Is Wastewater Reuse in Boise's Future?

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Overview

- Boise's Existing Wastewater System
- Boise's Wastewater Facilities Planning Process
- How Does Reuse Fit into Boise's Strategy
- Boise's Path Forward

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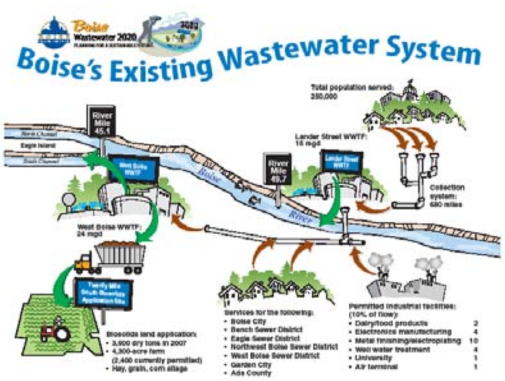

Boise's Wastewater Facilities Planning Process

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Boise's Wastewater Facilities Planning Process

- Coordination and alignment of the Wastewater Facilities Plan with the Mayor and Council's Strategic Plan was fundamental to the planning process
- Scope of the wastewater facility plan was identified to determine the collection and treatment facilities necessary to treat future flows for the service area and to meet more stringent effluent requirements

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Boise's Needs

- The City's future needs arise from the following:
  - Providing competitive and cost efficient wastewater services while investing in facilities that remain long-term assets
  - Responding to regulatory mandates for control of phosphorus and temperature
  - Responding to the demands for wastewater service that arise from unpredictable cyclic growth that may occur within or near the current area of impact.

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Key Outcomes of Pre-planning

- A well documented evaluation process was needed to guide wastewater facility planning based on monetary and non-monetary benefits of alternatives, and to document alignment between facilities planning and the Strategic Plan.

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Sustainability

"Meeting the needs of the present generation without compromising the ability of future generations to meet their needs"

(United Nations Brundtland Commission – 1987)

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Non-Monetary Criteria

- System reliability
- Adaptability/phasing/flexibility
- Operability
- Social impacts
- Environmental impacts

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Monetary Criteria

- Net present value (NPV) analysis
- Assessment of near-term budget impacts.
- Capital costs include costs for construction, engineering, land acquisition, easements, project administration, and contingency
- Operating cost

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Benefit to Cost Comparison

- Alternatives evaluated on a benefit-to-cost basis
- Benefits assigned by City staff using the 5 non-monetary criteria
- The total benefit for an alternative is the sum of individual criterion scores times their respective weightings to produce a weighted benefit score. The benefit-to-cost rating of an alternative is determined by dividing its total weighted benefit score by its normalized NPV cost

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How Does Reuse Fit Into Strategy?

- Water quality plan for lower Boise River for phosphorus envisions 50% wastewater reuse coincident with long-term growth and development in the watershed

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Lander Street Effluent Use Alternatives

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River Discharge

- Based on Lander alternative 3B-0.2
- Substantial rebuild with liquids treatment only (solids to WB)
- P removal to 0.2 mg/L
- Highest ranked LS Future alternative

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Farmers Union Canal

- Farmers Union Canal diverts an average of 160 cfs in the summer from the Boise River near Lander Street
- Eventually joins Conway Gulch → Boise River
- Board is opposed to adding ANY foreign material into its system and would not accept effluent discharge from Lander

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Water Usage at Golf Courses and Parks

- Open spaces identified on City's Parks and Recreation website and by visual inspection of aerial photos
- Area of open spaces determined by:
  - City's Parks and Recreation Website
  - Boise City Parks Inventory
  - Ada County Parks
- 70% of each site's area assumed to be irrigable (total irrigable area = 1359 acres)

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Water Usage at Golf Courses and Parks (continued)

- Effluent Exceeds Irrigable Capacity

Month	Lander Street Effluent (mgd)	Gross Irrigation Requirement* (mgd)	Excess Effluent (mgd)
May	15	7.5	7.5
June	15	9.8	5.2
July	15	11.3	3.7
August	15	9.8	5.2
September	15	7.1	7.9

Assumes 1359 acres of irrigable area

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Water Usage at Golf Courses and Parks (continued)

