



Automated Well Field Control

LMOP National Landfill Gas Energy Workshop
April 7th, 2016

Presented by: Andrew Campanella

About the presenter



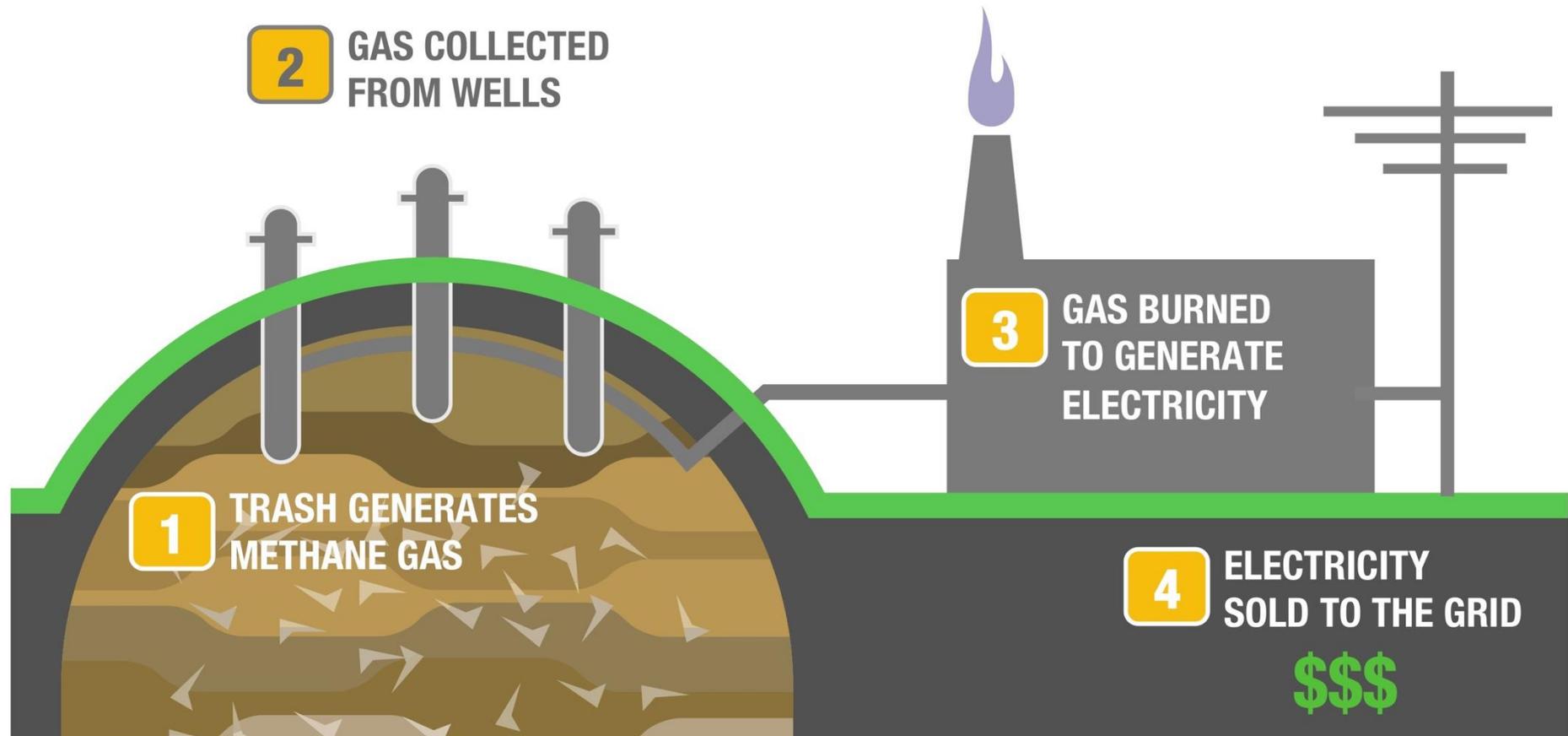
ANDY CAMPANELLA

- **B.S. Electrical Eng. and Computer Science at MIT**
- **M.S. in System Design and Management at MIT**
- **Founder and CEO of Loci Controls, Inc.**
- **Inventor on 35 US patents, dozens of applications**
- **Expert in control systems, instrumentation, power systems, and electronics**

Outline

- **Typical Landfill Gas Collection Process**
- **Remote Monitoring and Automatic Control**
- **Well Tuning vs. Well Field Tuning**

Typical gas collection system



Drawbacks of typical collection system

- *Manual surveys of well field are very labor intensive*
- *Infrequent measurement & tuning due to time/effort required*
- *Well adjustments are an art rather than a science*



Automated well field control system



MONITOR

real-time, wireless measurement
of landfill gas production



CONTROL

remote, automatic adjustments
to individual extraction points



OPTIMIZE

maximize system performance
with custom tuning algorithms

Installed device

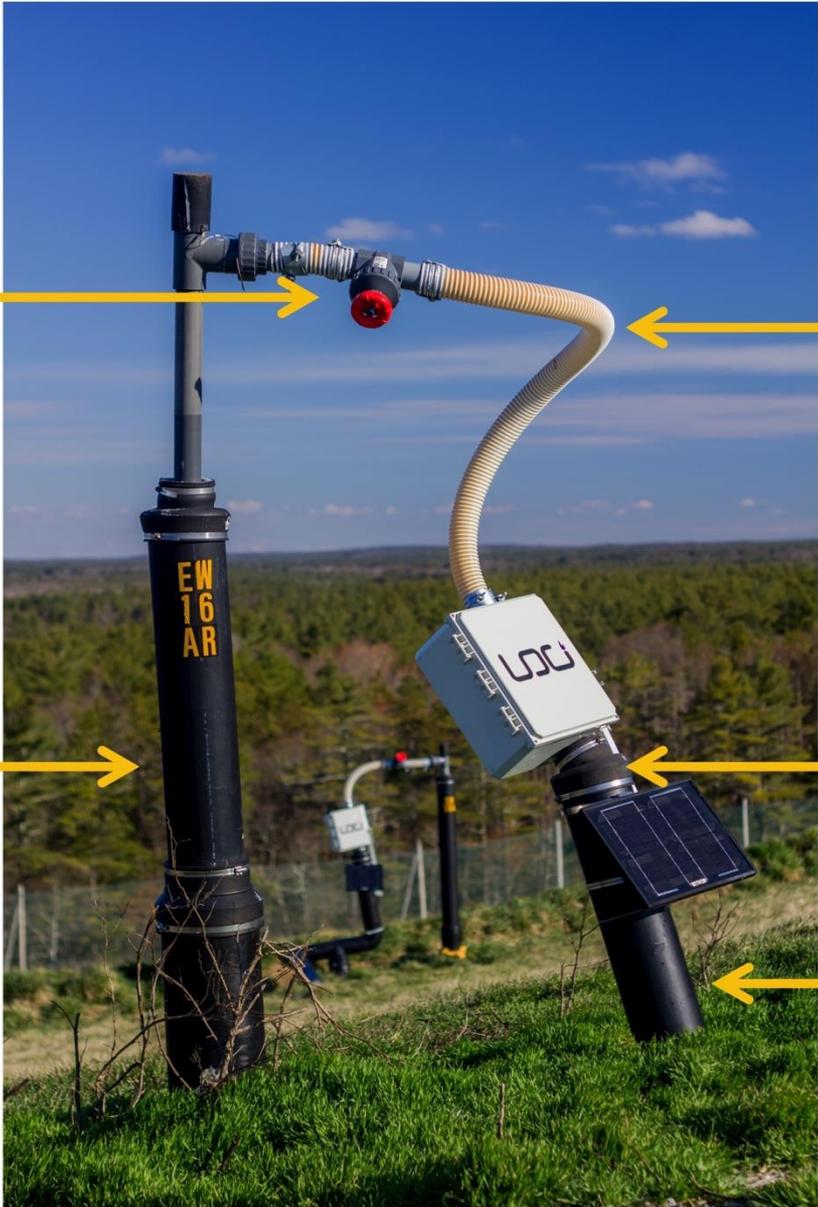
Manual valve
(bypassed)

