

# **Water Quality Testing by Source in Ahmedabad, India: Results & Maps**

**Suitability – India Field Team  
Comprehensive Initiative on Technology Evaluation  
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**Massachusetts  
Institute of  
Technology**



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# About This Evaluation

In summer 2014, a research team from the Comprehensive Initiative on Technology Evaluation (CITE) at MIT evaluated household water filters available on the market in Ahmedabad, India.

An important precursor to that work was a rapid assessment of water quality in Ahmedabad. The following slides detail what the CITE field team found in their research. You can read our full report at [cite.mit.edu](http://cite.mit.edu).

# Residual Chlorine (mg/L)

- Why measure Residual Chlorine?
  - “Chlorination is employed primarily for microbial disinfection” and there should be “suitable free chlorine available to protect the water against reinfection from the point of chlorination”. (WHO, Guidelines for Drinking-water Quality, 4<sup>th</sup> edition, 2011)

# Residual Chlorine Standards

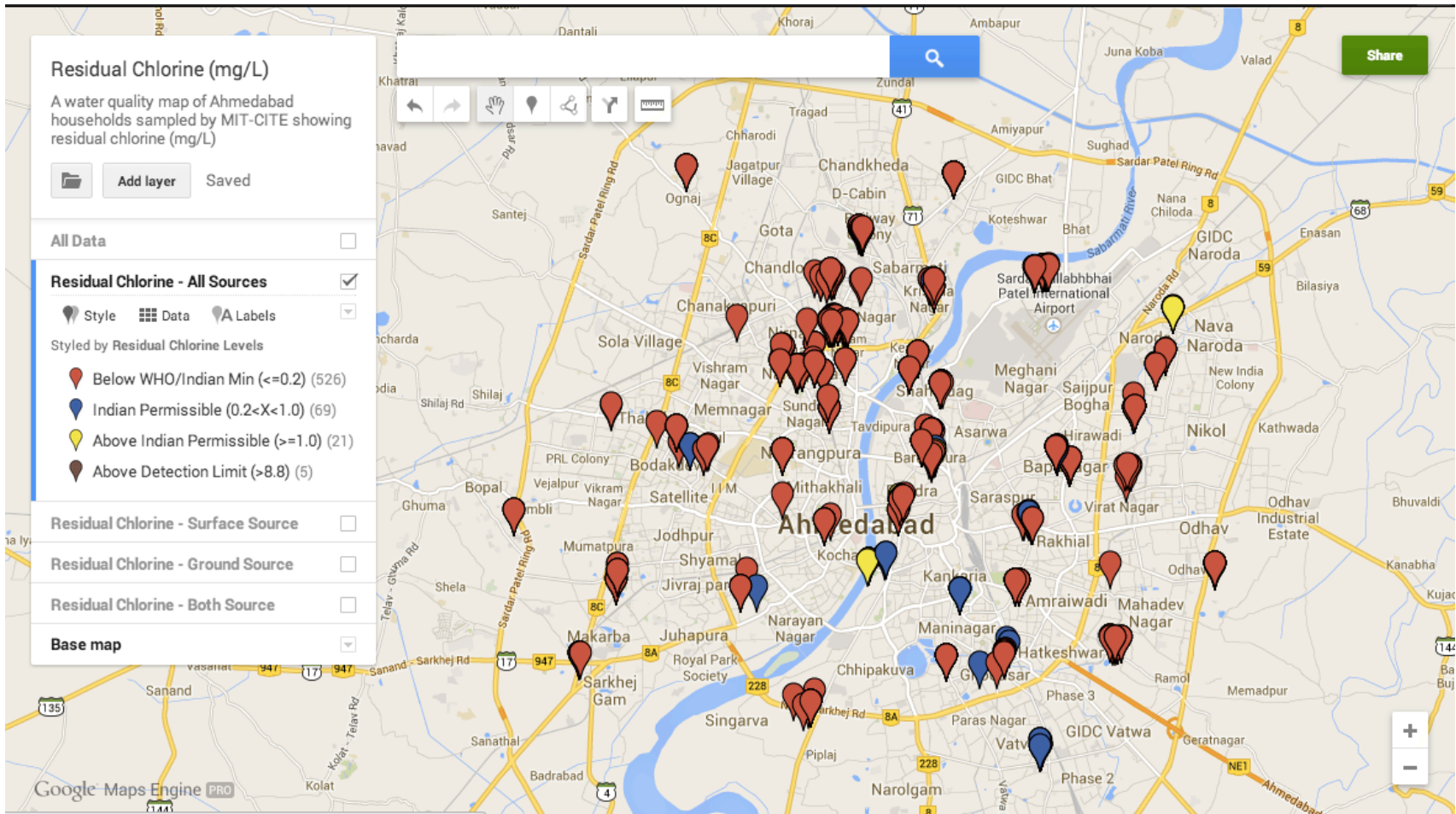
- Indian Standard
  - Acceptable Limit; Minimum: 0.2 mg/L
  - Permissible Limit; Maximum: 1 mg/L
- WHO Guidelines
  - Minimum: 0.2 mg/L



# Map Marker Colors

- Red
  - \* Below 0.2 mg/L - Indian and WHO minimum
- Blue
  - \* 0.2 to 1 mg/L - above minimum and below Indian permissible limit (correct target range)
- Yellow
  - > 1 mg/L - above Indian permissible limit

# Residual Chlorine – All Sources

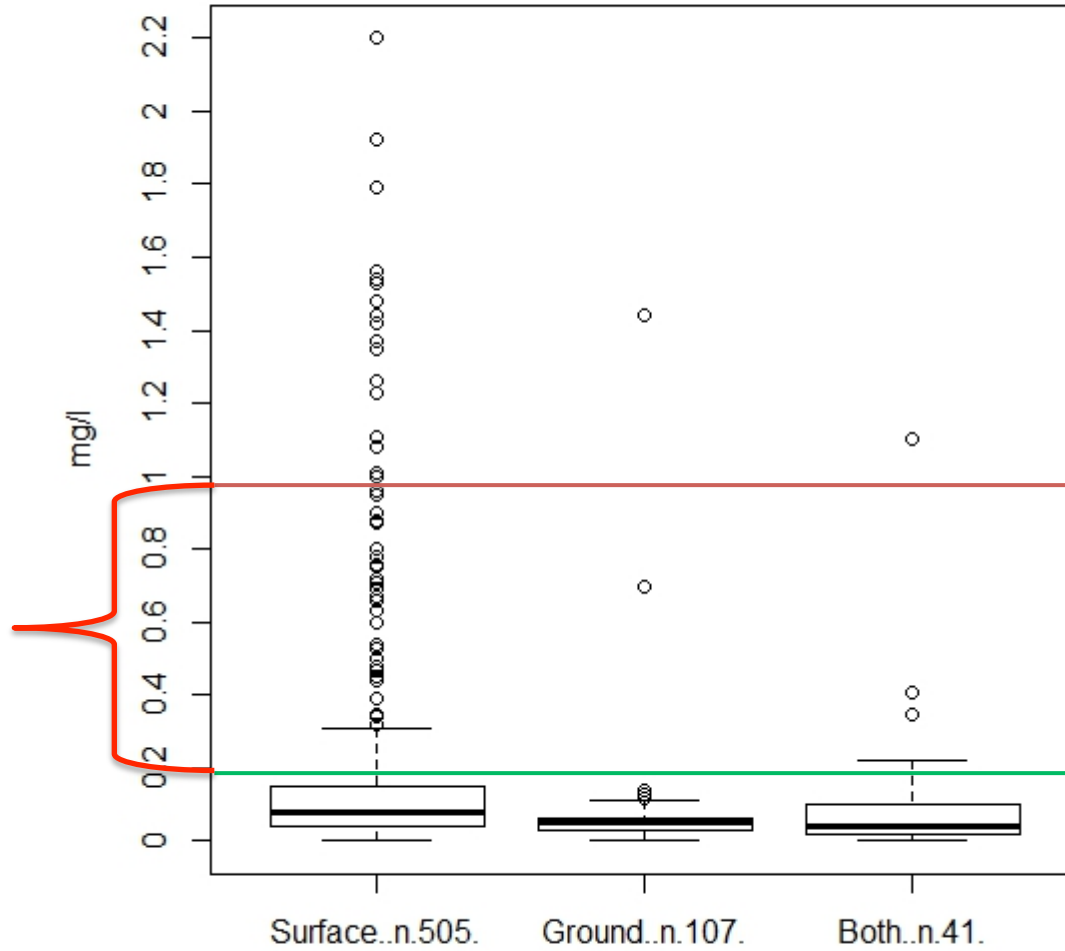


[Interactive Map](#)

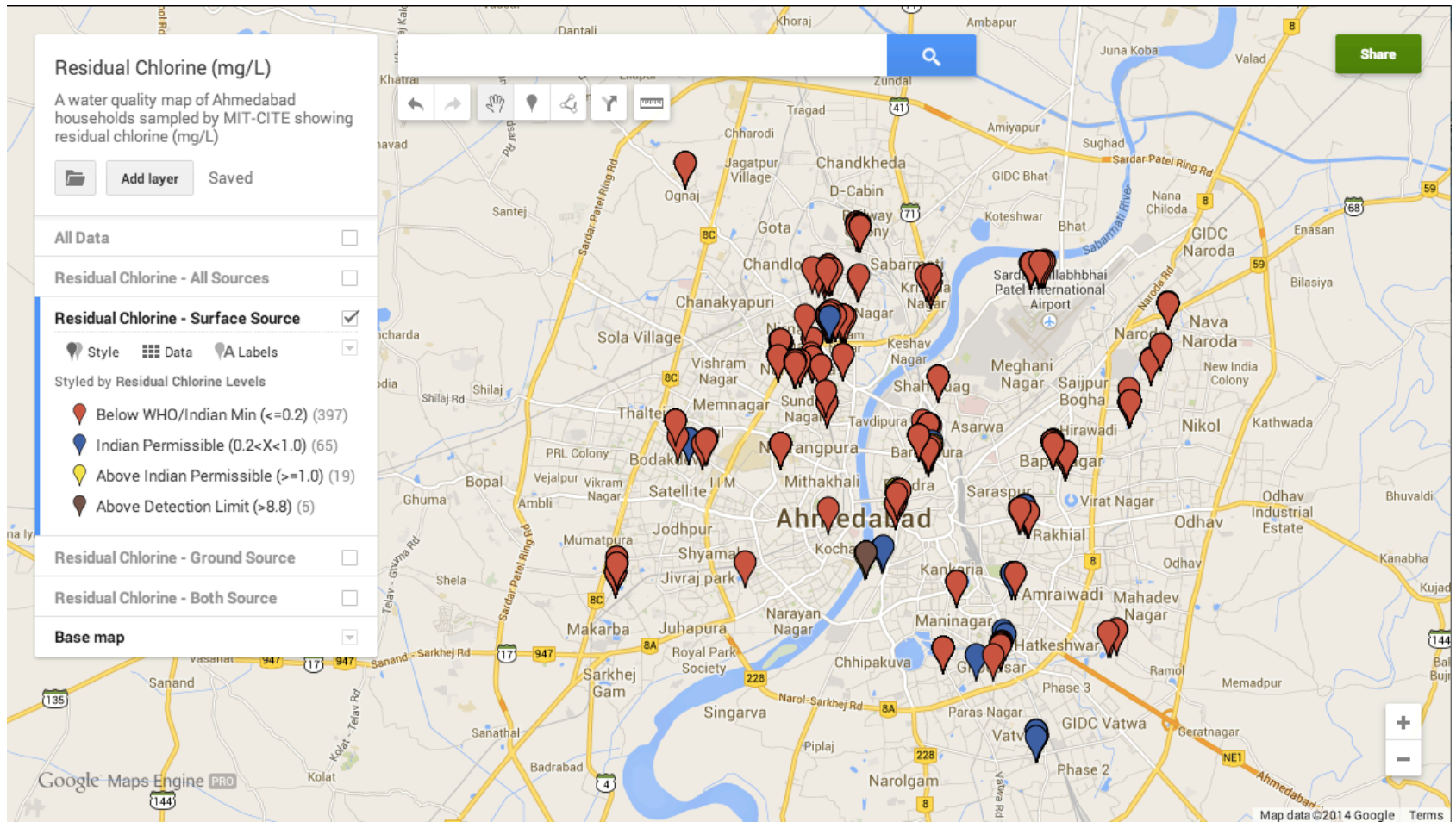
# Residual Chlorine - Results Summary

- Residual Chlorine not meeting WHO and Indian Standard minimum (< 0.2 mg/L):
  - 81.0% of Surface Water Samples
  - 96.5% of Groundwater Samples
  - 90.5% of Mixed Source Samples

# Residual Chlorine



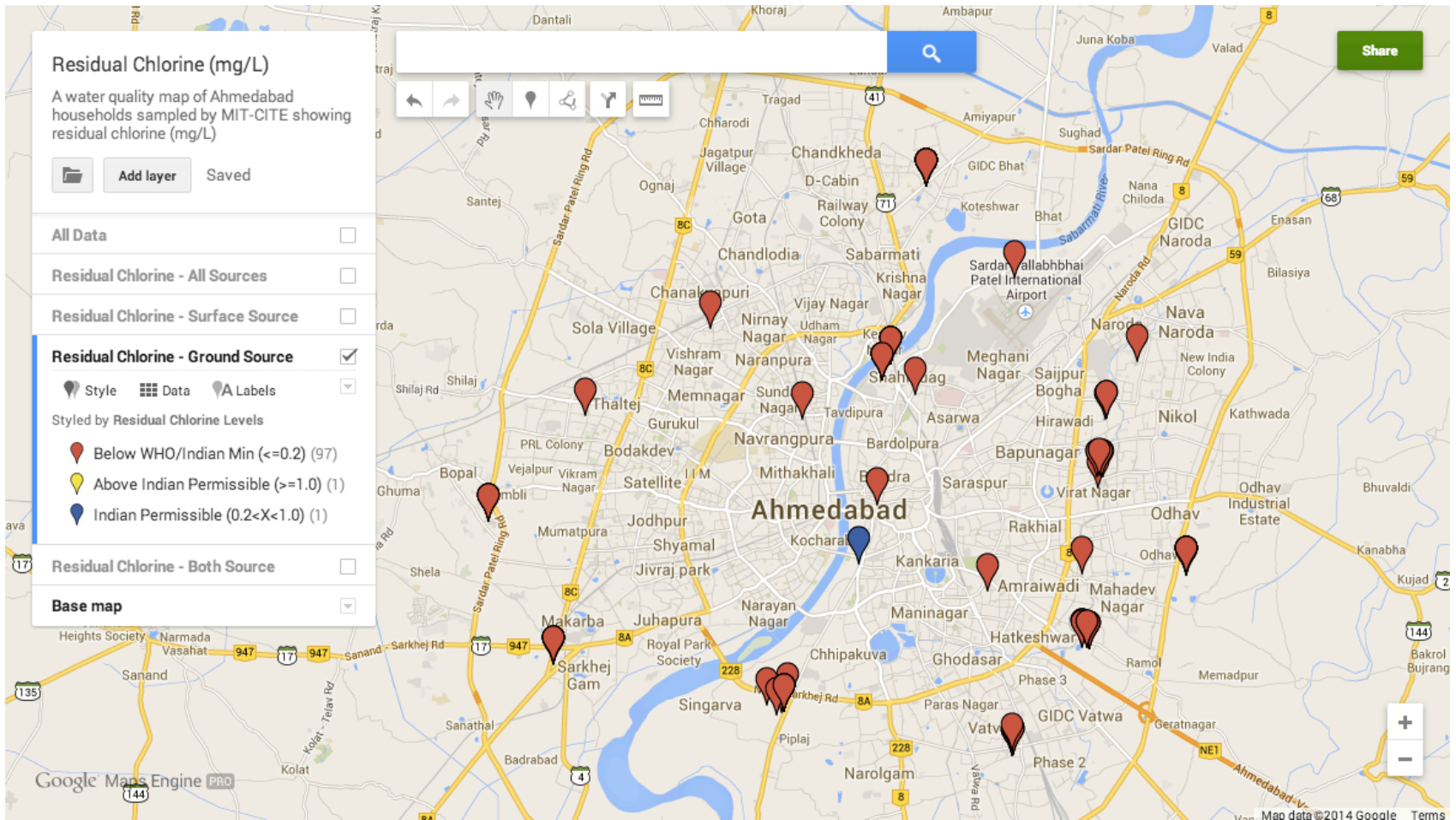
# Residual Chlorine - Surface



[Interactive Map](#)