- Assumed varying supply from Lander WWTP, highest in July, lower in the other months, with the balance of effluent going to West Boise
- Conveyance facilities designed for this peak month (July) delivery from Lander WWTP
- Assumed discharging to small ponds at each park/golf course
- Ponds sized to facilitate irrigation only at night for 8 hours

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Conveyance System Layout

- Pipe network developed to deliver water from Lander Street to golf courses & parks
- Pump needs and pressures determined via InfoWater distribution model
- Used Hazen Williams coefficient of 130 and target pipe velocities of 5-7 fps seeking reasonable optimization between pipe diameter and pumping requirements
- Total of 46 miles of pipelines ranging from 2 to 30 inch diameter
- Total of 7 pump stations ranging from 25 to 300 hp

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Conveyance System Cost Estimating

- Capital costs for pipelines and larger pump stations determined with CH2M HILL Parametric Cost Estimating System
- Assumed 24” or smaller pipe would be PVC with DI fittings and larger pipe would be steel
- Assumed 5’ cover over pipes and intermittent dewatering based on pipe diameter
- Appurtenances: assumed air valve, blowoff, and isolation every 1000 LF (one each)

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Conveyance System Cost Estimating (continued)

- Applied difficulty factor (based on visual inspection of aerial photos) to account for traffic control and level of utility interference
- Horizontal centrifugal pumps, one redundant pump, and CMU building
- Contingencies, NPV discount rate, and capital cost factors same as for other components of the alternative
- Pump power consumption = 2.44 M kW-hr/yr (at $0.035/kW-hr)

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Lander Upgrade to Class B

- Alternative creates from 7.1 to 11.3 mgd of Class B Reuse water for irrigating parks & golf courses.
- Irrigation is assumed to occur between May 1 and September 30
- Capital facilities include upgraded facilities for a full 15 mgd plant, but no phosphorus removal
- Filtration/chemical facility is downsized to 11.3 mgd.

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Cost Summary – Lander Street (thousands $)

	Reuse Distribution	Lander Upgrade to Class B	Total Reuse	Discharge to River (3B-0.2)
Capital	$52,112	$73,230	$125,342	$82,380
Annual O&M	$980	$2,410	$3,390	$2,690
Salvage	$9,760	$19,370	$29,130	$21,790
NPV	$61,280	$98,335	**$159,615**	**$110,285**

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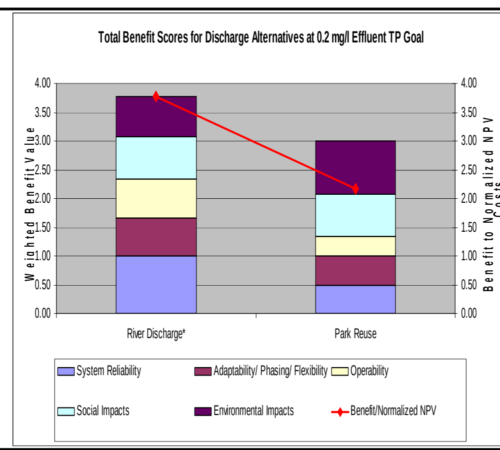

West Boise Effluent Use Alternatives

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River Discharge

- Based on BK2f-0.07
- EBPR w/ VFA supplement + PO4 release tank + intentional struvite
- Assumes 0.07 limit to be consistent with driving purpose of wetland treatment: to polish from 0.2 to 0.07 mg/L limit

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Irrigation Reuse at Biosolids Farm

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Water Usage at Twenty Mile Farm

- Assumed 4,000 acres of irrigated alfalfa
- Farm capable of consuming all effluent, except in September (need for 475 ac-ft storage)

Month	West Boise Effluent (mgd)	Gross Irrigation Requirement* (mgd)	Excess Effluent (mgd)
May	24	24.5	0
June	24	30.7	0
July	24	33.8	0
August	24	27.1	0
September	24	19.7	4.3

Assumes 4000 acres of irrigable area

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Conveyance System Layout

- Pipe network developed to deliver water from West Boise to Twenty Mile Farm
- Most efficient route goes directly south along Cloverdale
- Pump needs and pressures determined via InfoWater distribution model
- Used Hazen Williams coefficient of 130 and target pipe velocities of 5-7 fps seeking reasonable optimization between pipe diameter and pumping requirements
- Total of nearly 25 miles of 36-inch diameter pipeline
- Total of 3 pump stations ranging from 400 to 500 hp