2" Flexible hose
with pipe clamps

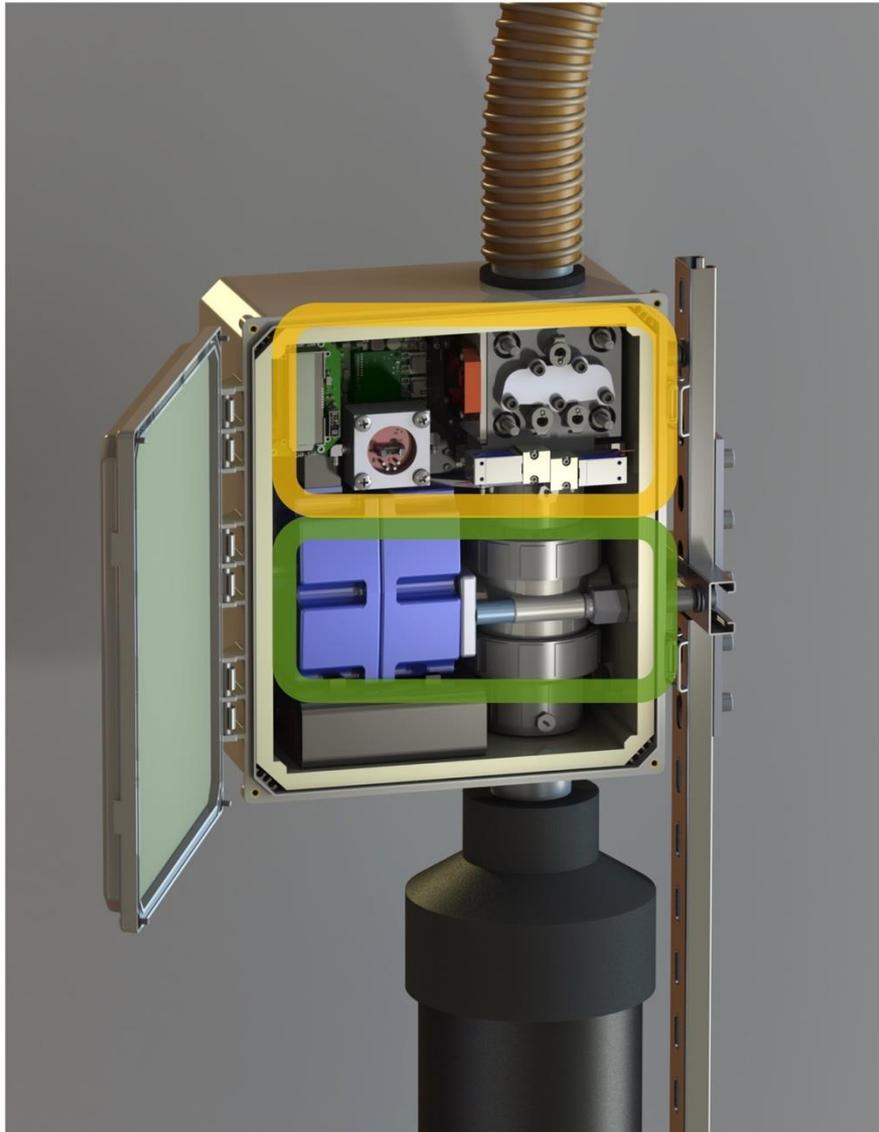
Gas extraction
well

Standard flexible
reducing coupling

Device mounts to
vacuum riser



Integrated measurement and control



MONITOR

real-time, wireless measurement of landfill gas production

- Gas Composition: % CH₄, CO₂ & O₂
- Temperature
- Flow rate
- Well Static Pressure
- System Vacuum



CONTROL

remote, automatic adjustments to individual extraction points

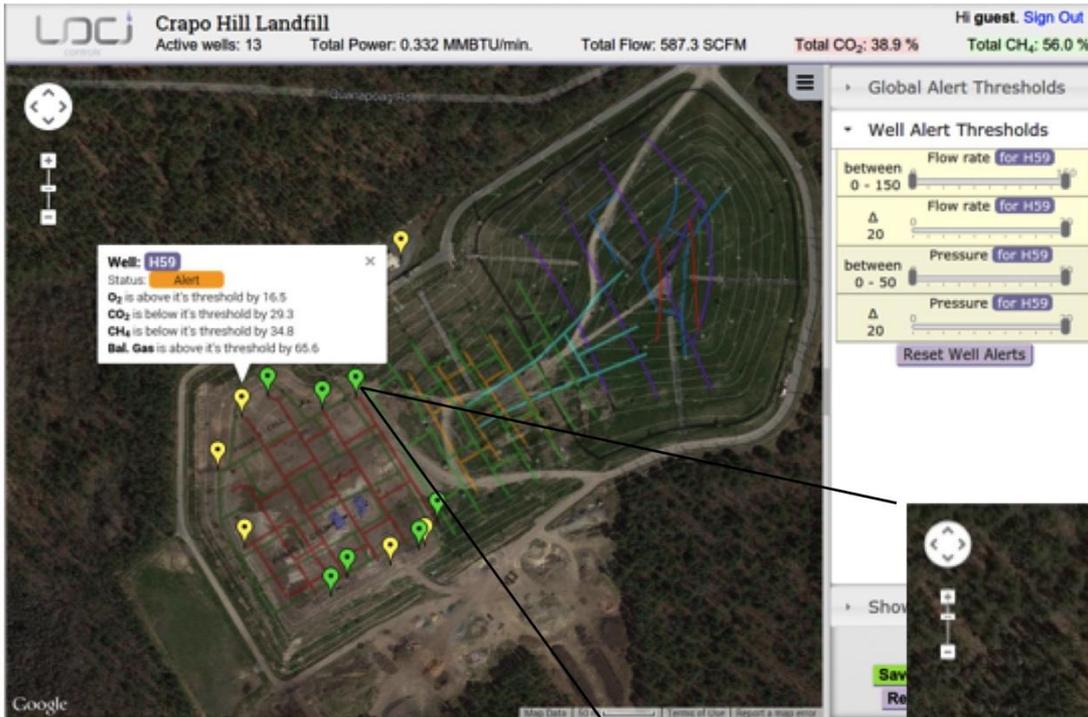
- Remotely actuated valve
- Continuous resolution, 0-100% range
- Variable control interval, step size



OPTIMIZE

maximize system performance
with custom tuning algorithms

- Set custom alarms
- Instantly identify problems
- View real time data
- Energy analytics

