Bryan Kelly, P.E. - Merced Irrigation District
   – DGM - Water Resources

Greg Eldridge, P.E. – CH2M
   – Water Resources Engineer

Jason Smesrud, P.E., CPSS – CH2M
   – Agricultural Engineer & Soil Scientist

Charles Burt, Ph.D., P.E., CID – Cal Poly
   – Board Chairman - Irrigation Training and Research Center

Allan Highstreet – CH2M
   – Agricultural Economist
Agenda

- Recap of information previously presented
  - WRMP Purpose
  - Results from Interviews, Land Use, and On-Farm Assessments
  - Capital Improvement Program

- Analytical Tools Used to Evaluate MID’s Water Resources and its Options
  - Water Balance Model
  - Financial Model

- Path Forward
Optimize and protect the District’s water rights and resources

Provide for long-term financial viability of the District

Address CEQA via a Programmatic Environmental Impact Report
Water Resources Management Plan

Purpose - What is It?

- A long range business plan
  - 30-year planning window
  - Intended to be updated on periodic basis

- A method of engaging stakeholders in decisions
  - Water rights/resources allocation and management
  - O&M, replacements, and modernization
  - Land planning issues
  - Financial options/solutions
Water Resources Management Plan

What is It?

- A way to ensure District’s long-range financial stability
  - Determines the cost to meet District’s long-range O&M and infrastructure needs
  - Provides financial options to meet these needs
  - Considers water-parks-hydro financial aspects
  - Does not include energy resources department
Three Phase Development Process

- PHASE I – Initial Assessment
  - Goal-setting
  - Information Gathering

- PHASE II – WRMP Development
  - Continued Stakeholder Engagement
  - Technical Studies
  - Evaluate Alternatives

- PHASE III – Evaluate and Align
  - Compliance with CEQA
  - Development of PEIR
Three Phase Development Process

- **PHASE I – Initial Assessment**
  - Goal-setting
  - Information Gathering

- **PHASE II – WRMP Development**
  - Continued Stakeholder Engagement
  - Technical Studies
  - Evaluate Alternatives

- **PHASE III – Evaluate and Align**
  - Compliance with CEQA
  - Development of PEIR
# Stakeholder Interviews

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<th>City &amp; County</th>
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### Local Business
- 2 interviews; 5 people
- Merced Chamber of Commerce
- Builders Exchange

### Providers
- 3 interviews; 3 people
- LeGrand Athlone Water District
- Chowchilla Irrigation District
- Stevinson Water District

Direct feedback from approximately 100 people
No real surprises on areas of interest

Awareness of complex water issues (impacts)

Sensitivity to water transfers

MID water is high value and may be “too cheap”

High interest in g/w recharging and equity

Desire for cooperation

Sensitivity to outside influences
What are the most important outcomes for this plan to achieve?

Study Goals

1. Protect and maximize MID's water rights
2. Ensure that MID remains financially sound
3. Provide a reliable and affordable water supply to MID customers
4. Continued focus on MID customer service
5. Promote sustainable management of groundwater resources
6. Support the agricultural economic base of the region
Three Phase Development Process

- PHASE I – Initial Assessment
  - Goal-setting
  - Information Gathering

- PHASE II – WRMP Development
  - Continued Stakeholder Engagement
  - Technical Studies
  - Evaluate Alternatives

- PHASE III – Evaluate and Align
  - Compliance with CEQA
  - Development of PEIR
WRMP is a Long-Term Business Plan for MID Based on these Key Building Blocks

- Current and Future On-Farm Practices
- Current and Future Land Use
- Constituents needs
- Infrastructure requirements
- Surface and Groundwater Considerations
- Institutional Issues
Understanding existing and future customer needs is the foundation of the analysis.

**On-Farm Systems Evaluation:**
- *Characterize cropping systems and factors affecting crop distribution*
- *Evaluate range of irrigation practices including methods, scheduling, efficiency, maintenance, and tailwater management*
- *Gather ideas from growers regarding future trends in land use and irrigation methods*

**Land Use Trends and Forecasting:**
- *Evaluate historical changes in land use*
- *Incorporate feedback gathered through the On-Farm efforts*
- *Forecast future land use trends within Merced ID and the surrounding area that affect water use*
Data Sources

- Merced ID Crop and Irrigation Databases
- California Department of Water Resources (DWR) Land Use Surveys (1995, 2002) and USDA Cropscape Database
- Merced County Ag Commissioner reports
- City and County General Plans
- Merced County Local Agency Formation Commission (LAFCo)
- Merced County Association of Governments (MCAG)
- Merced County Ag Commissioner Reports (2007 – 2012)
- Interviews with growers and local officials