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Conveyance System Cost Estimating

- Capital costs for pipelines and pump stations determined with CH2M HILL Parametric Cost Estimating System
- Assumed 36" steel pipe
- Assumed 5' cover over pipes and intermittent dewatering for approximately 1/3 of route
- Appurtenances: assumed air valve, blowoff, and isolation every 1000 LF (one each)

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Conveyance System Cost Estimating (continued)

- Applied difficulty factor (based on visual inspection of aerial photos) to account for traffic control and level of utility interference
- Horizontal centrifugal pumps, one redundant pump, and CMU building
- Contingencies, NPV discount rate, and capital cost factors same as for other components of the alternative
- Pump power consumption = 10.6 M kW-hr/yr (at $0.035/kW-hr)

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Wetlands/Hyporheic

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Background

- 120 acres of constructed wetlands
- Low-permeability berms surrounding perched wetlands to impede horizontal movement of water
- 100 acres of jurisdictional wetlands provide additional treatment
- 10 acres of poplars in buffer areas

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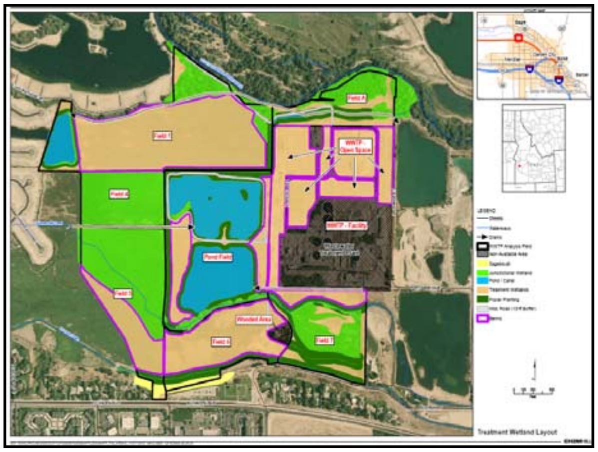

Hydrogeologic Characterization

- Regional hydrology consists of recent alluvial series overlying lacustrine deposits, overlying very deep (>1,000 ft) granitic bedrock (see Interpretive Cross Section)
- Local hydrology dominated by unconfined shallow sand & gravel aquifer (assumed to be 35 to 65 ft deep, based on borings advanced at the site and based on a review of existing well logs)
- Infiltration at the surface is controlled by a relatively thin unsaturated topsoil layer that overlies the shallow sand & gravel aquifer; infiltration rates are anticipated to range from ~0.5 in/day to 15 in/day based on empirical correlation with soil types and function

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Hydrogeologic Characterization (cont.)

- Groundwater depth ranges from less than 2 to greater than 10 feet across the site (depending on proximity to nearby surface water bodies, seasonal river level, and ground surface elevation)
- Past work at the site suggests groundwater elevation within the shallow unconfined aquifer typically ranges from 2566 to 2570 ft during normal annual river fluctuation
- Groundwater flow direction is generally toward the Boise River, in a northwest direction; gradient is estimated to be approximately 0.0019 ft/ft
- The shallow groundwater aquifer is partly fed by the upward gradient (artesian) of the underlying Interbedded Finer-Grained Alluvial aquifer (see Interpretive Cross Section)

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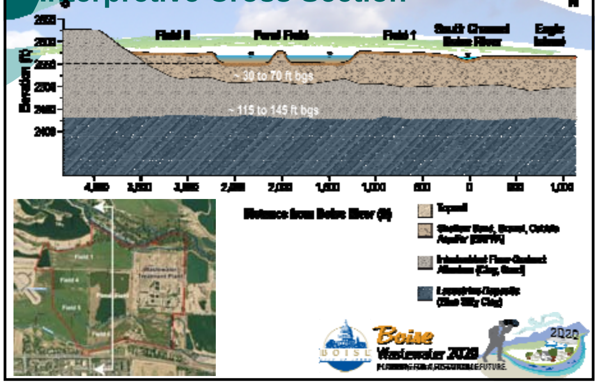
Interpretive Cross Section



