



King County CSO Treatment Technology Evaluation

**MWPAAC E&P Subcommittee
February 18, 2009
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CSO Treatment Technology Evaluation

Background/History

- The RWSP evaluated “high-rate sedimentation” treatment processes as well as conventional primary clarification.
- RWSP cost estimating found conventional primary clarification to be more cost-effective -- selected as the recommended treatment technology.
- Recommended continued monitoring of the implementation experience of other agencies and any development of new high-rate technologies

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- Information developed for the 2006 Program Review and the 2005/08 CSO Plan Update showed limited full-scale implementation of high-rate technologies
- Research suggested that high-rate technologies could perform well at much higher SORs
 - Higher SORs may translate into smaller plant footprints, and lower capital costs
 - Public interest in control of non-conventional pollutants was growing
- Pilot testing recommended to fill information gaps

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- CSO treatment defined as 50% TSS removal and an effluent settleable solids of 0.3 ml/L/hr.
- Primary treatment → 50% TSS removal at a surface overflow rate (SOR) of 4,000 gpd/ft².
- High rate sedimentation → 50% TSS removal at a surface overflow rate (SOR) of 20,000 gpd/ft².



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- The Pilot Project was added to the CSO Plan Update & Review project
- Budget was set at \$1.6 M
- CDM was hired in 2007 to support evaluation of current and emerging technologies, recommend technologies for testing and prepare a test plan.

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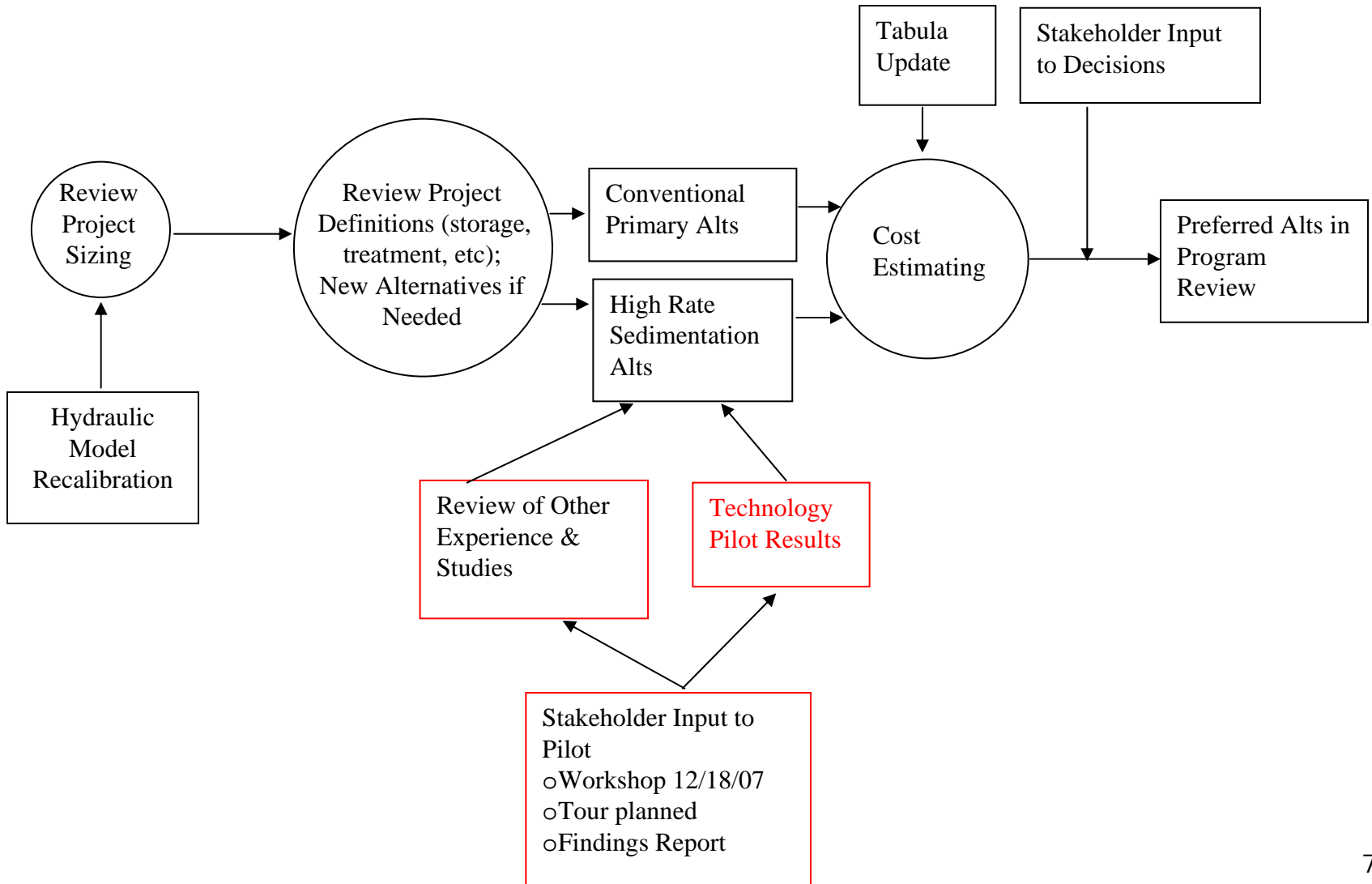
■ *Why Do Pilot-Scale Testing?*