On-farm system tours and grower interviews

- Growers of all major crop categories
- Merced County Farm Bureau
- Merced County Ag Commissioner
- UC Cooperative Extension
- Crop commodity interests
Projected Urban Land Expansion to 2040

Urban population expected to grow by 103,400 people between 2013 and 2040

Increase in Urban acreage based on a population density of 7.3 people per acre:

- Atwater: 1,641 acres
- Livingston: 1,534 acres
- Merced: 6,899 acres
- Unincorporated Areas*: 4,090 acres
- **Total Increase: 14,164 acres**

*Unincorporated Areas include: Cressey, Franklin, Planada, Le Grand, and Winton, and UC Merced
## Projected In-District Land Use to 2040

### 2013 In-District Land Use
- **Field Crops**: 23,655 acres (16%)
- **Grains**: 8,315 acres (6%)
- **Native/Riparian**: 3,078 acres (2%)
- **Other**: 2,078 acres (1%)
- **Pasture and Alfalfa**: 11,864 acres (8%)
- **Rice**: 862 acres (1%)
- **Truck Crops**: 11,474 acres (8%)
- **Urban**: 20,483 acres (13%)
- **Water**: 607 acres (0%)

### 2040 In-District Land Use
- **Field Crops**: 11,864 acres (15%)
- **Grains**: 4,170 acres (3%)
- **Native/Riparian**: 1,098 acres (2%)
- **Other**: 3,080 acres (4%)
- **Pasture and Alfalfa**: 11,505 acres (15%)
- **Rice**: 862 acres (1%)
- **Truck Crops**: 11,474 acres (8%)
- **Urban**: 33,642 acres (22%)
- **Water**: 607 acres (0%)

### Land Use Trend

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<th>2013</th>
<th>2040</th>
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<td>Pasture and Alfalfa</td>
<td>19,706</td>
<td>22,939</td>
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</table>

### 2013 Irrigated Lands
- 128,620 acres

### 2040 Irrigated Lands
- 117,665 acres

\[ \Delta = -10,955 \text{ acres} \]
The West Division has 70% drip/micro and sprinkler (30% flood)
The East Division has 80% flood (20% drip/micro and sprinkler)
Differences are partially due to soils (higher permeability coarse textured soils in the West) and partially due to crops (more field crops, pasture & alfalfa in the East)
The combination of crop shifting and irrigation technology changes is projected to result in:

- *Flood irrigation decrease by 39% of MID total*
- *Drip/micro irrigation increase by 34% of MID total*
- *Sprinkler irrigation increase by 5% of MID total*
Summary of Land Use/On-Farm Forecasts

- Urban growth is expected to continue into the future and will reduce total available irrigated acreage inside MID
  - 2013 Irrigated Crop Acreage: 128,620 acres
  - 2040 Irrigated Crop Acreage: 117,664 acres
- Irrigated acreage outside of MID (using groundwater) will increase by 10,000 acres
- Orchards and vineyards are estimated to increase from 35% to 48% of total land use within MID by 2040
- The combination of crop changes and technology adoption will result in more drip/micro irrigation and will influence infrastructure needs
- Increased permanent crop acreage will result in further increased hardening of water demand
Capital Improvement Program
Project Categories

- **Modernization Projects**
  - Overview by Dr. Charles Burt
- Critical Projects
- Programmatic Projects
- Partner Projects
- Conjunctive Management Projects
- Storm Drainage Projects
Critical Projects

- Rehabilitation of Major System Conveyance and Control Facilities that if Failed, Present Extraordinary Risk to District Operations, Such as Improvements to MID’s Tunnel No. 1
- Several Upcoming Critical Projects are not Included in Draft Long Range Capital Improvement Plan. These Projects are Currently Being Evaluated. Once Initial Evaluations are Complete, WRMP And 30-year Budget Will Be Updated.

