Agenda

• Camp Sanitary Wastewater – A Brief History
• The Case for On-Site Treatment & Reuse
• Typical System Designs
• Piceance Basin Project
  - History
  - Plant Design & Operation
  - Remote Monitoring
  - Water Reuse
• Q&A
Remote Workforce Camps

• Safe, Comfortable Workforce Housing
  - 10 to 5,000+ residents

• Critical in Remote Locations
  - CO, UT, ND, SD, MT, WY, TX, LA
  - Northern Canada

• Sanitary Wastewater
  - always an issue ($ and aesthetics)

• Passive On-Site Treatment (septic)
  - not good for populations >25
  - site remediation ($)
Remote Workforce Camps

- Hauling to Offsite Location (POTW, lagoon)
  - expensive
  - traffic safety issues; air pollution
  - truck availability/ delays (weather)
  - receiver capacity issues

- Active On-Site Treatment
  - permitting required
  - O&M required
  - cost effective
  - potential for water reuse
  - re-useable asset; mobile
Membrane Bioreactor
Modular/ Containerized
Automatic Operation
Remote Monitoring
Typical Waste Treatment Performance

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Unit</th>
<th>Influent</th>
<th>Effluent</th>
</tr>
</thead>
<tbody>
<tr>
<td>BOD5</td>
<td>mg/L</td>
<td>300 – 500</td>
<td>&lt; 10</td>
</tr>
<tr>
<td>TSS</td>
<td>mg/L</td>
<td>200 – 400</td>
<td>&lt; 10</td>
</tr>
<tr>
<td>Total Nitrogen</td>
<td>mg/L</td>
<td>50 – 70</td>
<td>&lt; 5</td>
</tr>
<tr>
<td>Total Coliform</td>
<td>cfu/100 ml</td>
<td></td>
<td>&lt; 200</td>
</tr>
<tr>
<td>Total Phosphorus</td>
<td>mg/L</td>
<td></td>
<td>&lt; 0.5</td>
</tr>
</tbody>
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Effluent is suitable for discharge, non-potable reuse such as dust suppression, low pressure boiler feed, cooling, fire suppression, process water.
Remote Camp Systems
Mobility is Important
Remote Village – 5,000 Residents
Remote Locations

- Locations: Afghanistan to Tuktoyatuk.
- Climate: from deserts +50°C, to arctic at -50°C
Piceance Basin Project

- Large O&G exploration/production company
- Central camp & satellite drill sites (25 to 100 pp)
- On-site treatment and reuse
- Mobility critical – drill sites move (12-24 hr s/u)
Piceance Basin Project

- In operation since March 2010; year round
- About 4 to 5 “moves” per year
- O&M services; remote monitoring/alarming
Remote Monitoring

- Automated Alerts sent to on-site operators if plant goes into Alarm during off hours
- Capability for remote access to plant control systems and programming to allow for efficient troubleshooting assistance and programming changes
Sanitary Wastewater Plant

- Membrane Bioreactor
- Modular/Containerized
- Automatic Operation
**Water Reuse**

- Effluent Quality Guarantee: 10 mg/L BOD/ TSS
- Actual Effluent: <2 mg/L BOD/ TSS; Fecal <ND
- Category 3 reclaim water per state regulations

- Effluent tested daily; daily and monthly reports reviewed by county EHO
- Split samples; 3rd party state-certified labs
- Monitoring and enforcement are critical

- Dust suppression, down hole drilling
- Permit also allows irrigation, fire protection, concrete mixing
Permitting

- Plant permits under Individual Sewage Disposal System Act (ISDS)
- Endorsed by COGCC
- Applies to plants <2000 gpd
- Very similar to other states:
  - TX: OSSF (5000 gpd)
  - NM: LWDP (2000 gpd)
- Administered at county level (EHO); COGCC
- Approval to move systems within the county
- Garfield and Rio Blanco counties

- >2000 gpd goes to state level; NPDES permit
Reuse Potential

- Remote and arid locations that haul in fresh water
  - West Texas; Alaska

- Purple pipe: Flushing; 30% volume savings

- *Extreme* purple pipe:
  - Non-potable sinks & showers
  - Additional treatment required
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