System Optimization: The First Step in CSO Control Alternatives Development

Don Walker

NEWEA 2015 Specialty Conference Series

October 26, 2015

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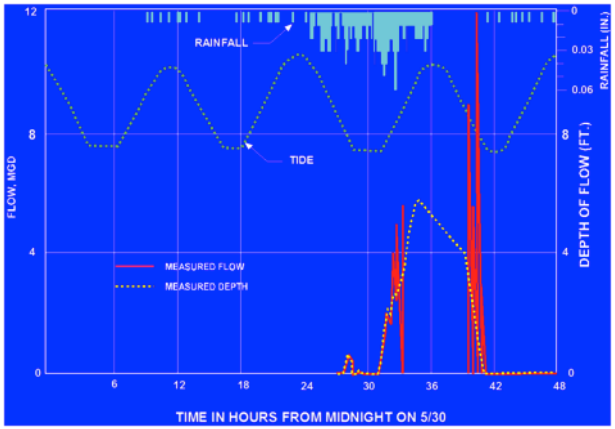
Outline

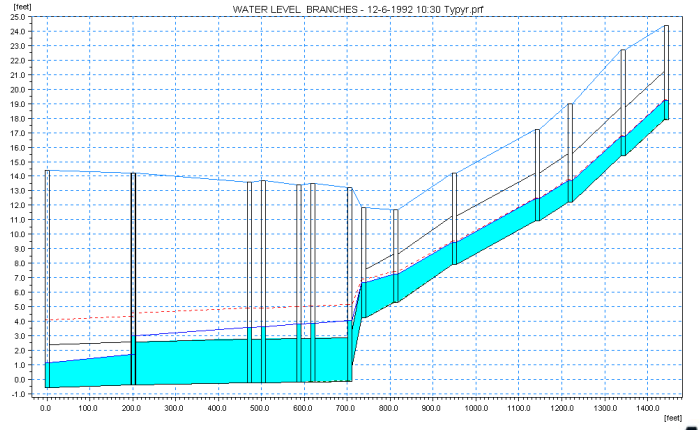
- System Characterization
  - ✓ Groundwork for system optimization
- Examples of Typical Optimization Measures
  - ✓ Static weir raising
  - ✓ Localized hydraulic relief
  - ✓ Vortex valves
  - ✓ Bending weirs
  - ✓ Pump station operations
  - ✓ Use of remote flow/level monitoring to optimize existing facility operation

System Characterization

- First step in LTCP development
  - ✓Collection system mapping/GIS
  - ✓Flow monitoring
  - ✓Inspection data
  - ✓Collection system modeling

- Develop system understanding & confidence in analytical tools used to assess optimization measures





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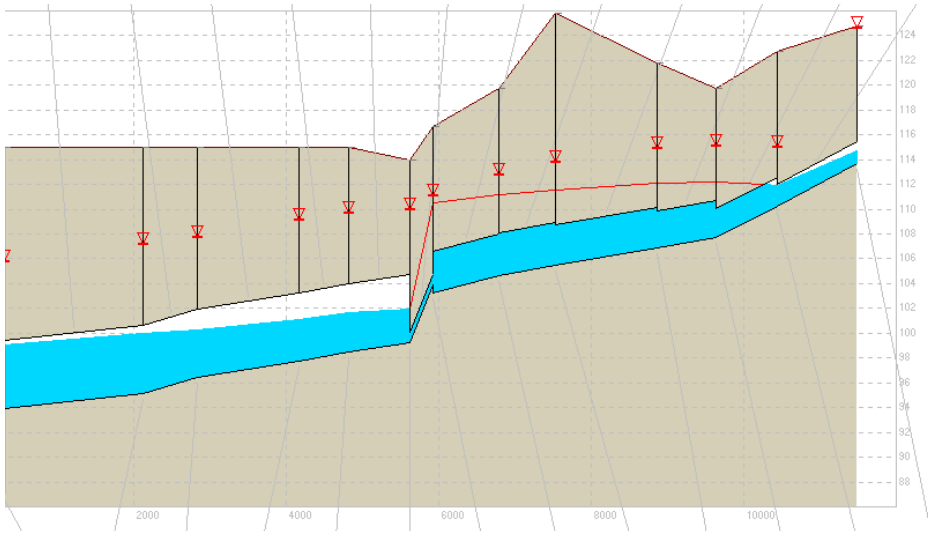
Optimization Approach

- Search for opportunities – what to look for:
  - ✓ Large-diameter pipes with available capacity
  - ✓ Flow restrictions/areas of high headloss
  - ✓ Under-utilized tanks/facilities
  - ✓ Pump capacities
  - ✓ CSO regulator configurations



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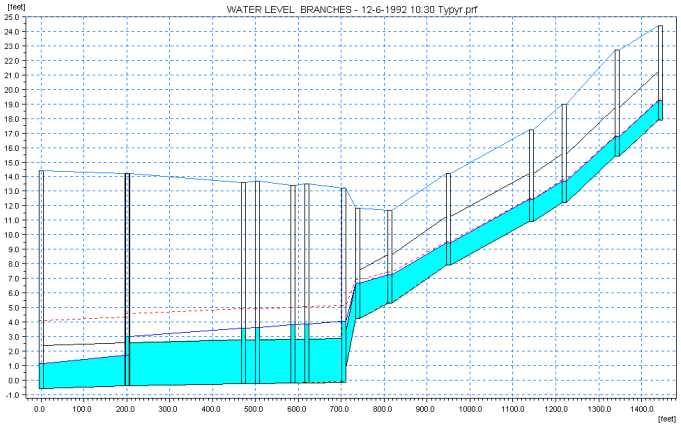
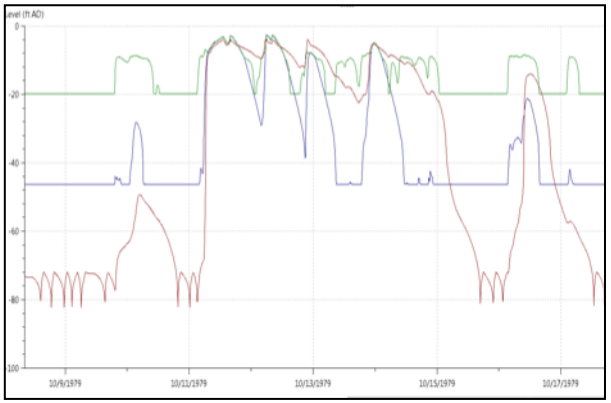
Modeling Tools

- Profiles
- Level and Flow vs. Time
- Color-coding output for pipe surcharge state, velocities, etc.





