Sharing Access
A (new) robust system for the management of groundwater use

Professor Mike Young

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Total returns - Median allocation and entitlement prices compared to capital growth, and the S&P ASX Accumulation Index Returns

G/W system choices

1. No limit – “If you have the land go for it!”
2. Embargo on new wells and well deepening
3. Limit on total irrigated area in a district
   • Fallowing schemes possible
   • Self-reporting possible
4. Limit on total “Standard crop-area”
   • Fallowing schemes possible
   • Self-reporting possible
5. Varying (Annual) limit on total volume that may be used
   • Leasing possible
   • Fully unbundled management system
A Blueprint, a Roadmap and two indicative plans

Sharing Groundwater: A Robust Framework and Implementation Roadmap for Sustainable Groundwater Management in California

Mike Young* and Bryce McAtee**

CONTENTS
Overview
Introduction
The Plan
Two Illustrative Case Studies
Broad Considerations
Appendix: Mockup of Groundwater Management Plan for the ABF Basin

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Citation

SUMMARY
This working paper offers a framework and roadmap for development of a robust groundwater-sharing system consistent with California’s Sustainable Groundwater Management Act, which requires communities in priority areas to prepare groundwater sustainability plans.

The proposed system draws on global experience. Robustness is its signature feature. Opportunities are maximized by a suite of robust local governance, allocation, and administrative arrangements.

Additionally, the proposed system incentivizes innovation, stimulates investment, and facilitates low-cost adjustment to changes in groundwater demand.

Among the dynamic components underlying this sharing system is a share register that records ownership and transfers of ownership in a basin’s available shares. These unit shares are fungible, each represents a proportional stake in access to the basin’s groundwater resources. Volumetric allocations are made in proportion to the number of shares held during determined periods throughout the water year. These allocations are recorded in bank-like water accounts, affording account holders an efficient means to manage their resource but also ensuring that they cannot use more than is available. Unused water can be saved for later use. At the start of the transition to the new system, users are given an allocation buffer so that they have flexibility and time to adjust. Those who want to can make quick non-contestable trades at low cost.
Robust systems have an unbundled structure (Tinbergen)

**Government Approved Plan**
Regulations that establish shares, set allocation zones, determine allocations & set transfer rules and protocols

**Management Board**
Trusted & respected

### Zone Share Register

<table>
<thead>
<tr>
<th>Zone</th>
<th>Share</th>
<th>Register (single)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1-249</td>
<td>ABC A John Doe 9999991</td>
</tr>
<tr>
<td></td>
<td>250-333</td>
<td>ABC B Doe Ltd. 9995556</td>
</tr>
<tr>
<td></td>
<td>...</td>
<td>... ... ... ...</td>
</tr>
</tbody>
</table>

### Water Accounts

<table>
<thead>
<tr>
<th>Date</th>
<th>Description</th>
<th>Debit</th>
<th>Credit</th>
<th>Balance</th>
</tr>
</thead>
<tbody>
<tr>
<td>15 March</td>
<td>Allocation 0.1” per share...</td>
<td>...</td>
<td>33 ac ft</td>
<td>433 ac ft</td>
</tr>
<tr>
<td>30 March</td>
<td>Net Use</td>
<td>30 ac ft</td>
<td>...</td>
<td>403 ac ft</td>
</tr>
</tbody>
</table>

### Groundwater Use Permits/License (multiple)

- **Groundwater Use License No. ######**
- License Holder: John Doe
- Linked Water Account: XYZ123
- Max Pumping Rate: n/a
- Max Annual Extraction: n/a
Design and communication

1. Maximize value and investment opportunities
   • Guaranteed register and water account integrity
   • Shares mortgageable at low cost
   • Excellence in all dimension of administration and communication

2. Avoid massive disruptions on implementation
   • Recognize current use and investments - Grandfather
   • Begin new system with an allocation buffer that can be carried-forward

3. Facilitate efficient use
   • Credit recharge and allow carry-forward of unused water
   • Facilitate rapid, low-cost transfers within and where possible between zones

4. Require the State Government to make timely & binding decisions
   • “Ratify” local decisions -- because fiddling & procrastinating decreases confidence

5. Keep the system simple, affordable and adaptable
   • Unbundled entitlement, allocation, and use management systems
   • Depth to groundwater as a proxy indicator of variable sustainable yield
   • Adaptive management of allocations

6. Restore equilibrium and remove undesirable outcomes at least cost
   • Set depth targets and allocation rules
   • Estimate use on an acre-by-acre or well-by-well basis
Indicative “Glide” Path

Buffer available for use now or in any future year.