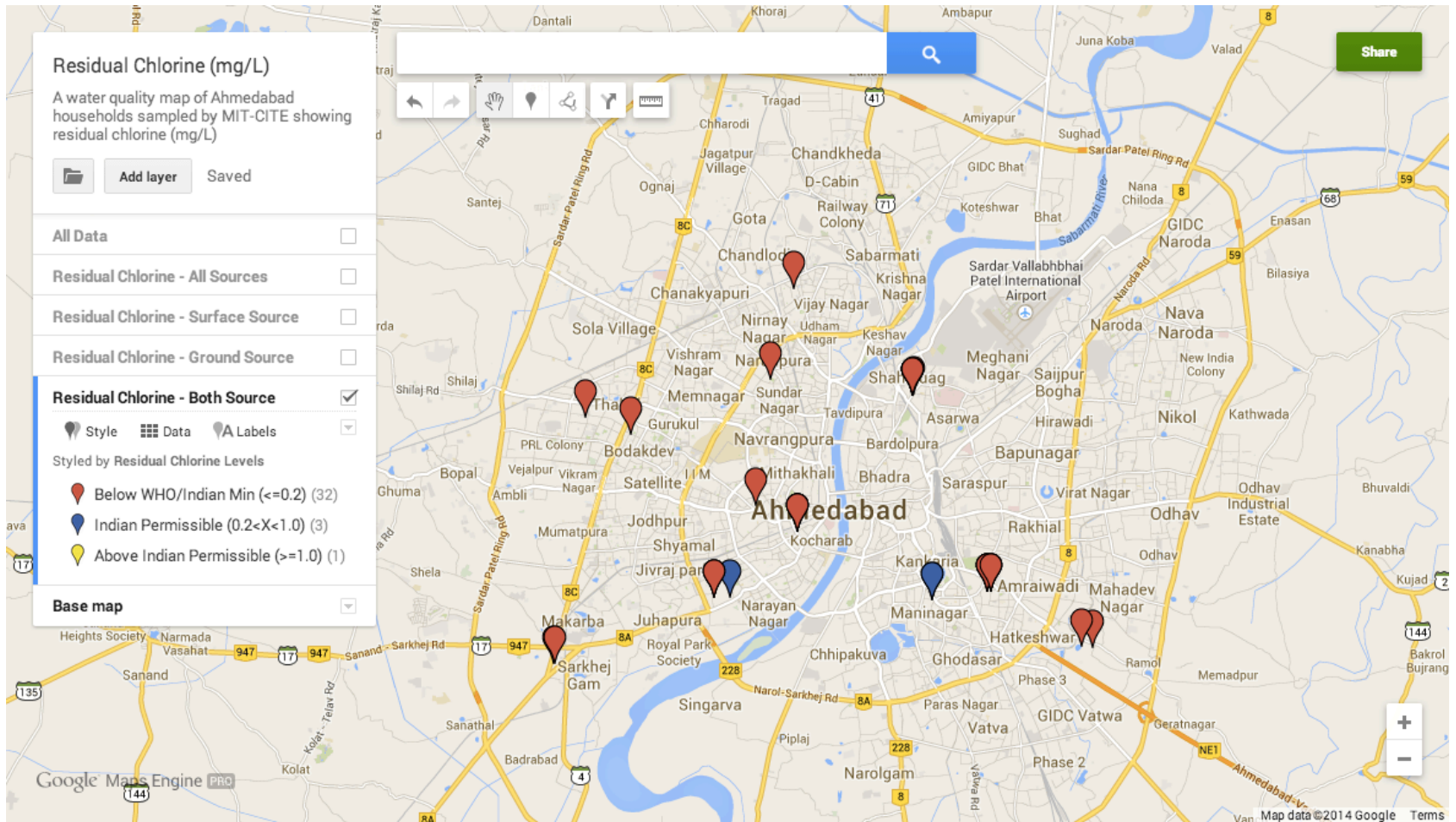


# Residual Chlorine - Ground



[Interactive Map](#)

# Residual Chlorine - Both



[Interactive Map](#)

# Turbidity (NTU)

- Why Measure Turbidity?
  - “Turbidity can seriously interfere with the efficiency of disinfection by providing protection for organisms” therefore “...achieving low turbidity by filtration (before disinfection) of water...is strongly recommended to ensure microbially safe water” (GDWQ)



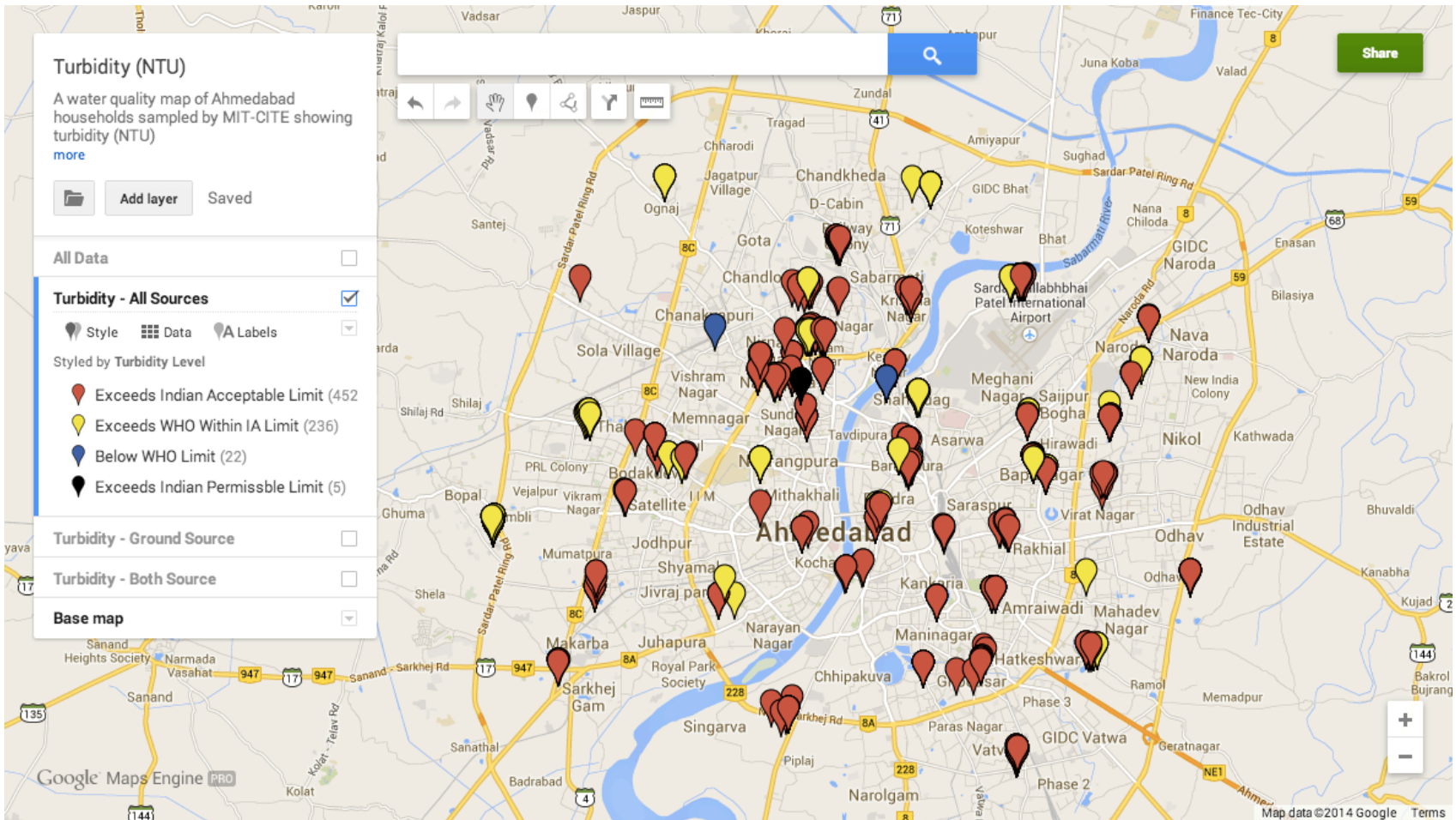
# Turbidity Standards

- Indian Standard
  - Acceptable Limit; Maximum: 1 NTU
  - Permissible Limit; Maximum: 5 NTU
- WHO Guideline
  - Maximum: < 0.5 NTU
    - “Large well run municipalities should be < 0.5 NTU at all times...” (GDWQ p.228)
  - <0.5 NTU used as WHO criteria, as Ahmedabad is a large municipality.

# Map Marker Colors

- Blue
  - Below WHO maximum limit
- Yellow
  - Above WHO maximum limit, but below Indian Acceptable limit
- Red
  - Above Indian Acceptable limit, but below Indian Permissible limit
- Black
  - Above Indian Permissible limit

# Turbidity - All Sources

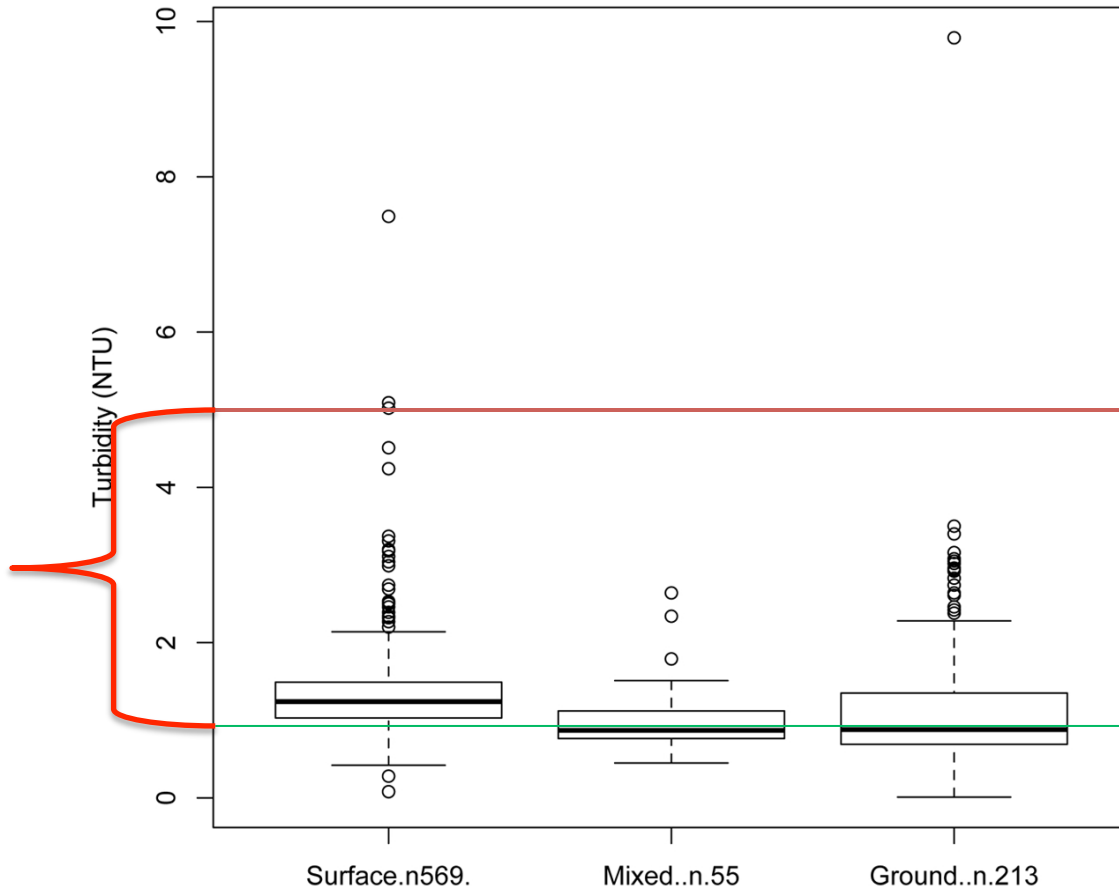


[Interactive Map](#)

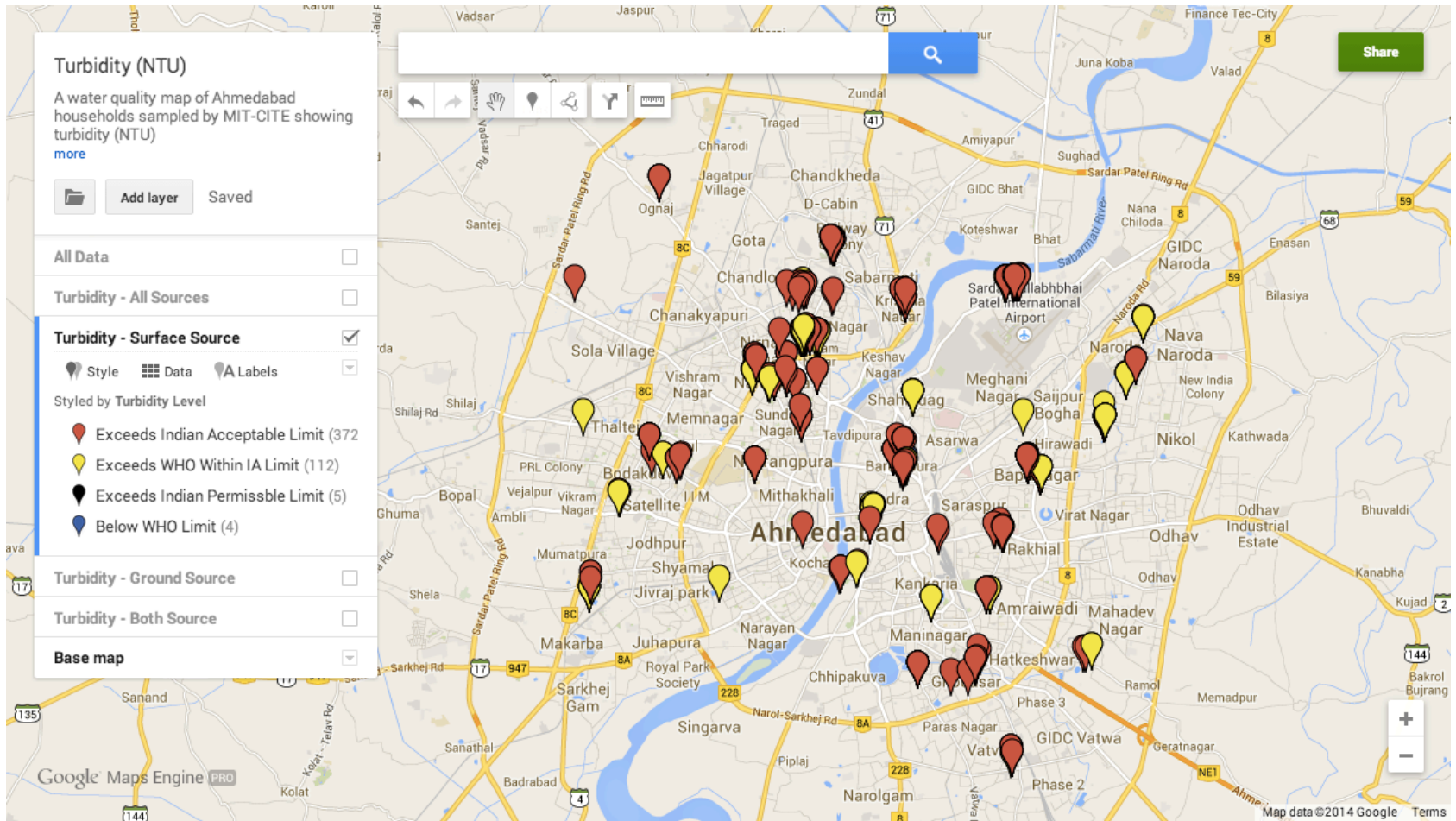
# Turbidity – Results Summary

- Turbidity exceeds Indian Acceptable limit (>1 NTU) in:
  - 81.0% of Surface Water Samples
  - 96.5% of Groundwater Samples
  - 90.5% of Mixed Source Samples