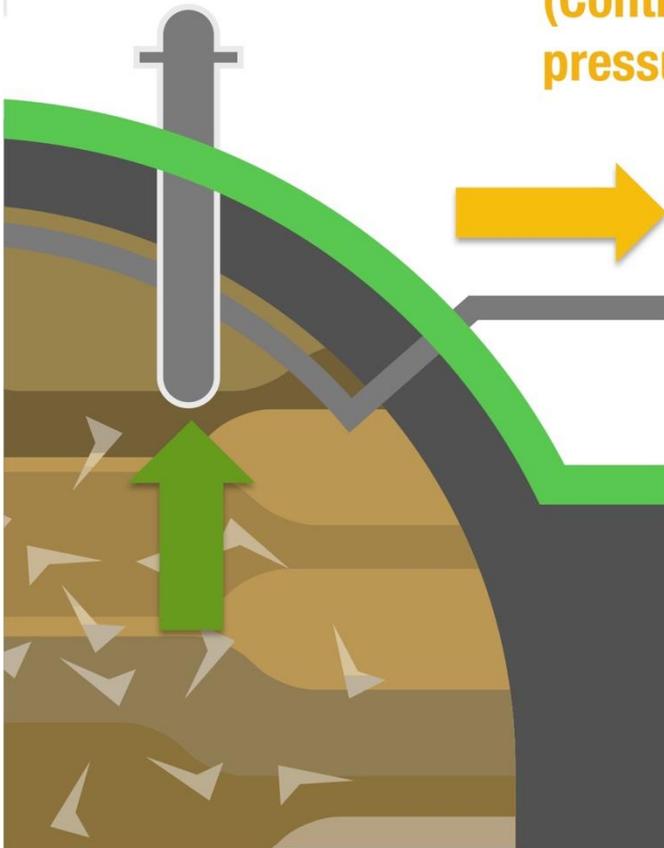


Control system objective

Gas Extraction = **Gas Generation**

(Controlled via static
pressure adjustment)

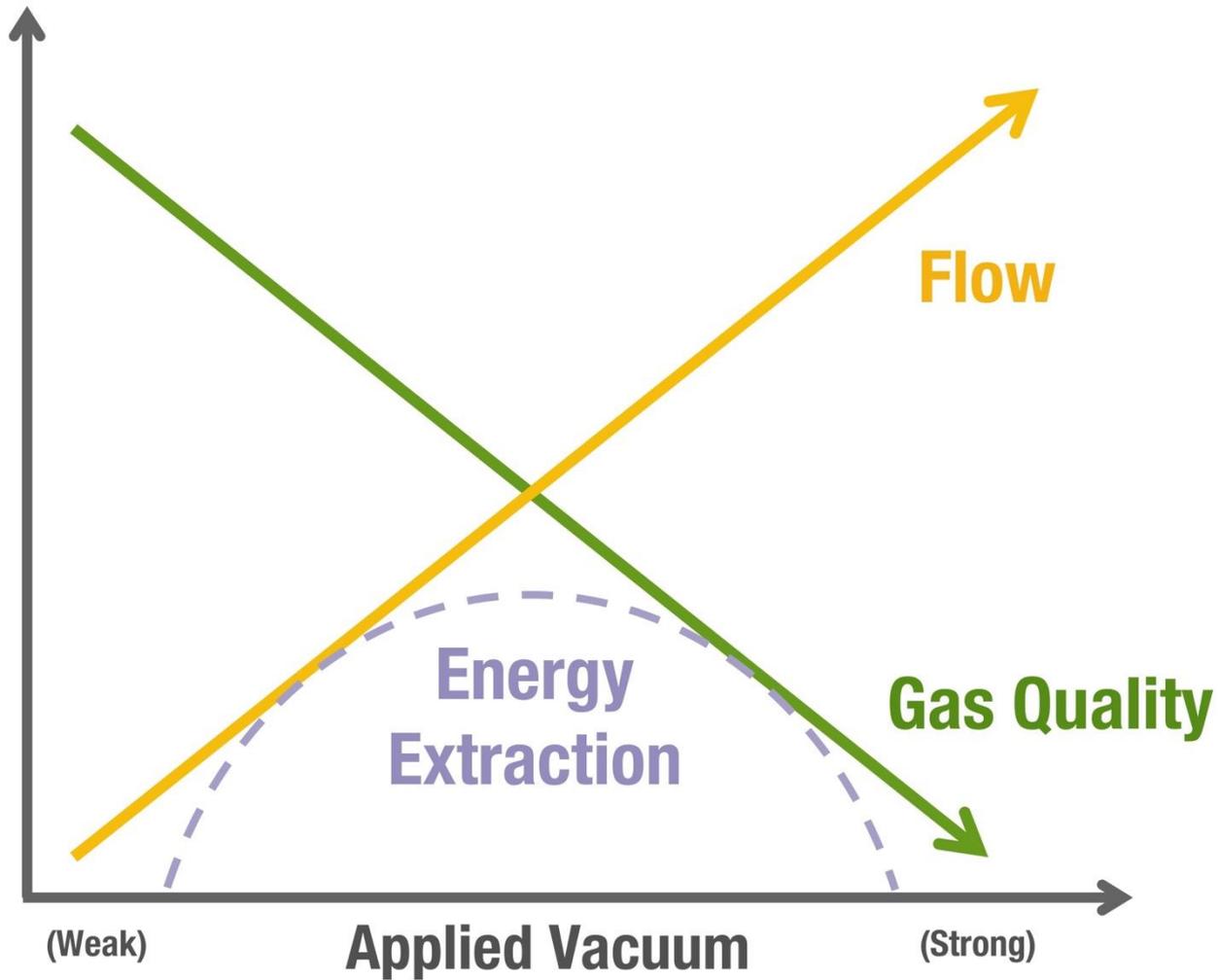
(Sensitive to external
factors, weather, etc.)



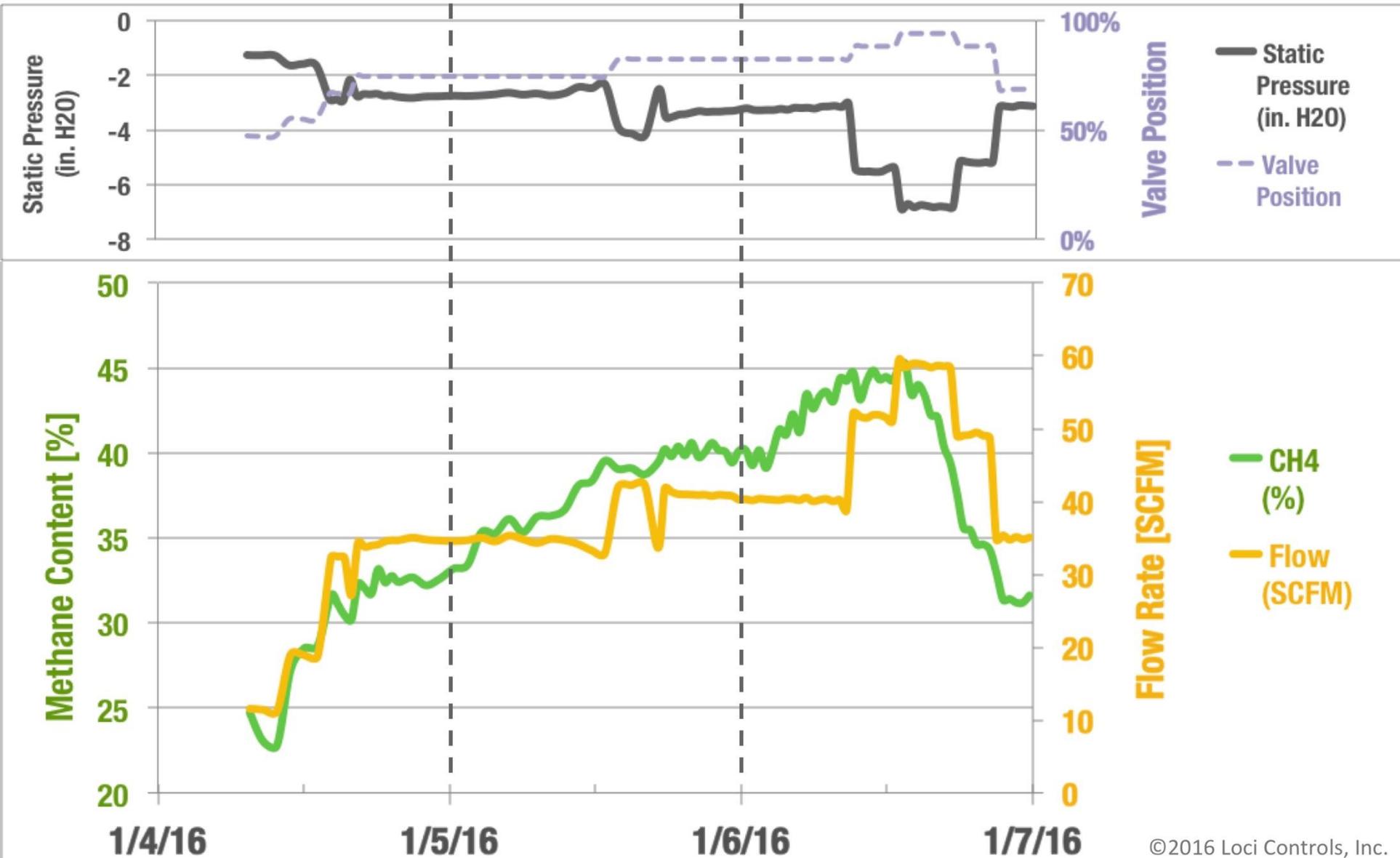
Successful well tuning:

- Stable gas quality
- Minimized emissions/odors
- Long term maximization of methane generation
- Low risk of underground thermal runaway

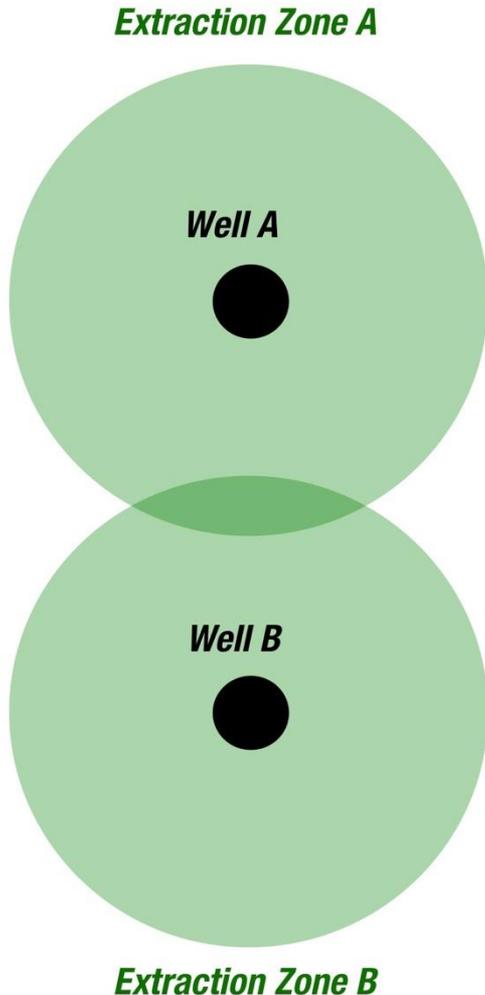
Typical Well Behavior



What's wrong with this picture?



Well to well interactions



Influence of Well B on A

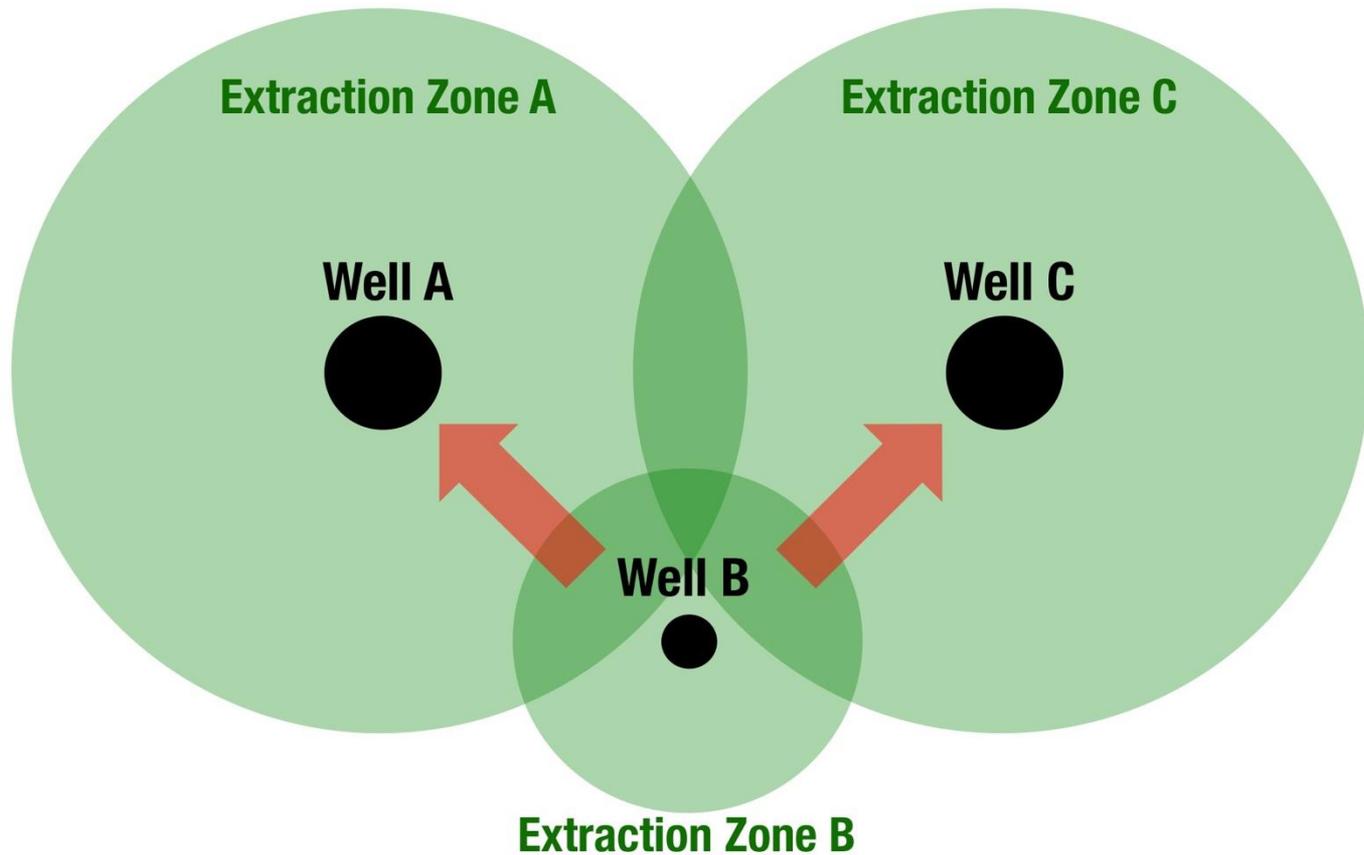
$$\frac{\partial LFG_A}{\partial t} \approx f(x_1, x_2, \dots) + f(LFG_B)$$