Provides reliable information to support decision-making.

- Better understanding of technology's strengths and weaknesses.
- Control wide range of conditions and operating modes to determine how technology responds.
- Control of sampling location and frequency.
- Hands-on operating experience.
- Learn from failures as well as successes.
- **Not selecting a technology for implementation.**

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How Pilot Information Will Be Used



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■ Project Work Plan (Phase 1)

- Updated information on existing facilities and previous studies.
- Identified and evaluated 19 existing and emerging technologies.
- Assessed technologies for suitability for KC applications, availability of design data and issues that could be addressed by pilot-scale testing.

Technology Evaluation Summary Table

Item	Description	Advantages relative to Primary Treatment	Disadvantages relative to Primary Treatment	Relative Footprint to Achieve 50% TSS Removal	Relative Capital Costs	Relative Annual O&M Costs	Estimated Removal Rates (%)				Operations and Maintenance Considerations (including odor)	Questions pilot scale testing would address		
				<i>Preliminary Site Plans for alternatives found in Appendix A</i>					TSS	BOD/COD	Organics	Metals		
A1.	Conventional Primary Clarification	<ul style="list-style-type: none"> Base Case Well known technology 			Low	Low	50 to 70%	25 to 40%	25 to 40%	30 to 40%	Large basins will require additional clean-up time	<ul style="list-style-type: none"> Address problems/feasibility in basin chlorination application 		
A2.	Chemically Enhanced Primary	<ul style="list-style-type: none"> Higher SOR (10 to 30 gpm/ft²) 	<ul style="list-style-type: none"> Greater chemical storage and application requirements 	<ul style="list-style-type: none"> About 10% reduction in site requirements 	Medium	Medium	70 to 90%	35 to 50%	35 to 40%	35 to 40%	Increase chemical storage and chemical deliveries	<ul style="list-style-type: none"> Determine variability in CE effluent with respect to turbidity and transmissivity as well as chlorine effectiveness 		
A3.	Ballasted Sedimentation	<ul style="list-style-type: none"> Higher SOR (20 to 40 gpm/ft²) 	<ul style="list-style-type: none"> Some technologies may have long start-up times (Densadeg) 	<ul style="list-style-type: none"> About 30% reduction in site requirements 	High	Medium	80 to 94%	50 to 75%	50 to 75%	50 to 65%	Same as A2	<ul style="list-style-type: none"> Determine feasibility of chemical addition/supplement to low power/O&M cost Evaluate O&M concerns regarding Actiflo Investigate SOR for this approach at remote location; sludge start-up issues 		
A4.	Bio-enhanced ballasted	<ul style="list-style-type: none"> Full secondary equivalent could be achieved during overflows (20 to 40gpm/ft²) 	<ul style="list-style-type: none"> More complicated operation 	<ul style="list-style-type: none"> About 30% reduction in site requirements 	High	High	97 to 99%	85 to 90%	50 to 80%	50 to 75%	Same as A2 Solids line flushing required	<ul style="list-style-type: none"> Address adding active biomass at remote location and start-up concerns (i.e. trucking or collecting from collection system) Address O&M issues using this approach 		
A4.	Hydrodynamic Separation (Vortex)	<ul style="list-style-type: none"> Simple operation (30 gpm/ft²) 	<ul style="list-style-type: none"> Can not meet removal efficiency 	<ul style="list-style-type: none"> Can not meet this standard with this approach alone 	Low	Low	10 to 35%	15%	>25%	NA	Would require extensive and continuous cleaning to maintain removal rates	<ul style="list-style-type: none"> Review suitability as pretreatment for other technologies Evaluate metal removal capability Evaluate chemical addition 		
A5.	Continuous Deflective Separation (CDS)	<ul style="list-style-type: none"> Simple operation (30 gpm/ft²) 	<ul style="list-style-type: none"> Can not meet removal efficiency 	<ul style="list-style-type: none"> Can not meet this standards with this approach alone 	Low	Low	10 to 45%	15% to 20%	>25%	NA	Would require extensive and continuous cleaning to maintain removal rates	<ul style="list-style-type: none"> Review suitability as pretreatment for other technologies Evaluate metal removal capability 		
A6.	Salsnes Filter	<ul style="list-style-type: none"> Potentially smaller site layout 	<ul style="list-style-type: none"> Complex piping arrangement 		Medium	Low	40 to 70%	30 to 40%		NA	Cleaning requirements	<ul style="list-style-type: none"> Suitability as pretreatment for other technologies O&M required for CSO use What size screen would improve performance Metal removal efficiency 		

