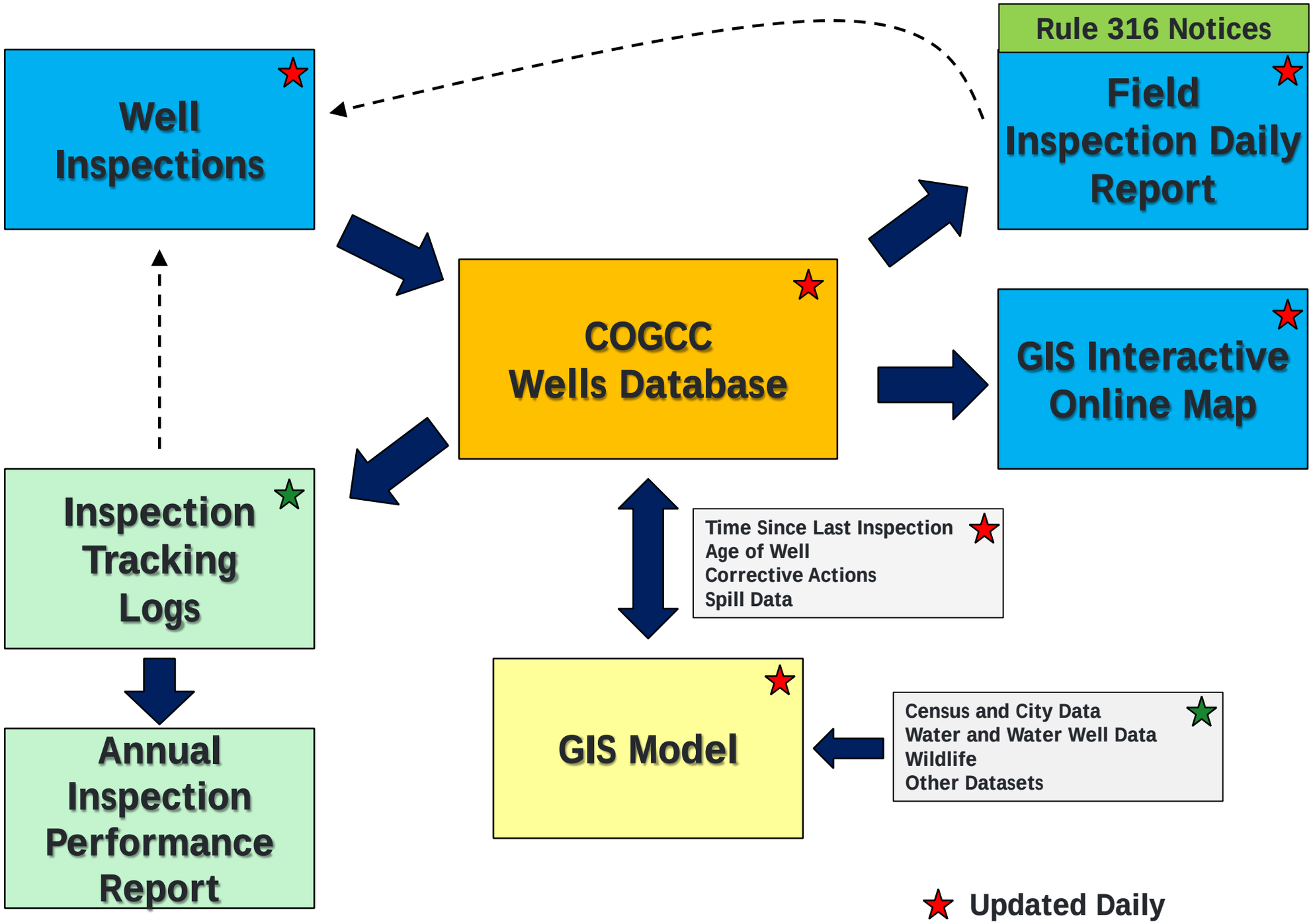
Results



Implementation

- Provide guidance to COGCC Field Inspection Unit
  - Daily reports
  - Map layers
- Metric we can use to evaluate agency progress internally and for inspection status updates to the Colorado Legislature and other interested parties
- Goal to inspect all higher-risk wells annually
- Basis for other COGCC risk-based assessments