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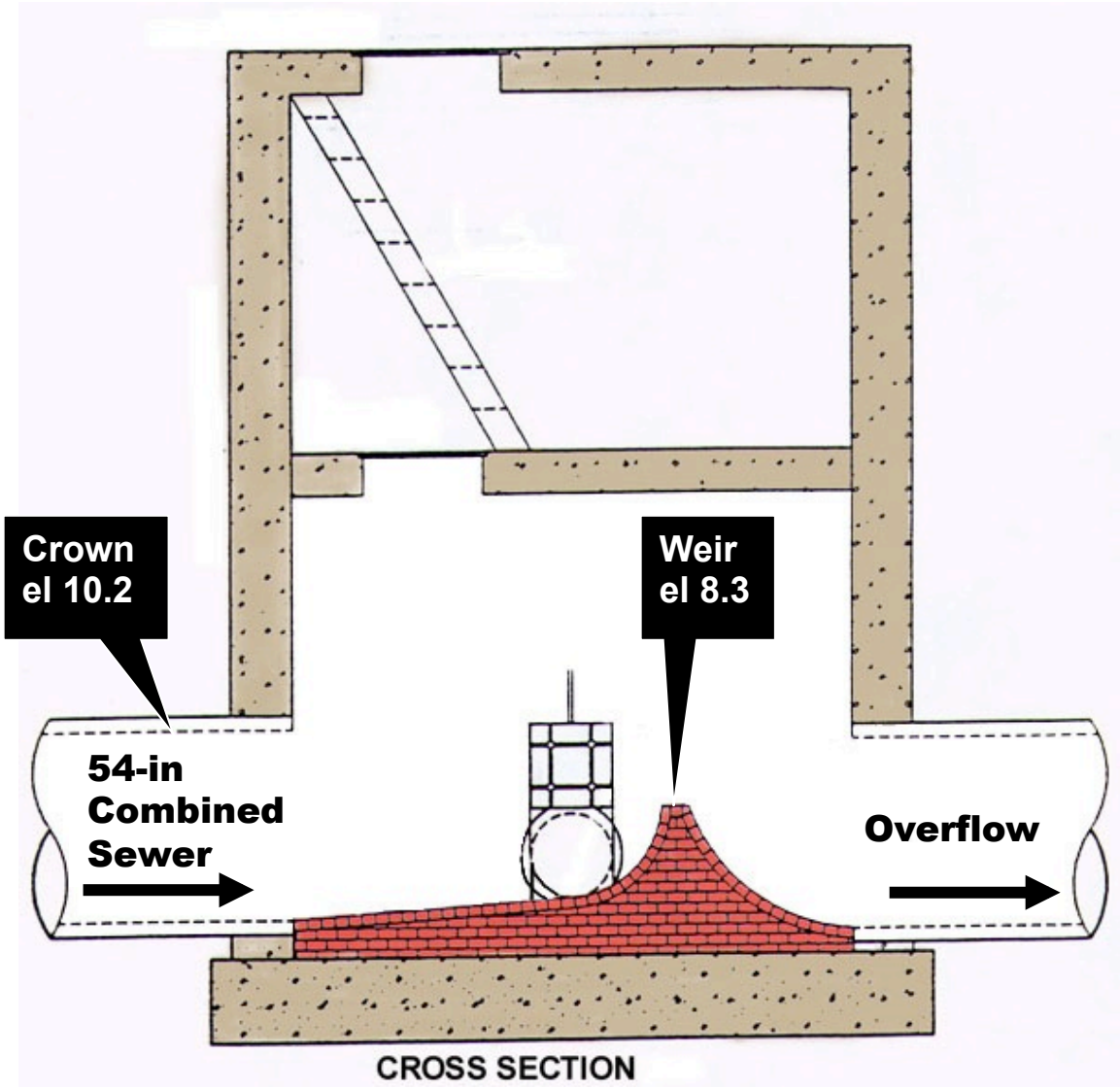
Example: Static Weir Raising



- Incrementally raise weir in model
- Check performance in typical year
- Check HGL impact in larger storm
- Look for opportunity to lengthen weir to offset higher HGL
- **Watch out for:**
  - Impacts to other outfalls
  - Adverse HGL impacts upstream or downstream

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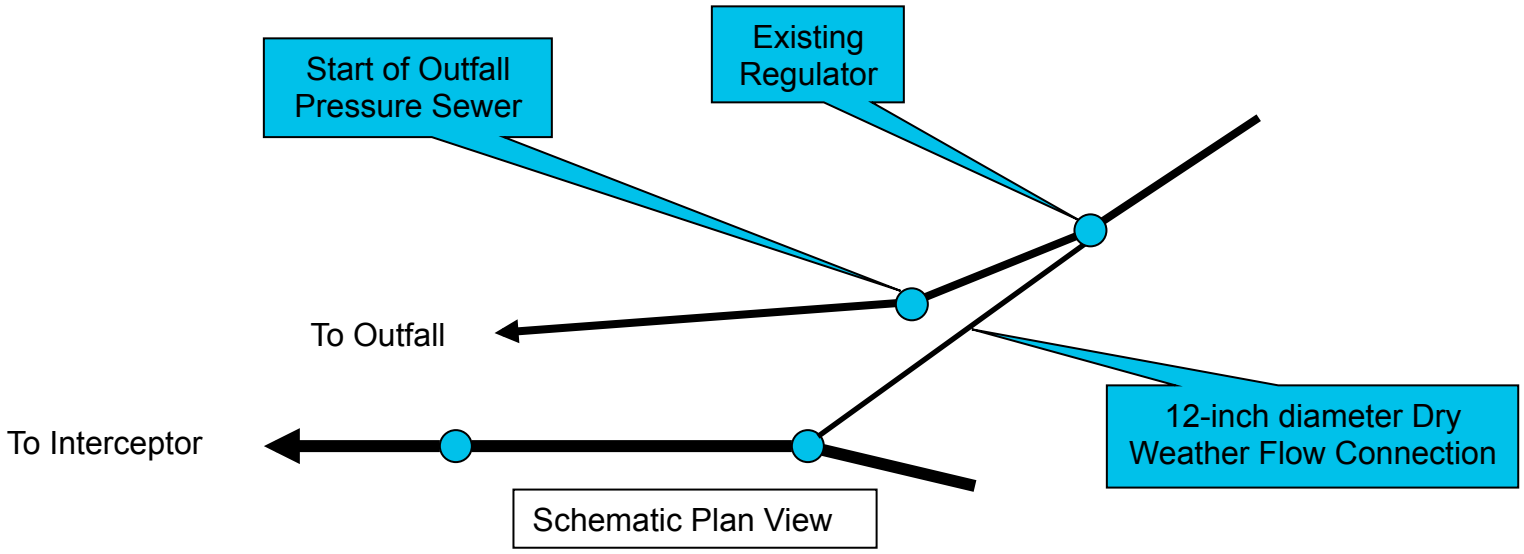
Example: Hydraulic Relief



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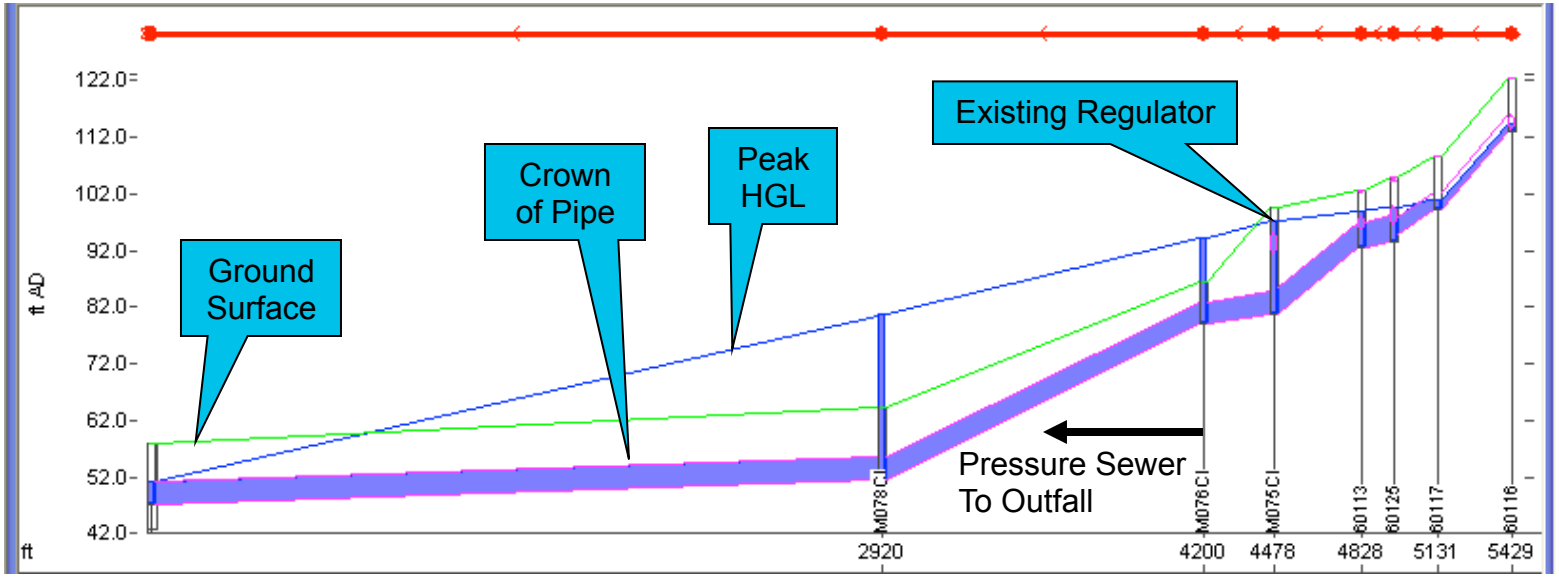