Conjunctive Management Projects

- Identified Projects that Could be Constructed to Benefit Merced Groundwater Basin by Further Enhancing Merced ID’s Ability to Manage Water Resources Conjunctively
30-Year Capital Improvement Plan
Grouping Description

Programmatic Projects - Long-Term Capital Replacement Efforts

- Canal Re-Lining
- Dead-End Lateral Modifications
- Headwall Modifications
- Well Rehabilitation

Partner Projects

- Identified Projects that Could be Constructed to Utilize Wet Year Water for Groundwater Recharge

Storm Drainage Projects

- Identified Projects that Benefit Merced ID’s Storm Drainage Operation
Modernization Plan Overview
Dr. Charles Burt, ITRC
Irrigation Training and Research Center

moving water in new directions
Modernizing Merced ID’s Delivery System
Goals

1. Improve service to agricultural users by increasing the flexibility of water deliveries.
Goals

1. Improved service to agricultural users by increasing the flexibility of water deliveries.

2. Reduce operational and management difficulties for in-field Distribution System Operators (DSOs).
Goals

1. Improved service to agricultural users by increasing the flexibility of water deliveries.

2. Reduce operational and management difficulties for in-field Distribution System Operators (DSOs).

3. Improve control of water deliveries made to water users outside MID District Boundaries such as Stevinson Water District and the U.S. Fish and Wildlife Service.
Daily water right does not include additional flow (up to 10% of the daily water right) to be delivered to account for seepage and evaporation losses.
Goals

1. Improved service to agricultural users by increasing the flexibility of water deliveries.

2. Reduce operational and management difficulties for in-field Distribution System Operators (DSOs).

3. Improve control of water deliveries made to water users outside MID District Boundaries such as Stevinson Water District and the U.S. Fish and Wildlife Service.

4. Reduce operational spills from canals and laterals.
Goals

1. Improved service to agricultural users by increasing the flexibility of water deliveries.
2. Reduce operational and management difficulties for in-field Distribution System Operators (DSOs).
3. Improve control of water deliveries made to water users outside MID District Boundaries such as Stevinson Water District and the U.S. Fish and Wildlife Service.
4. Reduce operational spills from canals and laterals.

5. Enhance groundwater aquifer health.
MID does not have a neat, rectangular grid of canals and pipelines with orderly boundaries.
Strategy: Modernize each area, and find linkages
An integrated scheme of:
• Improved control,
• Re-regulation,
• And new procedures was developed for each area.

It’s not just replacing old structures!
After the grand schemes, the details of how new sites will function were defined.
The Modernization Plan contains very specific details

Construct rounded flume inlet

Figure 279. Image showing new rounded inlet at Northside Canal Flume #2
The Modernization Plan

- Recommended priorities – from one viewpoint.
- Did not include cost estimates.
- Did not include construction drawings.

It is a PLAN on WHY and HOW and WHERE to do things to meet the goals.
Major Recommendations

1. Construct approximately a dozen new regulating reservoirs.

2. Change existing control directions at key points.

3. Improve water level control along the main canal “superhighways.”

4. Improve flow measurement and control at key points.

5. Create new pumpback, intertie, and diversion pipelines.
1. Purchase land for reservoir sites.

Available land for reservoir sites is extremely limited due to mass installation of permanent orchards and vineyards. The reservoir sites that would likely benefit MID the most from a management perspective would be the reservoir sites in the west part of the District that would re-regulate flows to Stevinson Water District and USFWS.
2. Improve flow measurement at heads of the main canals in the District.
3. Improve flow measurement at the heads of lateral canals.
4. Construct regulating reservoirs to ease operation management and provide better service to growers.
Priorities

5. Improve water level control structures along the canal “superhighways” to easily accommodate flow changes down the canals.
Priorities

6. Develop new operational procedures, combined with improved SCADA, to reduce the art that exists in the water management.
7. Work with ITRC to standardize SCADA, actuators, and control code and documentation for automation. In particular, special control will be needed for pumps, and reservoir in/out devices.
Thank you
Capital Improvement Plan
Project Category Prioritization
and Estimated Costs
Capital Improvement Plan Project Category Prioritization Assumptions

- Most Modernization Projects Scheduled to be Completed by Year 10

- Programmatic Projects
  - First 10 Years
    - Used to Help Annualize Other Prioritized Items
    - Most Critical Programmatic Projects will be Completed
  - Once Majority Of Modernization Projects Complete, Capital Projects to Consist of Primarily Programmatic Projects

- Critical Projects
  - Tunnel No. 1 Improvements Scheduled to be Completed within First 5 Years of Plan Adoption
  - Once Initial Evaluations are Complete on Other Critical Projects, WRMP And 30-year Budget Will Be Updated
Conjunctive Management Projects
- Due to Recent State Groundwater Legislation, Prioritization of these Projects will be Evaluated at Each Regular WRMP Update and as Referenced GW Legislation Develops
- Currently Included Beginning Year 16, Following Completion of Modernization Projects

Partner Projects Not Included in 30-year Planning Budget

Storm Drain Projects
- Not Included in 30-year Planning Budget
- Will be Paid for Through Storm Drainage Reserve Funds
How Did We Prioritize First Draft of Modernization Projects

