California will Adopt and Quantify Groundwater Management

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Outline

• Where is groundwater policy now?
  – Groundwater in California water management
  – Major groundwater problems
• Drivers of change
• Where are we going?
• How long to get there?
• Mechanisms for change
• Conclusions
• Some reading
Aquifers and Infrastructure

Top down view

Bottom up view

Reservoir volume (taf)
- 0–100
- 100–500
- 500–1,000
- 1,000–5,000
- 5,000+

Annual delivery (taf)
- 0–50
- 51–150
- 151–300
- 301–1,500
- 1,501–3,100

Legend:
- State project
- State and federal project
- Federal project
- Local project
- Urban area
- Agricultural area
- River
- Flow direction
- Pump/storage facility
- Pumping facility
- Hydroelectric powerhouse

County Lines
Hydrologic Regions
Groundwater Basin/Subbasin
Groundwater’s Roles

- **Collect** from precipitation, streams, reuse
- **Store** – seasonal, drought, and mined
- **Convey** water to local pumps
- **Drain** - sink for water, salts, nitrate, etc.
- **Support** riparian and wetland ecosystems

<table>
<thead>
<tr>
<th></th>
<th>maf</th>
<th>Surface</th>
<th>Groundwater</th>
</tr>
</thead>
<tbody>
<tr>
<td>Storage Capacity</td>
<td>42</td>
<td>149-1,145</td>
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<tr>
<td>Seasonal storage</td>
<td>5-8</td>
<td>3-6</td>
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<tr>
<td>Drought storage</td>
<td>15-18</td>
<td>20-25</td>
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<tr>
<td>Deliveries</td>
<td>60-70%</td>
<td>30-40%</td>
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Where is groundwater policy now?

- Largely laissez-faire
- Fairly tight groundwater adjudications in much of southern California
- Price-driven conjunctive use common in Central Valley
- County no-export ordinances in Sacramento Valley
- Insecure water rights for groundwater
Major groundwater problems in California

- Undermining surface water flows
- Overdraft (~15% Tulare use)
- Localized contamination (urban)
- Regional contamination – nitrate, salts
- Loss of riparian and wetland ecosystems
- Land subsidence – flood & canal problems
- Insecure groundwater and discharge rights

Almost all groundwater problems are local.
Drivers of Change in Groundwater

Growing scarcity and tightening management

• Overdraft – local, regional (cost & quality problems)
• Accumulations of nitrate, salts, etc. from irrigation
• More environmental flows increase aquifer pumping
• Surface water rights encroachments
• Ecosystem support from aquifers – wetlands, streams
• Water rights insecurity: banks, farmers, cities, markets
• Water quality insecurity and costs
• Permanent crops depend on groundwater in drought
Growing water scarcity

“Never a water shortage, only a shortage of cheap water”

Growing scarcity leads to:

• Tighter definition of property rights
• Higher prices
• More value from trading, conservation
Groundwater Overdraft

- Mostly in Tulare basin (1-2 maf/yr, ~15% of net use)
- Some additional overdraft in smaller local areas of Central Valley, Antelope Valley, Pajaro Valley, Salinas Valley, coastal aquifers
- Perhaps spreading with greater water scarcity?
Accumulating salts, nitrate, etc.

Salt accumulation
- Mostly SJ Valley and Tulare Basin
- Also some smaller basins
- Long-term loss of crop yields and land area, up to 500,000 acres
- San Joaquin R. and Delta effects

Nitrate contamination
- Primarily Tulare and Salinas basins
- Global problem of intensive agriculture
- Affects millions of acres in California
- Mostly small, household drinking water

Mobilizing natural contaminants? As, U?

Major problems
- Primarily from agriculture
- Major state regulatory role
- Source control solution prohibitive
- Managing inevitable degradation?