Implementation



Implementation

Field Inspection Daily Reports

AREA	INSPECT_PRIO	INSPECT_PRIO	YRSSINCEII	INITIAL_SERV	URBANRIS	ENVIRONMI	API
s	59	Red	1	04/16/1986	5	4	045-065
s	59	Red	1	07/23/1990	5	4	045-066
am (Ca	58	Yellow	5	12/15/1993	5	5	067-079
am (Ca	58	Yellow	5	12/14/1993	5	5	067-079
ıry	58	Red	4	02/04/1977	5	2	123-091
ıry	58	Red	4	08/27/1982	5	2	001-082
am (Ca	58	Red	4	01/07/1988	4	4	067-069
s	58	Red	4	10/11/1956	3	3	045-050
s	58	Red	4	10/14/1984	3	3	045-064
ıry	58	Red	4	10/26/1982	5	2	001-081
ıry	58	Red	4	12/19/1992	5	2	001-091
n	58	Red	4	01/14/1986	5	3	123-127
s	58	Red	4	05/23/1985	3	3	045-063
s	58	Red	4	05/27/1980	3	3	045-062
s	58	Red	4	12/11/1981	3	3	045-063
san	58	Red	4	07/21/1981	5	2	039-063
am (Ca	58	Red	4	01/30/1980	5	3	067-062
am (Ca	58	Red	4	08/23/1955	4	4	067-055
n	58	Red	3	12/18/1984	5	3	123-120
ıry	58	Red	3	02/27/1979	5	2	123-096
am (Ca	58	Red	2	01/15/1956	4	4	067-055
am (Ca	58	Red	2	03/27/1981	4	4	067-064
s	58	Red	1	07/11/1990	5	5	045-066
am (Ca	57	Orange	22	03/02/1994	5	4	067-079
am (Ca	57	Yellow	20	11/11/1911	5	4	067-071
am (Ca	57	Yellow	17	03/30/1981	4	4	067-064
am (Ca	57	Yellow	9	05/18/1987	5	4	067-069