**ITRC Recommendations**

1. Purchase Land for Reservoir Sites
   - Reservoir Sites In West Part of District that Would Re-regulate Flows to Downstream Commitments
2. Improve Flow Measurement at Heads of Major Canals
3. Improve Flow Measurement at Heads of Laterals
4. Construct Regulating Reservoirs to Ease Operational Management and Provide Better Service to Growers
5. Improve Water Level Control Structures Along Canal “Superhighways” to Easily Accommodate Flow Changes Down Canals
How Did We Prioritize First Draft of Modernization Projects

- Interviews/Presentations
  - Board of Directors
  - MIDAC
  - District Management
  - Operations/Maintenance Department
  - Engineering Department

Annualized Budget Considerations
<table>
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<th>Grouping</th>
<th>Grand Total</th>
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<tr>
<td>Programatic</td>
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## 30-Year Capital Improvement Plan by Category

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**Grand Total**
- **Conjunctive Management**: $6,780,000
- **Critical**: $4,860,000
- **Modernization**: $47,360,000
- **Programatic**: $64,180,000
- **Grand Total**: $123,180,000
Agenda

- Recap of information previously presented
  - WRMP Purpose
  - Results from Interviews, Land Use, and On-Farm Assessments
  - Capital Improvement Program

- Analytical Tools Used to Evaluate MID’s Water Resources and its Options
  - Water Balance Model
  - Financial Model

- Path Forward
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  – Water Balance Model
  – Financial Model

• Path Forward
Analytical Tools Used to Evaluate MID’s Existing and Future Operations
Analytical Tools

Water Balance Model

- Land Use
- Water Use
- System Improvements
- Groundwater Management
Analytical Tools

Merced River Operations Model

Water Balance Model

Groundwater Model

REVENUE

POLICIES

COSTS
Water Balance Model
MID Water Balance Model
WBM Schematic

MERCED IRRIGATION DISTRICT
Water Balance Model Schematic – Historic Conditions

LEGEND
- Measured
- Estimated in WBM
- Estimated in IDC
- WBM Closure

Groundwater System
METRIC for Calibration of Water Balance Using Actual Evapotranspiration

Actual ET Reduced By:
- Actual irrigated area
- Water shortage
- Disease/Pests
- Soil limitations
- Salinity
- Planting density
- Crop age

Actual ETc ≤ Potential ETc

Landsat

Surface Temperature

METRIC Energy Balance

The energy balance includes all major sources (Rn) and consumers (ET, G, H) of energy
Water Balance Calibration Using METRIC

\[ ET_c = ET_o \cdot K_c \cdot IMF \]

- \( ET_c \), crop evapotranspiration
- \( ET_o \), grass reference evapotranspiration
- \( K_c \), crop coefficient for ideal conditions
- IMF, irrigation management factor

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<td>Orchard</td>
<td>0.83</td>
<td>0.72</td>
<td>0.86</td>
<td>Almonds</td>
</tr>
<tr>
<td>Pasture</td>
<td>0.55</td>
<td>0.62</td>
<td>0.55</td>
<td>Pasture and Misc. Grasses</td>
</tr>
<tr>
<td>Alfalfa</td>
<td>0.80</td>
<td>0.78</td>
<td>0.80</td>
<td>Alfalfa Hay and Clover</td>
</tr>
<tr>
<td>Field Crops</td>
<td>1.00</td>
<td>1.03</td>
<td>1.00</td>
<td>Corn and Grain Sorghum</td>
</tr>
<tr>
<td>Truck Crops</td>
<td>0.74</td>
<td>1.07</td>
<td>0.70</td>
<td>Avg of &quot;Tomatoes and Peppers&quot; and &quot;Potatoes, Sugar beets, Turnip etc.&quot;</td>
</tr>
<tr>
<td>Grains</td>
<td>0.57</td>
<td>0.57</td>
<td>0.57</td>
<td>Pasture and Misc. Grasses</td>
</tr>
<tr>
<td>Vineyards</td>
<td>1.03</td>
<td>0.94</td>
<td>1.03</td>
<td>Immature Grapes Vines with 50% canopy</td>
</tr>
<tr>
<td>Rice</td>
<td>NA</td>
<td>1.20</td>
<td>NA</td>
<td>Rice</td>
</tr>
</tbody>
</table>
**METRIC and WBM Results Comparison**

- WBM builds up demands from land use/cropping and climate data
- METRIC demands based on Landsat surface temperature and climate data