Conclusions

- Sampling sites 6 and 7 appear most favorable for P removal, but may not sustain needed perc. rate
- Pilot testing needed to confirm infiltration values and potential for P removal

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Phyllis Canal

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Potential Discharge into Irrigation Canals

- Three Idaho examples where effluent is already allowed to discharge into irrigation canals via a NPDES permit:
  - Caldwell Housing Authority (Sebree Canal → Conway Gulch → Boise River)
  - Sorrento Lactalis (Purdam Drain → Mason Cr. → Boise River)
  - City of Jerome (Northside Canal Co. → Snake River)

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IDEQ Requirements

- In all three cases, water within the canals only needs to be protected to meet the uses for which the canals were developed
  - Man-made waterways = agricultural water supply standards
- More stringent standards (and TMDL requirements) not required until the canals/ditches discharge into waters of the state (creeks and rivers)

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Phyllis Canal – Characteristics

- Phyllis Canal diverts an average of 300 cfs in the summer
  - Receiving an effluent discharge of 37-60 cfs (24-39 MGD) would be a small portion of the total canal flow
- Eventually joins the Highline Canal, which drains to both Dixie Slough and the Snake River

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Phyllis Canal – Settlers Irrigation District

- Interested in discussing direct summer discharge from West Boise further because they recognize the potential operational and financial benefits.

Phyllis Canal - Background

- Water is pumped from West Boise WWTP uphill to Chinden where a gravity pipe carries flow to the Phyllis Canal at Linder
- Combined pressure-gravity design and estimated costs based on 24mgd

Conveyance System Cost Estimating

- Capital costs for pipelines and pump stations determined with CH2M HILL Parametric Cost Estimating System
- Pressurized Section
  - Pump station with two operating 250 hp pumps and one standby pump for redundancy
  - 0.5 miles of 30" diameter steel pipe
- Gravity Section
  - 4.75 miles of 42" HDPE pipe
- Assumed 5' cover over pipes and dewatering for lower elevation portion of route
- Appurtenances: assumed air valve, blowoff, and isolation every 1000 LF (one each)

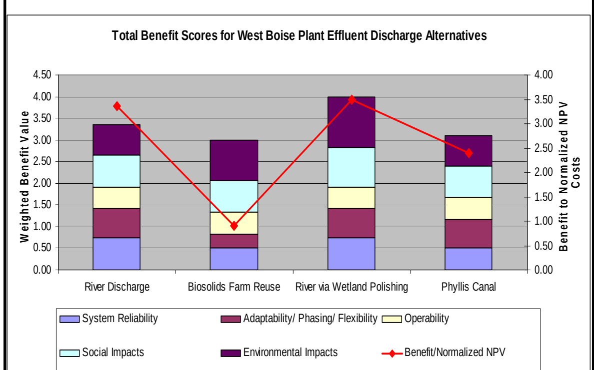
Conveyance System Cost Estimating (continued)

- Applied difficulty factor (based on visual inspection of aerial photos) to account for traffic control and level of utility interference
- Horizontal centrifugal pumps, one redundant pump, and CMU building
- Contingencies, NPV discount rate, and capital cost factors same as for other components of the alternative
- Pump power consumption = 1.44 M kW-hr/yr (at $0.035/kW-hr)

Cost Summary – West Boise (thousands $)

	River Discharge (BK2f-0.07)	Wetlands			Phyllis Canal			Biosolids Farm
		BK2f-0.2	Wetlands	Total	BK2f-0.2*	Conveyance	Total	
Capital	55,670	55,400	12,939	68,339	55,400	17,389	72,789	127,010
Annual O&M	(459)	(1,060)	100	(960)	(1,060)	550	(510)	2,400
NPV	**50,274**	43,112	14,430	**57,542**	43,112	24,570	**67,682**	**151,580**

* Degree of P removal required by irrigation district is negotiable, this is conservative assumption



Future Service Area Effluent Use Alternatives

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Growth and Expansion of the Service Area to the South and Southeast

- The proposed expanded planning area outside of the existing Area of Impact contains approximately 42,900 acres.
- An objective of the Plan was to assess the "big picture" regarding the long-term strategy for satisfying the area's wastewater service needs for conveyance, treatment, discharge, and reuse.
- Potential growth is strongest to the south/southeast of the City creating the likelihood of a future expansion of the City's area of impact.

