Understanding the Flint water crisis

- Forensic policy analysis
- Reconciling policy theories
- Identifying potential solutions

Institutional failure

- Sound governance
- Independent regulation
- Public science
Timeline: institutional decision analysis (first cut)
Flint as institutional failure

- **Failing the letter and the spirit of the law**
  - Implications of institutional failure
  - Beyond Michigan, Flint, and infrastructure
  - Other challenges and crises

- **Policy process**
  - Federalism and role clarity
  - Fiscal austerity at all levels
  - Politicization and partisanship

- **Decision-making process**
  - Culture and commitment
  - Information and procedures
  - Judgment and empowerment

- **Regulatory process**
  - Compliance
  - Enforcement
  - Response
Contributing and interactive factors

- Professionalsupport
- Chainofcommand
- Consultants
- Policypriorities
- Pipeline
- Complacency
- Infrastructure
- Publicrelations
- Finances
- Emergencymanagement
- Austerity
- Loopholes
- Incompetence
- Protocols
- Politics
- Poverty
- Accountability
- Pressure
- Legalities
- Ethics
- Empowerment
- Inexperience
- Bureaucracy
- Technicalities
- Environmentaljustice
- Pathdependency
## Water federalism and regulation in the U.S.

<table>
<thead>
<tr>
<th></th>
<th>Water quality</th>
<th>Water quantity</th>
<th>Water funding</th>
<th>Water prices</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Federal</strong></td>
<td>Congress and EPA</td>
<td>Court review as applicable</td>
<td>Congress and EPA</td>
<td>Judicial review</td>
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<td><strong>Interstate</strong></td>
<td>Basin commissions</td>
<td>Basin commissions</td>
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<td>n/a</td>
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<tr>
<td><strong>States</strong></td>
<td><strong>Primacy agencies</strong></td>
<td>Resource agencies</td>
<td>Revolving loan funds (SRF)</td>
<td>PUCs and/or judicial review</td>
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<tr>
<td></td>
<td>(health &amp; environmental)</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td><strong>Substate</strong></td>
<td>Management districts (varies)</td>
<td>Management districts (varies)</td>
<td>n/a</td>
<td>n/a</td>
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<tr>
<td><strong>Local</strong></td>
<td>Local health departments</td>
<td>Local zoning and fire officials (pressure)</td>
<td>Local financing (bonds)</td>
<td>Municipal and other local boards</td>
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</tbody>
</table>
Federal water-quality legislation and goals

**Clean Water Act**
Achieving “fishable and swimmable waters” through pollution control, wastewater treatment, and stormwater management

**Safe Drinking Water Act**
Achieving a quality of drinking water that is as close as feasible to where there will be no known or anticipated adverse impacts on human health with an adequate margin of safety.
Federal Safe Drinking Water Act (SDWA)

- SDWA is democratically established federal law (1974, 1986, 1996)
- Federal drinking water regulation reflects the “precautionary principle”
  - Equal protection under uniform preventive standards and multiple barriers to contamination informed by public-health and environmental science
  - While there is no “right” to drinking water there is an obligation to deliver compliant water
  - Compliance is not discretionary, regardless of structural or fiscal conditions
  - Variances and exemptions are narrow and uncommon (Michigan reported none in 2014)
- The goal is to achieve a level of drinking water quality as close as feasible to that at which there are no known or anticipated adverse impacts to human health including an adequate margin of safety
Regulatory compliance as decision-making constraint

Feasible solution set

SDWA compliant  Noncompliant
Regulatory chains of command

- A culture of compliance foregoes the need for oversight and enforcement
- Weak links and denial of urgency argue for institutional reform
Core elements of the SDWA

- Microbial contaminants
- Chemical, metal, and radiological contaminants
- Disinfectants and disinfection byproducts
- Contaminant candidate listing
- Monitoring and reporting
- Public information and notice
- System capacity and planning
- Funding (DWSRF) and incentives
- Variances and exemptions
- Six-year regulatory review
Regulating water contaminants under the SDWA