### 2010 ET Comparison

- **Evapotranspiration (Acre-Feet)**
- **2010 METRIC**
- **2010 WBM**

2010 MID Irrigated Lands ET Totals
- METRIC – 247,053 AF
- WBM – 264,194 AF
WBM +7% over METRIC

### 2013 ET Comparison

- **Evapotranspiration (Acre-Feet)**
- **2013 METRIC**
- **2013 WBM**

2013 MID Irrigated Lands ET Totals
- METRIC – 250,065 AF
- WBM – 263,170 AF
WBM +5% over METRIC
### CIP Effects on Uncaptured Spills

<table>
<thead>
<tr>
<th>Water Year Type</th>
<th>Current Spills</th>
<th>Future Spills with CIP</th>
<th>Water Savings</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wet</td>
<td>119,700</td>
<td>118,200</td>
<td>-1,500</td>
</tr>
<tr>
<td>Above Normal</td>
<td>64,400</td>
<td>53,150</td>
<td>-11,250</td>
</tr>
<tr>
<td>Below Normal</td>
<td>27,400</td>
<td>16,650</td>
<td>-10,750</td>
</tr>
<tr>
<td>Dry</td>
<td>20,100</td>
<td>10,850</td>
<td>-9,250</td>
</tr>
<tr>
<td>Critical</td>
<td>11,000</td>
<td>7,250</td>
<td>-3,750</td>
</tr>
</tbody>
</table>

*Note: Values are in AFY (Annual Foot-Yield).*
Average Year Seepage by LSA

- **Northside LSA**
  - 2.3 in/d
  - 2,800 AFY

- **Escaladian LSA**
  - 5.3 in/d
  - 9,900 AFY

- **Livingston LSA**
  - 4.1 in/d
  - 16,000 AFY

- **Crocker Dam LSA**
  - 0.8 in/d
  - 4,200 AFY

- **El Nido LSA**
  - 2.5 in/d
  - 6,200 AFY

- **Main Canal LSA**
  - 2.7 in/d
  - 34,000 AFY

- **Castle Reservoir LSA**
  - 2.8 in/d
  - 9,600 AFY

- **Henderson-Fahrens LSA**
  - 1.8 in/d
  - 5,700 AFY

- **Fairfield LSA**
  - 2.0 in/d
  - 10,700 AFY

- **Le Grand LSA**
  - 3.0 in/d
  - 27,500 AFY

*Projected for average year with 221 day irrigation season
## Breakdown of Seepage Losses

<table>
<thead>
<tr>
<th>LSA</th>
<th>Unlined Canal Seepage Rate (in/d)</th>
<th>Seepage Rate for Lined Canals in Good/Fair Condition (AFY)</th>
<th>Seepage Rate for Unlined Canals and Lined Canals in Failed/Poor Condition (AFY)</th>
<th>Seepage Rate for Unlined Creeks, Drains, Reservoirs, and Off Channel Areas (AFY)</th>
<th>Total Seepage (AFY)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Main Canal</td>
<td>2.7</td>
<td>0</td>
<td>10,521</td>
<td>23,449</td>
<td>33,969</td>
</tr>
<tr>
<td>Escaladian</td>
<td>5.5</td>
<td>71</td>
<td>9,506</td>
<td>330</td>
<td>9,908</td>
</tr>
<tr>
<td>Castle Reservoir</td>
<td>2.8</td>
<td>0</td>
<td>0</td>
<td>9,564</td>
<td>9,564</td>
</tr>
<tr>
<td>Henderson-Fahrens</td>
<td>1.8</td>
<td>27</td>
<td>1,911</td>
<td>3,746</td>
<td>5,684</td>
</tr>
<tr>
<td>Fairfield</td>
<td>2.1</td>
<td>124</td>
<td>4,299</td>
<td>6,286</td>
<td>10,709</td>
</tr>
<tr>
<td>Le Grand</td>
<td>3.1</td>
<td>97</td>
<td>16,331</td>
<td>11,096</td>
<td>27,524</td>
</tr>
<tr>
<td>El Nido</td>
<td>2.6</td>
<td>0</td>
<td>3,516</td>
<td>2,706</td>
<td>6,222</td>
</tr>
<tr>
<td>Livingston</td>
<td>4.4</td>
<td>318</td>
<td>14,431</td>
<td>1,252</td>
<td>16,001</td>
</tr>
<tr>
<td>El Nido</td>
<td>2.6</td>
<td>0</td>
<td>3,516</td>
<td>2,706</td>
<td>6,222</td>
</tr>
<tr>
<td>Livingston</td>
<td>4.4</td>
<td>318</td>
<td>14,431</td>
<td>1,252</td>
<td>16,001</td>
</tr>
<tr>
<td>Crocker Dam</td>
<td>0.9</td>
<td>3</td>
<td>2,177</td>
<td>1,985</td>
<td>4,164</td>
</tr>
<tr>
<td>Northside</td>
<td>2.3</td>
<td>1</td>
<td>2,775</td>
<td>0</td>
<td>2,775</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>640</strong></td>
<td><strong>65,467</strong></td>
<td><strong>60,412</strong></td>
<td><strong>126,520</strong></td>
<td></td>
</tr>
</tbody>
</table>