Influence of Well A on B

$$\frac{\partial LFG_B}{\partial t} \approx f(x_1, x_2, \dots) + f(LFG_A)$$

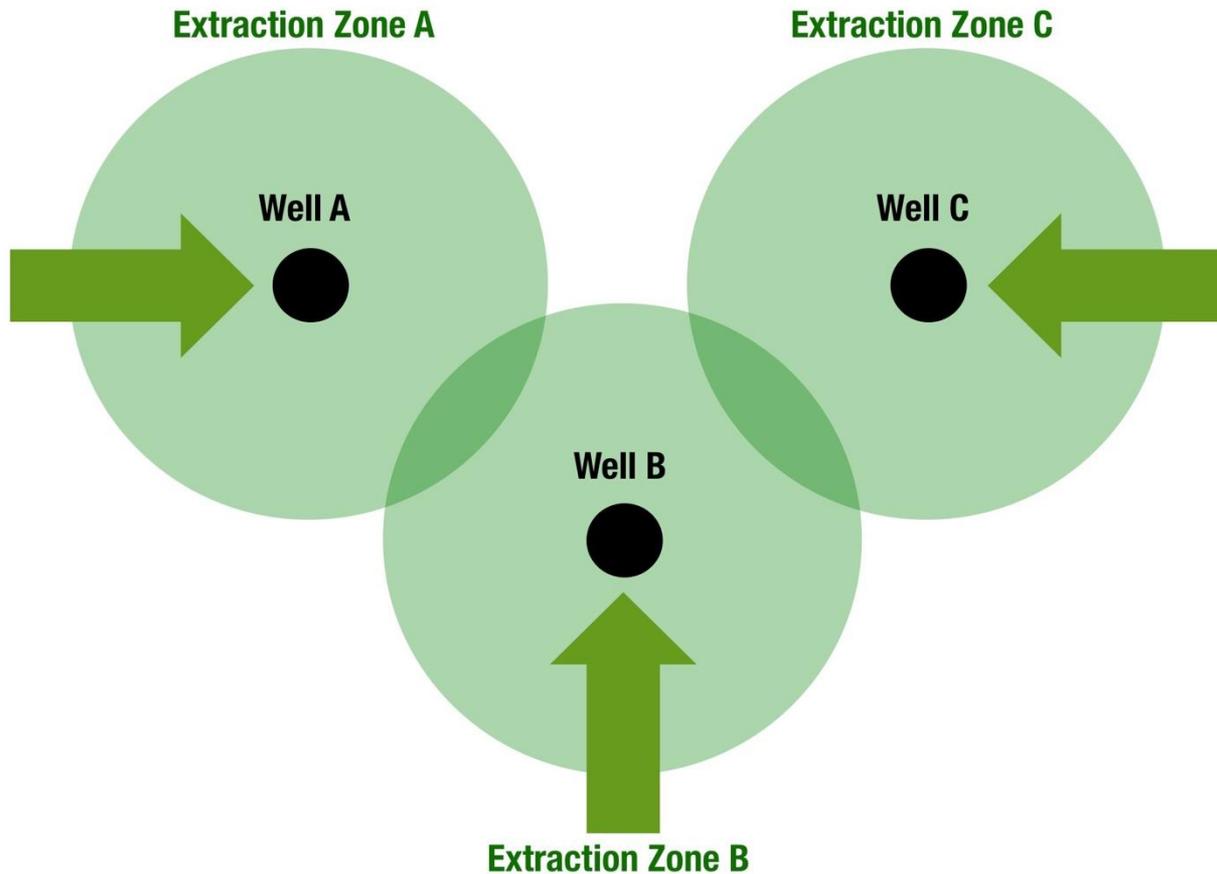
Well to well interactions

Well B must first overcome excess vacuum from A and C!

