IPR/Reservoir Augmentation
Reservoir Storage Permitting Issues

Michael R. Welch, Ph.D., P.E.
Focus of today’s discussion:

- Present overview of reservoir-related regulations for indirect potable reuse/reservoir augmentation (IPR/RA)
- Summarize key regulatory issues affecting the City of San Diego San Vicente IPR/RA project
- Speculate on the probable basis of statewide CDPH IPR/RA regulations
Focus of today’s discussion:

- Present overview of reservoir-related regulations for indirect potable reuse/reservoir augmentation (IPR/RA)
- Summarize key regulatory issues affecting the City of San Diego San Vicente IPR/RA project
- Speculate on the probable basis of statewide CDPH IPR/RA regulations
Comparison of IPR Reservoir Augmentation Concept With Direct Injection Groundwater Recharge
<table>
<thead>
<tr>
<th>Type of Permit</th>
<th>Issuing Agency</th>
<th>Permitee</th>
<th>Permit Incorporates</th>
<th>When Permit is Issued</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water Supply Permit</td>
<td>• California Department of Public Health</td>
<td>Water purveying agency</td>
<td>• State and federal drinking water requirements</td>
<td>• After project implementation</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Project-specific CDPH requirements</td>
<td></td>
</tr>
<tr>
<td>NPDES Discharge Permit</td>
<td>• California Regional Water Quality Control Board</td>
<td>Reservoir augmentation discharger</td>
<td>• Clean Water Act requirements</td>
<td>• After CEQA</td>
</tr>
<tr>
<td></td>
<td>• U.S. Environmental Protection Agency</td>
<td></td>
<td>• State and regional water quality plan standards and requirements</td>
<td>• Before project start-up</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• Site-specific discharge requirements</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>• CDPH requirements</td>
<td></td>
</tr>
</tbody>
</table>
CDPH Water Supply Permit regulates entire range aspect of project

Regional Board/EPA permits address discharges to groundwater/surface water, but incorporate applicable CDPH requirements.
CDPH IPR/RA Regulation:

- Statewide IPR/RA regulations are in development; scheduled for adoption in 2016 per Senate Bill 918
- Until adoption of statewide regulations, CDPH reviews IPR/RA projects on a case-by-case basis
- CDPH concept approval provided in 1994 for City of San Diego San Vicente Reservoir IPR/RA project
- CDPH concept approval provided in 2012 for City of San Diego IPR/RA project for expanded San Vicente Reservoir IPR/RA project
Reservoir Discharge Permit:

- IPR/RA discharge is regulated by EPA as a “wastewater” subject to requirements of the Clean Water Act
- California Regional Water Quality Control Board issues NPDES permits per authority delegated by the U.S. Environmental Protection Agency
- NPDES permits will establish discharge concentration standards based on federal, state, and regional water quality plans and standards
- NPDES permits valid for five-year period
Focus of today’s discussion:

- Present overview of reservoir-related regulations for indirect potable reuse/reservoir augmentation (IPR/RA)
- Summarize key regulatory issues affecting the City of San Diego San Vicente IPR/RA project
- Speculate on the probable basis of statewide CDPH IPR/RA regulations
CDPH Reservoir Issues: Proposed San Vicente Reservoir IPR/RA Project

San Vicente Reservoir (prior to expansion)

Expanded San Vicente Reservoir
### IPR/RA Reservoir Storage
**Key CDPH Concerns and Goals**

<table>
<thead>
<tr>
<th>CDPH Issue</th>
<th>CDPH Goal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Time to respond</td>
<td>Minimize potential for short-circuiting</td>
</tr>
<tr>
<td>Environmental Buffer</td>
<td>Provide additional pathogen barrier</td>
</tr>
</tbody>
</table>

CDPH issues and goals consistently expressed during the 20-year planning history of the City of San Diego San Vicente Reservoir IPR/RA project.
## CDPH Concept Approval
### City of San Diego IPR/RA at San Vicente Reservoir

<table>
<thead>
<tr>
<th>Requirement to Address CDPH Concern</th>
<th>Time to Respond</th>
<th>Environmental Buffer</th>
</tr>
</thead>
<tbody>
<tr>
<td>Maintain 12-month mean hydraulic detention time (V/Q) at all times</td>
<td></td>
<td>✓</td>
</tr>
<tr>
<td>Locate inflow and outflow diversion sites to minimize potential for short-circuiting</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Maintain minimum 100:1 initial dilution at all times</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>Demonstrate compliance with short-circuiting, initial dilution, and detention requirements</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>utilizing a calibrated and verified reservoir hydrodynamic model</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Discharge purified water above the thermocline and withdraw reservoir waters from below the</td>
<td>✓</td>
<td>✓</td>
</tr>
<tr>
<td>thermocline when reservoir stratification occurs</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Maintain ability to take reservoir offline on 24-hour notice</td>
<td>✓</td>
<td></td>
</tr>
</tbody>
</table>
IPR Discharge Locations Evaluated at San Vicente Reservoir

- Existing Aqueduct Purified Water Inlet Location
- New Aqueduct Purified Water Inlet Location
- Barona Arm Purified Water Inlet Location
- Design Purified Water Inlet Location

Legend:
- Lake Boundary at EL. 780 ft
- 20-ft contours < EL. 650 ft
- 20-ft contours > EL. 650 ft
Reservoir Modeling Results:
City of San Diego IPR/RA Studies