58,500 AFY potential seepage reduction from lining all unlined canals and relining all failed/poor condition canals
Water Balance Results

Current Condition
Deliveries and Shortages
Water Demands/Deliveries – Current Conditions

Based on delivery of water to 98,221 acres of irrigated lands
Surface Water Shortages – Current Conditions

Based on delivery of water to 98,221 acres of irrigated lands
MID Net Groundwater Recharge – Current Conditions

Based on delivery of water to 98,221 acres of irrigated lands with 124,675 acres paying standby fees.

Long term average annual MID net recharge of 105 TAF.
Water Balance Results

Impact of Future Conditions on MID’s Water Balance
Future In-District Water Demands are Influenced by the Following Changes ...

- Land Use
- On-Farm Practices
- Canal Seepage
- Uncaptured Spills
- Policy Decisions
Impact of Land Use on Applied Water Demand

2013: Based on delivery of water to 98,221 acres of irrigated lands

2040: Based on delivery of water to 92,803 acres of irrigated lands

Δ = 25 to 30 TAF
Impact of Changes in Reservoir Operations
<table>
<thead>
<tr>
<th>Scenario</th>
<th>Land Use</th>
<th>Climate</th>
<th>Reservoir Operations</th>
<th>Capital Projects</th>
<th>Irrigated Lands w/ Deliveries</th>
<th>Standby Only Lands</th>
<th>Total MID Irrigated Lands</th>
</tr>
</thead>
<tbody>
<tr>
<td>Current Conditions</td>
<td>2013</td>
<td>1922-2014</td>
<td>Current</td>
<td>None</td>
<td>98,222</td>
<td>26,453</td>
<td>124,675</td>
</tr>
<tr>
<td>Current Conditions</td>
<td>2013</td>
<td>1922-2014</td>
<td>FERC DEIS</td>
<td>None</td>
<td>98,222</td>
<td>26,453</td>
<td>124,675</td>
</tr>
</tbody>
</table>
Surface Water Shortages
2013 w/ and w/o FERC DEIS Rules

Based on delivery of water to 98,221 acres of irrigated lands
Applied Water Delivered 2013 w/ and w/o FERC DEIS Rules

Based on delivery of water to 98,221 acres of irrigated lands
MID Net Groundwater Recharge 2013 w/ and w/o FERC DEIS Rules

Current Operations: 105 TAF Average Annual MID Net Recharge
FERC DEIS Operations: 55 TAF Average Annual MID Net Recharge
Water Balance Results

Impact of Future Amount of “Stand By” Lands on MID’s Water Balance
## Assumptions for Future Standby Scenarios

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Land Use</th>
<th>Climate</th>
<th>Reservoir Operations</th>
<th>Capital Projects</th>
<th>Irrigated Lands w/ Deliveries</th>
<th>Standby Only Lands</th>
<th>Total MID Irrigated Lands</th>
</tr>
</thead>
<tbody>
<tr>
<td>Future Baseline - Current Standby Profile</td>
<td>2040</td>
<td>1922-2014</td>
<td>FERC DEIS</td>
<td>None</td>
<td>92,803</td>
<td>23,353</td>
<td>116,156</td>
</tr>
<tr>
<td>Future Baseline – All-in</td>
<td>2040</td>
<td>1922-2014</td>
<td>FERC DEIS</td>
<td>None</td>
<td>111,156</td>
<td>5,000</td>
<td>116,156</td>
</tr>
<tr>
<td>Future Baseline - 50% Detachment</td>
<td>2040</td>
<td>1922-2014</td>
<td>FERC DEIS</td>
<td>None</td>
<td>101,980</td>
<td>5,000</td>
<td>106,980</td>
</tr>
</tbody>
</table>
Surface Water Shortages – Future Standby Scenarios