### Turbidity in Ahmedabad Source Waters



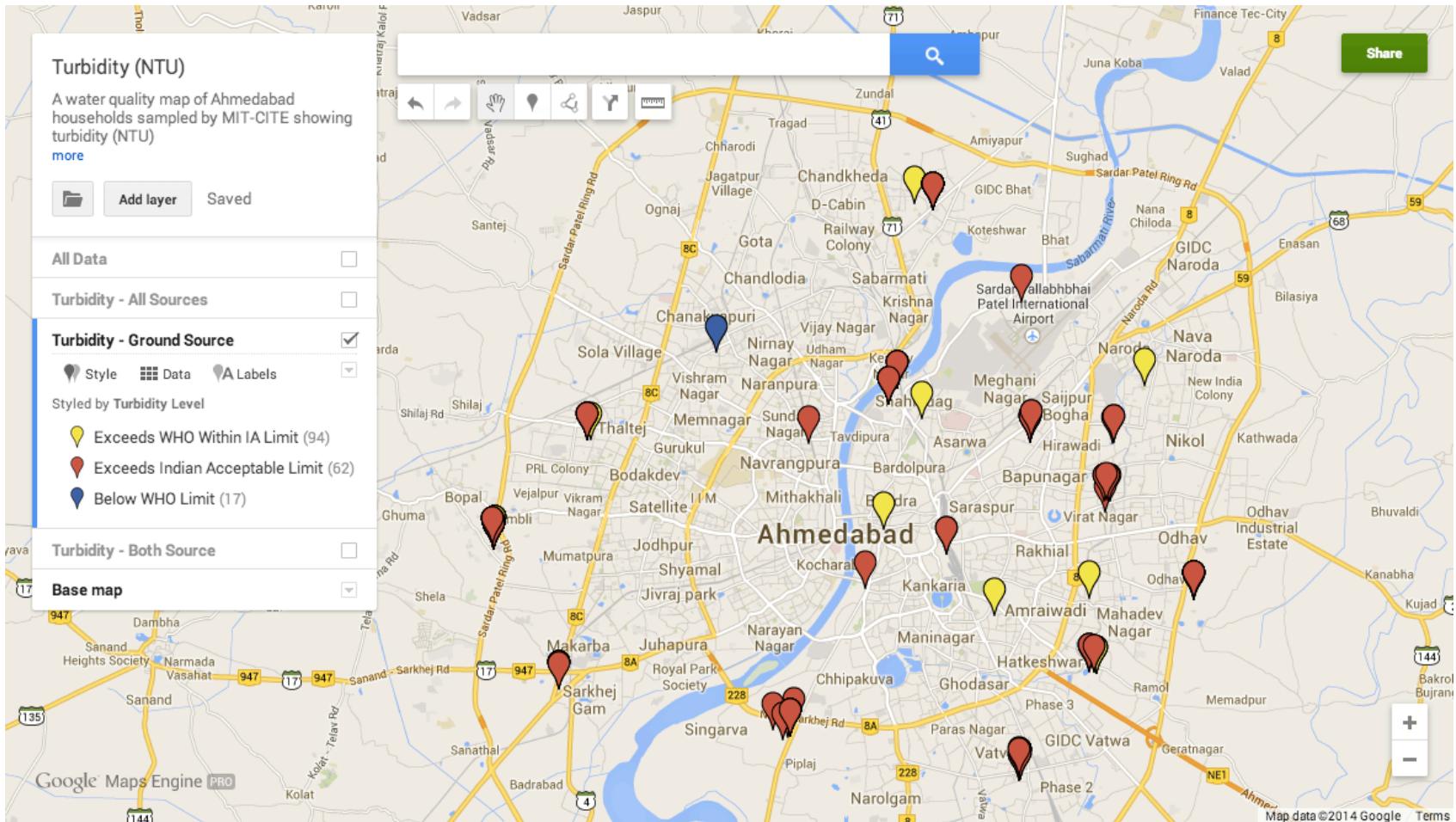
# Turbidity - Surface



[Interactive Map](#)

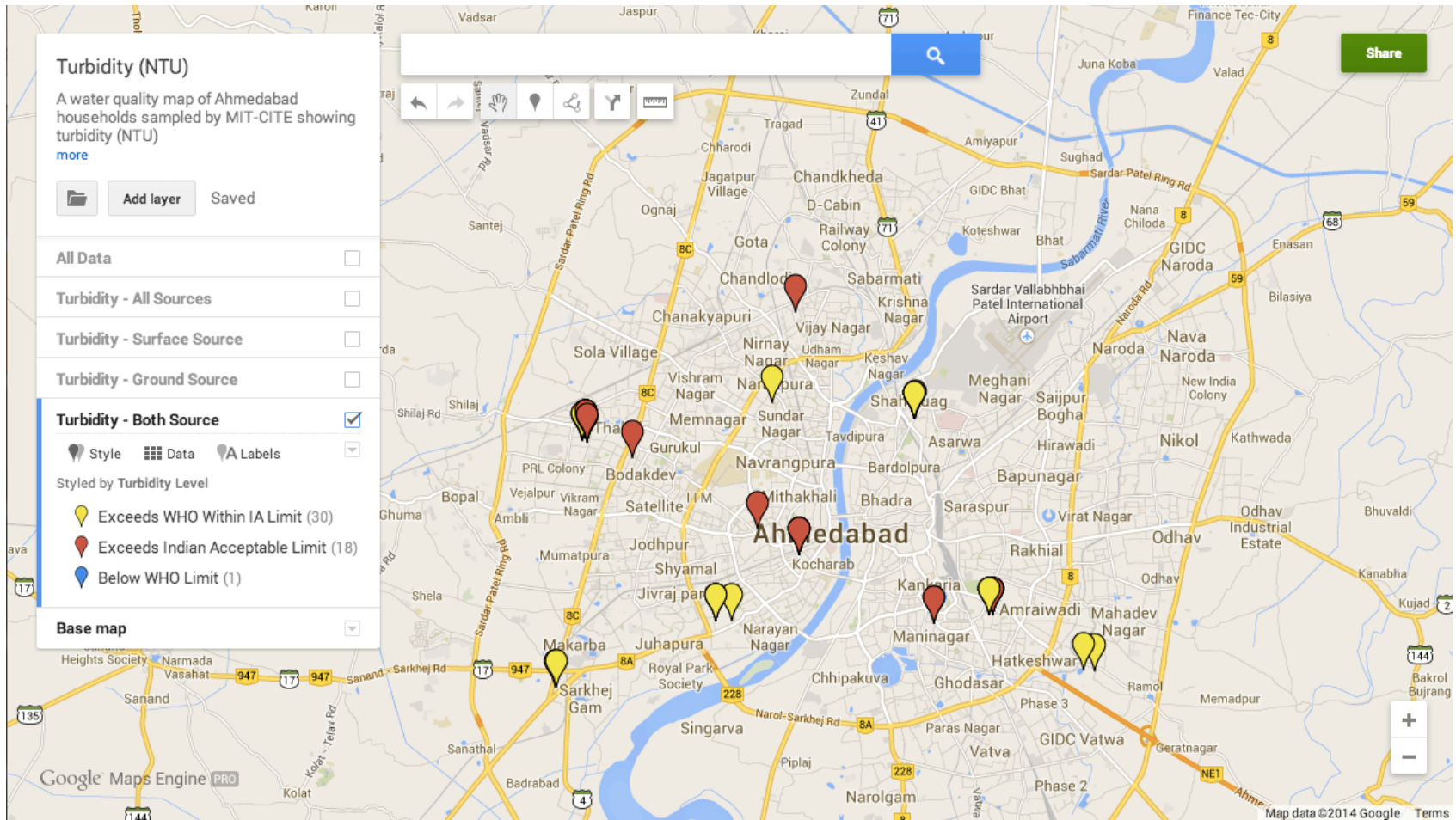


# Turbidity - Ground



[Interactive Map](#)

# Turbidity - Both



[Interactive Map](#)



# Hardness (as CaCO<sub>3</sub>)

- Why measure Hardness?
  - Although the WHO notes hardness is “not of health concern at levels found in drinking-water” (GDWQ) there are Indian Standard acceptable and permissible limits

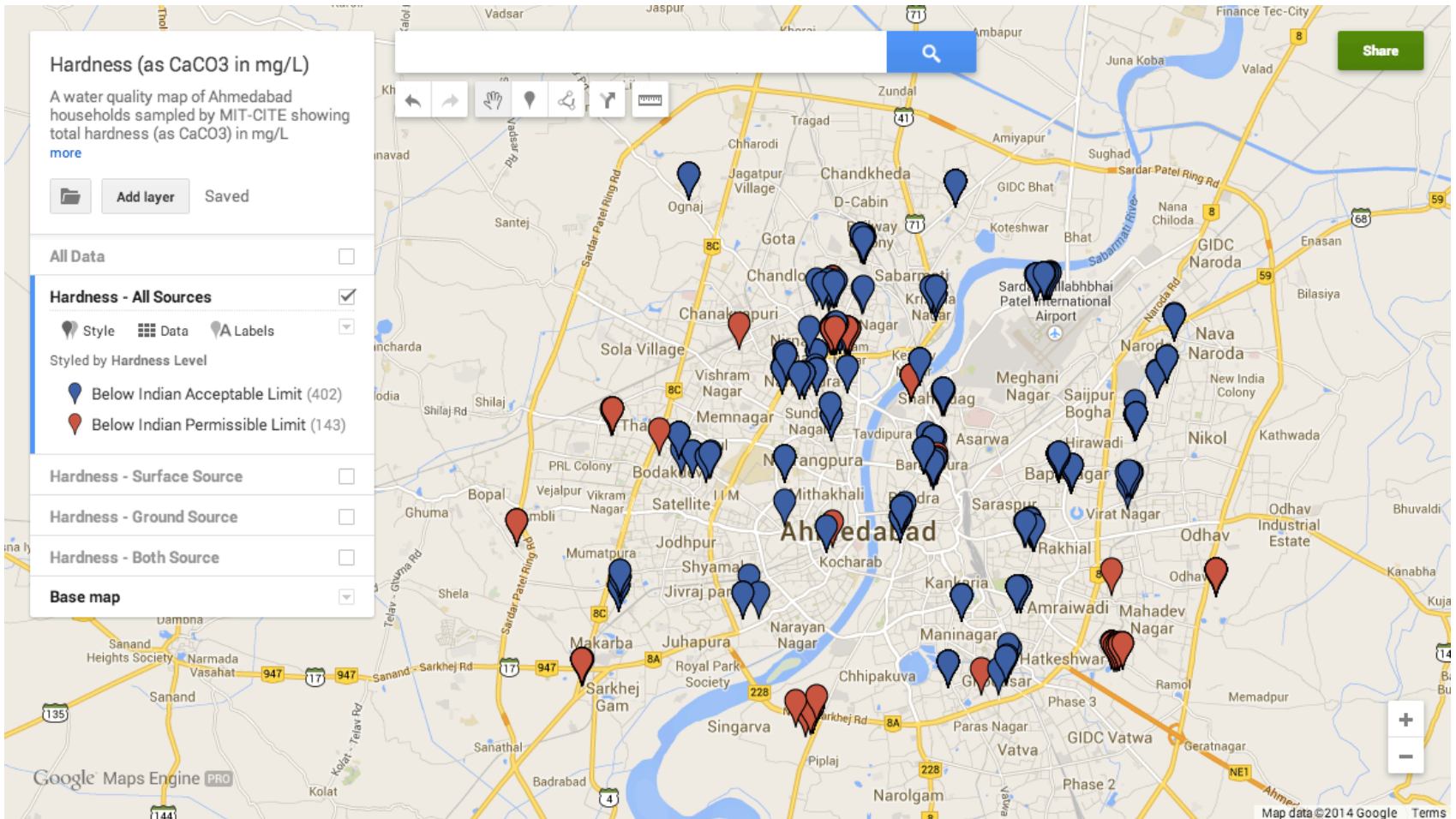
# Hardness Standards

- Indian Standard
  - Acceptable Limit; Maximum: 200 mg CaCO<sub>3</sub>/L
  - Permissible Limit; Maximum: 600 mg CaCO<sub>3</sub>/L
- WHO Guidelines
  - None

# Map Marker Colors

- Blue
  - Below Indian Acceptable limit
- Red
  - Above Indian Acceptable limit, but below Indian Permissible limit

# Hardness – All Sources

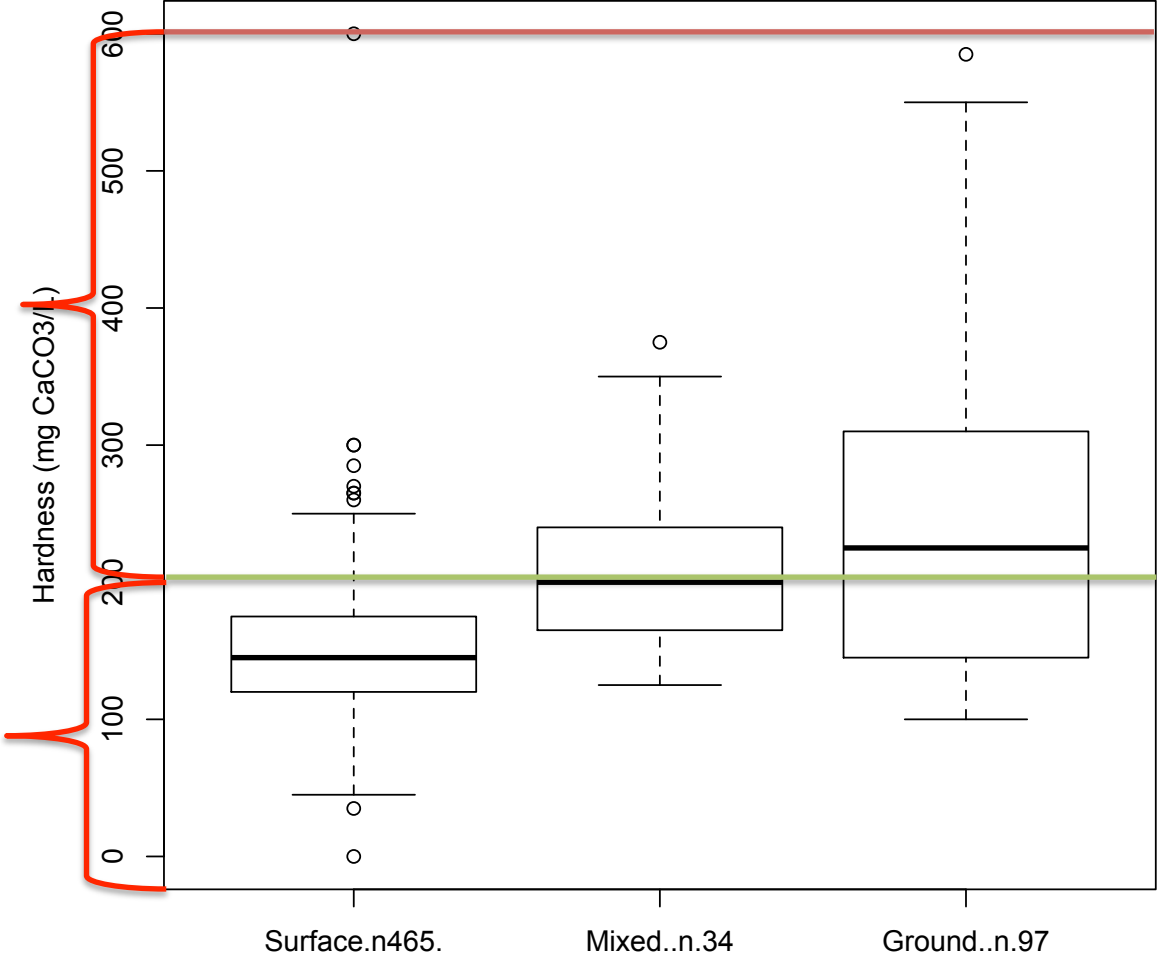


[Interactive Map](#)