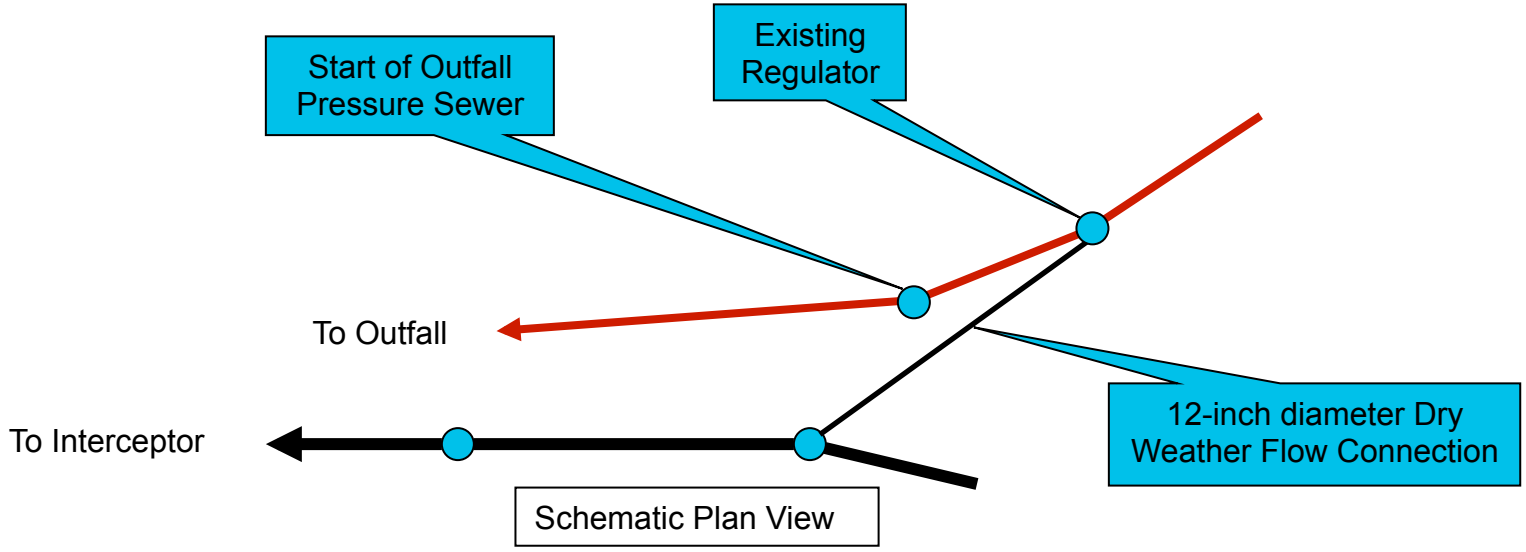

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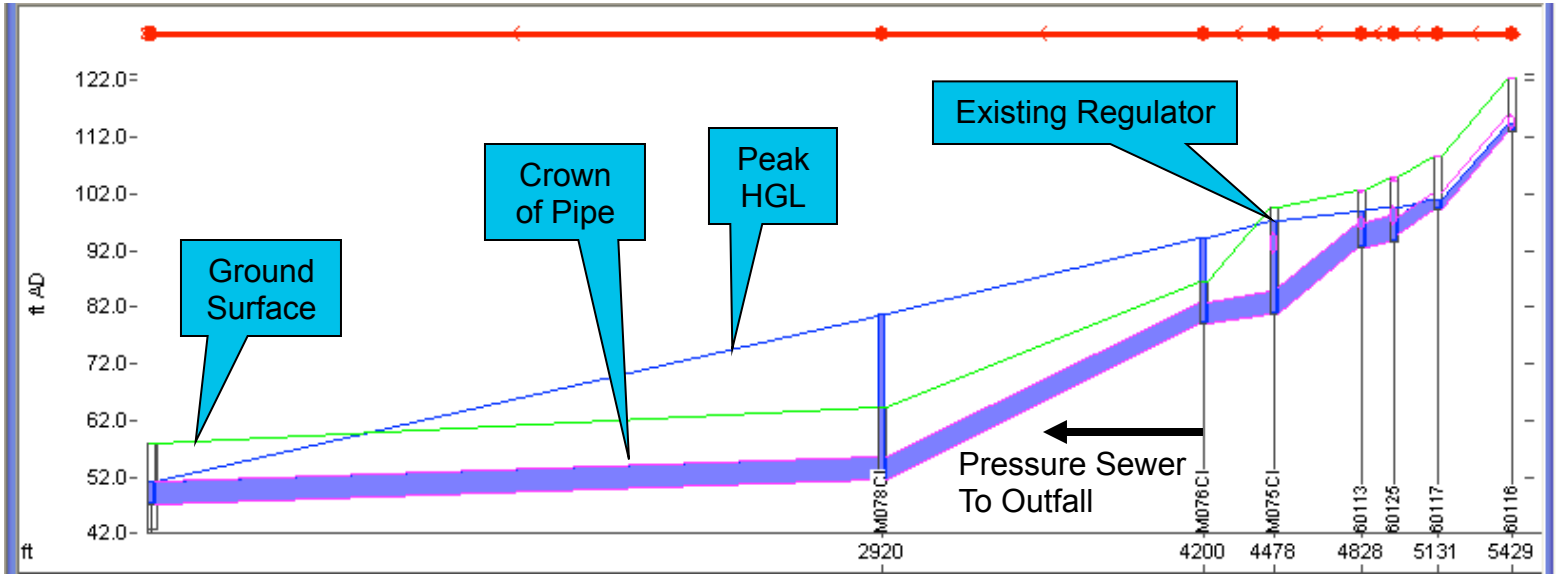