2040 Future Baseline: Delivery to 92,803 acres
2040 Future Baseline 50% Detachment: Delivery to 101,980 acres
2040 Future Baseline All-in: Delivery to 111,156 acres
**Average Deliveries – Future Standby Scenarios**

- **Future Baseline:**
  - Delivery to 92,803 acres

- **Future Baseline 50% Detachment:**
  - Delivery to 101,980 acres

- **Future Baseline All-in:**
  - Delivery to 111,156 acres
Water Balance Results

Impact of Implementing CIP on MID’s Water Balance
### Assumptions for Future w/ and w/o CIP

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Land Use</th>
<th>Climate</th>
<th>Reservoir Operations</th>
<th>Capital Projects</th>
<th>Irrigated Lands w/ Deliveries</th>
<th>Standby Only Lands</th>
<th>Total MID Irrigated Lands</th>
</tr>
</thead>
<tbody>
<tr>
<td>Proposed Program – Alt A</td>
<td>2040</td>
<td>1922-2014</td>
<td>FERC DEIS</td>
<td>Proposed CIP</td>
<td>101,980</td>
<td>5,000</td>
<td>106,980</td>
</tr>
<tr>
<td>Future Baseline - 50% Detachment</td>
<td>2040</td>
<td>1922-2014</td>
<td>FERC DEIS</td>
<td>None</td>
<td>101,980</td>
<td>5,000</td>
<td>106,980</td>
</tr>
</tbody>
</table>
Shortages – Future w/ and w/o CIP

Both Scenarios - 101,980 acres
Average Deliveries – Future w/ and w/o CIP

Both Scenarios - 101,980 acres
Water Balance Model Provides Ability to Quantify Effects of Future Conditions on MID’s Water Resources

- Improved understanding of seepage and spills helps prioritize CIP
- Implementation of proposed FERC rules would have a profound effect on reliability and shortages
- Urbanization, Crop Type, Lands in Standby, CIP, and Climatic Conditions all have an effect and are all considered
- SGMA implementation may influence future water use – flexible toolset allow evaluation of possible outcomes
Financial Model
Analytical Tools

Cross Section of San Joaquin Valley: USGS (http://ca.water.usgs.gov/projects/central-valley/central-valley-hydrologic)
The Water Balance and Financial Model are integrated

Water Year Type is San Joaquin 60-20-20 Index
Starting Lake McClure Storage for all periods is 80,000 acre-feet

Period 1: 1935 - 1964 new FERC license starts WY 1941
Period 2: 1978 - 2007 new FERC license starts WY 1984
Period 3: 1927 - 1956 new FERC license starts WY 1933
Period 5: 1987 - 2016 new FERC license starts WY 1991
Let’s look at the financial model layout
Budget Projection

View annual revenues, expenditures, and total reserve for next thirty years.
Historic Hydrologic Scenario Controls
Analyze financial implications of five hydrologic periods
General Budget Sheet
Displays all accounts in greater detail
Adjustable In-District Water Rates
Vary by annual sales volume and over time
Water Rates

- In-District Water Rate Assumptions
  - *Varies by surface water availability*

- Ability to Change Rates at a desired future date

### In-District Water Rates

Set In-District Water Rates by yearly sales volume. Rates may be adjusted once in the 30-year hydrologic period. Enter the year of change here. **2030**

<table>
<thead>
<tr>
<th>Sales (TAF)</th>
<th>2016 - 2030 Water Rate</th>
<th>2031-2045 Water Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>More than 300</td>
<td>$60</td>
<td>$60</td>
</tr>
<tr>
<td>250 to 300</td>
<td>$70</td>
<td>$70</td>
</tr>
<tr>
<td>200 to 249</td>
<td>$80</td>
<td>$80</td>
</tr>
<tr>
<td>150 to 199</td>
<td>$80</td>
<td>$80</td>
</tr>
<tr>
<td>Less Than 150</td>
<td>$100</td>
<td>$100</td>
</tr>
</tbody>
</table>
Cash Reserve Policy
Sets the band of minimum and maximum reserve levels
Capital Improvement Planner
Vary implementation date or choose timing of individual projects to meet district goals

Greater Detail in “CIP Viewer” Sheet
Water Transfer Options

Three transfer options and displays effect on In-District sales
Hydrology Sheet
Year-to-year detailed tracking of water sales, transfers, and hydropower generation
Water Balance Model Scenario Selection
Vary assumptions on acreage, demand, and CIP impacts and shows financial impact above
Hydropower is a large, fluctuating revenue source and requires in-depth evaluation.