- **Regulatory framework**
  - National Primary Drinking Water Regulation – legally enforceable standards
  - National Secondary Drinking Water Regulation – non-enforceable guidelines
  - Maximum Contaminant Level Goal (MCLG) – non-enforceable goals
  - Maximum Contaminant Level (MCL) – enforceable
  - Treatment Technique – enforceable

- **Evaluation of contaminants**
  - Adverse health effects
  - Carcinogenicity
  - Sensitive sub-populations

- **Multiple barriers to contamination**
  - Source water assessment and protection
  - Qualified water treatment operators
  - Integrity of water distribution systems
  - Informed public (notice, CCR reports)
Lead and Copper Rule (LCR)

- **Vexing and persistent challenge of lead**
  - MCLG for lead is 0 and there is no MCL
  - Concerns about clarity of testing protocols and loopholes
  - Action level (AL) requires treatment in the form of optimized corrosion control
  - Corrosion control is well known and accepted practice
  - SRF funding can be used for lead pipe removal and replacement
  - NDWAC urged a proactive approach in December 2015
  - EPA has enhanced LCR oversight and will revise the rule in 2017

- **Government, regulatory, and water industry responsibilities**
  - Operational practices and infrastructure affect water quality
  - Remediation is complicated by service line ownership and property rights
  - Lead has not been addressed primarily due to lack of political will at all levels
Capacity assurance requirements

- States must ensure that all new community and nontransient noncommunity water systems demonstrate technical, managerial and financial capacity for compliance prior to start-up.

- States must develop and implement a strategy to assist existing public water systems in acquiring and maintaining technical, managerial, and financial capacity, including:
  - Methods or criteria to identify systems and prioritize need
  - Factors that encourage or impede capacity development
  - Authority and resources to:
    - Provide assistance for compliance
    - Encourage partnerships
    - Promote training and certification
Capacity development for existing systems

- **Michigan strategy**
  - Reactive based on noncompliance
  - Noncompliance triggers financial assessment
  - Systems must accept assistance

- **Enhancing capacity development**
  - Proactive engagement with communities
  - Fiscally distressed list on a watch list
  - Support for sustainable infrastructure
Technical issues in Flint

- Qualifications and experience of internal staff
- Testing and monitoring protocols
- Complex treatment challenge
- Need for corrosion control study
- Consulting studies and reports
- Application of accepted practices
- Professional support networks (AWWA)
Managerial issues in Flint

- Professional staffing levels
- Operator certification and experience
- Empowerment to act
Flint organizational chart
Financial issues in Flint

Flint water and sewer finances

<table>
<thead>
<tr>
<th>Year</th>
<th>Water operating revenue</th>
<th>Water operating expenses</th>
<th>Net water transfers</th>
<th>Sewer operating revenue</th>
<th>Sewer operating expenses</th>
<th>Net sewer transfers</th>
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<tbody>
<tr>
<td>2007</td>
<td>33,172,084</td>
<td>31,636,273</td>
<td>0</td>
<td>17,918,595</td>
<td>35,720,095</td>
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<td>2008</td>
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<td>33,575,165</td>
<td>0</td>
<td>17,143,474</td>
<td>26,532,667</td>
<td>0</td>
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<tr>
<td>2009</td>
<td>34,080,677</td>
<td>37,783,016</td>
<td>-1,130,000</td>
<td>17,836,304</td>
<td>26,087,167</td>
<td>-1,860,000</td>
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<tr>
<td>2010</td>
<td>31,956,754</td>
<td>38,583,364</td>
<td>-1,130,000</td>
<td>15,978,110</td>
<td>31,128,098</td>
<td>-1,860,000</td>
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<tr>
<td>2011</td>
<td>36,762,663</td>
<td>41,539,956</td>
<td>-1,130,000</td>
<td>17,637,811</td>
<td>29,900,969</td>
<td>-1,860,000</td>
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<tr>
<td>2012</td>
<td>44,854,439</td>
<td>41,836,494</td>
<td>-1,130,000</td>
<td>23,214,899</td>
<td>25,321,161</td>
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<td>2013</td>
<td>49,903,868</td>
<td>41,302,290</td>
<td>-1,130,000</td>
<td>28,025,929</td>
<td>25,177,633</td>
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<tr>
<td>2014</td>
<td>43,552,152</td>
<td>43,674,347</td>
<td>-1,130,000</td>
<td>28,605,162</td>
<td>23,863,184</td>
<td>-1,860,000</td>
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<tr>
<td>2015</td>
<td>33,808,809</td>
<td>20,645,424</td>
<td>-1,130,000</td>
<td>30,527,772</td>
<td>23,095,155</td>
<td>-1,860,000</td>
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</tbody>
</table>
Flint water rates