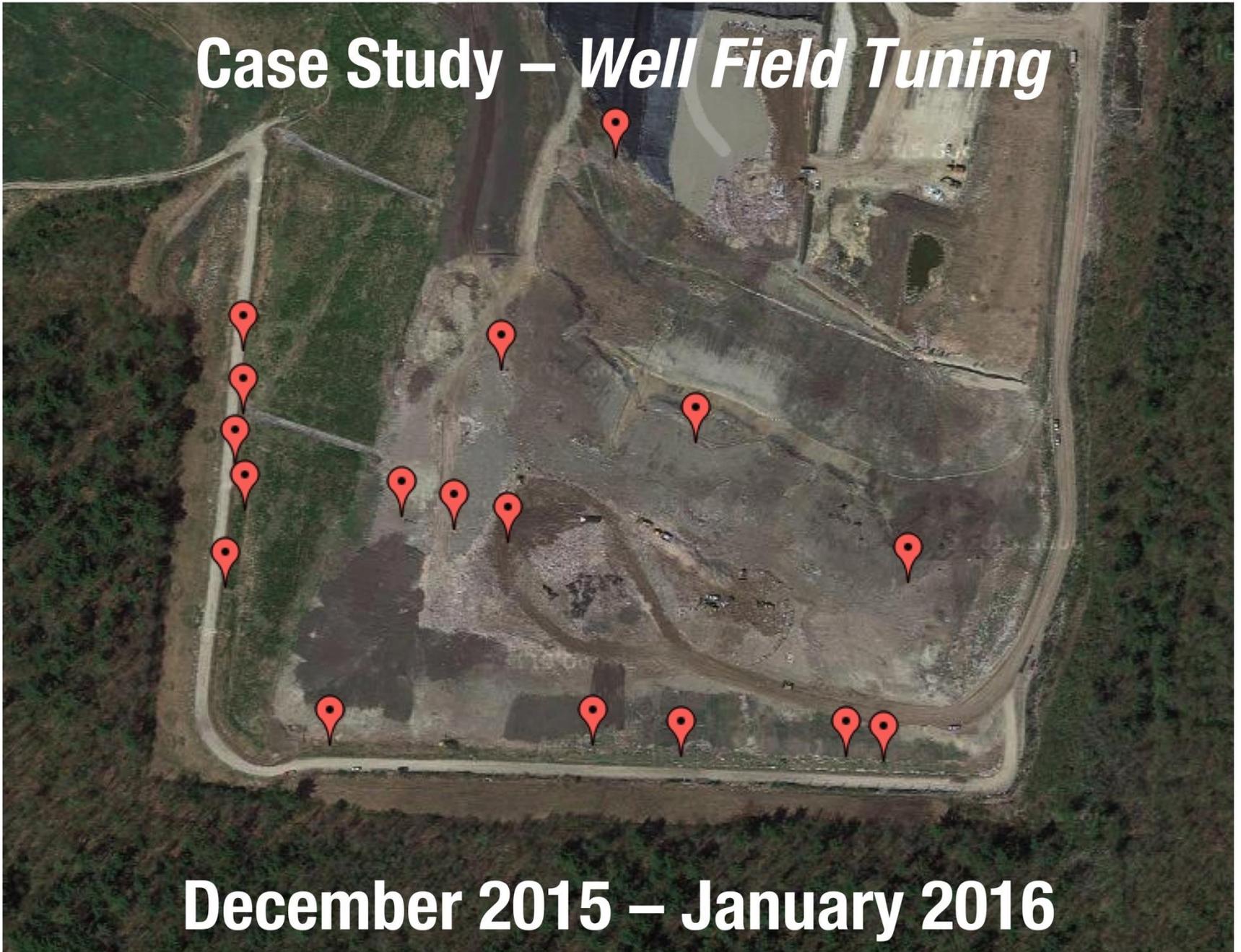


Well to well interactions

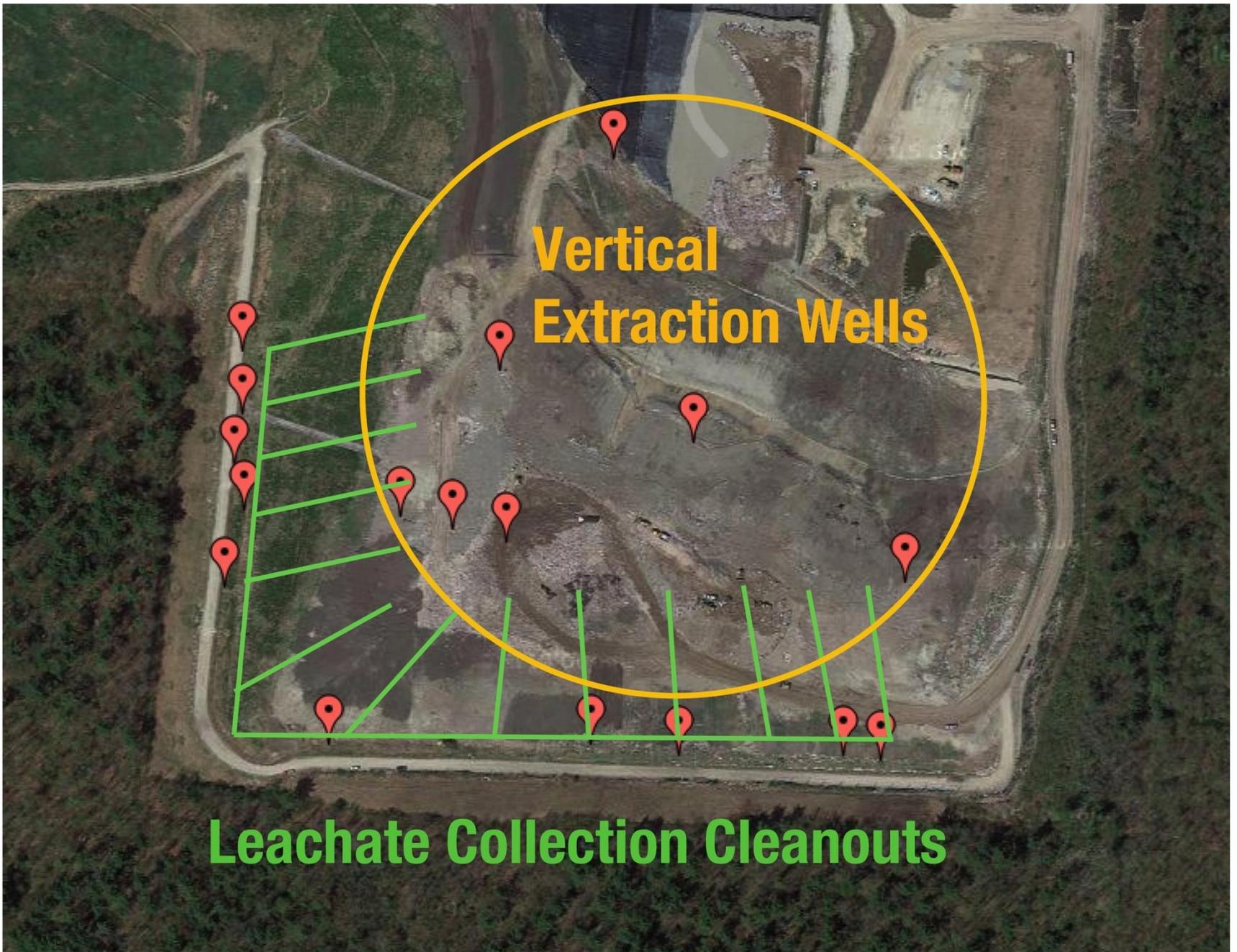
Better configuration from a system perspective!



Case Study – *Well Field Tuning*

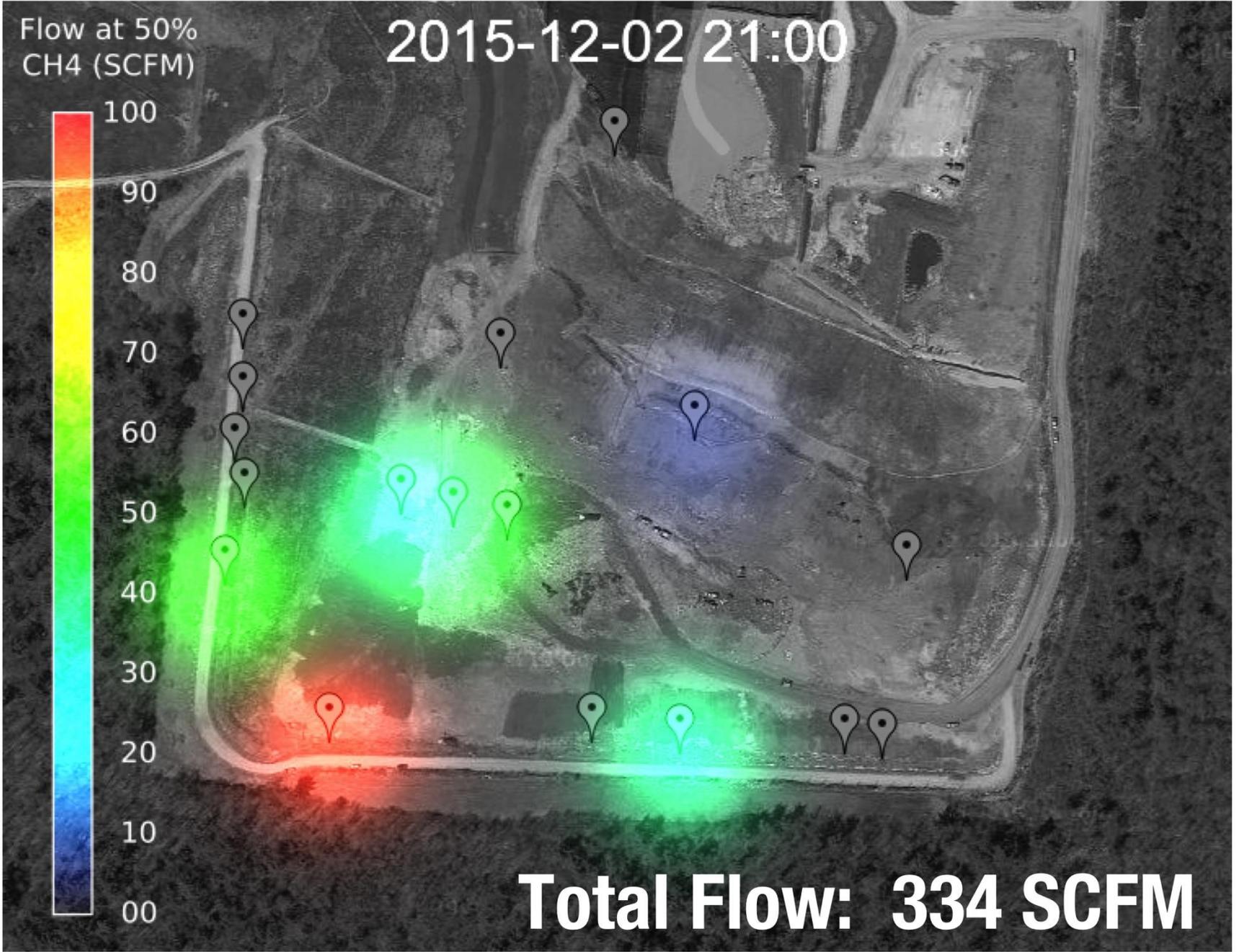


December 2015 – January 2016



Flow at 50%
CH4 (SCFM)

2015-12-02 21:00



Total Flow: 334 SCFM

Flow at 50%
CH4 (SCFM)