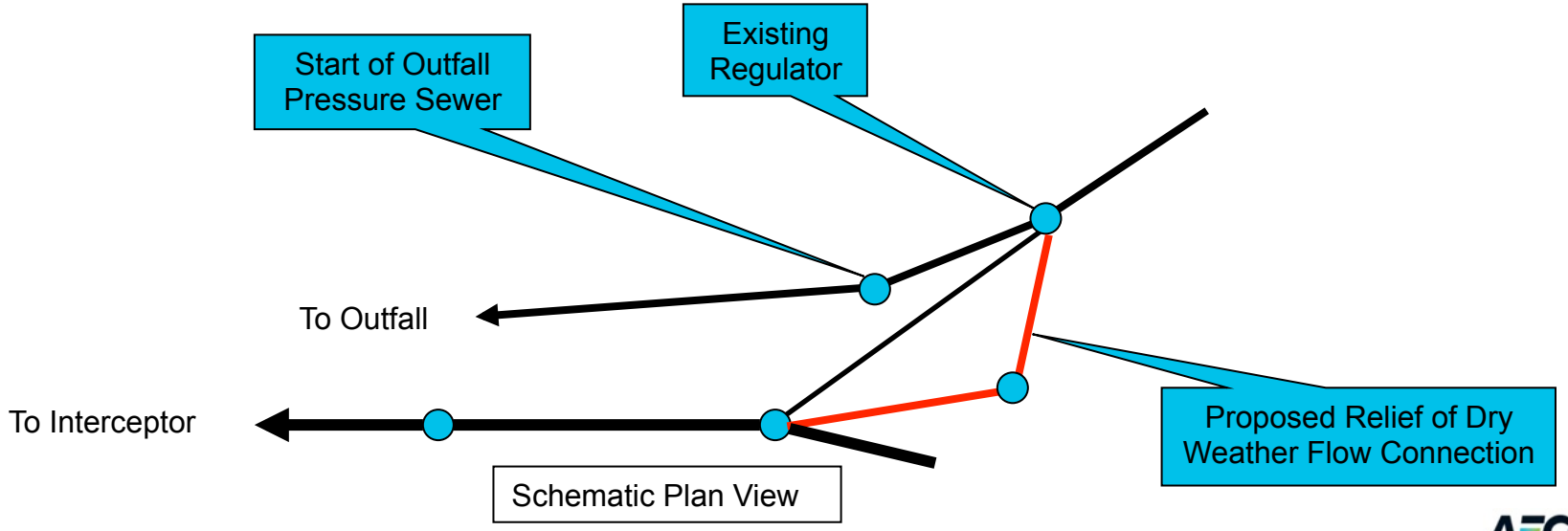

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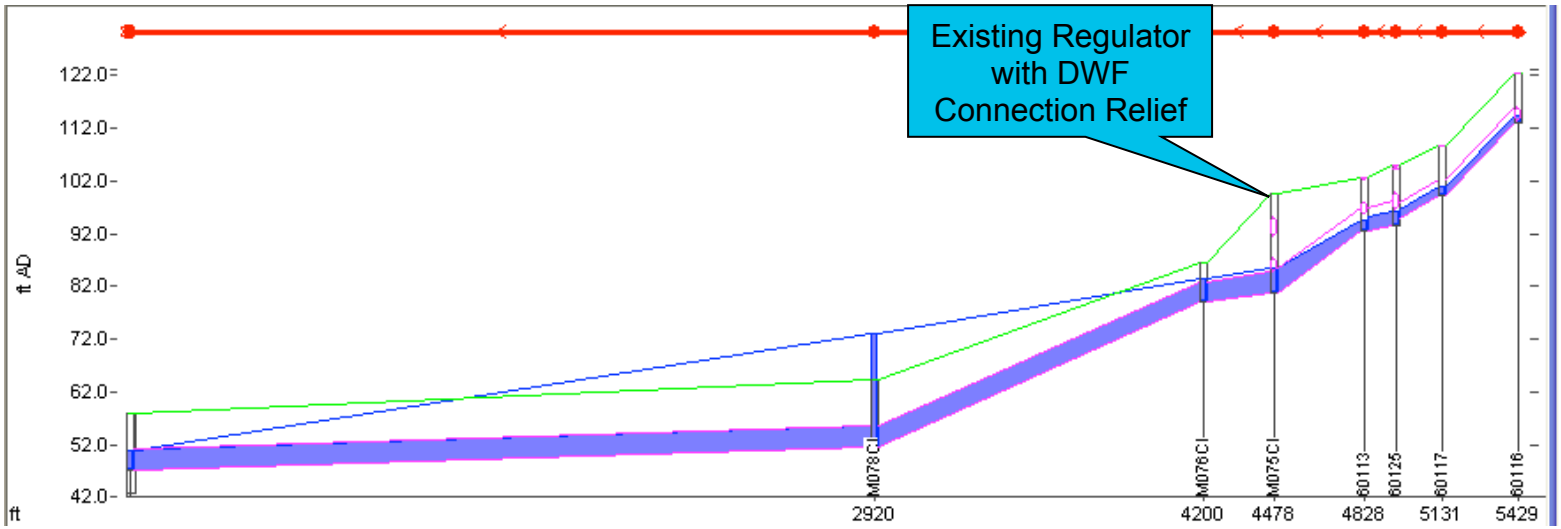

- Relief of DWF connection reduced CSOs in typical year
- **BUT**: Model predicted adverse HGL impact downstream of relief point during 25-year storm
- **Solution**: Provide vortex valve in regulator to limit peak flow through DWF connection

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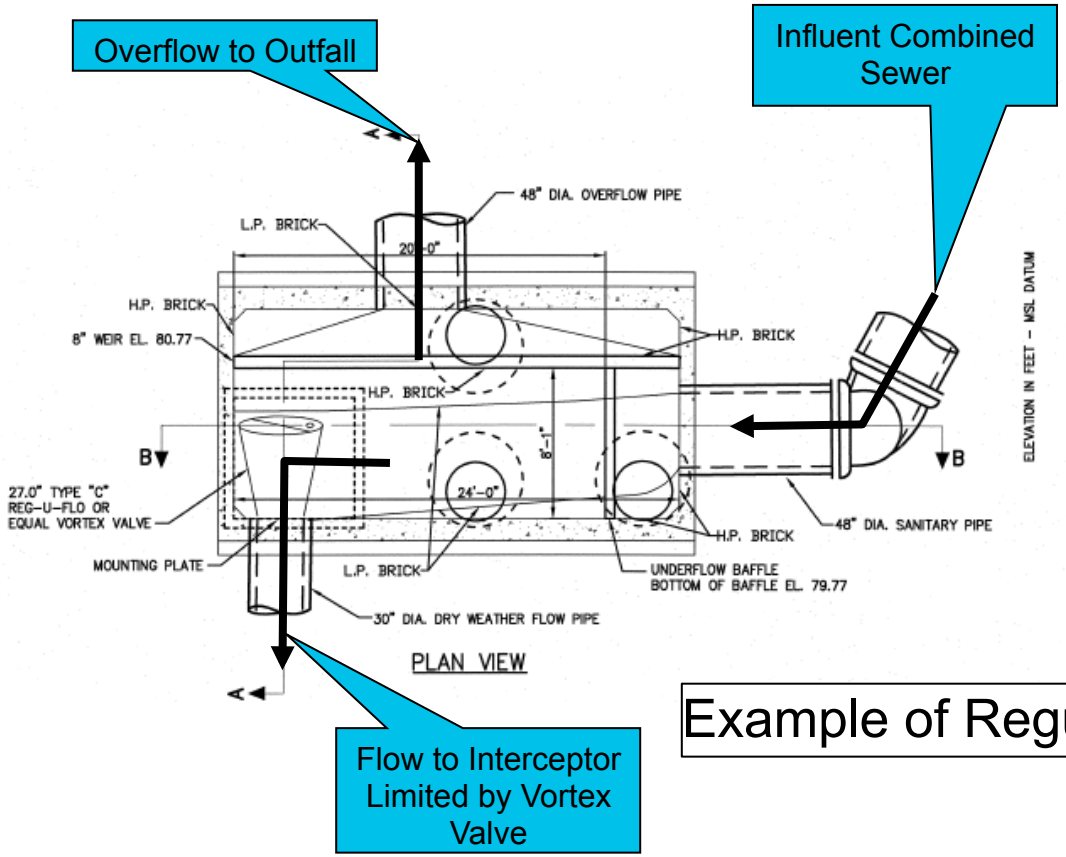