- Introduction of IPR water does not materially affect reservoir stratification
- Mean hydraulic detention times of more than a decade are projected under typical reservoir operating conditions
- Minimum of 2000:1 initial dilution of 24-hour IPR discharge is maintained during reservoir turnover under typical reservoir operating conditions
- Minimum of 200:1 initial dilution of 24-hour IPR discharge is maintained during reservoir turnover under all extreme conditions (including emergency drawdown or extended drought)
Pathogen Reduction Findings:  
City of San Diego IPR/RA Studies

- Solar radiation can cause significant inactivation in a matter of hours in the most resistant viral strains
- Effects of solar radiation on pathogen inactivation can be influenced by time of year, depth of epilimnion, and water clarity; pathogen inactivation is reduced during winter periods
- Even during winter periods, UV inactivation in surface waters can be greater than reported inactivation rates in groundwater
- Greater than 6 logs of virus inactivation at San Vicente Reservoir is projected during times of reservoir stratification (10 months of year)
- Greater than 2 logs of virus inactivation at San Vicente Reservoir is projected during reservoir turnover (2 months of year)
Regional Board/EPA Reservoir Discharge Issues: Proposed San Vicente Reservoir IPR/RA Project
<table>
<thead>
<tr>
<th>Regulation</th>
<th>Potential Issue</th>
</tr>
</thead>
<tbody>
<tr>
<td>Basin Plan water quality objectives</td>
<td>• Stringent nutrient standards</td>
</tr>
<tr>
<td></td>
<td>• Secondary drinking water standards established in Basin Plan as enforceable federal water quality standards</td>
</tr>
<tr>
<td></td>
<td>• Basin Plan dissolved oxygen standards do not address natural reservoir thermal stratification</td>
</tr>
<tr>
<td>California Toxics Rule receiving water standards</td>
<td>• Standards for protection of aquatic life may be significantly more stringent than drinking water standards</td>
</tr>
<tr>
<td>303(d) Impaired Water listing status</td>
<td>• Impaired water listings may impact how Regional Board may establish discharge standards</td>
</tr>
</tbody>
</table>
Expansion of San Vicente Reservoir in combination with IPR/RA is projected to reduce future nutrient concentrations below historic concentrations. The City’s proposed nutrient compliance approach is based on (1) regulating N:P ratios in San Vicente Reservoir to limit the potential for biostimulation, and (2) performing reservoir monitoring and modeling to confirm the lack of impacts.

## San Vicente Reservoir: Nutrient Loads

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Basin Plan Objective</th>
<th>Purified Water</th>
<th>Imported Water Inflow</th>
<th>Runoff Inflow</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total nitrogen</td>
<td>0.25</td>
<td>0.78</td>
<td>0.17 - 0.68</td>
<td>0.18 - 4.2</td>
</tr>
<tr>
<td>Total phosphorus</td>
<td>0.025</td>
<td>0.004</td>
<td>0.024 - 0.081</td>
<td>0.22 - 0.32</td>
</tr>
</tbody>
</table>
Nutrient Modeling of San Vicente Reservoir:
## California Toxics Rule: Implications for IPR/RA Projects

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Potential Issue</th>
</tr>
</thead>
</table>
| NDMA      | - Water quality objective 0.00069 is $\mu g/l$
|           | - Reverse osmosis typically achieves only partial removal
|           | - May require use of mixing zone and evaluation of environmental persistence |
| DDT, Aldrin, Dieldrin, Heptachlor, PCBs, PAHs | - Receiving water standards are more stringent than approved monitoring technology (e.g. detects = noncompliance) |

**Note:** California Toxics Rule water quality concentration standards must be achieved in receiving waters upon completing of mixing (initial dilution)
303(d) Impaired Water Listing Process:

- Regional Board is required to identify receiving waters not meeting standards per Section 303(d) of the Clean Water Act
- Regional Board is required to develop and impose TMDLs (Total Maximum Daily Loads) on both point- and non-point sources for 303(d) listed receiving waters to ensure compliance with the water quality standards
303(d) Impaired Water Listings: Implications on IPR/RA Projects:

- Barratt, El Capitan, Guajome, Hodges, Miramar, Morena, Murray, Otay, San Vicente and Sutherland are currently on 303(d) list as impaired for nitrogen or nutrients, despite limited amount of available data.
- Difficult to delist receiving water once placed on the 303(d) impaired water list.
- Placing imported water reservoirs on the 303(d) list may limit the ability of the Regional Board to establish water quality standards for IPR/RA projects.
- TMDLs developed by the Regional Board could potentially impact or restrict allowable mass loads from IPR/RA projects.
Focus of today’s discussion:

- Present overview of reservoir-related regulations for indirect potable reuse/reservoir augmentation (IPR/RA)
- Summarize key regulatory issues affecting the City of San Diego San Vicente IPR/RA project
- Speculate on the probable basis of statewide CDPH IPR/RA regulations
Speculation on Development of IPR/RA Regulations:

- Conservative approach taken by City of San Diego provides significant degree of regulator comfort but sets the bar high for subsequent projects.

- IPR/RA regulations will likely include metrics to address:
  - reservoir volume relative to discharge flow
  - short-circuiting
  - pathogen inactivation

- IPR/RA regulations will likely include “fail safe” requirements:
  - ability to divert IPR water elsewhere
  - ability to take reservoir offline
Speculation on Development of DPR Regulations:

- Concerns over unspecified combinations of “what ifs” are likely to likely to limit the possibility for approval of “pipe to pipe” DPR

- Future DPR approach is likely to focus on a “streamlined” version of IPR/RA where combination of short-term storage and monitoring is required to provide same degree of protection as conventional IPR/RA