2015-12-02 21:00

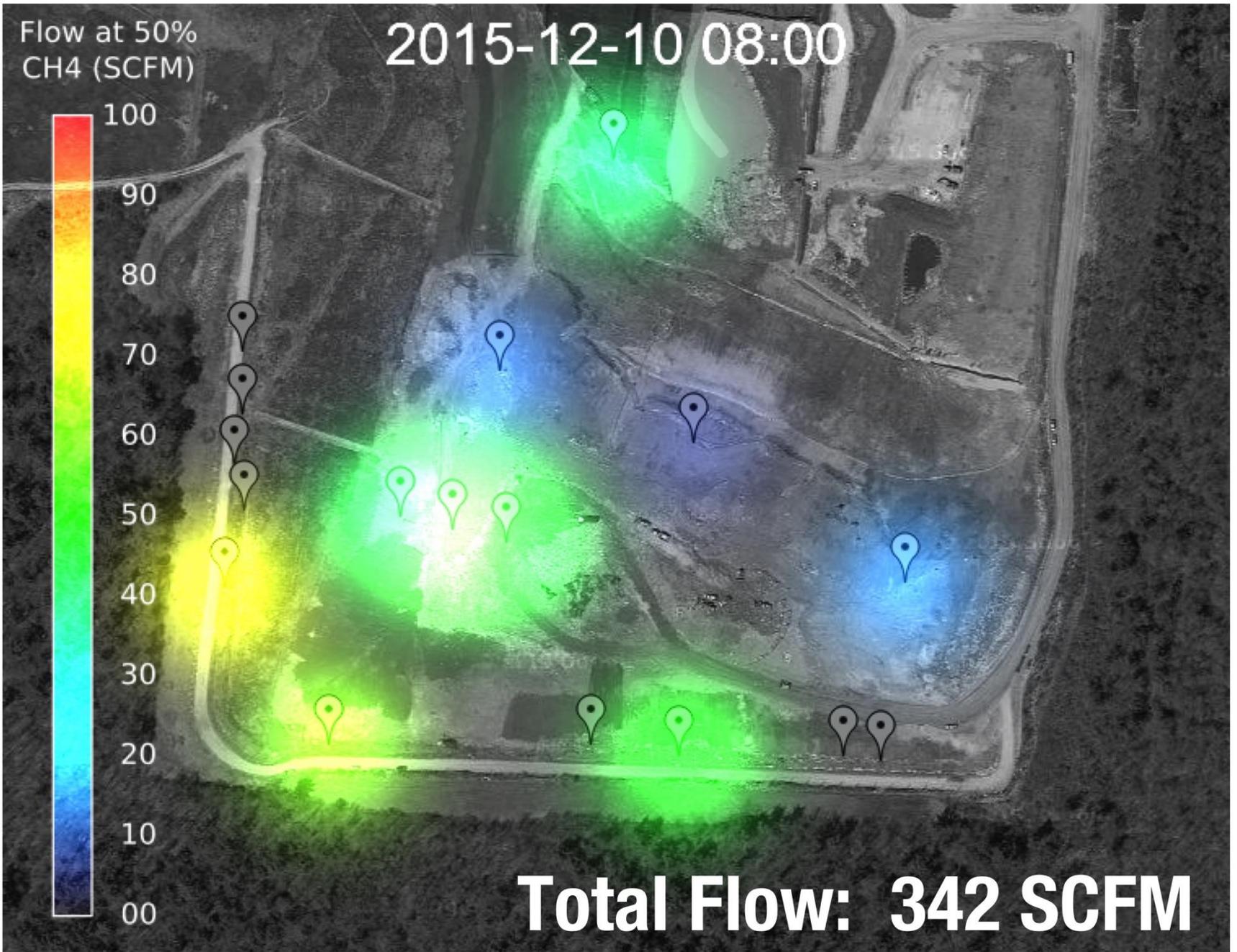


Under utilized extraction wells

Total Flow: 334 SCFM

Flow at 50%
CH4 (SCFM)

2015-12-10 08:00



Total Flow: 342 SCFM

Flow at 50%
CH4 (SCFM)

2015-12-21 09:00



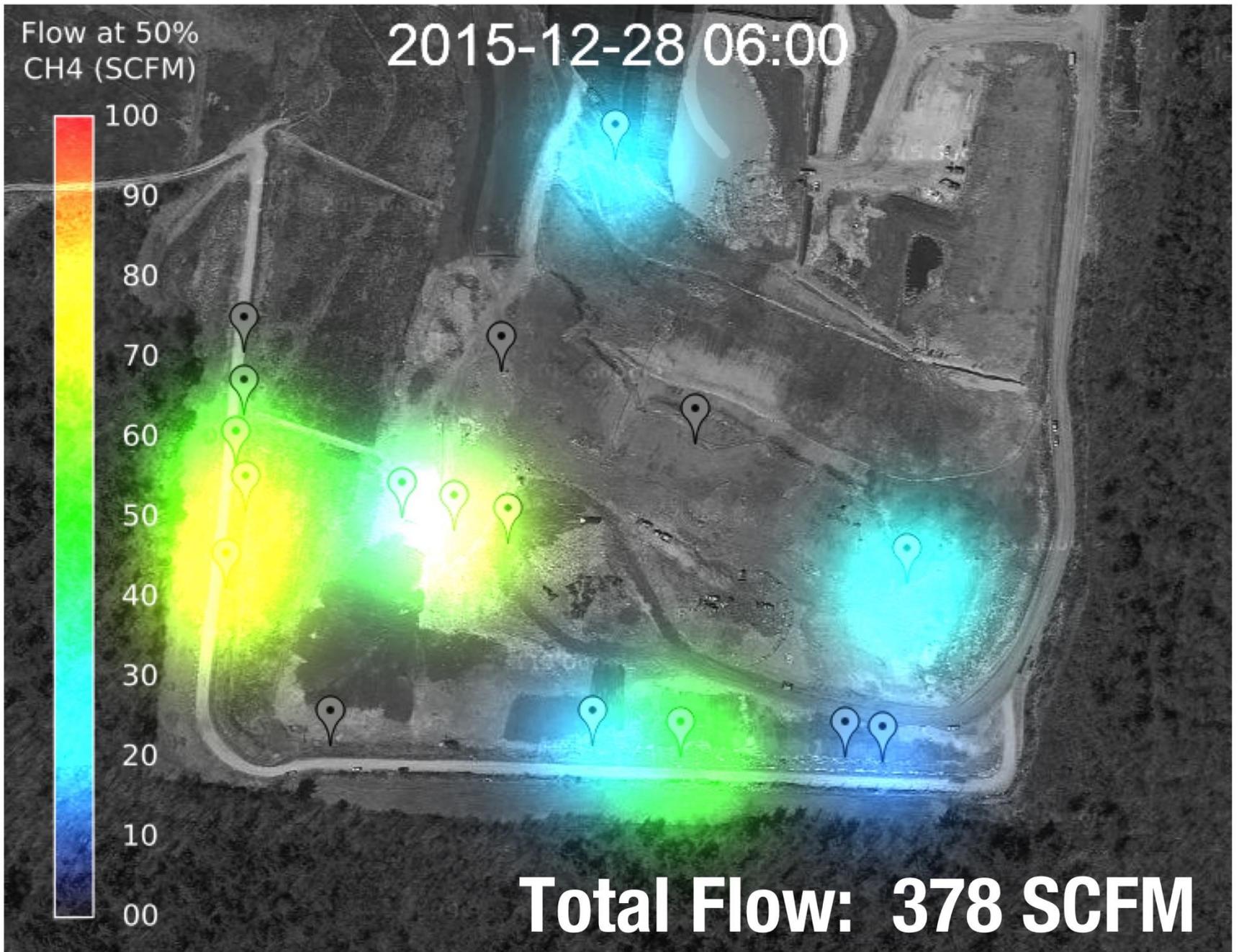
**Push extraction towards
"dead" wells**



Total Flow: 375 SCFM

Flow at 50%
CH4 (SCFM)