Guaranteed allocation in first two years.

Basin Authority invests in groundwater augmentation project on behalf of all shareholders.

Aquifer found to sustain greater use than expected.

- Preferred Av. Depth
- Preferred Max Depth
- Absolute Max Depth
• Every time depth to groundwater drops, allocations per share must go down by, at least, 1.5%!

• When the absolute maximum depth is reached, allocations per share must go down to zero and remain at zero until there is a return to the preferred minimum.

• Any water left in any water account may still be used
1. Unit shares issued to land holders in each zone

2. Each share entitles its holder to a pro-rata share of all allocations made to the zone

3. Allocations announcements made and 30 days later credited to an account that is nominated by the shareholder

4. Shares are transferable

5. Mortgaged shares can be transferred if and only if a mortgage is cleared
## A Mock-Up Water Account

<table>
<thead>
<tr>
<th>Date</th>
<th>Action or event</th>
<th>Debit</th>
<th>Credit</th>
<th>Balance</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Oct 2019</td>
<td>Opening balance</td>
<td></td>
<td></td>
<td>0.00</td>
</tr>
<tr>
<td>1 Oct 2019</td>
<td>Start-up buffer</td>
<td>+83.33</td>
<td>+83.33</td>
<td>+83.33</td>
</tr>
<tr>
<td>1 Oct 2019</td>
<td>Share allocation 10,000 shares at one acre-inch per share</td>
<td>+833.33</td>
<td></td>
<td>+916.66</td>
</tr>
<tr>
<td>15 Oct 2019</td>
<td>Net use—estimated using satellite imagery and land parcel area</td>
<td></td>
<td>-10</td>
<td>+906.66</td>
</tr>
<tr>
<td>30 Oct 2019</td>
<td>Net use—estimated using satellite imagery and land parcel area</td>
<td></td>
<td>-15</td>
<td>+891.66</td>
</tr>
</tbody>
</table>

**End of year Amount to be carried forward to the next water year with 10% adjustment for losses**

-89.3
+803.36
## Zone transfer exchange rate matrix

<table>
<thead>
<tr>
<th>Transfer from</th>
<th>Transfer to</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Zone 1</td>
</tr>
<tr>
<td>Zone 1</td>
<td>1.0</td>
</tr>
<tr>
<td>Zone 2</td>
<td>0.9</td>
</tr>
<tr>
<td>Zone 3</td>
<td>0.0</td>
</tr>
<tr>
<td>Zone 4</td>
<td>0.0</td>
</tr>
</tbody>
</table>

Limit on max volume that may be transferred out of or into a zone \( \Rightarrow \) Adaptive experimentation.
G/W Use Permits

All wells are associated with a Groundwater Use Permit and linked to a water account.

Well License #123

Well: #CSE123, Zone D1
Water Account Name: CSE
Well Conditions:
• Monitoring Method: Metered
• Max. Pumping Rate: 50 af/day
• Max. Annual Extraction: 900 af
• Account must have non-negative balance

Pumping is conditional upon compliance with all Zone D1 access conditions in the G/W Plan

CSE Water Account

<table>
<thead>
<tr>
<th>Date</th>
<th>Description</th>
<th>Debit</th>
<th>Credit</th>
<th>Balance</th>
</tr>
</thead>
<tbody>
<tr>
<td>09/01/17</td>
<td>Allocation</td>
<td></td>
<td>+200 af</td>
<td>+200</td>
</tr>
<tr>
<td>10/02/17</td>
<td>Extraction from Well #CSE123</td>
<td>-10 af</td>
<td></td>
<td>+190</td>
</tr>
</tbody>
</table>
Domestic Water Use = Human Right to Water

• Shares held by County or City with obligation to keep the “domestic water account” in positive balance

• 5 yr estimate of average use

• Each household allowed to take up to locally agreed limit

• When allocations per share are zero, households still allowed to take sufficient for essential purposes
Issuing Shares

Requires careful engagement and consultation

1. Determine eligibility criteria

2. Build the database needed to decide on the best way to distribute shares among eligible share holders

3. Assemble and validate the database

4. **Develop and finalize the allocation formula**
   - Use independent person or persons to recommend fairest formula to use

5. Build share register and, where appropriate, record financial interests