Hydropower revenue comes from 3 sources:
- $15/Mwh RPS Revenue From McSwain
- Capacity Revenue
  - $2.3 million/year (existing Shell Contract)
- Hydropower Revenues for Exchequer/McSwain
  - Annual generation provided by Operations Model
  - Forward Prices provided by MID through 2021
  - Adjust Forecasted prices beyond 2021

We developed flexibility in the financial model to evaluate hydropower revenue impacts.
Hydropower revenues are based on $/MWH from TEA FPC report provided by MID and forecasted values. The provided forward prices are from 10/2015-12/2021. Linear Trend Forecasts are calculated and sensitivity analysis can be performed in the drop down menu beside the graph. The user can change the annual percentage change in energy from -5% to 2.5%. The default is "Trend" and is a linear trend based on provided forward prices.
Acreage and Annexed Lands

- The financial model can accommodate different water balance model scenarios
- The model also can handle Class 2 to Class 1 Conversion
- Annexing additional acreage can also be evaluated

### Water Balance Model Scenario Assumptions Display

1. Input duration of baseline scenario → 6 years
2. Select WBM model scenario for the remainder of the 30-year Hydrologic period

<table>
<thead>
<tr>
<th>Scenario</th>
<th>Duration</th>
<th>Irrigated Acres</th>
<th>Standby Acres</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline</td>
<td>2016 - 2022</td>
<td>96,222</td>
<td>26,453</td>
</tr>
<tr>
<td>Midpoint Land Use and CIP</td>
<td>2023 - 2045</td>
<td>105,463</td>
<td>6,000</td>
</tr>
</tbody>
</table>

### Class 2 → Class 1

- Acreage费: $2,600
- Year of Fee: 2020

### Annexed Acres

- Turn On/Off Annexed Acres
- New Acres as Class 1 (ON) / as Class 2 (OFF)

<table>
<thead>
<tr>
<th>Item</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Buy-in Fee per acre</td>
<td>$2,600</td>
</tr>
<tr>
<td>Year of Buy-in</td>
<td>2,016</td>
</tr>
<tr>
<td>Acreage of Buy-in</td>
<td>8,149</td>
</tr>
<tr>
<td>Standby Fee</td>
<td>$24</td>
</tr>
</tbody>
</table>

Quantity available depends on WBM Scenario
Financial Model Examples
Let’s examine how varying the hydrologic period impacts District revenue, starting with Period 1.

* Assumes no external revenue
Period 2 has the drought end, but then highly variable water supplies

* Assumes no external revenue
Period 3 has the drought end, then consistently dry for several more years

* Assumes no external revenue
Period 4 has the drought intensify for a few more years, then highly variable water supplies.

* Assumes no external revenue
Period 5 has the drought continue for several years followed by very few years above normal.

* Assumes no external revenue
The model can show the impact of increasing water rates over varying hydrologic scenarios.

Period 3

Period 4

Period 5
Another approach could be to hold down water rates but transfer water

Period 3

Period 4

Period 5
District revenue is highly sensitive to hydropower prices

Conservative Forecast
30-year annual average: $13M

Trend Forecast
30-year annual average: $17M
Path Forward
Water Resources Management Plan

Purpose - What is It?

• A long range business plan
  – 30-year planning window
  – Intended to be updated on periodic basis

• A method of engaging stakeholders in decisions
  – Water rights/resources allocation and management
  – O&M, replacements, and modernization
  – Land planning issues
  – Financial options/solutions
MID's WRMP Goals Continue to Guide All Aspects of Planning Process

What are the most important outcomes for this plan to achieve?

Study Goals

1. Protect and maximize MID’s water rights
2. Ensure that MID remains financially sound
3. Provide a reliable and affordable water supply to MID customers
4. Continued focus on MID customer service
5. Promote sustainable management of groundwater resources
6. Support the agricultural economic base of the region
Analytical Tools

Merced River Operations Model

Water Balance Model

Groundwater Model

REVENUE

POLICIES

COSTS

Land Use

Water Use

System Improvements

Groundwater Management

Cross Section of San Joaquin Valley: USGS (http://ca.water.usgs.gov/projects/central-valley/central-valley-hydrologic)
Work to date provides platform for District to evaluate choices and develop strategy for its future

- Water Balance Review & Financial Model Primer (this meeting)
- Policy Issues Discussion Items
  - *Standby Lands*
  - *Class I/II Users*
  - *Annexations*
  - *SB x7-7*
- Financial Model Part 2 Workshop to Evaluate Potential Strategies
- Alternatives Evaluation Results and Comparison with Program Goals
- Water Resources Plan Recommendations
- Begin Development of Programmatic EIR