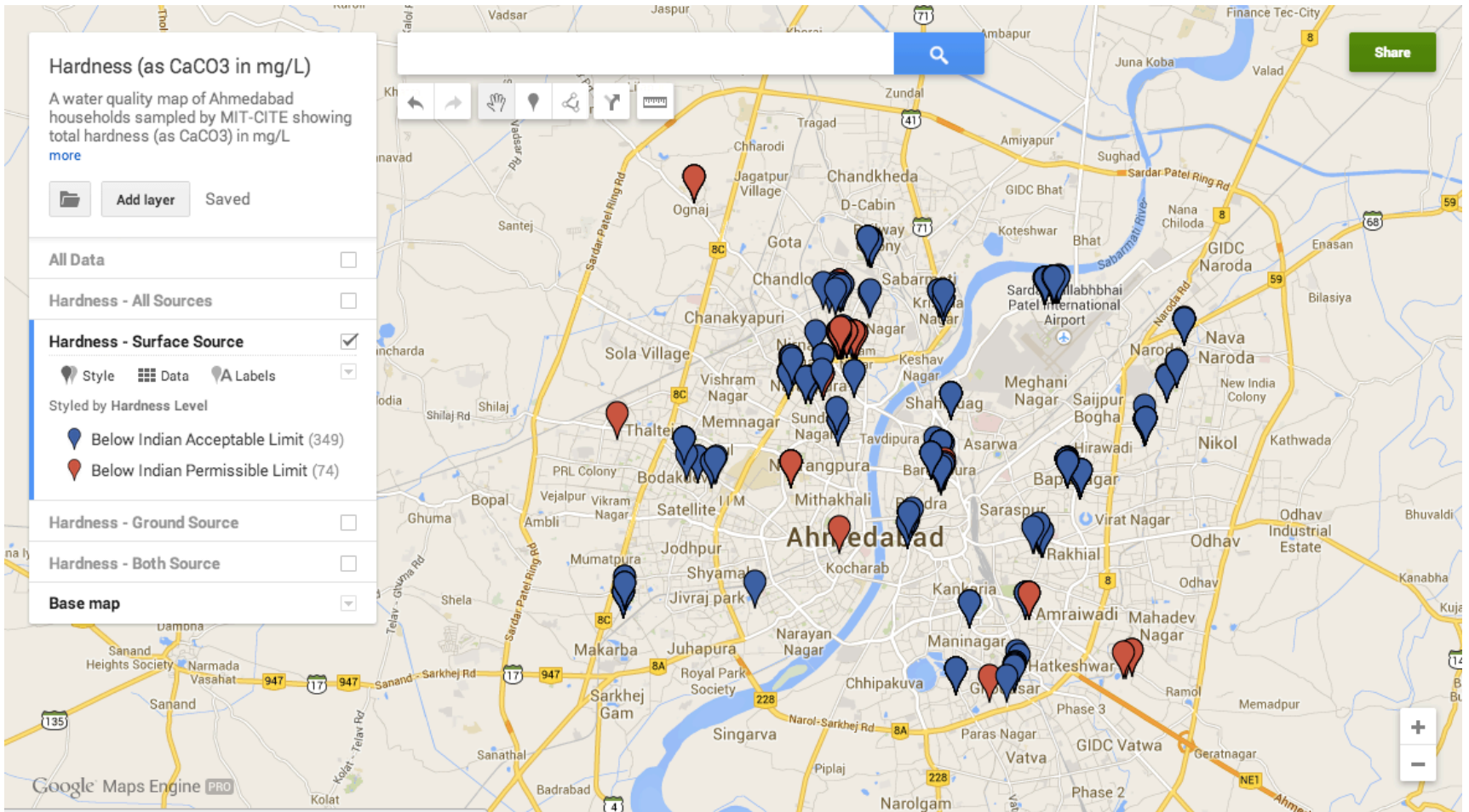
# Hardness – Results Summary

- Results did not meet Indian Standards Acceptable Limit (<200 mg CaCO<sub>3</sub>/L) in:
  - 7 % of Surface Water Samples
  - 58% of Groundwater Samples
  - 43% of Mixed Source Samples
- Note, no samples exceeded the Indian Permissible limit (600 mg CaCO<sub>3</sub>/L)

# Hardness in Ahmedabad Source Waters



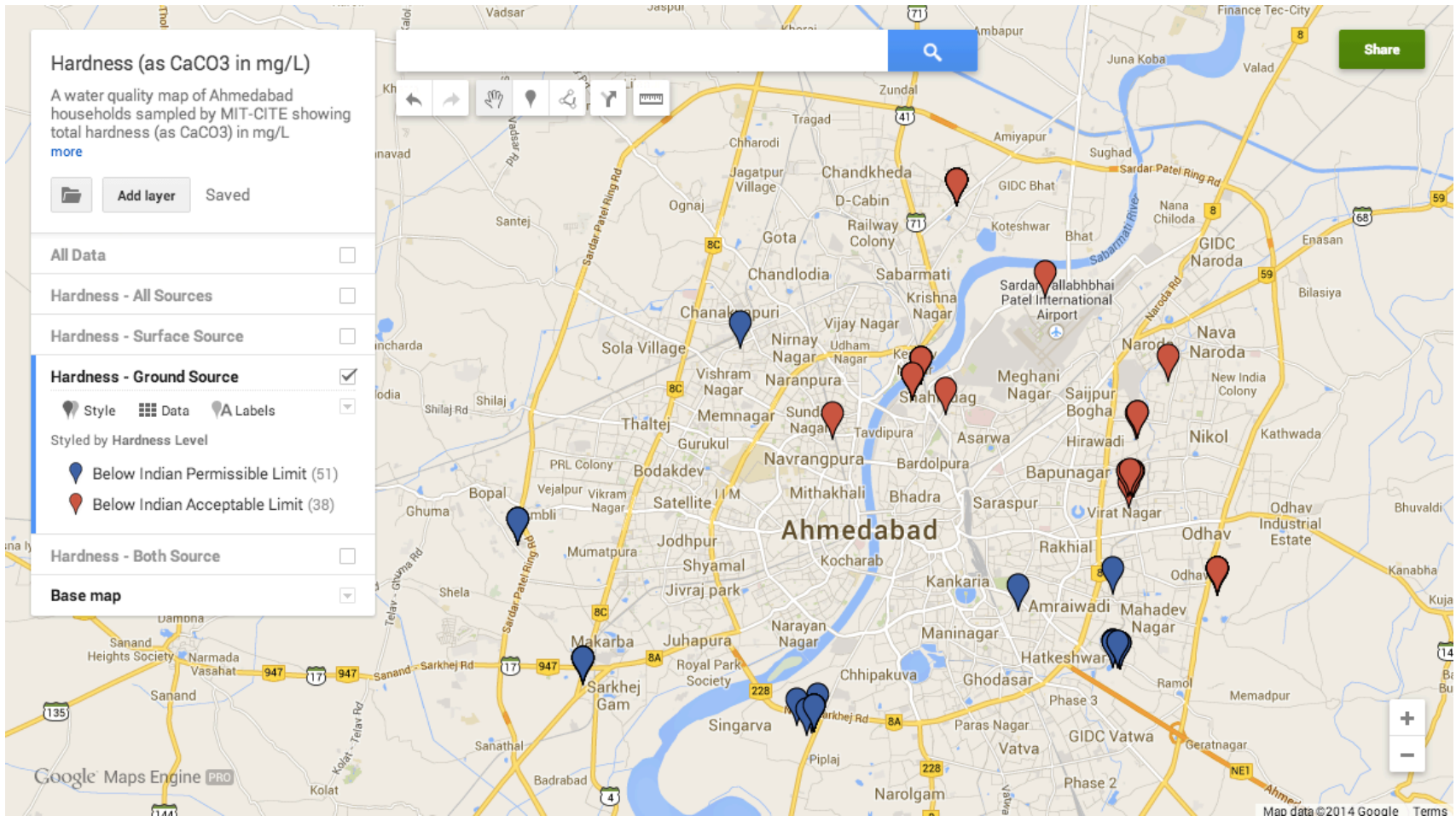
# Hardness - Surface



[Interactive Map](#)



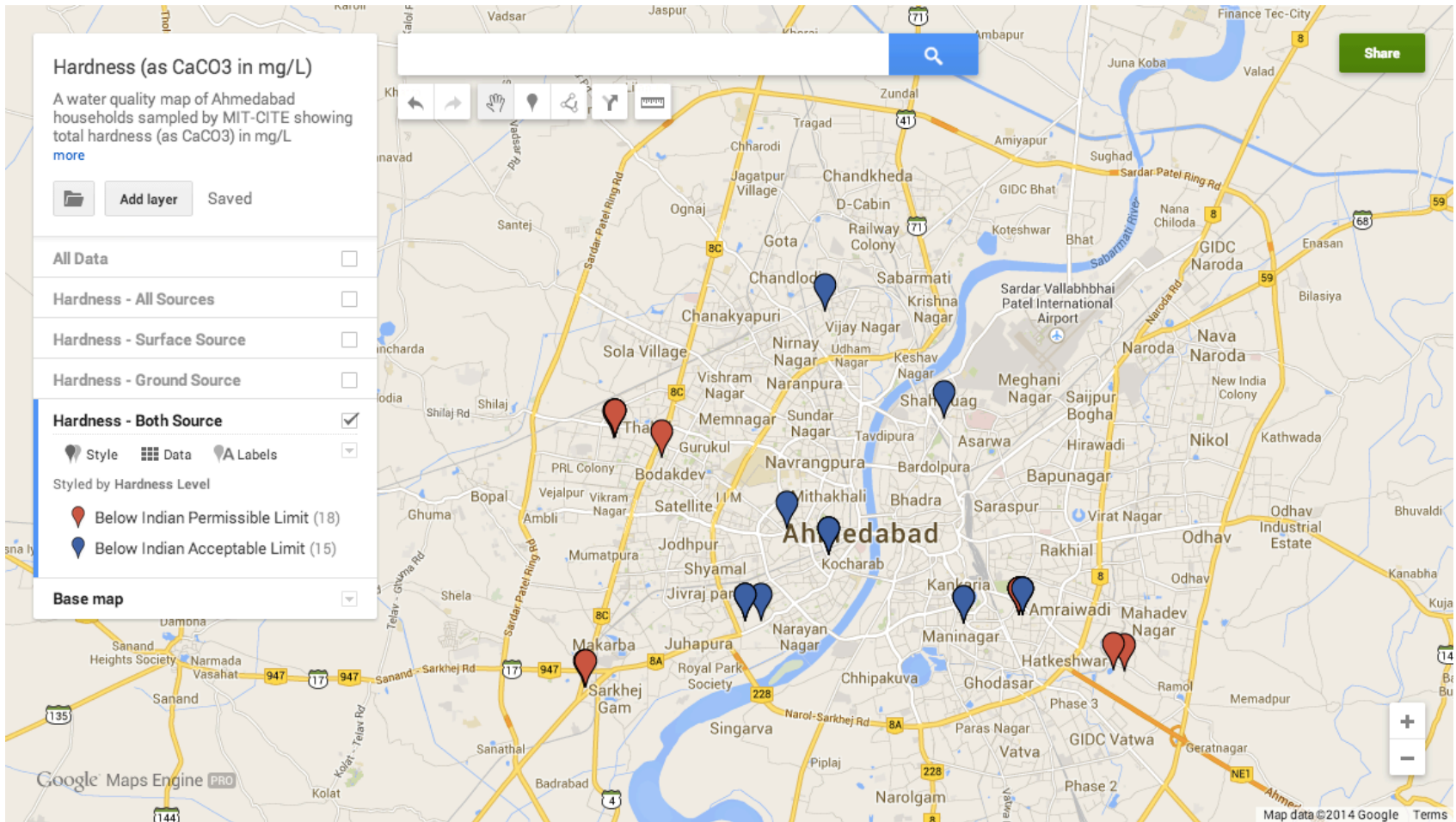
# Hardness - Ground



[Interactive Map](#)



# Hardness - Both



[Interactive Map](#)

# TDS (mg/L)

- Why measure TDS?
  - “TDS in drinking-water originates from natural sources, sewage, urban runoff and industrial wastewater” (GDWQ)