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Overview of Alternatives

- Build Trunk Sewers and Convey to West Boise
  - Collection
  - Treatment
  - River Discharge
- Satellite Alternatives
  - Collection System
  - Treatment System
  - Reuse & Distribution System
  - Storage/Infiltration/Wetlands/Extraction System
  - Creek Discharge

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Trunk Sewers in Drainages/To West Boise

Trunk Sewers in Drainages/Reuse Plants

All Trunk Conveyance to West Boise – Conveyance

All Trunk Conveyance to West Boise – Treatment

- Design Flows
  - Total System Average Day Flow Max Month= 92 mgd
  - West Boise is on-line
    - Design Average Day Flow Max Month = 77 mgd
  - Lander Street is On-Line as Liquids Only
    - Design Average Day Flow Max Month = 15 mgd

All Trunk Conveyance to West Boise – Treatment

- Effluent Criteria
  - Year-Round River Discharge
  - May 1 thru September 30
    - Effluent Total P = 0.2 mg/L
  - Effluent Total N = 10 to 20 mg/L
  - Phosphorus Treatment Option is BK2F–0.2
    - (EBPR; w/Fermentation; PO4 Release on WAS; Intentional Struvite on WAS Thickening Underflow and Dewatering Filtrate
    - 1/2–Year & Year-Round Intentional Struvite Operations Comparison

All Trunk Conveyance to West Boise – Treatment

- Additional Facilities for a Capacity Expansion from 24 to 77 mgd
- Additional Facilities for 77 mgd Phosphorus Removal

All Trunk Conveyance to West Boise – Treatment

- Biosolids
  - Anaerobically Digested & Dewatered
  - Trucked and Land Applied at TMSBAS and beyond
  - Expansion of Farm Acreage

Satellite Alternatives - Treatment

- Single Plant
- Three Plants
- Five Plants

Satellite Alternatives – 3 Treatment Scenarios

- One Class A Treatment Plant
  - 25 mgd
- Three Class A Treatment Plants
  - One 11 mgd
  - One 5 mgd
  - One 9 mgd
- Five Treatment Plants
  - One 10 mgd Class A
  - Four 5 mgd Class B

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Satellite Alternatives – Single Plant

- Treatment
  - Influent Pump Station
  - Screening & Grit Removal
  - Primary Clarifiers
  - Aeration Basins
  - MBR Basins
  - Disinfection with Sodium Hypochlorite
  - PS & WAS Thickening
  - Anaerobic Digestion & Dewatering

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Satellite Alternatives – non solids handling plants

- Influent Pumping
- Screening & Grit Removal
- Aeration Basins
- MBR Basins
- Disinfection with Sodium Hypochlorite
- WAS to Sewer

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Reuse

- Conceptual Layout and Cost Estimating for Conveyance System Components

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Future Service Area Definition

- Service area defined by City's future service planning boundary and topographical features
- Number of irrigation sites established based on density calculated from Lander Street network (1.2 sites/mi) – assuming future development in the Future Service Area would yield a similar layout of parks and golf courses
- Irrigation sites evenly distributed throughout service area

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The Distribution Network

- Conveyance system established to deliver water from sources (WWTFs) to distributed sites of constant demand within each collection zone
- In options with multiple WWTFs, reuse distribution systems for each WWTF are independent
- Pipes terminate at next upstream WWTF without tying in

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Water Usage

- Water assumed to be used at parks or other open spaces for 6 month period (April 15 – October 15)
- Parks "sized" to completely consume supply during peak demand month (July)
- Excess effluent during shoulder months → need for rapid infiltration basins or wetlands
  - Irrigation season shoulder months require ~120 acre rapid infiltration basin for excess effluent
  - Non-irrigation season disposal facilities required
- Assumed discharging to small ponds at each park/golf course, with those ponds sized to facilitate irrigation only at night for 8 hours

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Water Usage (continued)