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■ Project Work Plan - Conclusions

- Most pilot-testing has been based on wastewater treatment (not CSO).
- Most active CSO (peak flow) treatment facilities are located at wastewater treatment facilities and blend with effluent.
- 16 Ballasted Sedimentation systems installed since 2001 (2 stand-alone).

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■ Project Work Plan - Conclusions

- Ballasted Sedimentation units can be designed based on existing data and operating experience.
- Many technologies eliminated from pilot test consideration because they can not reliably meet suspended solids standards (e.g. Vortex Separator, Continuous Deflective Separation)
- Other technologies eliminated because they are not suitable for very large CSO flows (e.g. compressed media filter, Salsnes Filter, membranes).

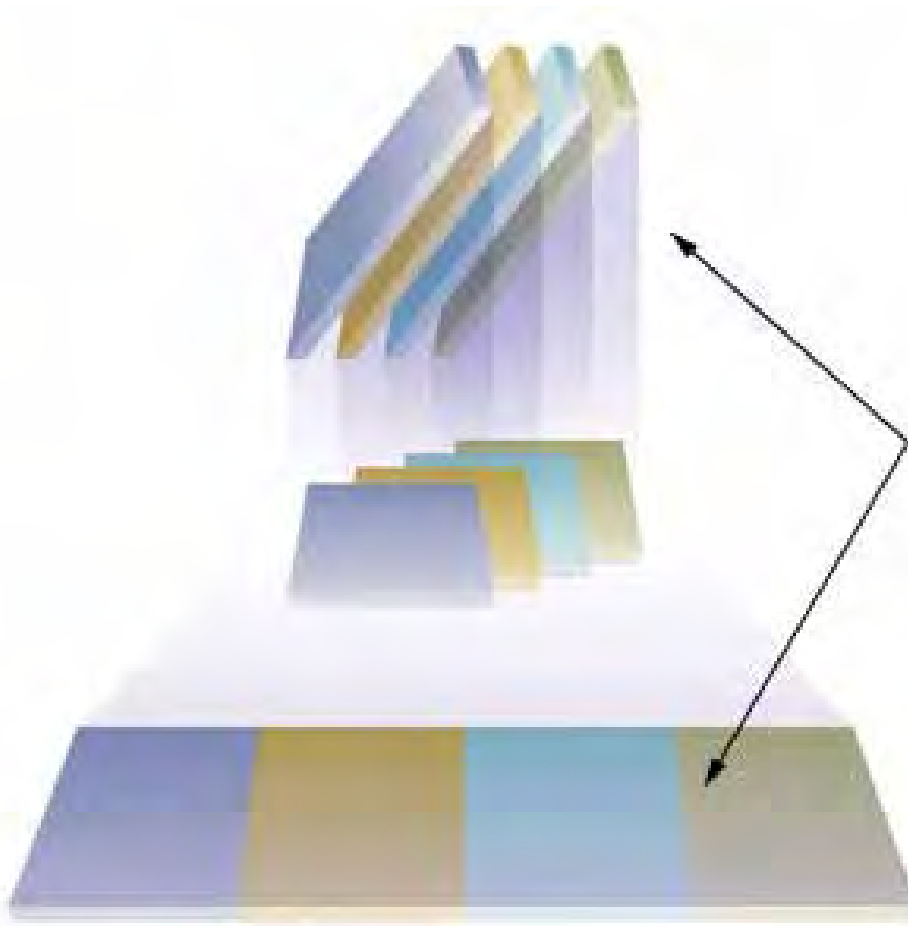
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■ Project Work Plan - Conclusions

- Chemically Enhanced Primary Clarification (CEPC) and CEPC with Lamella Plates (CEPC-LP) have potential to meet standards, reduce costs, reduce footprint.
- Data gaps associated with CEPC and CEPC-LP can be addressed by pilot testing.
- Jar testing can establish boundaries for pilot testing, narrow range of testing conditions and reduce time/cost of pilot testing.

