Total Maximum Daily Loads

Waste Load Allocation (WLA)  Load Allocation (LA)
Point Source + Nonpoint Source + Background
TMDL “waste load allocation” forms the basis of the permit discharge limitations – for Total Nitrogen (TN)

- 500 lb/day TN on monthly average between May 1 and October 31
- 500 lb/day TN on an annual average basis
- The permitted annual average flow rate of 40 million gallons per day (MGD)
- To achieve TN compliance at 40 MGD (with no reuse) the maximum allowable final effluent TN would be 1.5 mg/L TN
Total Nitrogen discharge from TMWRF with Existing Treatment Processes

- Total Nitrogen discharge from TMWRF
- With Existing Treatment Processes
- Pounds per Day
- Total Nitrogen

- Waste Load Allocation: 500 lbs/day
- Exceeds Limit

- TMWRF Discharge: Million Gallons per Day (MGD)
Outside the Fence
• WRWC Approved funding last year for a high level planning study of nitrogen removal alternatives
• A scope of work was developed with Carollo Engineers to look at alternatives that would supplement existing facilities at TMWRF
• Three treatment alternatives were considered
Existing Nitrogen Removal is via Nitrification / Denitrification

Truckee Meadows Water Reclamation Facility (TMWRF)
Raw Wastewater Nitrogen

- Principally as ammonia
- Organic Nitrogen
  - Soluble (SON)
  - Particulate
- The Nitrification/Denitrification Process:
  Ammonia $\rightarrow$ Nitrite $\rightarrow$ Nitrate $\rightarrow$ Nitrogen gas
- The bacteria populations in the Nitrification/Denitrification Process can’t do much with the remaining Soluble Organic Nitrogen (SON)
Effluent Total Nitrogen

- Nitrite
- Nitrate
- Ammonia
- Organic Nitrogen
  - Soluble (SON)
  - Particulate

Nitrate and Nitrite

Total Kjeldahl Nitrogen (TKN) measures ammonia and organic nitrogen

Even with good nitrification/denitrification performance, TN = 2.1 mg/L of that about 1.6 mg/L remains as SON.
Soluble Organic Nitrogen (SON)

Effluent Soluble Organic Nitrogen 2008-2012 History
Three Alternative Considered to address the Soluble Organic Nitrogen (SON)

• Enhanced Coagulation
  – Flocculation that can be removed by filtration

• Advanced Oxidation
  – Conversion of unbiodegradable SON to biodegradable. SON that can be removed existing processes

• Reverse Osmosis
  – Separates the dissolved constituents from the effluent
Enhanced Coagulation

- Converts the SON to particles that can be removed by filtration.
- Practical to treat entire plant flow (40 MGD)
- New facilities would be between existing Post Aeration and Filters:
  - Rapid Mix Basins to introduce coagulant – Alum recommended
  - Flocculation and Sedimentation Basins
- Resulting sludge could go to the digester
- Warrants 0.5 Full-time equivalent for operations
Advanced Oxidation

- Converts the SON “unbiodegradable” into “biodegradable” so that it can be treated
- New facilities would follow existing Nitrification Towers:
  - Liquid oxygen storage tanks
  - Ozonation Equipment building
  - Ozone Contact basin
- 20 MGD ozonated and back into Nitrification
- Warrants 1.0 Full-time equivalent for operations
Reverse Osmosis

• Concentrates the SON & other constituents from the effluent into a brine stream
• New facilities would follow existing filtration:
  – Pumps, cartridge filters, Microfiltration modules,
  – More Pumps, Reverse Osmosis Modules
• 20 MGD would result in about 17 MGD of product, 3 MGD of brine (about 3,362 ac-ft)
• Brine disposal is assumed to be by deep well injection –
• Warrants 2 full-time equivalent for operations
Considerations in the planning analyses

• These processes could be designed to treat all or part of the 40 MGD

• Total Net Present Worth
  – Construction Costs
  – Engineering, Legal and Administration
  – Annual O&M Costs

• The expected accuracy range for this estimate from 50 % higher to 30 % lower
### Summary of Alternative Cost Comparisons

<table>
<thead>
<tr>
<th>Description</th>
<th>Enhanced Coagulation (40 MGD)</th>
<th>Advanced Oxidation Ozone (20 MGD)</th>
<th>Reverse Osmosis (20 MGD)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Construction Cost</td>
<td>$36,064,000</td>
<td>$24,649,000</td>
<td>$156,437,000</td>
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<tr>
<td>Engineering/Admin</td>
<td>$10,819,000</td>
<td>$7,395,000</td>
<td>$46,931,000</td>
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<td>Project Cost</td>
<td>$46,883,000</td>
<td>$32,044,000</td>
<td>$203,368,000</td>
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<td>Annual O&amp;M</td>
<td>$9,312,000</td>
<td>$1,474,000</td>
<td>$4,425,000</td>
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<tr>
<td>Net Present O&amp;M Cost (at 3% for 20 years)</td>
<td>$138,539,000</td>
<td>$21,929,000</td>
<td>$65,833,000</td>
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<td>TOTAL NET PRESENT WORTH</td>
<td>$185,422,000</td>
<td>$53,973,000</td>
<td>$269,201,000</td>
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</tbody>
</table>
Questions?
Truckee Meadows Water Reclamation Facility (TMWRF)
Flow to River reduced by Reuse

TMWRF Flow to River & Reuse

Avg Millions of Gallons per Day

May
June
July
Aug

Months (2012)

MGD to Reuse total
MGD Effluent to River
N Loading to river reduced by Reuse

TMWRF Nitrogen (N) loading to River & Reuse

Pounds of N per day

Months (2012)
### Truckee Meadows Water Reclamation Facility

#### 2013 Outfall Nitrogen Loading Compared to 6,700 AF Reuse Scenario

**Date: 1/31/2014**

<table>
<thead>
<tr>
<th></th>
<th>Actual Monthly Daily Average</th>
<th>6,700 AF Reuse Scenario</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Outfall Flow (mgd)</td>
<td>Nitrogen Load to Creek (lbs/day)</td>
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<tr>
<td>January</td>
<td>26.73</td>
<td>877</td>
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<tr>
<td>February</td>
<td>25.72</td>
<td>1054</td>
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<tr>
<td>March</td>
<td>23.12</td>
<td>1035</td>
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<tr>
<td>April</td>
<td>19.02</td>
<td>381</td>
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<tr>
<td>May</td>
<td>19.86</td>
<td>333</td>
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<tr>
<td>June</td>
<td>19.13</td>
<td>299</td>
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<tr>
<td>July</td>
<td>18.45</td>
<td>270</td>
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<tr>
<td>August</td>
<td>20.61</td>
<td>287</td>
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<tr>
<td>September</td>
<td>19.95</td>
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<td>October</td>
<td>22.17</td>
<td>345</td>
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<tr>
<td>November</td>
<td>26.98</td>
<td>472</td>
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<tr>
<td>December</td>
<td>27.93</td>
<td>731</td>
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<tr>
<td></td>
<td>22.5</td>
<td>535.2</td>
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</table>
Ammonia NH₃
RS – Raw Sewage   FE – Final Effluent
Ammonia (NH3) mg/L
Soluble Organic N
RS – Raw Sewage   FE – Final Effluent
Particulate Kjeldahl N
Final Effluent, TN and NH3
Temperature, C