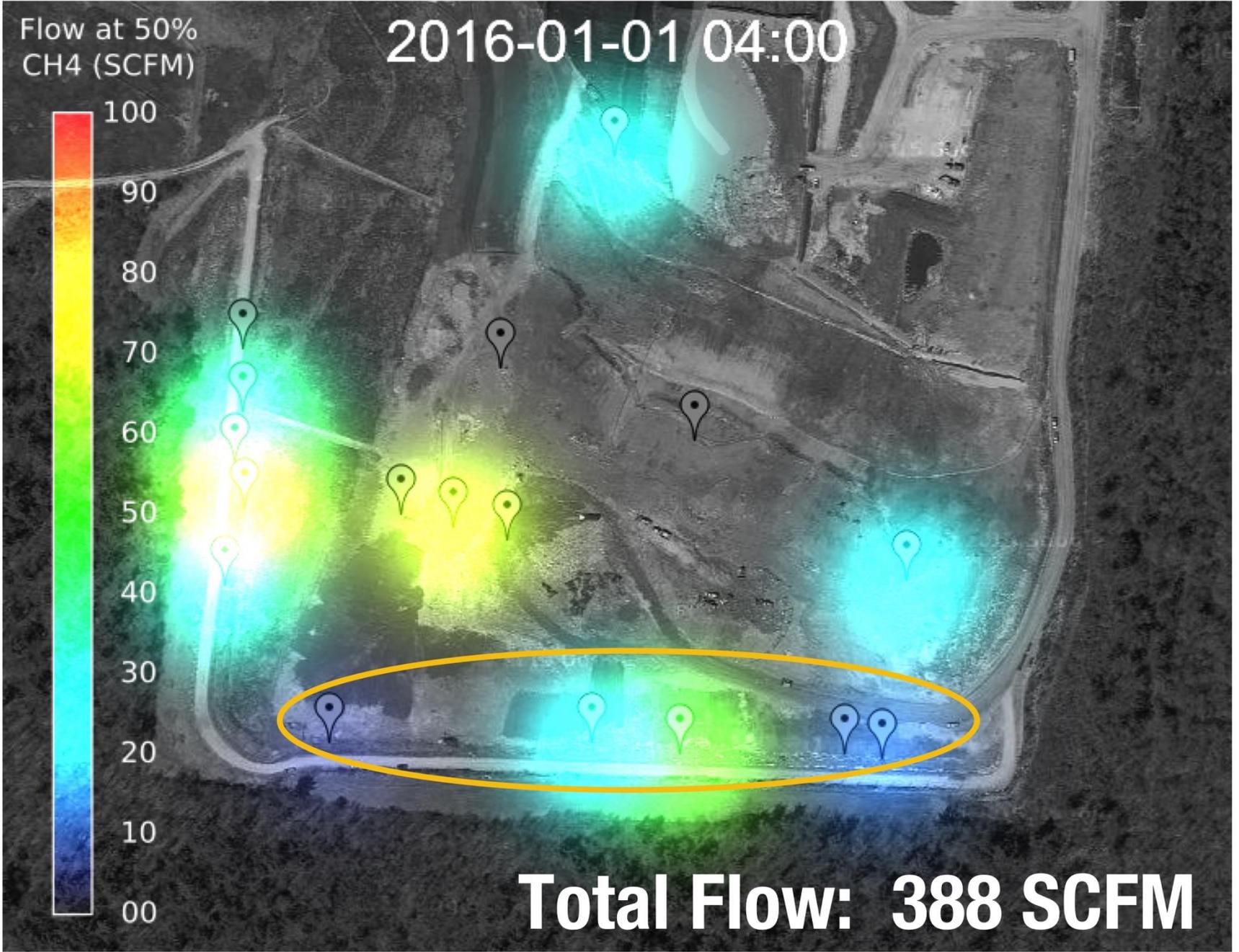
2015-12-28 06:00



Total Flow: 378 SCFM

Flow at 50%
CH4 (SCFM)

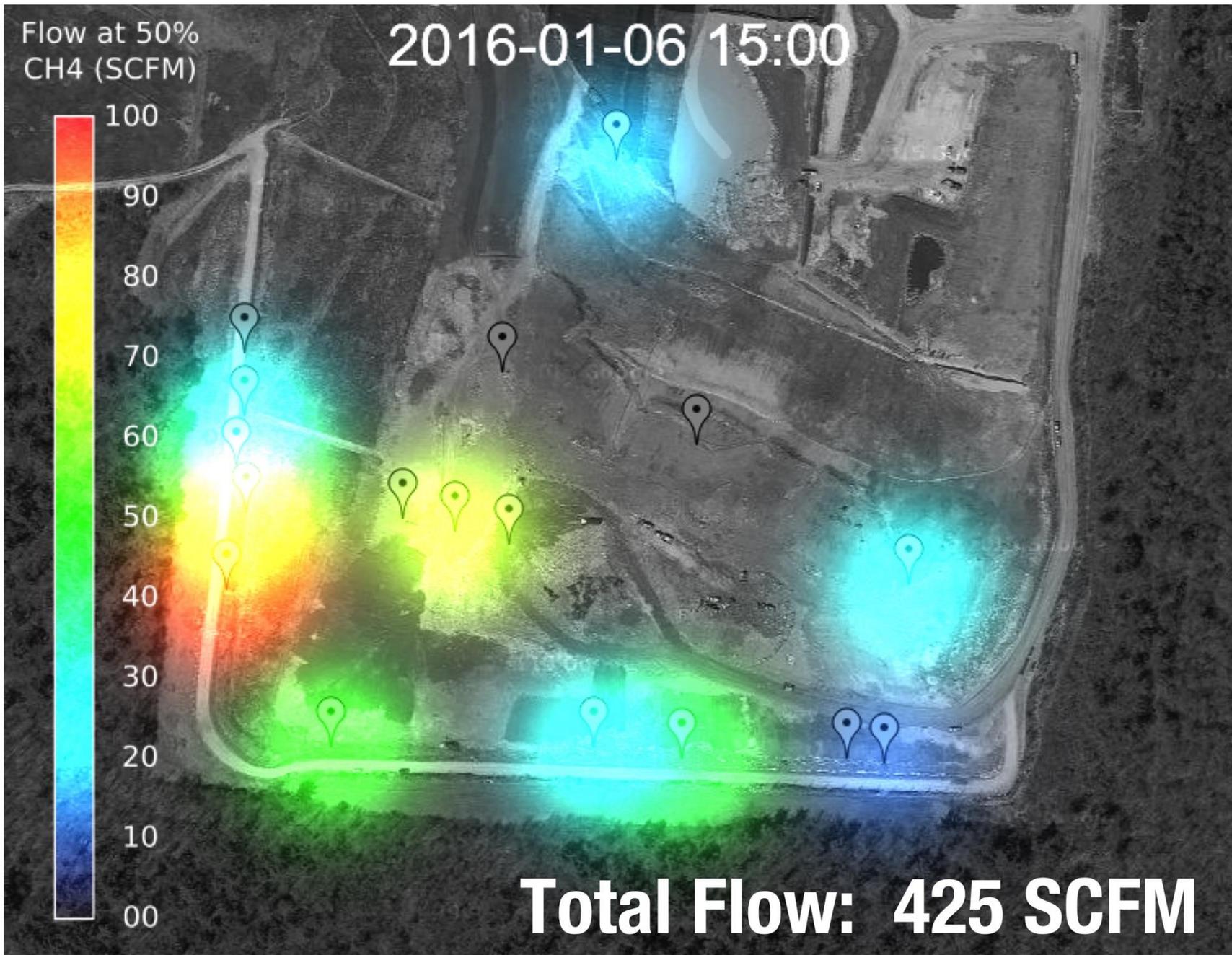
2016-01-01 04:00



Total Flow: 388 SCFM

Flow at 50%
CH4 (SCFM)

2016-01-06 15:00



Total Flow: 425 SCFM

Flow at 50%
CH4 (SCFM)

2016-01-25 03:00



Total Flow: 479 SCFM

Potential for system automation

- Improved LFG collection efficiency
- More gas = more LFGTE revenue
- Odor control by reducing fugitive emissions
- Labor savings – more efficient use of technician time





LOCI

controls

THANK YOU!

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