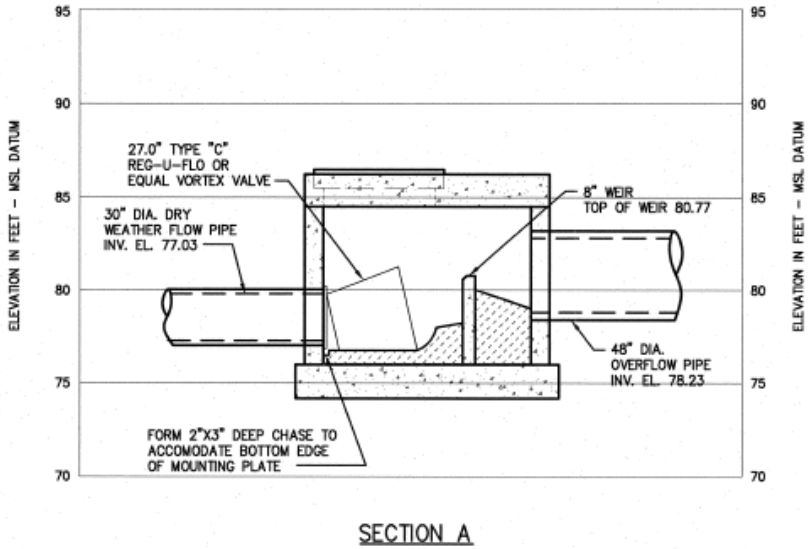

Example of Regulator with Vortex Valve

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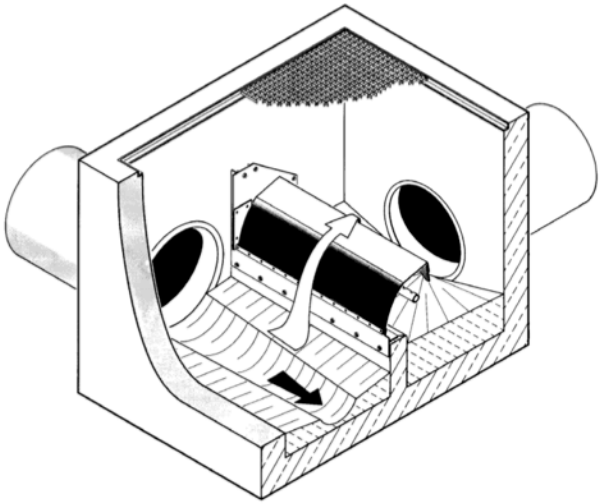
Example: Bending Weirs

A common issue: Raising weir provides benefit in small storm, but creates unacceptable increase in upstream HGL in larger storm

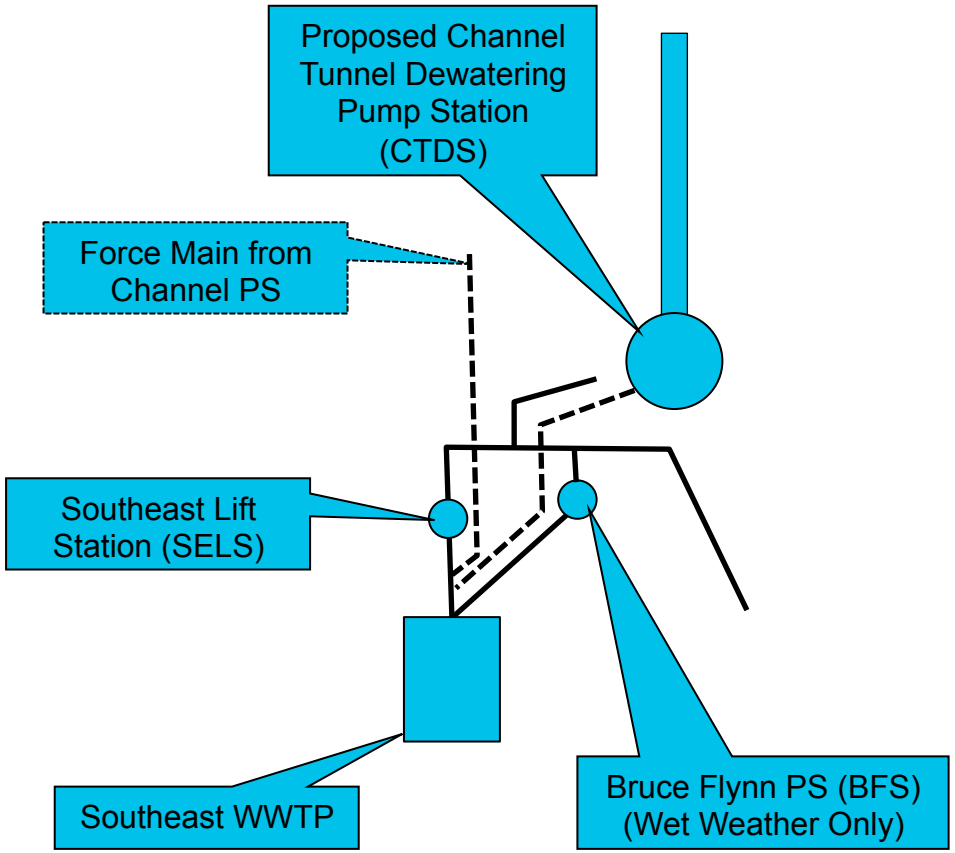
Solution: Provide bending weir instead of static raised weir



John Meunier

Grande Water Management Systems

Example: Pump Station Optimization



Question: Can the existing pump stations be used to optimize the dewatering of the Channel Tunnel?

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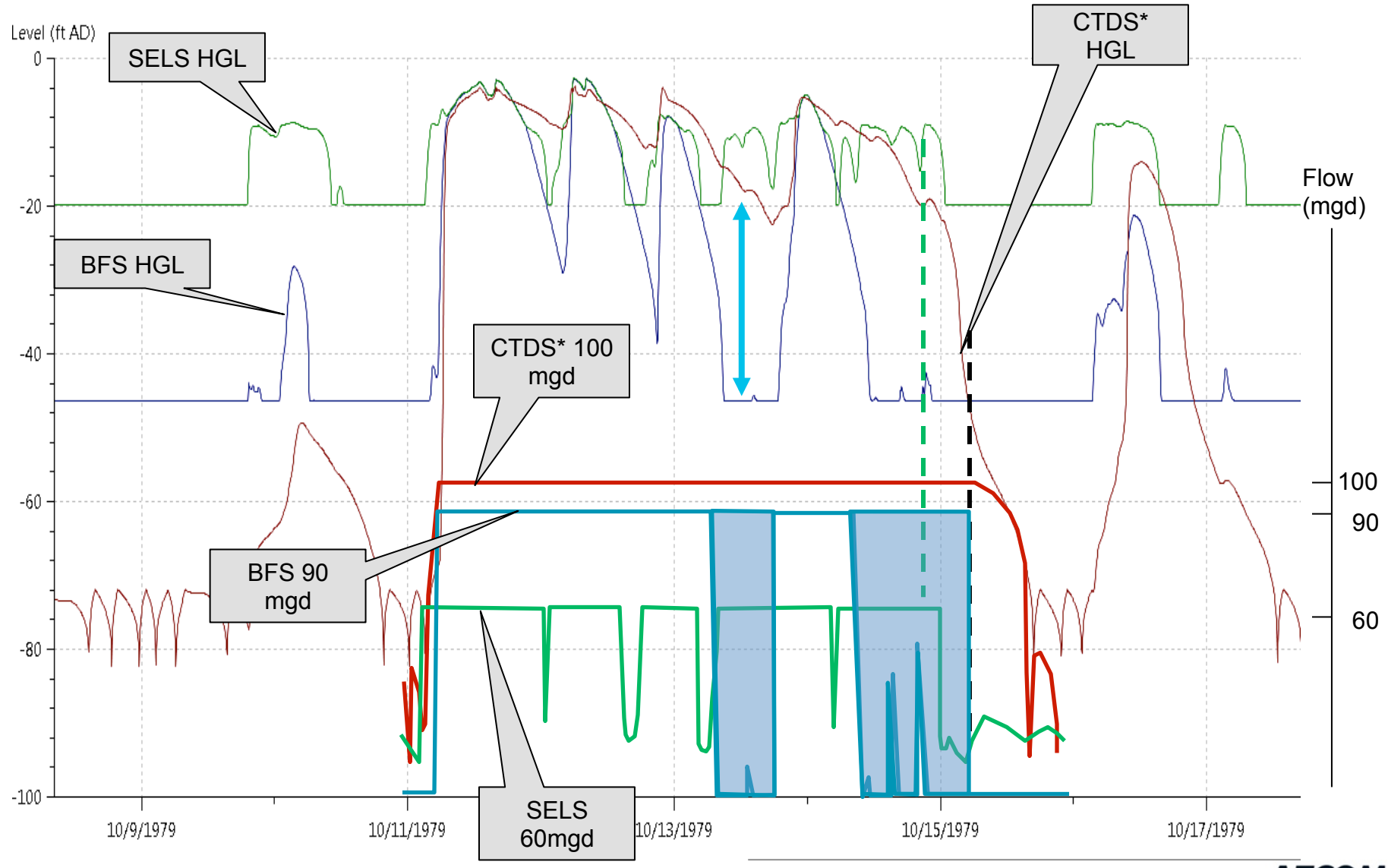