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What are Lamella Plates?



Because each plate settler provides an effective settling area equal to that of its horizontal projection, MRI Plate Settlers will increase a basin's effective settling area by up to ten times.

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Lamella Plate Settlers Assembled for Delivery



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Installation of Lamella Plate Settlers



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■ Project Test Plan

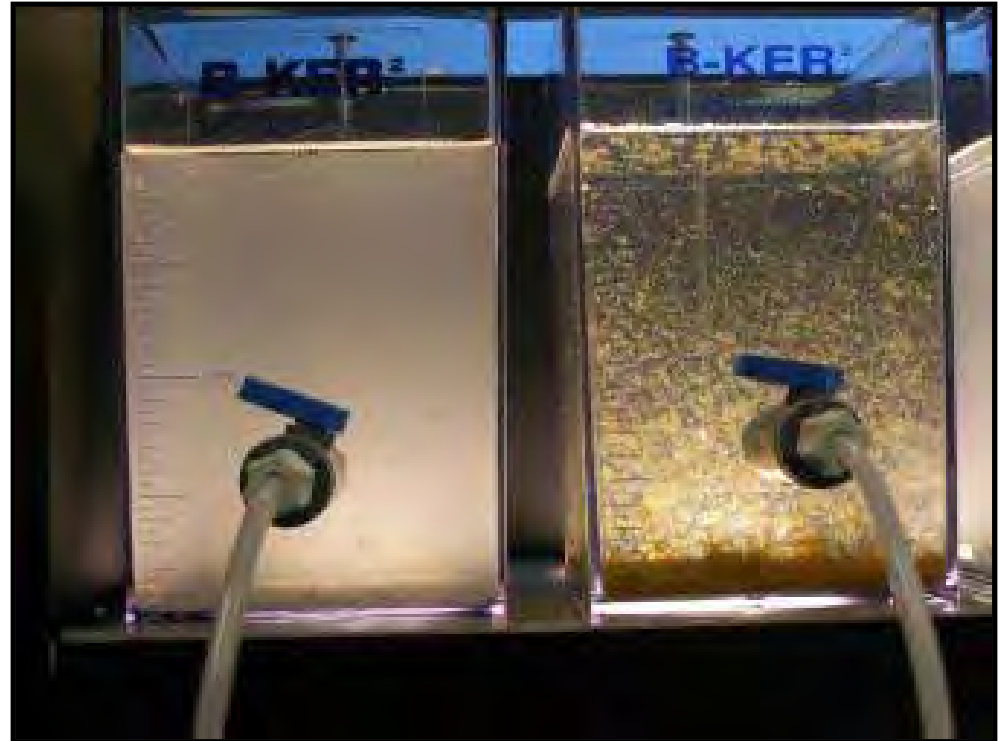
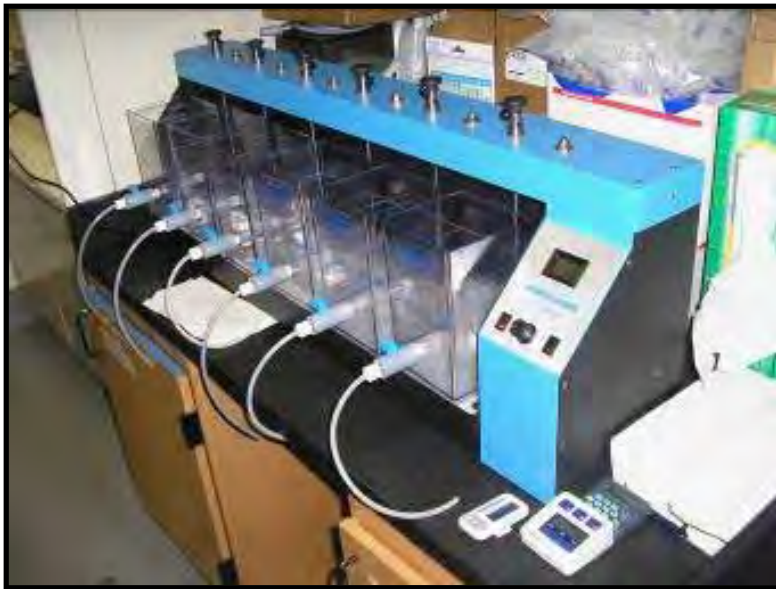
- Test CEPC and CEPC with lamella plates.
- Procure pilot unit with ability to test both technologies side-by-side.
- Feed pilot unit with primary influent diluted with secondary effluent as necessary to approximate CSO water.
- Testing will be conducted at both constant flow and variable flow designed to match CSO hydrographs.
- Additional jar testing