# TDS Standards

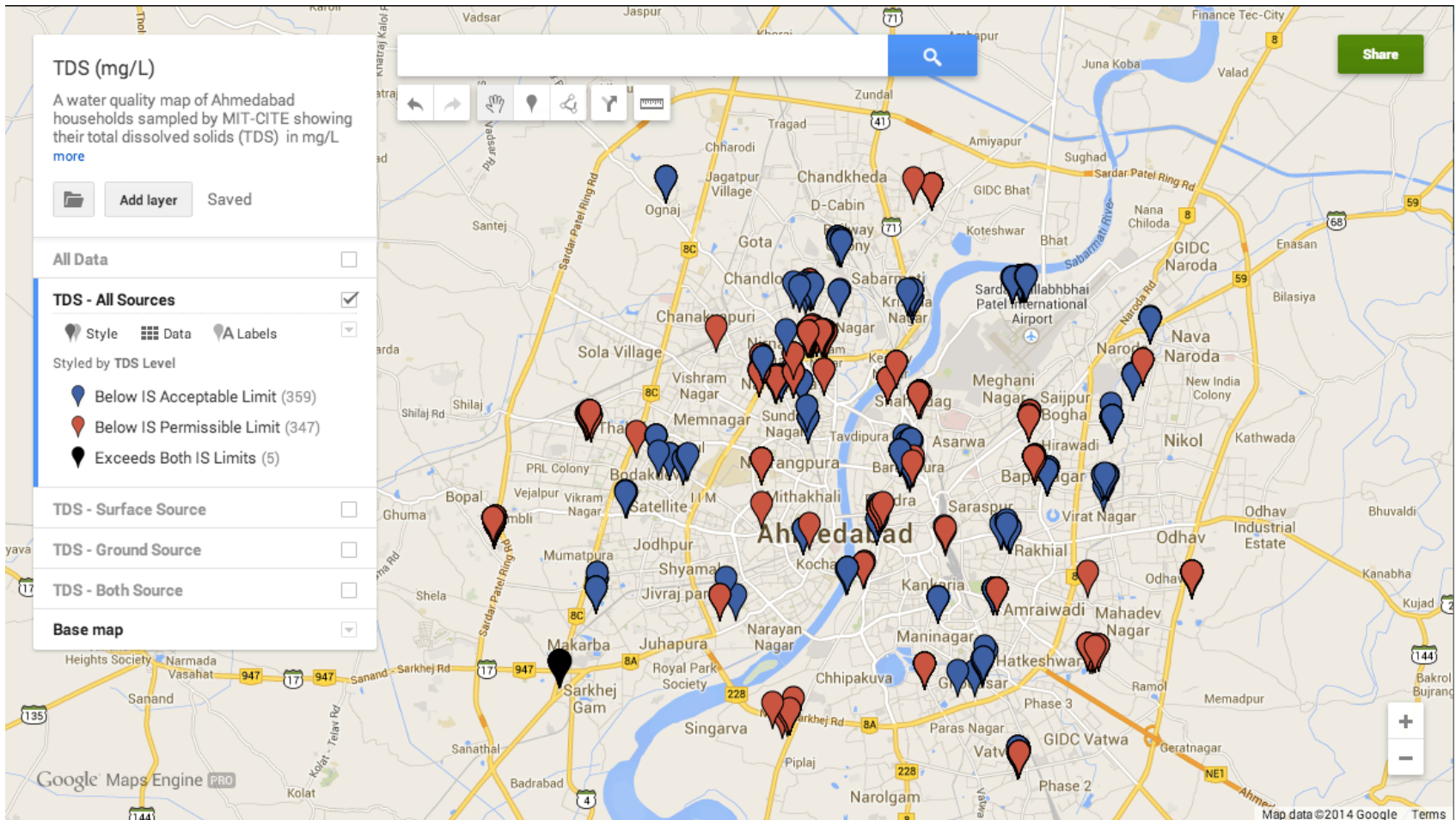
Turbidity

- Indian Standard
  - Acceptable Limit; Maximum: 500 mg/L
  - Permissible Limit; Maximum: 2000 mg/L
- WHO Guidelines
  - None

# Map Marker Colors

- Blue
  - Below Indian Acceptable limit
- Red
  - Above Indian Acceptable limit, but below Indian Permissible limit
- Black
  - Above Indian Permissible limit

# TDS – All Sources

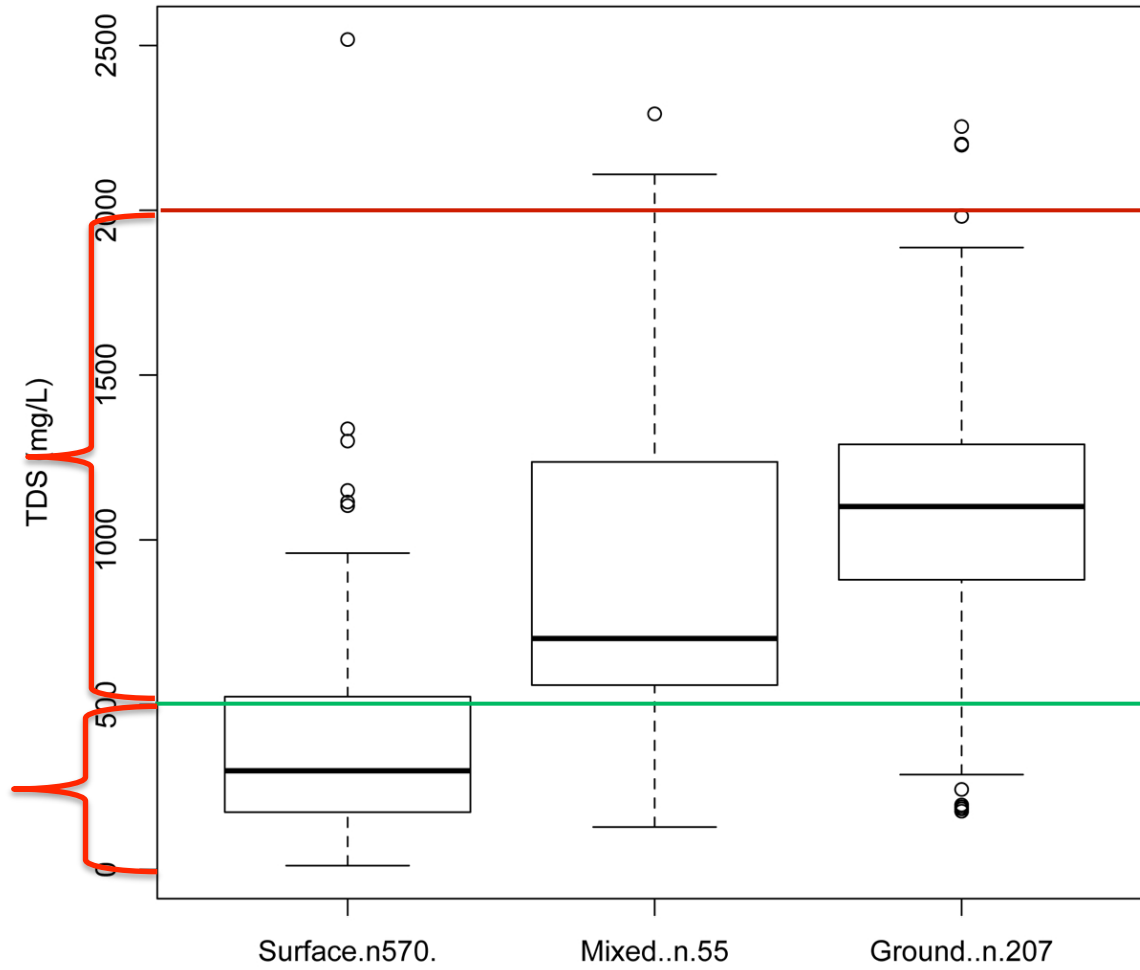


[Interactive Map](#)

# TDS – Results Summary

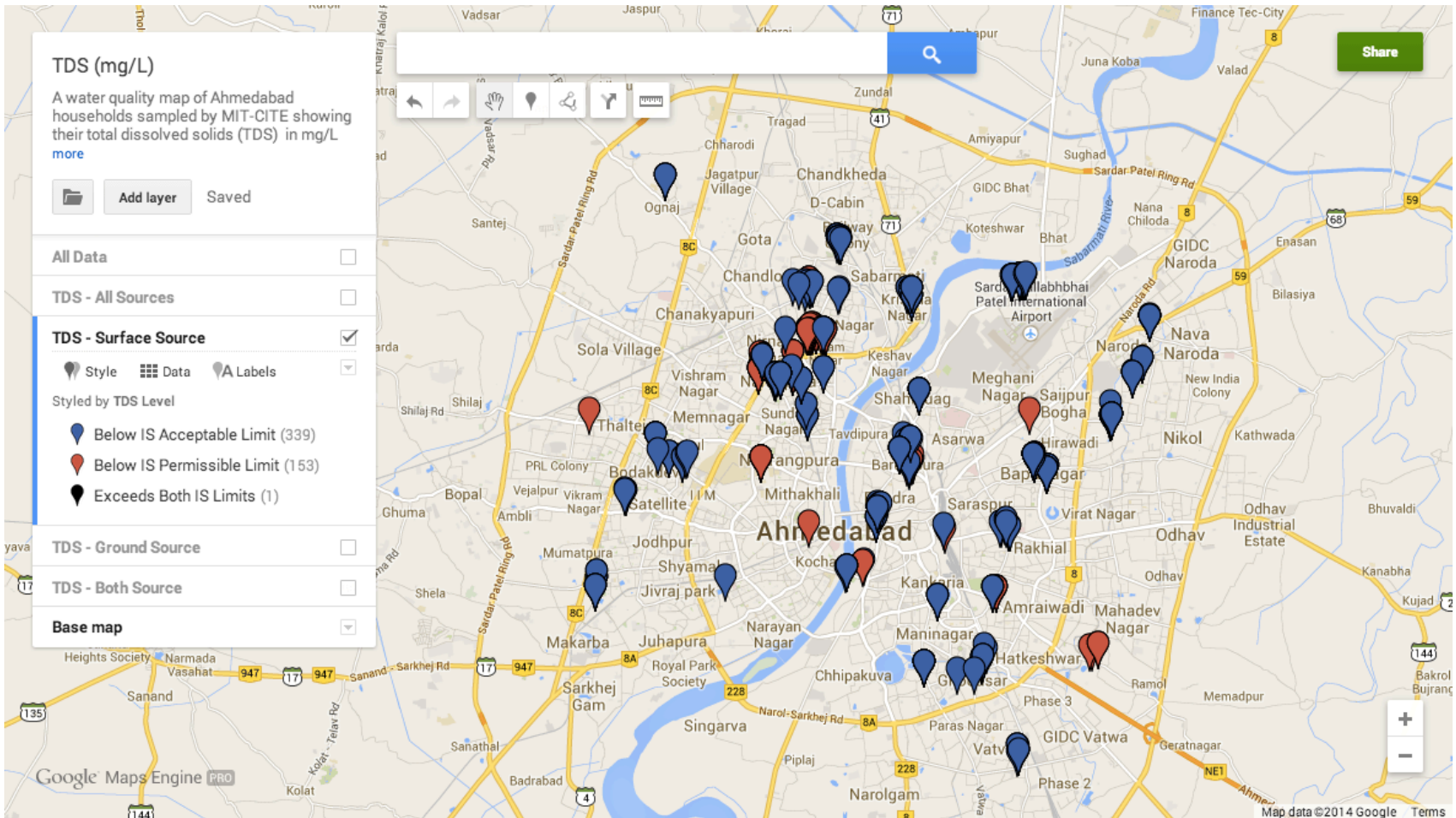
- Results did not meet the Indian Standard Acceptable Limit of TDS (<500 mg/L) in:
  - 31% of Surface Water Samples
  - 94% of Groundwater Samples
  - 80% of Mixed Waters Samples

### TDS in Ahmedabad Source Waters





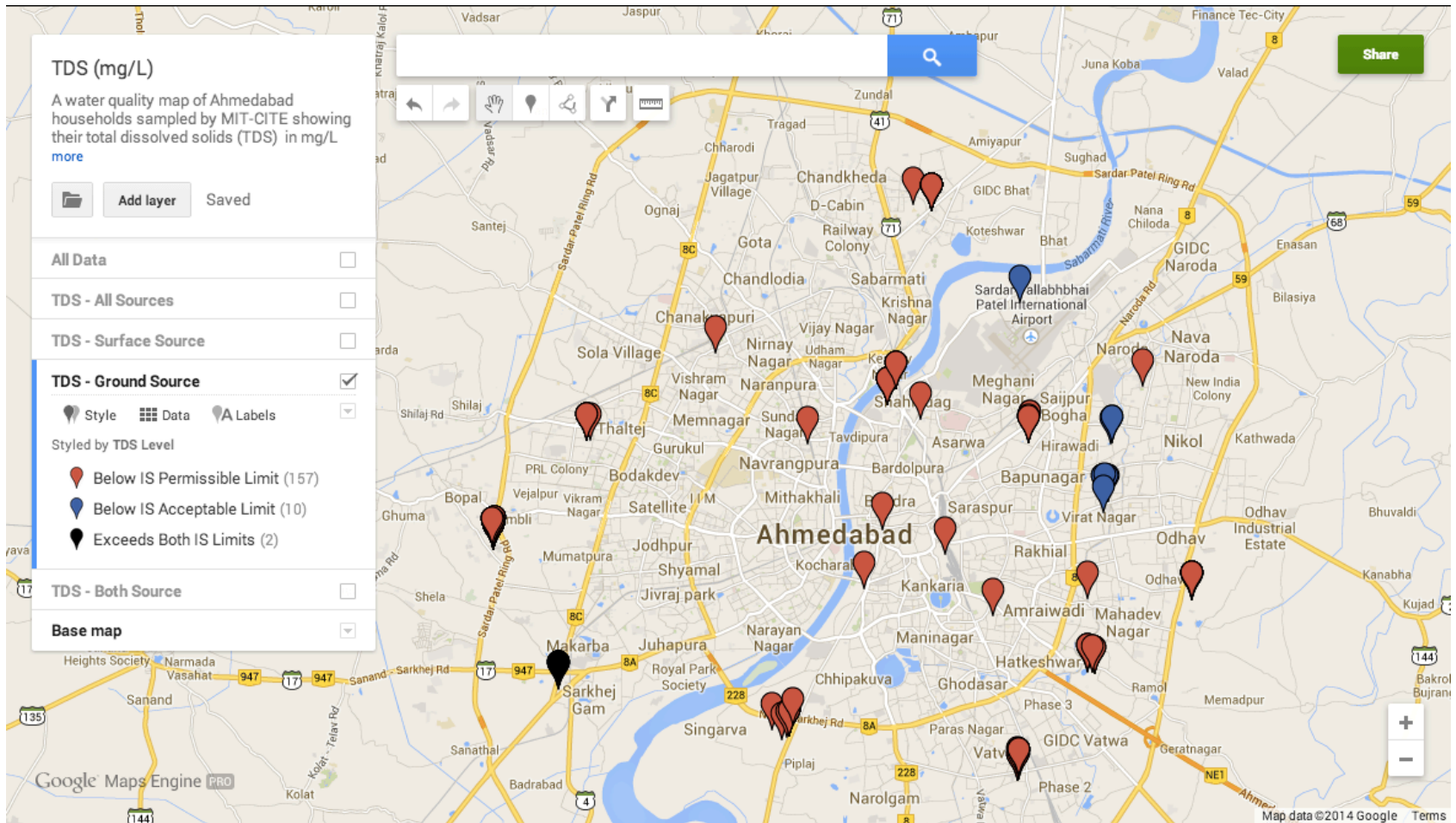
# TDS - Surface



[Interactive Map](#)