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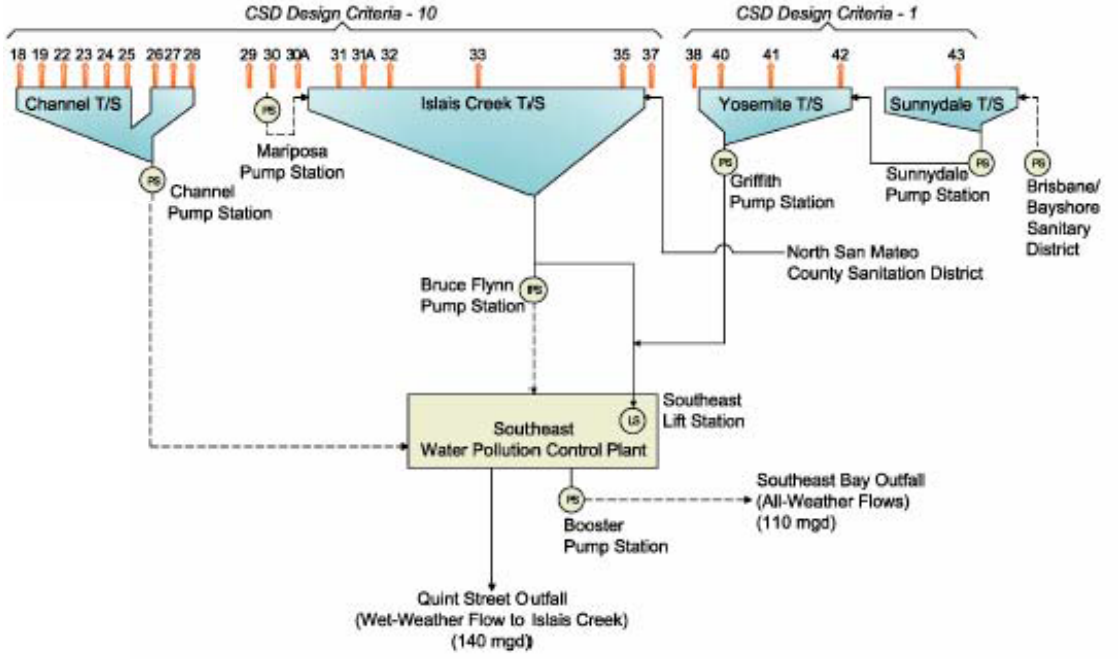
Example: Storage Optimization



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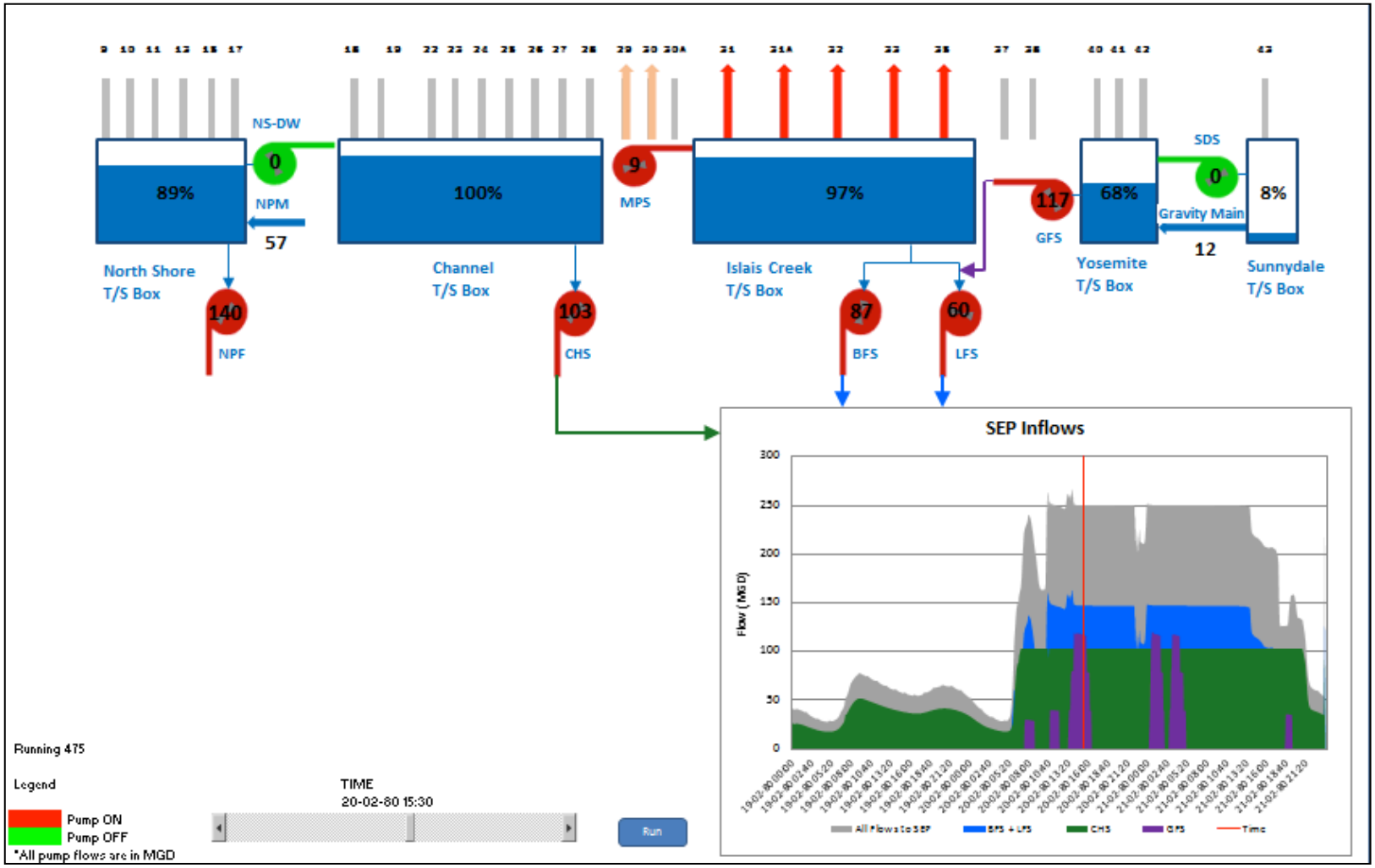