s | TopTWP | HRCount | **HighRisk** | YrsSince | CA | LOC_CA | LOC_FlowRisk

Higher-risk wells by well and inspector

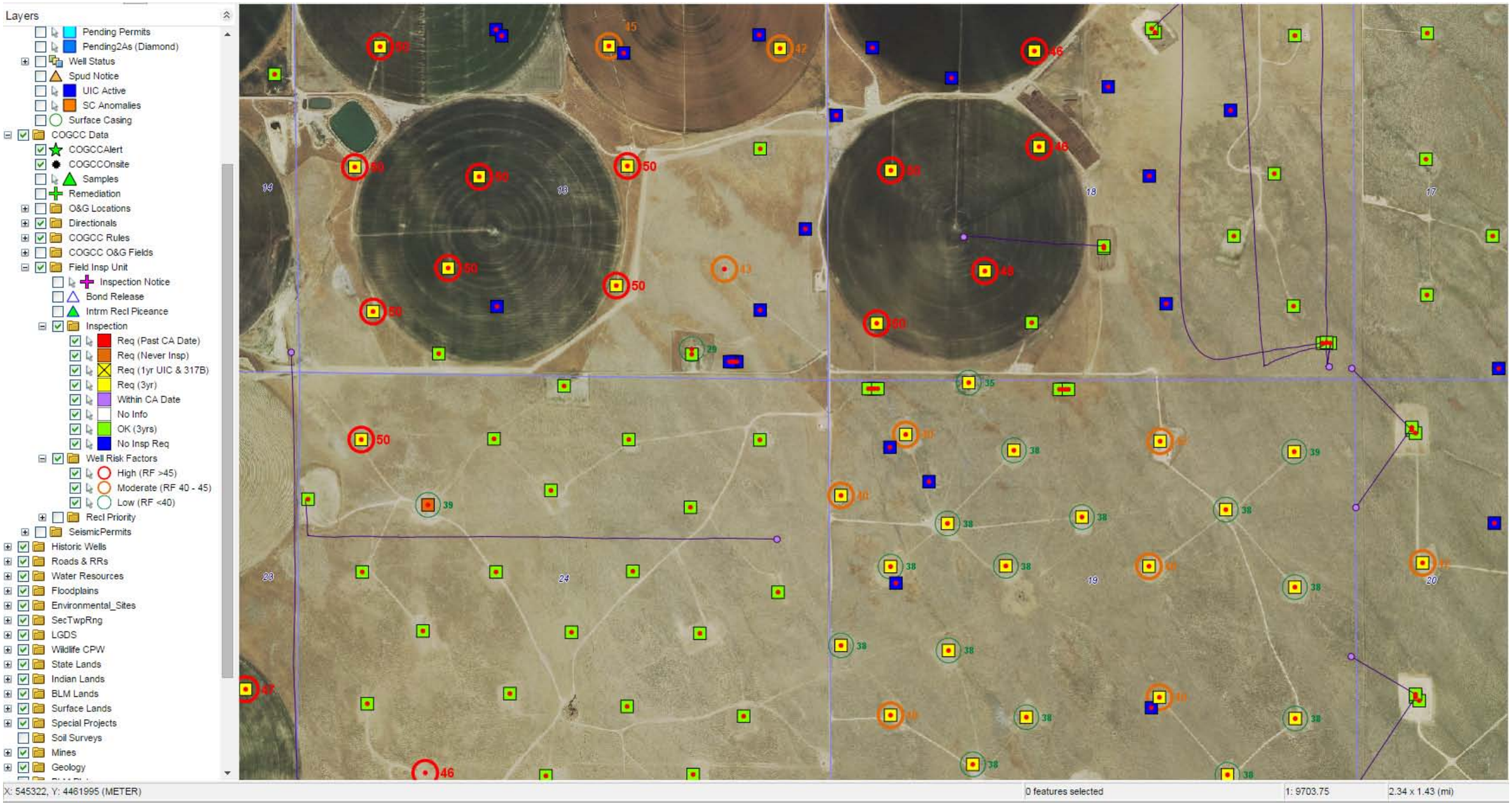
A	INSPECTOR_SUF	TWP	RANGE	HIGHRISKCOU
	150	2S	101W	37
ck	160	6N	67W	36
	150	6S	96W	36
	150	3S	101W	34
	170	4N	45W	34
	160	2S	62W	33
	170	1N	58W	33
Ca	180	32N	7W	32
Ca	180	34N	6W	32
	150	2S	103W	31
	160	1N	65W	31
	160	2N	65W	31
	150	4S	102W	30
	150	6S	91W	30
	180	44N	16W	28
	150	8S	104W	28
	170	1N	45W	28
Ca	160	1N	69W	28
	160	2S	64W	27
Ca	180	34N	10W	27
	160	2S	63W	26
	150	1N	95W	25
	150	2S	102W	25
	150	3S	100W	25
	160	1S	68W	25
Ca	180	33N	6W	25
	180	34S	65W	24

TopTWP | **HRCount** | HighRisk | YrsSince | CA | LOC_

Higher-risk well count by Township/Range and inspector

Implementation

GIS
Interactive Online Map



As of 2/21/2016

Somewhere in Weld County . . .