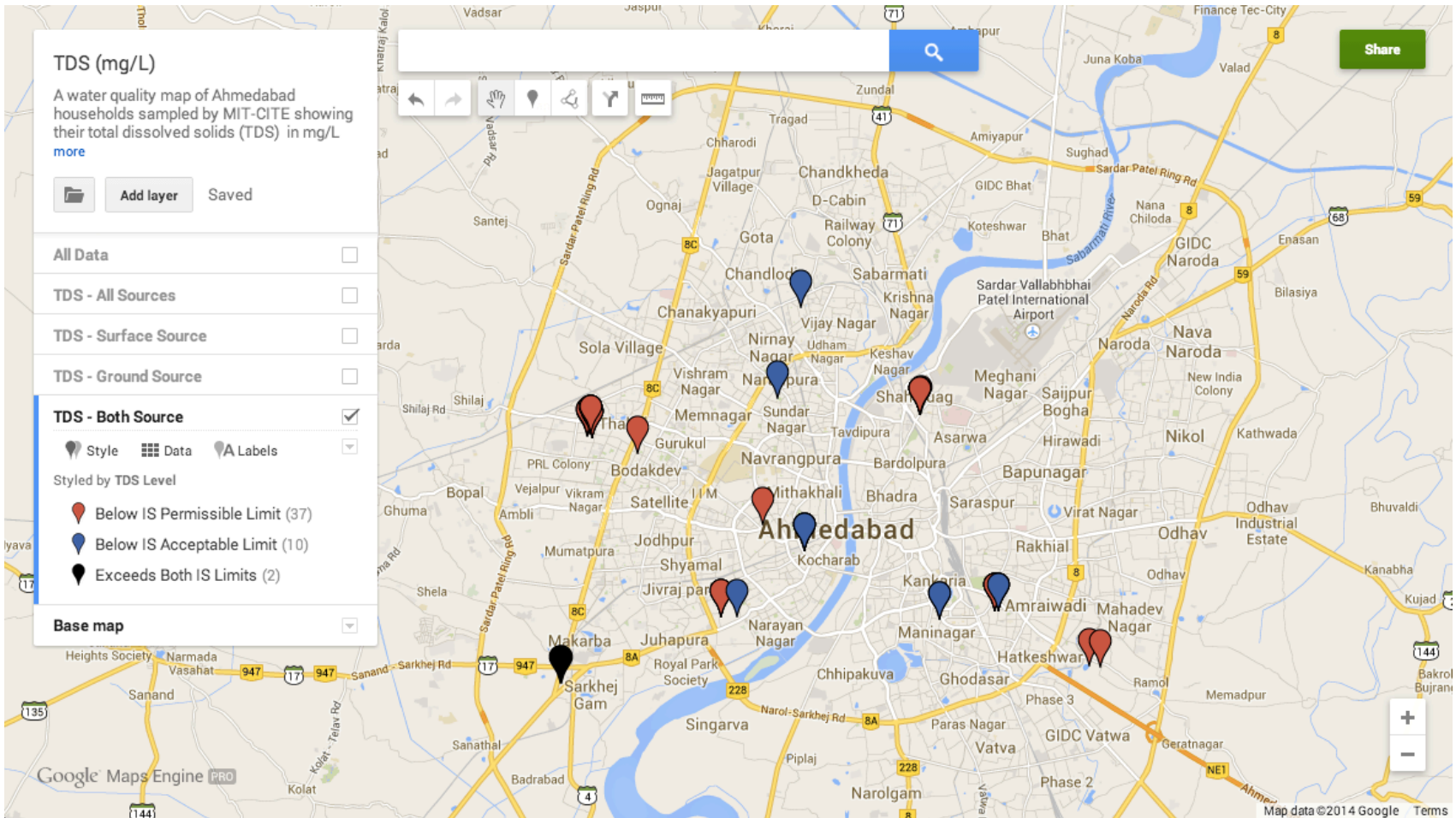


# TDS - Ground



[Interactive Map](#)

# TDS - Both



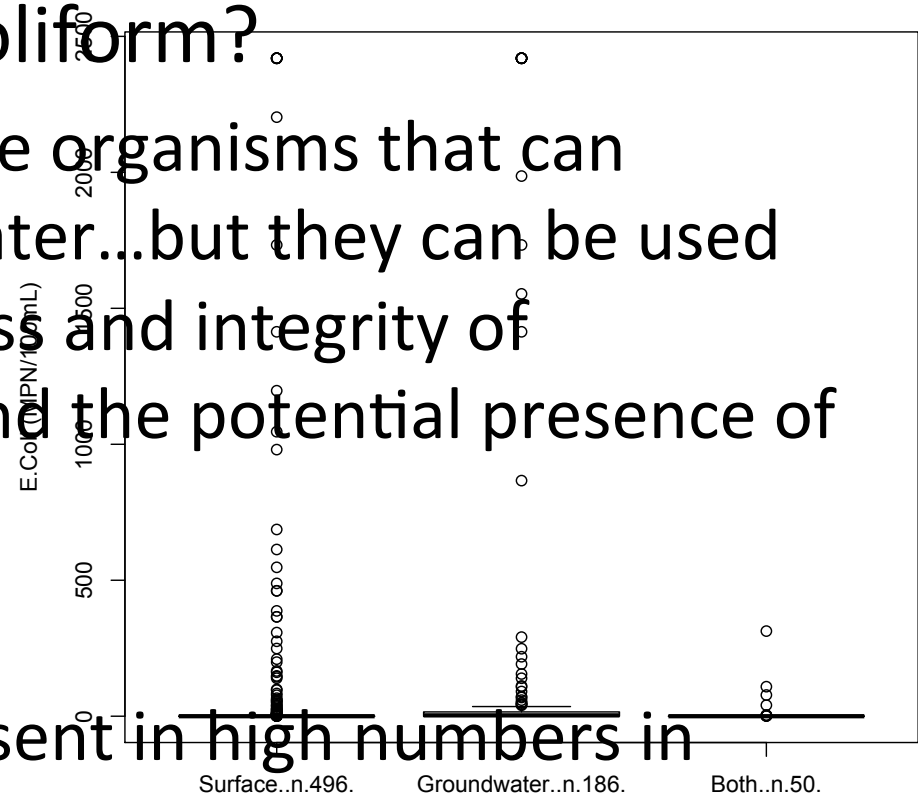
[Interactive Map](#)

# Total Coliform (MPN) and *E.coli* (MPN)

Total Coliform

*E. Coli*

- Why measure Total Coliform?
  - “Total coliforms include organisms that can survive and grow in water...but they can be used to assess the cleanliness and integrity of distribution systems and the potential presence of biofilms” (GDWQ)
- Why measure *E.coli*?
  - “*Escherichia coli* is present in high numbers in human and animal faeces” (GDWQ)



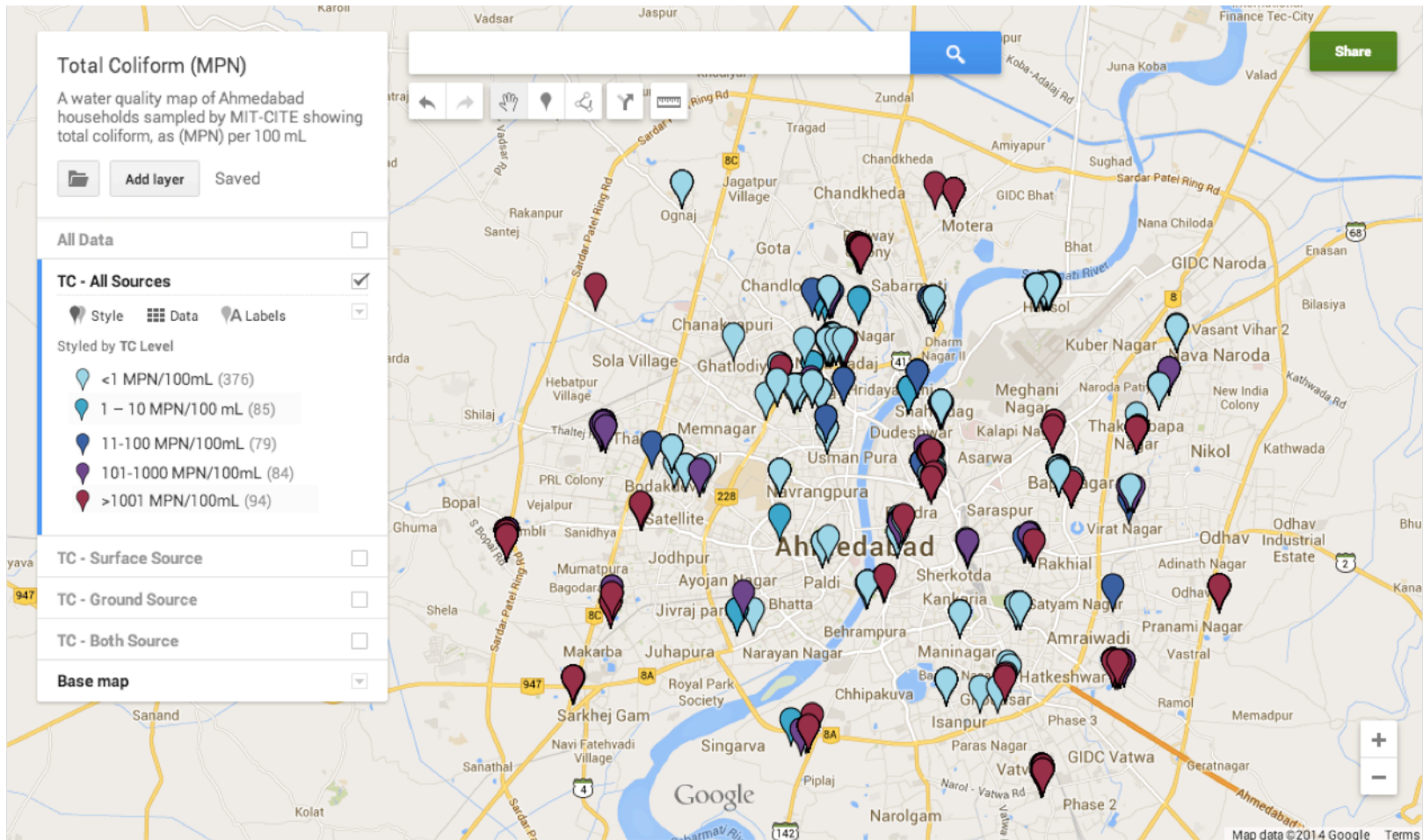
# Total Coliform and *E.coli* Standards

- Indian Standard
  - Maximum: zero (0 MPN/100 mL)
- WHO Guidelines
  - Maximum: zero (0 MPN /100 mL)

# Map Marker Colors

- Spectrum: light blue to maroon
  - Where light blue is low to no bacteria (<1 MPN/100mL) and maroon is very high (>1000 MPN/100mL)

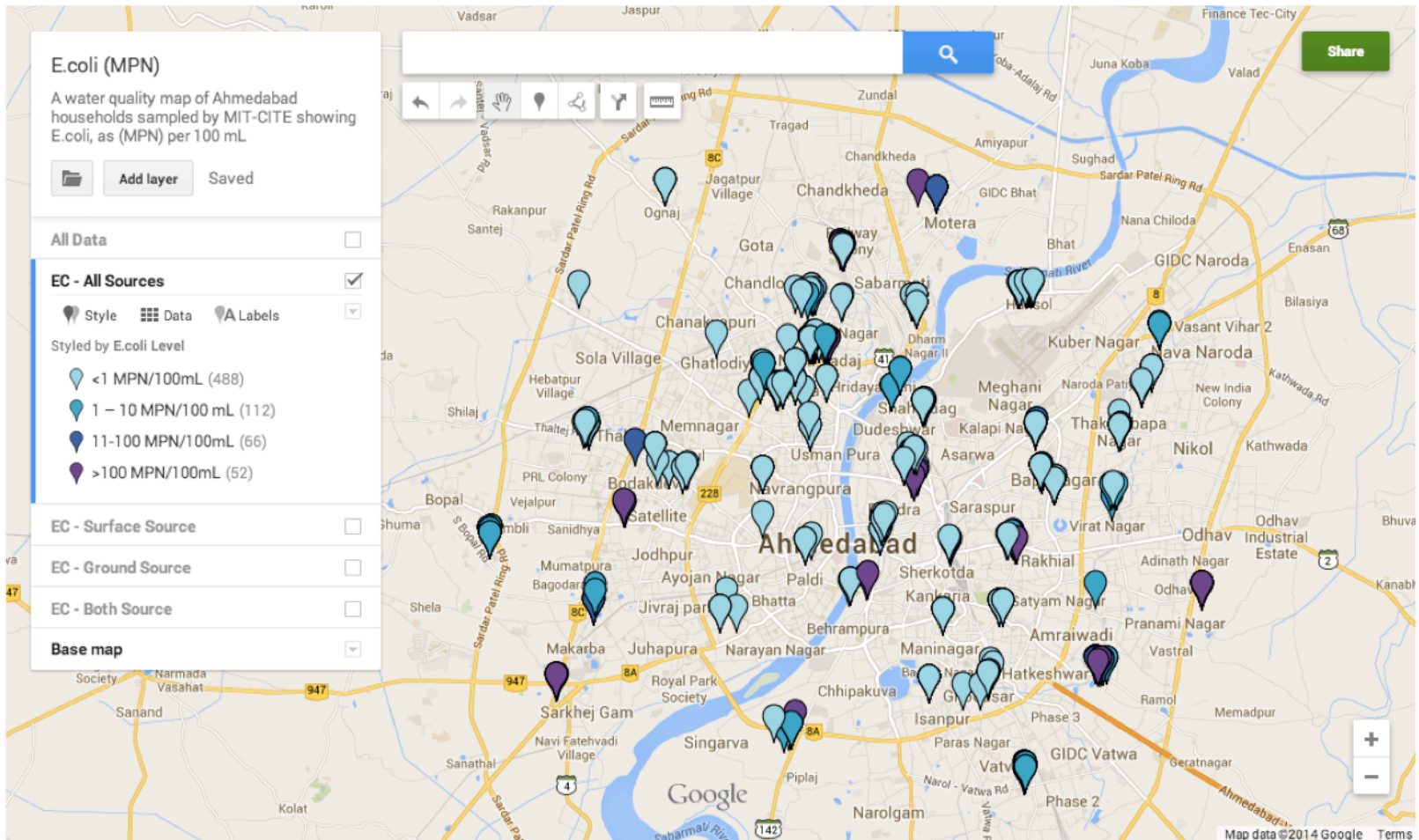
# Total Coliform – All Sources



[Interactive Map](#)



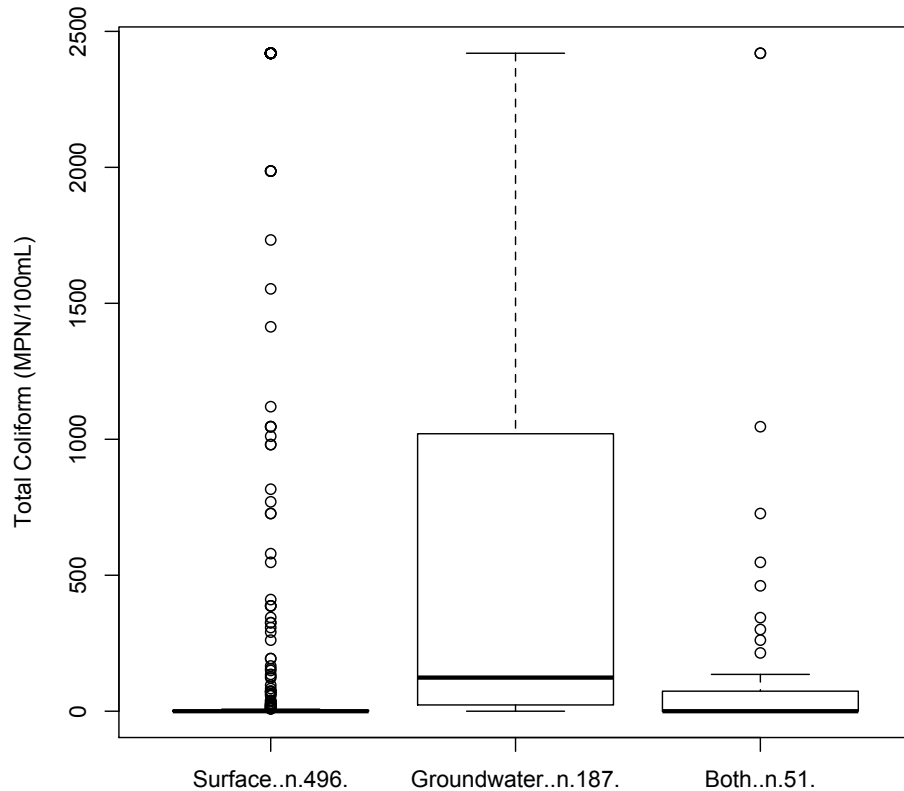
# *E.coli* - All Sources



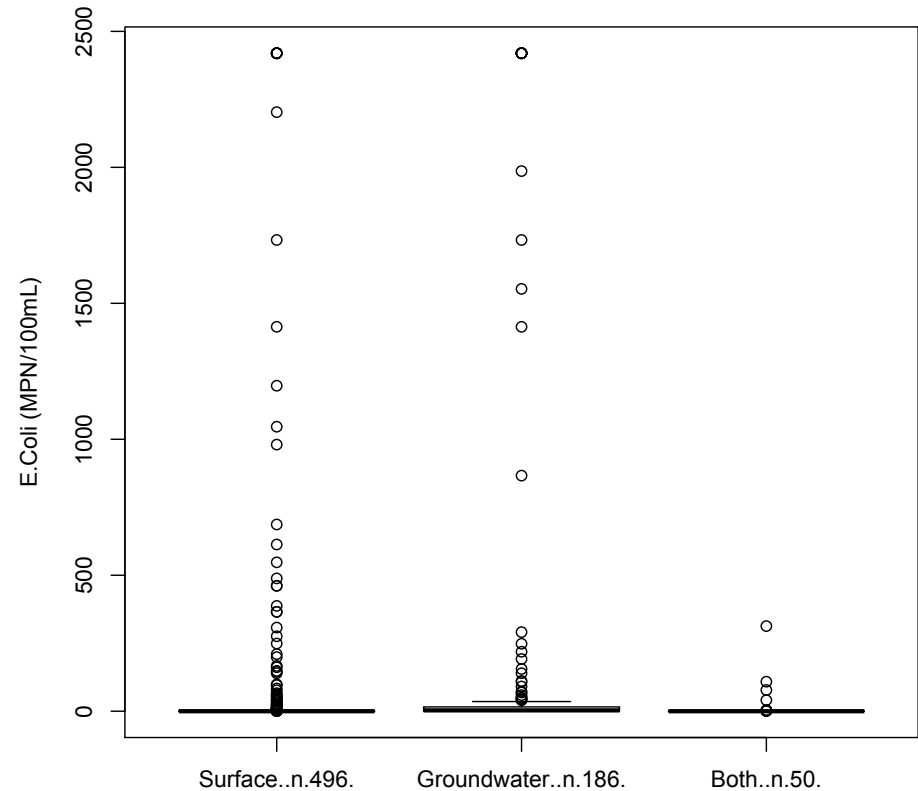
[Interactive Map](#)