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- Project Test Plan
 - Sampling and Analytical Plan
 - TSS/VSS
 - Alkalinity
 - COD
 - Nutrients
 - Metals
 - Organics
 - UV-254

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Jar Testing

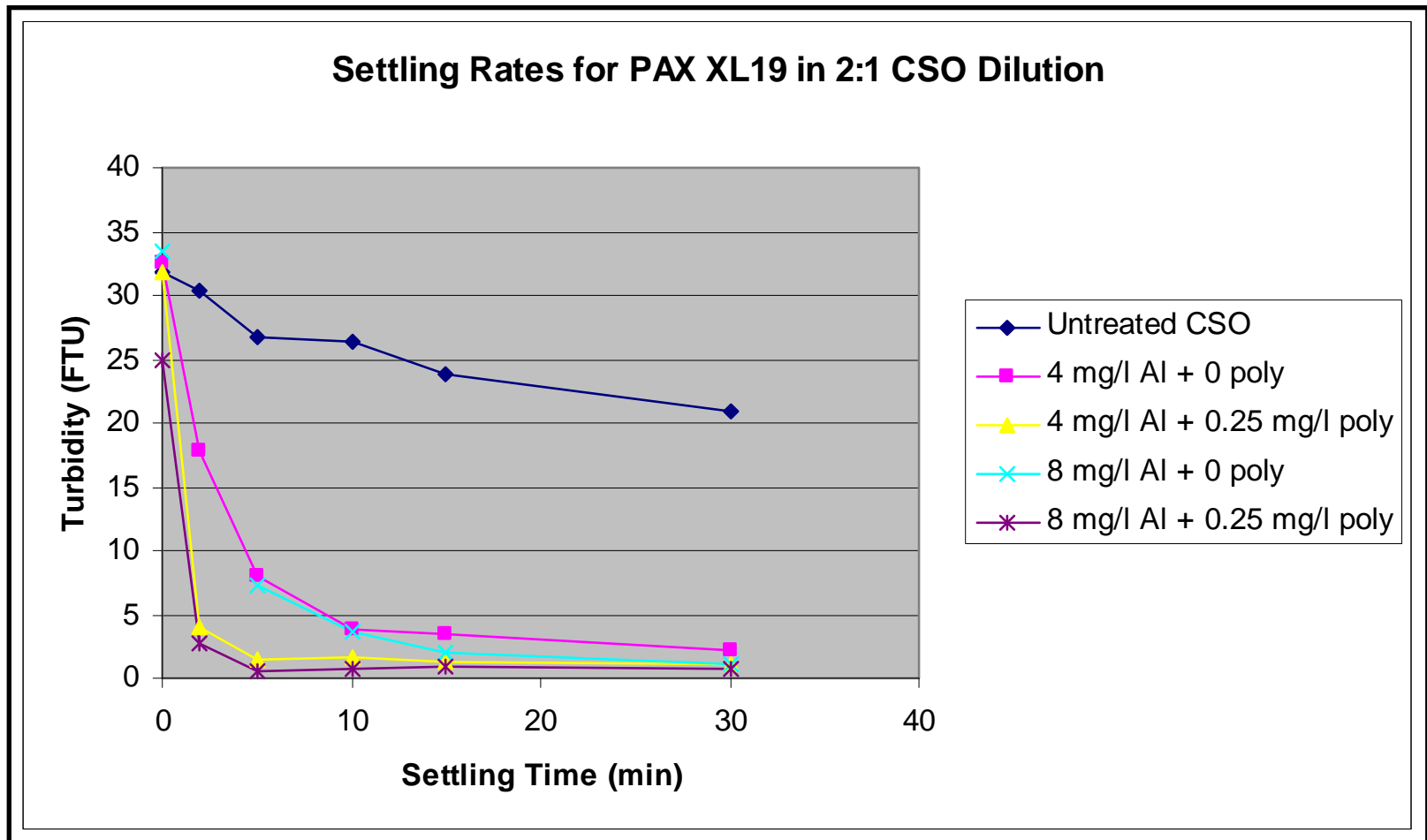


Provides rough idea of effectiveness of different chemicals on solids settling.