Eastern Tulare Basin: Wells with Nitrate above 45 mg/L (MCL)

Harter et al., 2012
Lower water tables pull from surface water

- Loss from streams to groundwater
- Lost habitat
- Subsidence

Estimated change in hydraulic head, predevelopment to 1961

<table>
<thead>
<tr>
<th>Change in Hydraulic Head</th>
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<tbody>
<tr>
<td>Rise of 0 to 40 ft</td>
<td>Light Blue</td>
</tr>
<tr>
<td>Decline, 0 to 40 ft</td>
<td>Light Pink</td>
</tr>
<tr>
<td>40 to 80</td>
<td>Pink</td>
</tr>
<tr>
<td>80 to 120</td>
<td>Light Red</td>
</tr>
<tr>
<td>120 to 200</td>
<td>Red</td>
</tr>
<tr>
<td>200 to 300</td>
<td>Light Dark Red</td>
</tr>
<tr>
<td>300 to 400</td>
<td>Dark Red</td>
</tr>
<tr>
<td>&gt; 400</td>
<td>Red</td>
</tr>
</tbody>
</table>

Faunt et al., 2009
Ecosystem flows will press groundwater

Pre-development Central Valley
Faunt et al., 2009

- Alkali desert scrub
- Aquatic
- Grassland
- Other floodplain habitat
- Riparian
- Valley/Foothill hardwood
- Wetland

Riparian and wetland ecosystems often depend on high groundwater elevations.
Water rights insecurity

Reduces profitability:
• Banks, farmers, developers, cities, water markets
• Instability for profitable permanent crops
• Reduces regional and statewide water efficiency
• Reduces adaptability
• Reduces value of water
Water quality insecurity & costs

Regional groundwater pollution imposes a growing tax on drinking water systems

• Rural households
• Small communities
• Larger communities
There will be change in groundwater policy.
Permanent crops need groundwater management

- Recharge in wet to withdrawal in dry
- Fewer wet years mean more dry-year fallowing, and less permanent crops after a point

- More water scarcity leads to less profitable annual crops
- Insecurity reduces permanent crops
Groundwater Management Forms

1. Laissez-faire

2. Surface water pricing to manage groundwater use (Yolo, Kern)

3. Large irrigation district (Semitropic, Arvin-Edison)

4. Irrigation district payments to use more expensive groundwater (GCID, YCWA)

5. County Well Permits and export restrictions (Butte)

6. Replenishment districts (SCVWD, OCWD, PVWMA)

7. Court adjudications (mostly S. California)
Where are we going?

- Locally-led groundwater management
- State backstop regulation, “cooperative federalism”
  - More quantified and secure groundwater rights
  - More defined pollution rights and costs
  - Groundwater regulations to support ecosystems
  - More information - well logs, better modeling & data
- More active and effective water markets
- Groundwater integrated into portfolio management
- Tree and vine farmers take a leading role
Some Avenues Forward

• An integrated package?
  – ACWA 2014 groundwater policy recommendations

• Small individual steps
  – Well log access, perhaps 15 years after drilling
  – Regional technical quantification work
  – Easier water market procedures
  – More SWRCB recognition of surface-groundwater connections
  – More active RWQCB on aquifer quality information
  – Local and regional quantification efforts
  – Faster Court or SWRCB groundwater adjudications
Conclusions

1. Unmanaged groundwater now threatens agricultural, rural, and ecological prosperity
2. Integrated water portfolios include groundwater
3. Local/regional groundwater management will prevail
4. State has information, guarantor, and backstop roles
Some Readings


Blomquist (1992), Dividing the waters: governing groundwater in S. California, ICS Press.


Conspiracy theories (xkcd.com)

October 7th 2013


CAN YOU PLEASE GET YOUR SHIT TOGETHER?
THIS IS EMBARRASSING.

SINCERELY,
A CONCERNED CITIZEN
How long to get there?

- Uneven. Faster in some places than others.
- Already there in some adjudicated basins – So. Cal.
- Richer, more desperate areas first
- Local & regional users need to see value
- A long time, statewide
Mechanisms for change

All imperfect, but still improved.

- Markets and contracts - $$$
- Local ordinances – counties
- Local jurisdictions and users being creative
- Information availability
- State legislation – district enabling, easier adjudications
- Court or SWRCB basin groundwater adjudications?