# Total Coliform and *E.coli* - Summary

## Total Coliform



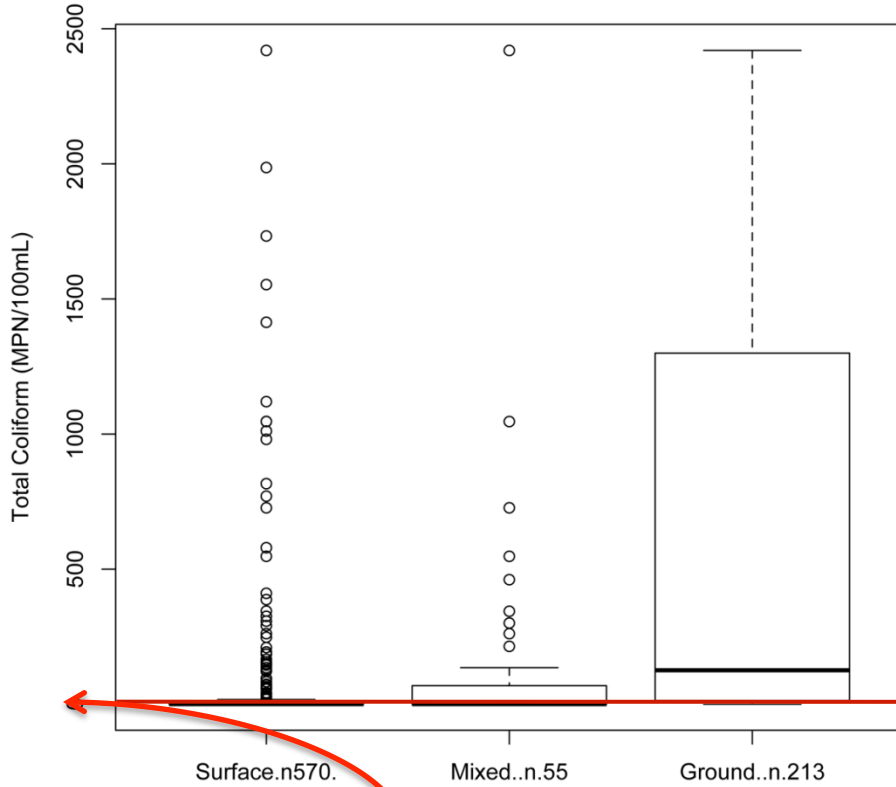
## *E. Coli*



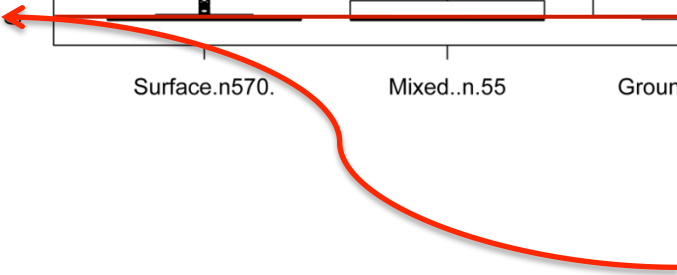
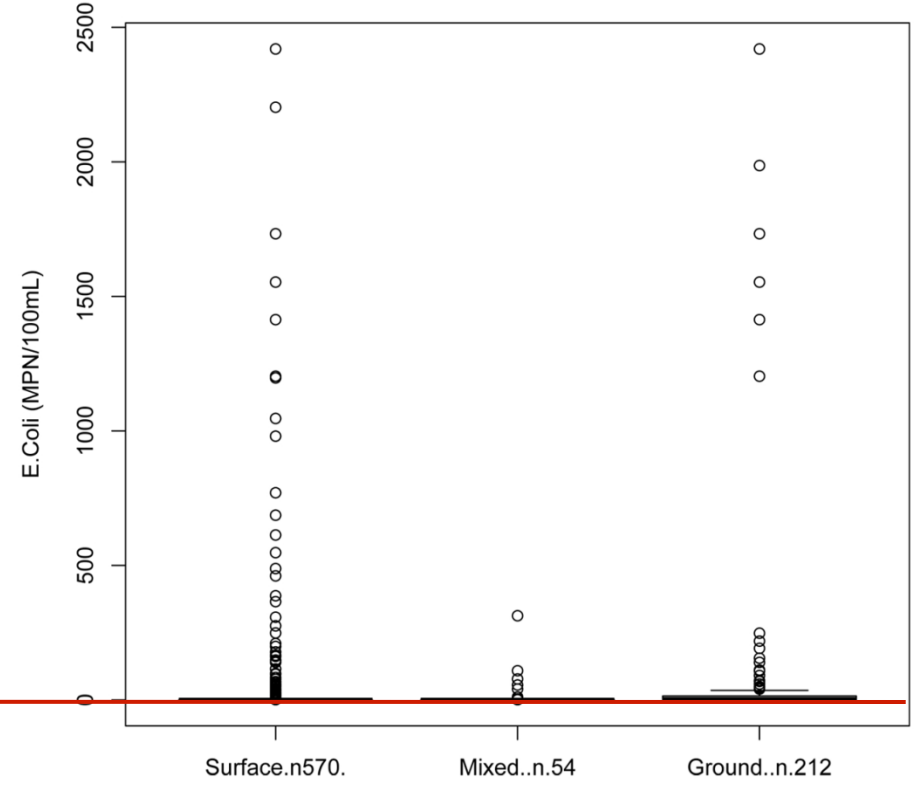
- Total coliform is present in almost 50% of samples and *E.coli* in 32% of samples
- Surface water (municipally treated water from the Narmada Canal) is less likely to be contaminated with total coliform and *E.coli* than groundwater, which is typically contaminated with both.



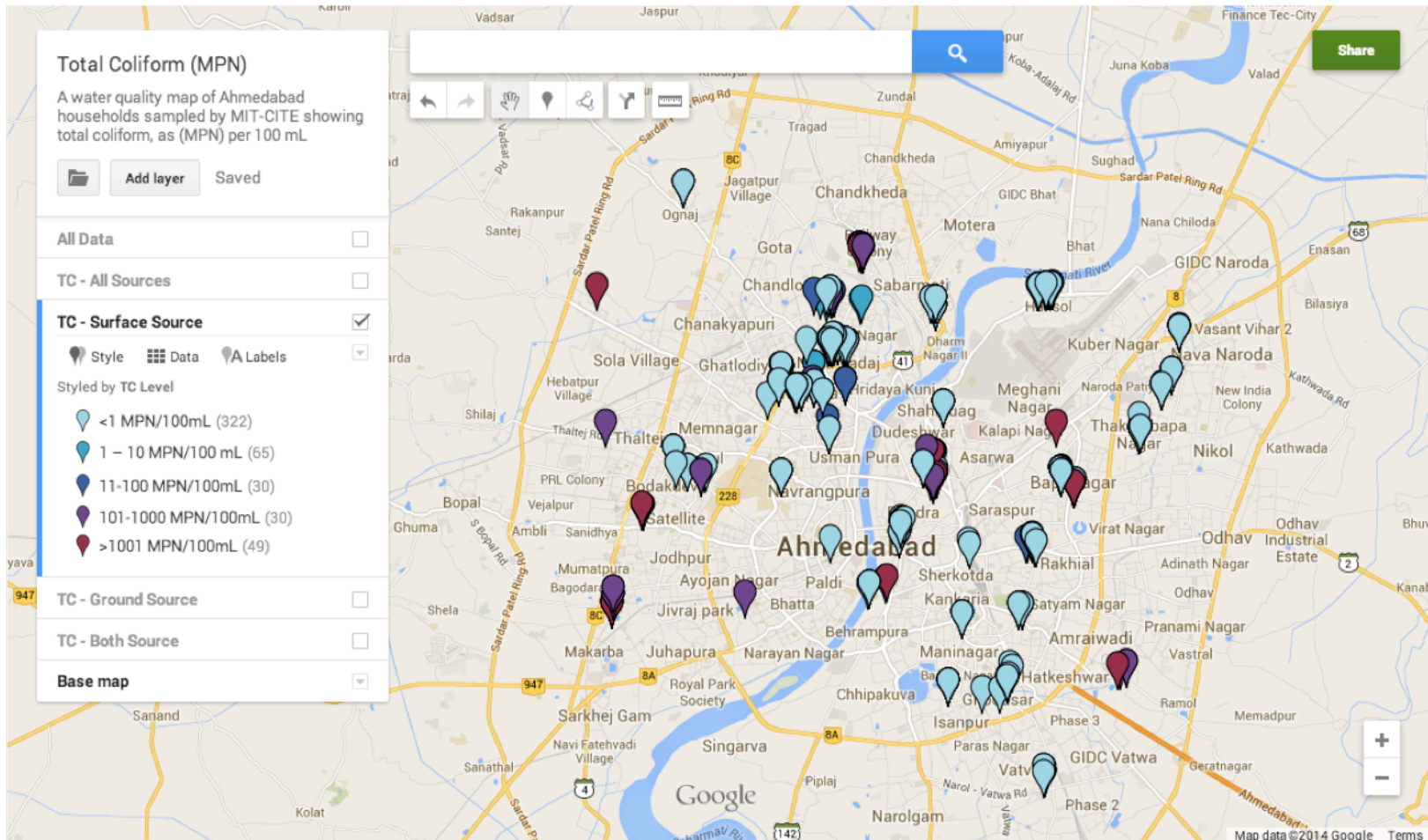
**Total Coliform in Ahmedabad Source Waters**