- Effluent Exceeds Irrigable Capacity

Month	S-SE Effluent (mgd)	Gross Irrigation Requirement* (mgd)	Excess Effluent (mgd)
April	25	10.5	14.5
May	25	16.6	8.4
June	25	21.1	3.9
July	25	25.0	0.0
August	25	21.5	3.5
September	25	15.1	9.9
October	25	8.6	16.4

*Assumes Option 1 (one 25 mgd WWTF): 3,000 acres of irrigable area

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Off-season Infiltration Facilities

WWTP Option #	Effluent (mgd)	Constructed Wetland Ksat @ 0.48 in/day Est. Area, ac	Constructed Wetland Ksat @ 5 in/day Est. Area, ac	Rapid Infiltration Basin Ksat @ 6 in/day Est. Area, ac
1	25	2476	222	184
2	9	891	80	66
	5	495	44	37
	11	1089	98	81
Option Total	25	2475	222	184
3	8.33	825	74	61
	4.17	413	37	31
	4.17	413	37	31
	4.17	413	37	31
	4.17	413	37	31
Option Total	25	2477	222	185

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Conveyance System Analysis

- Pump needs and pressures determined via InfoWater distribution model
- Used Hazen Williams coefficient of 130 and target pipe velocities of 5-7 fps seeking reasonable optimization between pipe diameter and pumping requirements
- Total of 60 miles of pipelines ranging from 6 to 40 inch diameter
- Total of 12 pump stations ranging from 15 to 1,350 total operating hp per facility

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Conveyance System Cost Estimating

- Capital costs for pipelines and larger pump stations determined with CH2M HILL Parametric Cost Estimating System
- Assumed 24" or smaller pipe would be PVC with DI fittings and larger pipe would be steel
- Assumed 5' cover over pipes and dewatering for 25% of network (with this 25% accounting for areas that could be adjacent to creek drainages, irrigated fields, or perched GW tables)
- Appurtenances: assumed air valve, blowoff, and isolation every 1000 LF (one each)

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Conveyance System Cost Estimating (continued)

- Assumed area would be undeveloped at time of construction and applied "open country" site condition factor to account for minimal traffic control or utility interference
- Horizontal centrifugal pumps, one redundant pump, and CMU building
- Contingencies, NPV discount rate, and capital cost factors same as for other components of the alternative
- Pump power consumption = 2.44 M kW-hr/yr (at $0.035/kW-hr)

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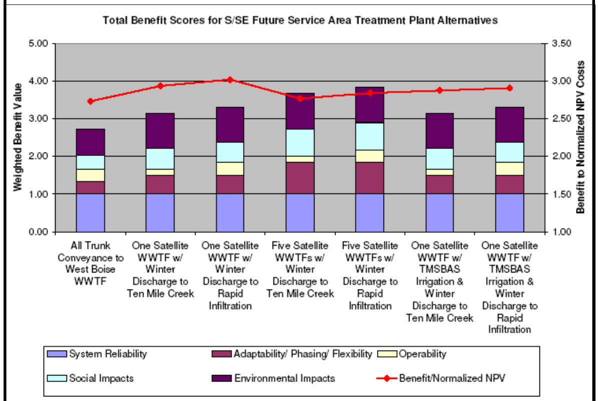

FSA Summary

- Wastewater management in the FSA (beyond the next 5 years) is not clear because technical and regulatory uncertainties prohibited final selection of FSA alternatives.
- The facilities planning process did not identify specific implementation plans for wastewater management in the FSA.
- The preferred build-out model for providing wastewater management in the FSA is to provide a central gravity sewer system with Five Satellite WWTFs along it for treatment of wastewater that is generated up gradient.

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FSA Summary

- The Five Satellite WWTFs would provide treated wastewater for turf irrigation (landscapes, golf courses, open spaces, roadsides, and greenbelts). The up gradient WWTFs would be liquids-only treatment facilities wherein the solids generated from each satellite WWTF would be conveyed down the central gravity sewer to a single WWTF with solids treatment capability
- The biosolids would be applied to agricultural land at the TMSBAS.

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FSA Summary

- The Five Satellite WWTF Alternative was the staff-preferred approach because of the adaptability, flexibility, and phasing ability of having five satellite WWTFs. In addition, each of the five WWTFs could also be readily phased in because of the modular treatment units available for the treatment technology that would be used (membrane bioreactors).

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