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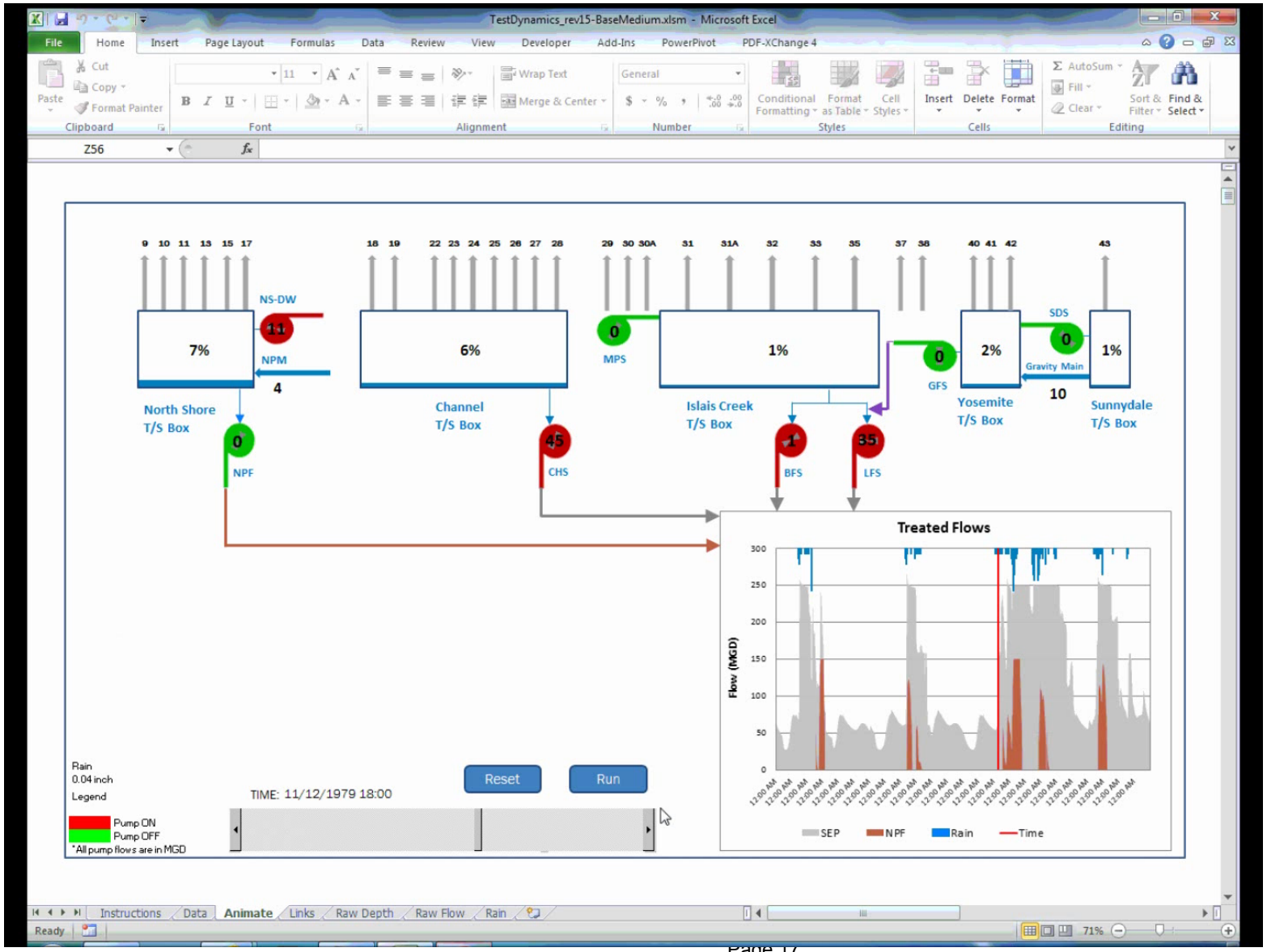

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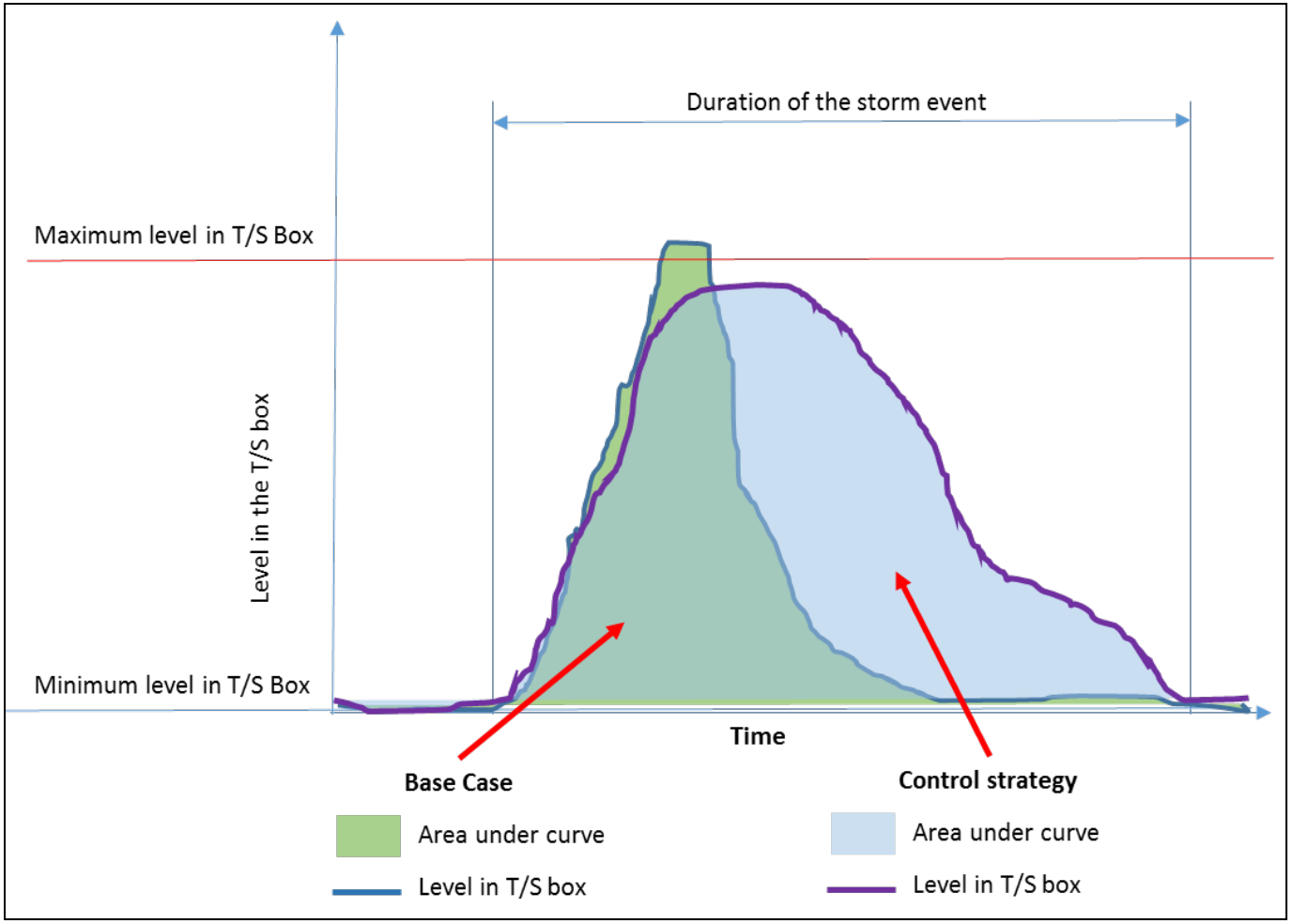

Optimization Performance Summary Scorecard

Overflow Volume/ Frequency Summary

Strategy Name:	Base

North Shore CSD	
Volume (MG)	37
Count	4

Mission Creek CSD	
Volume (MG)	544
Count	11

Mariposa, 20th, 22nd CSD	
Volume (MG)	4
Count	9

Islais Creek CSD	
Volume (MG)	696
Count	10

Evans, Hudson & Yosemite CSD	
Volume (MG)	0
Count	0

Sunnydale CSD	
Volume (MG)	0
Count	0

North Basin	
Volume (MG)	37
Count	4

Central Basin	
Volume (MG)	1244
Count	11

South Basin	
Volume (MG)	0
Count	0

Treatment	NFP Primary	SEP Secondary	SEP Primary	CSD over baffle	CSD through gate	Total CSD
Volumes (MG)	1024	5206	1366			