- All utility rates have regressive impacts and affordability must be addressed
- Rates should not be used as a taxing mechanism
- Financial and rate reforms are needed
Flint customers and consumption

- Water usage is declining everywhere due to efficiency
- Legacy cities have also lost economic activity and population
- Sales in Flint have plummeted – state is providing $30 mil. in bill relief
- Flint appears to have favorable capacity factors (demographics and price)
Water systems: five products, one set of pipes

- Consumption: drinking and cooking
- Personal hygiene: washing and sanitation
- Home hygiene: laundry and cleaning
- Discretionary: irrigation and other outdoor uses
- Fire protection
Community water systems in Michigan

Community water systems in Michigan (n=1,380, SDWIS 2015)
Water infrastructure needs

- Invisible water infrastructure is aging
  - Loss of both water and energy
  - Main breaks also jeopardize quality

- Michigan’s 20-year water infrastructure need (EPA, 2011)
  - A state with significant needs
  - $13.8 billion total
  - $9.5 billion in transmission and distribution
Financing lead service-line replacement

- Environmental remediation funds ("superfund")
- Federal or state tax credits
- City or utility financed with low-cost loans
- Customers on their own or shared
- Transfer ownership to utility (ratepayers)
- Finance and recover in utility revenue requirements
Flint forward: building tomorrow’s infrastructure

- **Sustainable infrastructure supports healthy and prosperous communities**
  - Recognize that infrastructure supply and demand are dynamic
  - Don’t build tomorrow’s infrastructure for yesterday’s demand
  - Place a priority on public health and welfare

- **Strategies**
  - Optimize systems in the course of infrastructure renovation
  - Leverage investment resources across infrastructure types
  - Modernize the infrastructure with available technologies
  - Integrate infrastructure planning and projects
  - Coordinate infrastructure oversight across agencies
Infrastructure optimization

- Engineering as both problem and solution
  - Impulse to replace everything in kind (pipe for pipe)
  - Need for prudent investment (possibly economic regulation)
  - Genetic algorithm optimization models
### Sustainable water systems

- Sustainable systems live within ecological, economic, and equity tolerances
- Optimal service level is constrained by compliance with mandates and standards

<table>
<thead>
<tr>
<th>Price revenues relative to expenditures</th>
<th>Expenditures relative to optimal compliant service level</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>&lt; 1 expenditures are below optimum (“cost avoidance”)</td>
</tr>
<tr>
<td>&lt; 1 price revenues are below expenditures (“price avoidance”)</td>
<td>Deficient system</td>
</tr>
<tr>
<td>= 1 price revenues are equal to expenditures</td>
<td>Underinvesting system</td>
</tr>
<tr>
<td>&gt; 1 price revenues are above expenditures (“profit seeking”)</td>
<td>Revenue-diverting system</td>
</tr>
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</table>
Thinking about a new drinking water paradigm

- Aspire to affordable universal service
- Plan to reoptimize and modernize systems
- Provide economic fire protection
- Install advanced metering systems
- Price fire protection costs based on property size or value
- Meet basic needs as a “byproduct”
- Price outdoor usage aggressively and encourage alternatives
- Coordinate with other infrastructure providers
Lessons learned

- **Regulatory institutions are much maligned until we experience crisis**
  - Flint is now the quintessential example

- **Institutional failure has consequences – measured in lost security, trust, and lives**
  - Our institutions are only as good as the people we entrust to serve them
  - Integrity of people and infrastructure are connected

- **Institution introspection in the face of failure is a step toward justice**
  - Better institutions can support better infrastructure