Implementation

Inspection Tracking

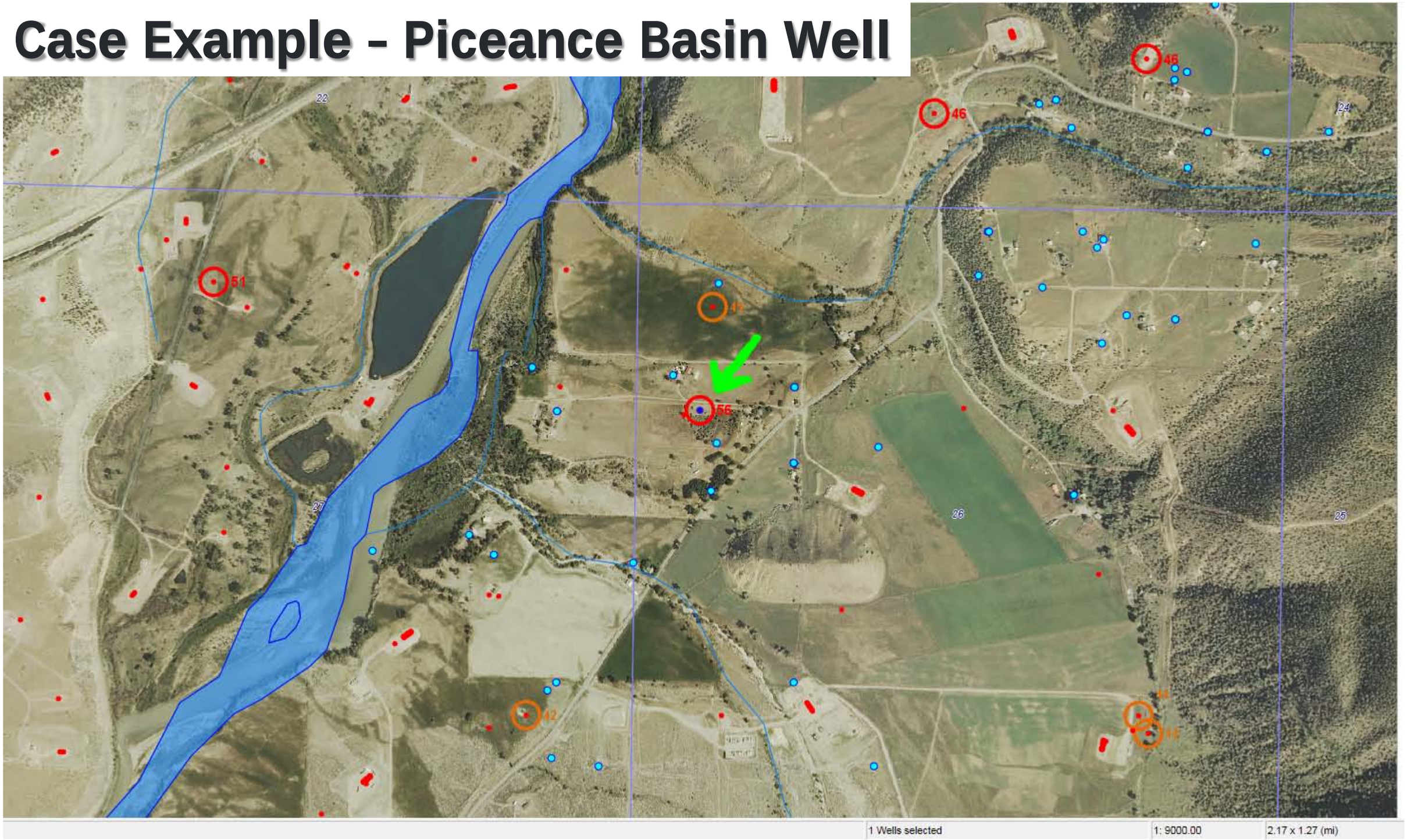
- Database queries track performance on a monthly and annual basis
- Metric for performance assessment
- Allows validation of model workflow and data quality issues

Yr	Mo	HighCount	ModCount	LowCount	Total	Highpcent
2015	8	7	65	1638	1722	0.41%
2015	9	83	253	2337	2673	3.11%
2015	10	45	270	3103	3418	1.32%
2015	11	109	280	2960	3349	3.25%
2015	12	252	669	2931	3852	6.54%
2016	1	419	599	2168	3186	13.15%
2016	2	318	646	1302	2266	14.03%
					20466	

Preliminary estimate of well inspections by month from August 2015 through February 2016