Narrows scope of testing for pilot test.

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Jar Testing (cont'd)



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- Pilot Clarifier Installation
 - *Test unit delivery – Nov 17th*
 - *Pilot installation complete – December*
 - *Facility modifications complete – January 2009*
- Commissioning
 - *Hydraulic testing – January*
 - *PI testing (comparison to WP primary) – February*
- Optimization Testing
 - *Chemical selection – February*
- Performance Testing
 - *Variable flow – February-April 2009*
 - *Wet weather events – February-April 2009*
- Final Report – Q3 2009

Pilot Clarifier Configuration



Temporary piping installed
for hydraulic testing

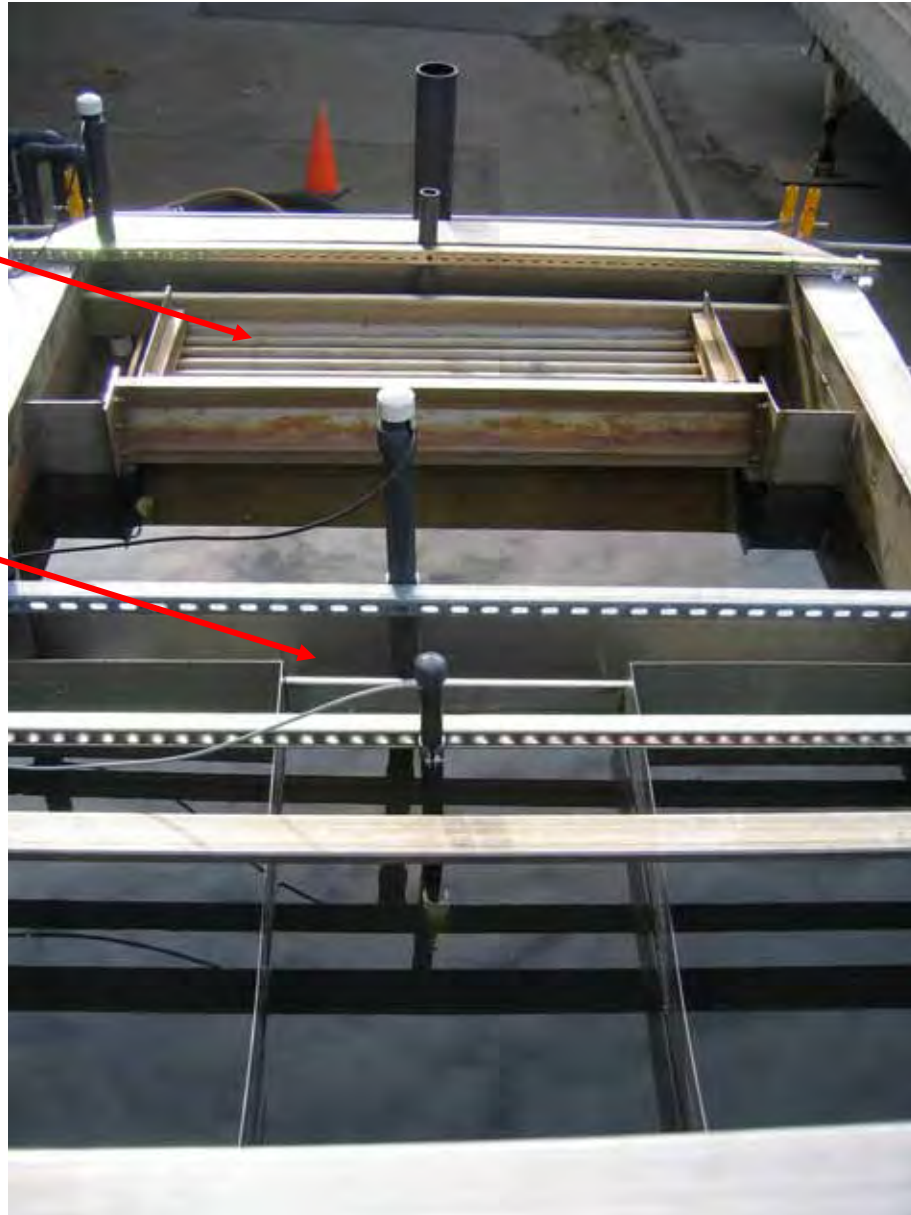




CSO Treatment Pilot Plant Exterior

Lamella Plates

Chemically Enhanced
Effluent Channel



Lamella Plates



Chemically Enhanced Effluent Weir





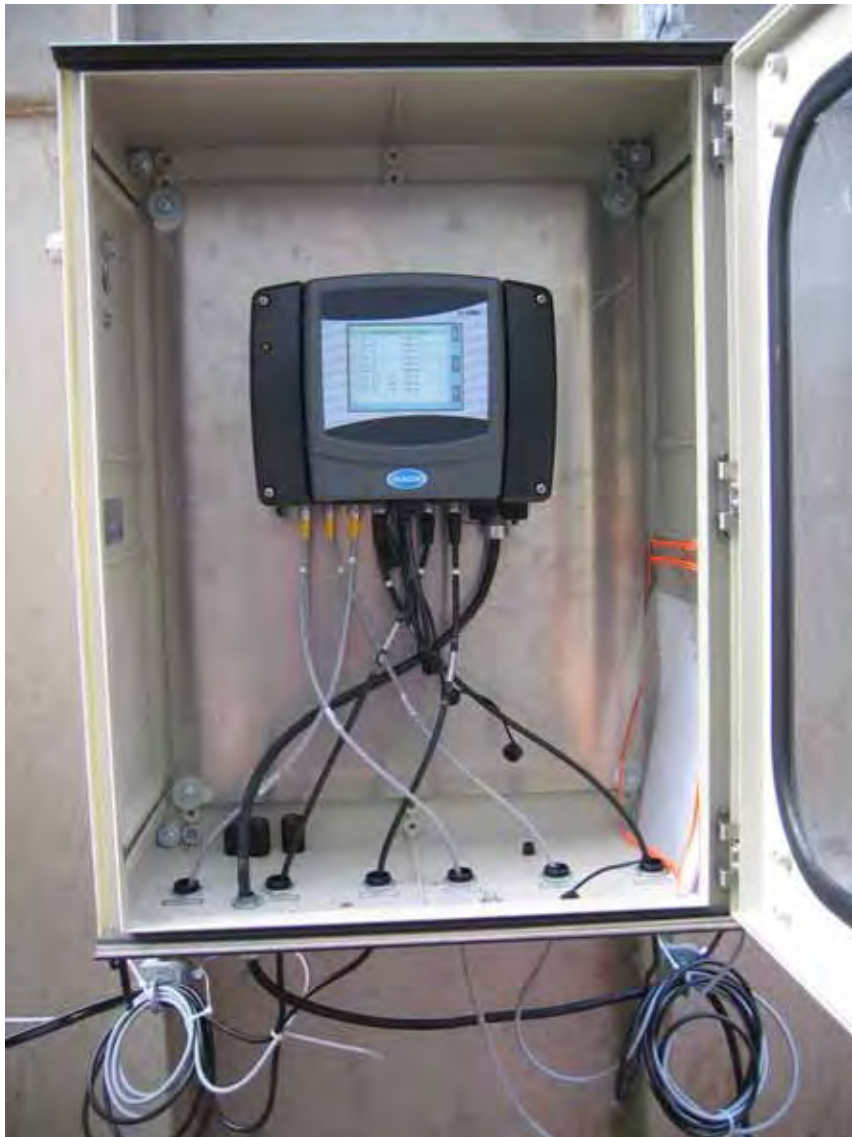
Influent Blend Tank



Chemical Feed Pumps

Coagulant Addition





Sensor Control Panel and Display

MEASUREMENT VALUE DISPLAY

6.71 pH		PHM1-71
8.5 °C		PHM1-71
6.74 pH		PHM2-70
9.0 °C		PHM2-70
6.72 pH		PHM3-94
9.6 °C		PHM3-94
2.26 NTU	TRB	TM1-79
1.74 NTU	TRB	TM2-59
4.53 NTU	TRB	TM3-88



Questions?

Wastewater Treatment Division
Technology Assessment Program

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