**E.Coli in Ahmedabad Source Waters**

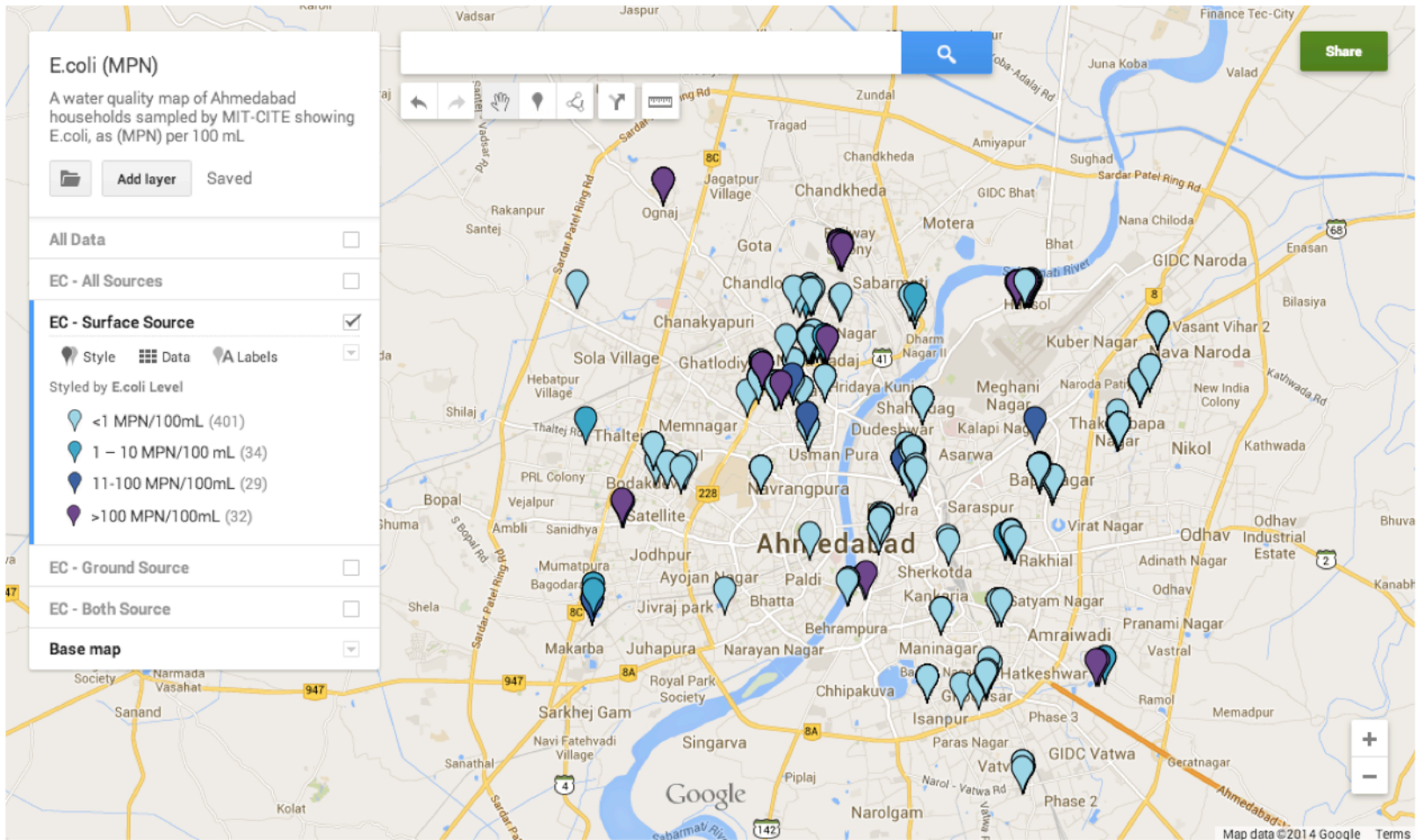


# Total Coliform - Surface



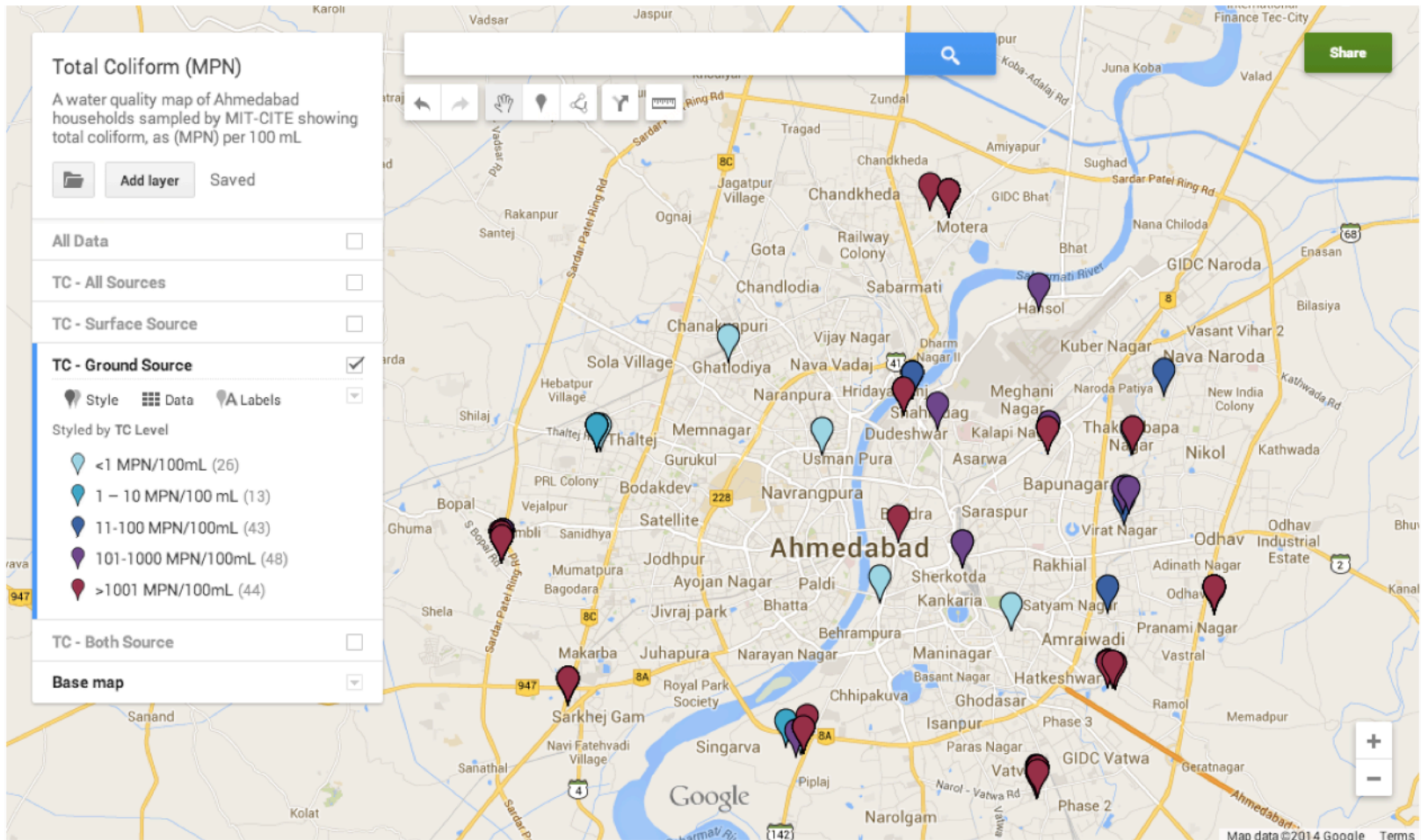
[Interactive Map](#)

# E.Coli - Surface



[Interactive Map](#)

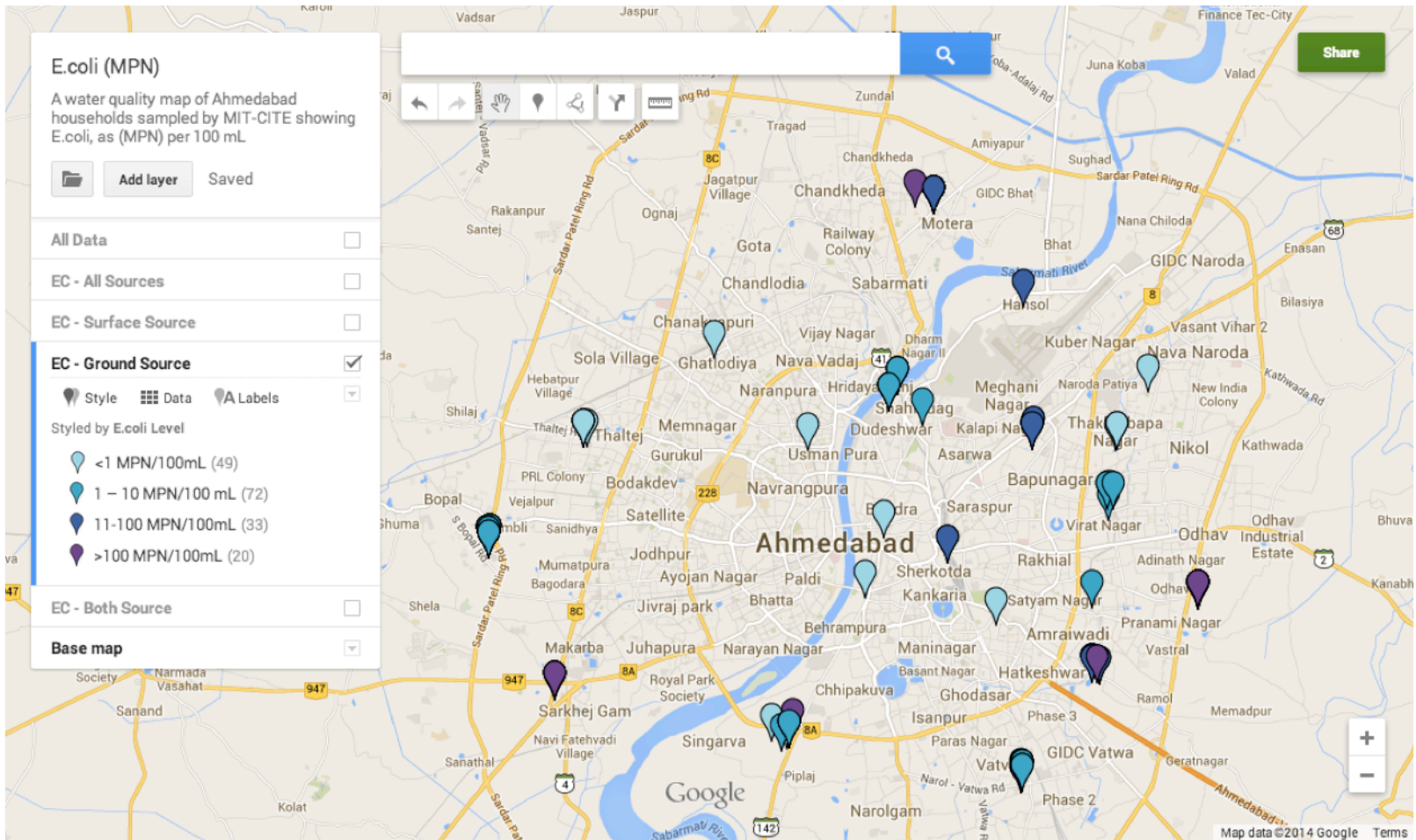
# Total Coliform - Ground



[Interactive Map](#)

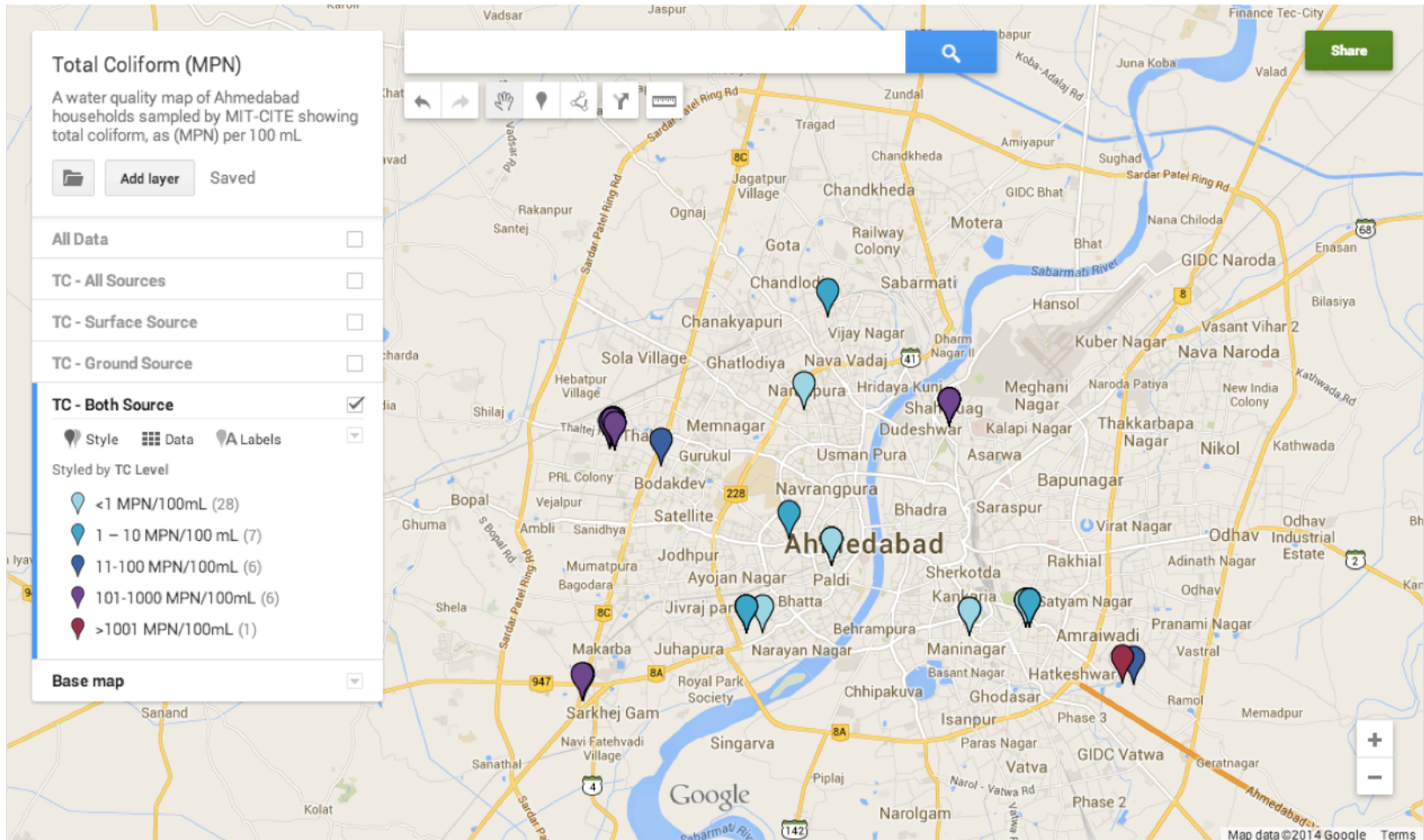


# E.Coli - Ground



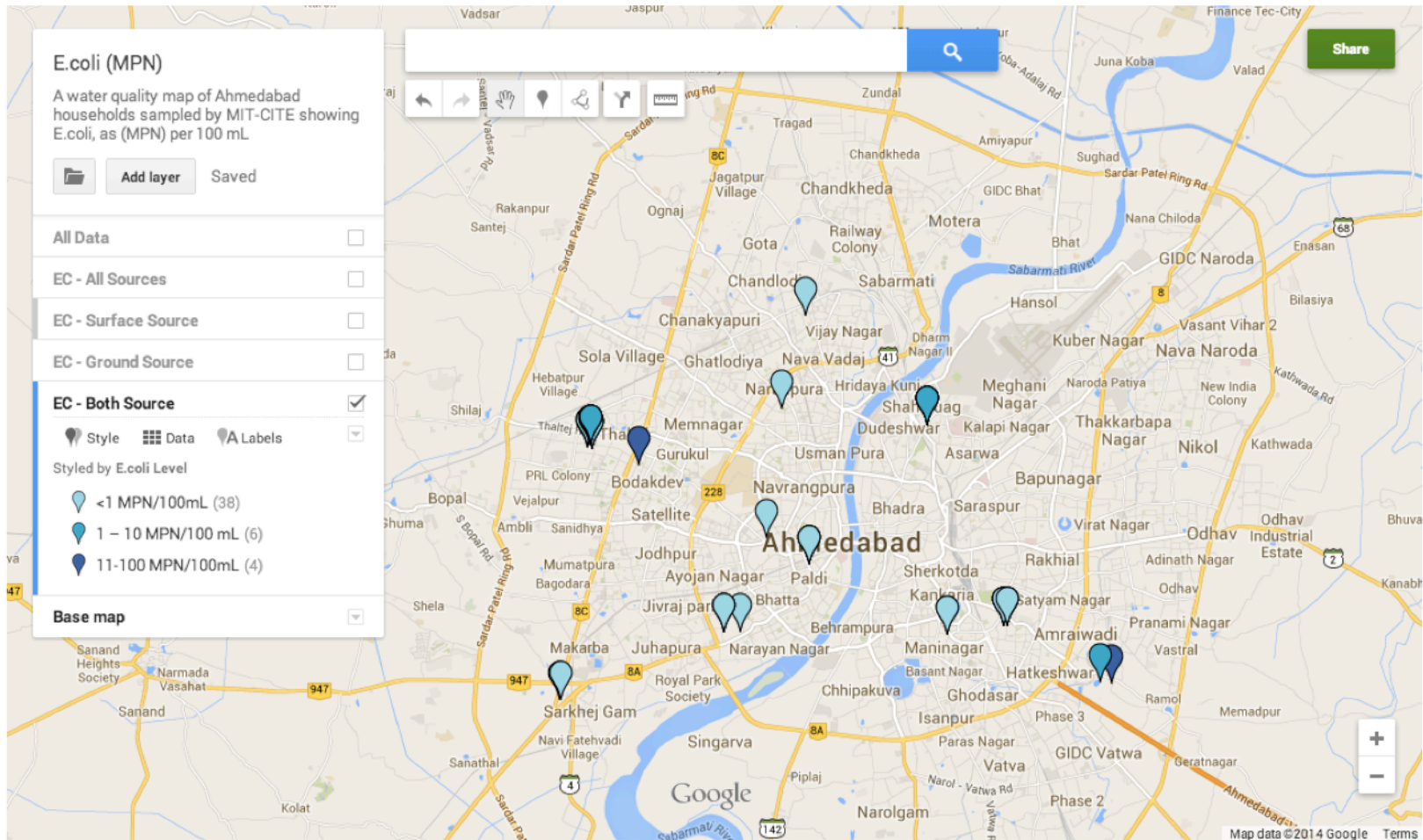
[Interactive Map](#)

# Total Coliform - Both



[Interactive Map](#)

# E.Coli - Both



[Interactive Map](#)

# Suitability – India Field Team Members

## MIT Team Members:

Susan Murcott  
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Vihar Parikh  
Jenny Tanphanich  
Tamanna Urmi  
Teng Ke Wong

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## India Team Members

All India Disaster Mitigation Institute (AIDMI): Mihir Bhatt

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TERI-Delhi: Chander Singh, Sonal Bindal, Nidhi Jha.

Ahmedabad University: Mitaxi Mehta, Saumil Shah, Surbhi Mistry, Jalangi Shah, Netra Pathak, Mohana Saraf, Anand Kotadiya, Vishvesh Busa .

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# References

- WHO. Guidelines for Drinking Water Quality, 4<sup>th</sup> Edition. Geneva, 2011.