Implementation

Case Example – Piceance Basin Well



Implementation

Case Example – Piceance Basin Well

Well Recently Inspected 02/18/2016

Pre-Inspection Scores

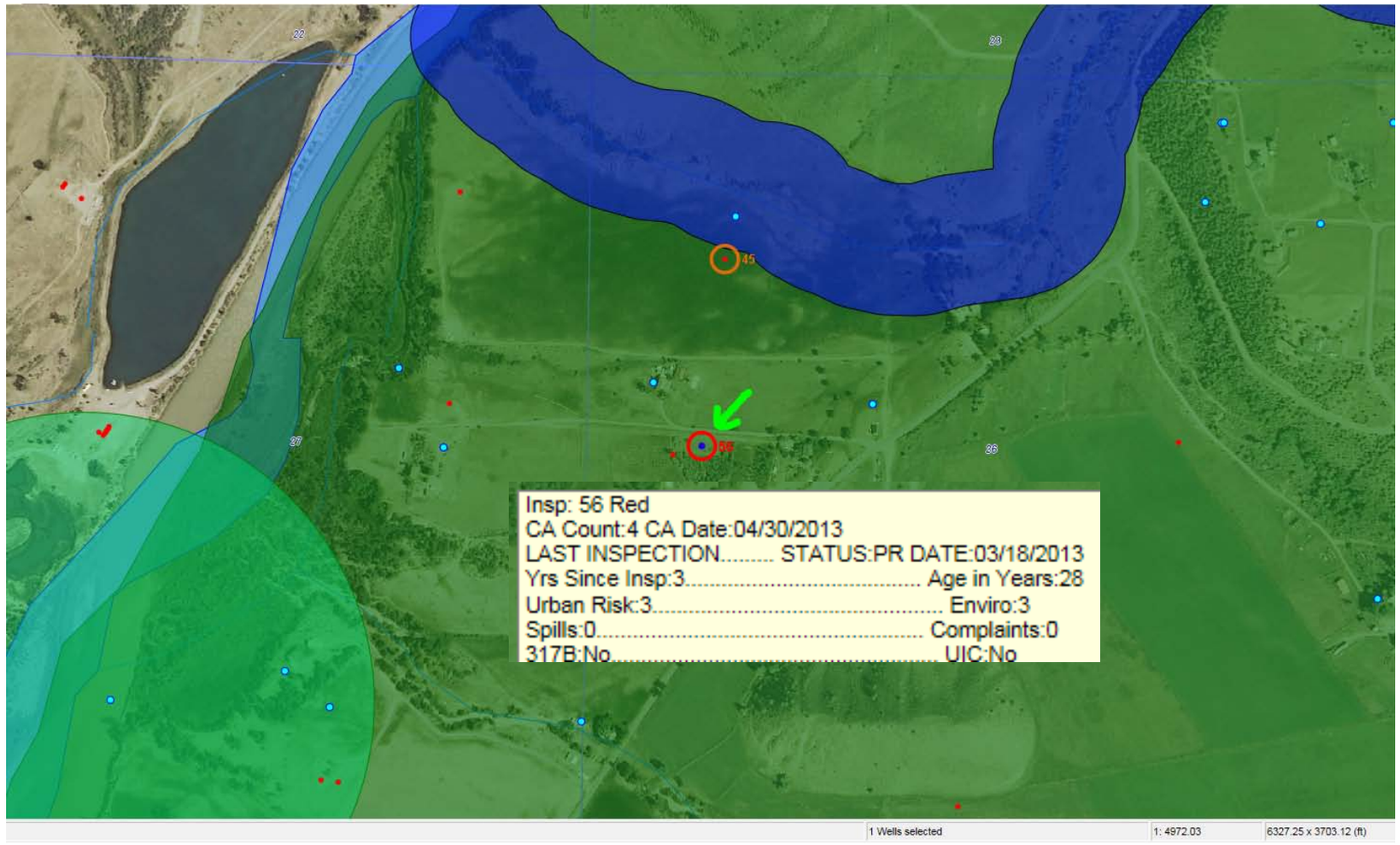
Urban RF: 3
Environment RF: 3
Time Since Last Inspection RF: 3
Age of Well RF: 5
Corrective Actions RF: 5

Overall Score: 56 - Higher

Post-Inspection Scores

Urban RF: 3
Environment RF: 3
Time Since Last Inspection RF: 1
Age of Well RF: 5
Corrective Actions RF: 1

Overall Score: 42 - Average



Summary

- Established a risk-based strategy for prioritizing well inspections that improves the timing and frequency – higher-risk wells to be inspected annually
- Using a manageable GIS-based model to generate daily relative risk factor scores for active wells in Colorado
- Automated workflow (integrated with COGCC databases) allows practical implementation for agency's field inspection unit
- Current classification scheme shows ~12% of all active wells in Colorado as higher risk
- Still tweaking model parameters and getting practical feedback
- Leveraging agency information - in the spirit of 'Big Data' - to be better regulators

Questions?

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COLORADO
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