Flow-Through Raceways
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Flow-through Raceways

- Need large quantities of good quality water
- Functions as a mechanical system rather than biological
- Inflowing water provides $O_2$ and metabolic wastes are carried out by effluent
- Water quality gradient down long axis of raceway
- Production is high per unit space
- Overall management of fish easier
- Commercial viability requires gravity flow
- Large volume of dilute effluent needs treatment
- Discharge is regulated
Production System

• Combined in-series & parallel raceways
• Average 4-6 uses for trout; up to 17 uses for warmwater species
• Turnover rate 3-6/hour trout; 13-18/hour warmwater
Passive Aeration

Vertical drop ranges from 0.5 – 4 feet
Splash boards and other devices used to break up the water
<table>
<thead>
<tr>
<th></th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Farm</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Raceway flow (gpm)</td>
<td>251</td>
<td>1,585</td>
<td>1,401</td>
<td>2,645</td>
<td>2,694</td>
</tr>
<tr>
<td>Farm flow (gpm)</td>
<td>1,437</td>
<td>15,401</td>
<td>50,737</td>
<td>42,835</td>
<td>134,700</td>
</tr>
<tr>
<td>Load (lb/gpm)</td>
<td>13.4</td>
<td>36</td>
<td>11.7</td>
<td>15</td>
<td>12.5</td>
</tr>
<tr>
<td>Fish density (lb/ft³)</td>
<td>2.37</td>
<td>1.69</td>
<td>2.00</td>
<td>3.18</td>
<td>2.31</td>
</tr>
<tr>
<td>Production (lb/CFS) (20,000)</td>
<td>15,927</td>
<td>29,268</td>
<td>19,937</td>
<td>25,221</td>
<td>23,347</td>
</tr>
<tr>
<td>Water use (gal/lb) (11,744)</td>
<td>14,889</td>
<td>8,086</td>
<td>11,844</td>
<td>9,375</td>
<td>10,112</td>
</tr>
<tr>
<td>Annual production (million lb)</td>
<td>0.05</td>
<td>1.00</td>
<td>2.25</td>
<td>2.40</td>
<td>7.00</td>
</tr>
</tbody>
</table>

**Trout Facility Characterization: True et al. 2004**

CFS = cubic feet per second; 1 CFS = 449 gpm
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<tbody>
<tr>
<td>Begin (fish/lb)</td>
<td>162</td>
<td>168</td>
<td>45</td>
<td>46</td>
<td>146</td>
<td>86</td>
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<tr>
<td>Harvest (fish/lb)</td>
<td>0.66</td>
<td>0.58</td>
<td>0.83</td>
<td>0.48</td>
<td>0.96</td>
<td>0.92</td>
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<tr>
<td>Days</td>
<td>363</td>
<td>300</td>
<td>369</td>
<td>419</td>
<td>278</td>
<td>352</td>
</tr>
<tr>
<td>Growth (g/day)</td>
<td>1.89</td>
<td>2.60</td>
<td>1.46</td>
<td>2.23</td>
<td>1.69</td>
<td>1.39</td>
</tr>
<tr>
<td>FCR</td>
<td>1.60</td>
<td>1.32</td>
<td>0.94</td>
<td>0.85</td>
<td>1.27</td>
<td>0.93</td>
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<tr>
<td>Survival %</td>
<td>87</td>
<td>71</td>
<td>72</td>
<td>81</td>
<td>49</td>
<td>72</td>
</tr>
</tbody>
</table>

Trout Production Indices – Yield Verification
Warm Water Raceways

- Estimated production is 40,000 lb/CFS
- Fish density 5-10 lb/ft³
- Generally more water uses and higher turnover rates compared to trout
- Tilapia and Catfish
Waste Management

• Begins with high quality feed and low FCR
• Solids are captured and removed using settling basins
• Settling basin design is based on “overflow rate” – volume of water flow per unit time divided by the surface area of the settling basin – usually expressed as a velocity
• Solids with a settling velocity \( \geq \) to the overflow rate will settle out
Demand feeders are commonly used to deliver feed

Advantages include:

• reduced labor
• access for all fish
• spreads oxygen demand throughout the day
Water Supply → Distribution Box

Waste Drain → Offline Settling Basin → Full-Flow Settling Basin

Quiescent Zone

Fish

Quiescent Zone

Fish

Quiescent Zone

Fish

Quiescent Zone
Discharge is regulated by National Pollutant Discharge Elimination System Permit