Control Goals	
Maximize storage in Sunnydale T/S Box	
Maximize storage in Yosemite T/S Box	
Maximize storage in Islais Creek T/S Box	
Maximize storage in Channel T/S Box	
Maximize storage in North Shore T/S Box	
Maximize total flow to SEP	
Maximize secondary flow to SEP	
Maximize total NPF + SEP volume	
Improve velocities in NPM	
Reduce CSD volume/counts	

Storag			
	North Shore T/S	Channel T/S	Sunnydale T/S
Small Storm	100%	100%	100%
Medium Storm	100%	100%	100%
Large Storm	100%	100%	100%

Evans, Hudson & Yosemite CSD	
Volume (MG)	0
Count	0

5th and Berry	Henry Adams	BFS	Baker and Marina Blvd	17th and Folsom	NSS	Bluxome and 6th
Y	Y	N	Y	Y	N	Y

DWF Minimum Velocity (ft/s)				
Sansome and Union	9th and Harrison	NPM from 16th and Harrison	Mission and 3rd	
0.9	0.3	0.0	0.4	

Existing

NPF	NPM	NSFM
Existing strategy	Existing strategy	Existing strategy
Use rainfall forecas		Pump WWF to Channel
Use rainfall		Use rainfall forecast (EOS)
		Use rainfall forecast

CHS
Existing strategy
Modify level set points
Keep SEP at 250 MGD if possible
Use storm characterization
Use rainfall forecast (EOS)
Use rainfall forecast
Modify channel gates controls

BFS	SELS
Existing strategy	Existing strategy
Keep SEP at 250 MGD if possible	Keep SEP at 250 MGD if possibl
Use Islais Creek & Channel T/S levels	Use storm characterization
Use storm characterization	Use rainfall forecast (EOS)
Use rainfall forecast (EOS)	Use rainfall forecast
Use rainfall forecast	

GFS
Existing strategy
PID off Yosemite T/S level
Keep SEP at 250 MGD if possible
Use fourth pump (total at 150 MGD)
Use storm characterization
Use rainfall forecast (EOS)
Use rainfall forecast

SDS
Existing strategy
Lower weir on 78" sewer
Raise on/off set points

EOS: Rainfall forecost to determine end of storm

UWA

NPM Modifications
Passive controls of dropout
Active controls of dropout
Active control at 16th and Harrison
Use storm characterization
Use rainfall forecast
Shut 16th St. Gate
Rehab NPM with liner N=0.009
No Sediment

Other Modifications
Re-activate 30" force main
Increased flow capacity at NPF
NPM Flushing
Increased flow capacity at NSFM

Control Elements
Add active gate at Alana Way

CSD Preferential Discharges
Prioritize Baker outfall for discharge
Prioritize Howard/Brannan outfalls for discharg
Prioritize Islais Creek N. outfall for discharge
Prioritize Evans outfall for discharge
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Volume (MG)	0
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Sunnydale CSD	
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Count	0

North Basin	
Volume (MG)	37
Count	4

Central Basin	
Volume (MG)	1244
Count	11

South Basin	
Volume (MG)	0
Count	0

Treatment Volume Summary

Treatment	NFP Primary	SEP Secondary	SEP Primary	CSD over baffle	CSD through gate	Total CSD
Volumes (MG)	1021	5206	1366	746	537	1282

Maximize storage in Islais Creek T/S Box	
Maximize storage in Channel T/S Box	
Maximize storage in North Shore T/S Box	
Maximize total flow to SEP	
Maximize secondary flow to SEP	
Maximize total NPF + SEP volume	
Improve velocities in NPM	
Reduce CSD volume/counts	

Storage Utilization with respect to Baseline Condition (%)

	North Shore T/S	Channel T/S	Islais Creek T/S	Yosemite T/S	Sunnydale T/S
Small Storm	100%	100%	100%	100%	100%
Medium Storm	100%	100%	100%	100%	100%
Large Storm	100%	100%	100%	100%	100%

SEP Secondary	SEP Primary
5206	1366

(Y/N)

...na Blvd	17th and Folsom	NSS	Bluxome and 6th
	Y	N	Y

(ft/s)

Sansome and Union	9th and Harrison	NPM from 16th and Harrison	Mission and 3rd	
0.9	0.3	0.0	0.4	

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BFS	SELS
Existing strategy	Existing strategy
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Control Goals	
Maximize storage in Sunnydale T/S Box	
Maximize storage in Yosemite T/S Box	
Maximize storage in Islais Creek T/S Box	
Improve velocities in NPM	
Reduce CSD volume/counts	

Storage Utilization Summary

Storage Utilization with respect to Baseline Condition (%)					
	North Shore T/S	Channel T/S	Islais Creek T/S	Yosemite T/S	Sunnydale T/S
Small Storm	100%	100%	100%	100%	100%
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Flooding in LOS Storm (Y/N)						
5th and Berry	Henry Adams	BFS	Baker and Marina Blvd	17th and Folsom	NBS	Bluxome and 6th
Y	Y	N	Y	Y	N	Y

DWF Minimum Velocity (ft/s)				
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0.2	0.2	0.0	0.4	

Storage Utilization with respect to Baseline Condition (%)

Channel T/S	Islais Creek T/S	
100%	100%	
100%	100%	
100%	100%	

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Flooding and Dry Weather Velocity Summaries

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Maximize total flow to SEP	
Maximize secondary flow to SEP	
Maximize total NPF + SEP volume	
Improve velocities in NPM	
Reduce CSD volume/counts	

Storage Utilization with respect to Baseline Condition (%)					
	North Shore T/S	Channel T/S	Islais Creek T/S	Yosemite T/S	Sunnydale T/S
Small Storm	100%	100%	100%	100%	100%
Medium Storm	100%	100%	100%	100%	100%
Large Storm	100%	100%	100%	100%	100%

Flooding in LOS Storm (Y/N)						
5th and Berry	Henry Adams	BFS	Baker and Marina Blvd	17th and Folsom	NSS	Bluxome and 6th
Y	Y	N	Y	Y	N	Y

DWF Minimum Velocity (ft/s)				
Sansome and Union	9th and Harrison	NPM from 16th and Harrison	Mission and 3rd	
0.9	0.3	0.0	0.4	

Existing

NPF	NPM	NSFM
Existing strategy	Existing strategy	Existing strategy
Use rainfall forecas		Pump WWF to Channel
Use rainfall		Use rainfall forecast (EOS)
		Use rainfall forecast

EOS: Rainfall forecost to determine end of storm

CHS
Existing strategy
Modify level set points
Keep SEP at 250 MGD if possible
Use storm characterization
Use rainfall forecast (EOS)
Use rainfall forecast
Modify channel gates controls

BFS	SELS
Existing strategy	Existing strategy
Keep SEP at 250 MGD if possible	Keep SEP at 250 MGD if possibl
Use Islais Creek & Channel T/S levels	Use storm characterization
Use storm characterization	Use rainfall forecast (EOS)
Use rainfall forecast (EOS)	Use rainfall forecast
Use rainfall forecast	

GFS
Existing strategy
PID off Yosemite T/S level
Keep SEP at 250 MGD if possible
Use fourth pump (total at 150 MGD)
Use storm characterization
Use rainfall forecast (EOS)
Use rainfall forecast

SDS
Existing strategy
Lower weir on 78" sewer
Raise on/off set points

UWA

NPM Modifications
Passive controls of dropout
Active controls of dropout
Active control at 16th and Harrison
Use storm characterization
Use rainfall forecast
Shut 16th St. Gate
Rehab NPM with liner N=0.009
No Sediment

Other Modifications
Re-activate 30" force main
Increased flow capacity at NPF
NPM Flushing
Increased flow capacity at NSFM

Control Elements
Add active gate at Alana Way

CSD Preferential Discharges
Prioritize Baker outfall for discharge
Prioritize Howard/Brannan outfalls for discharg
Prioritize Islais Creek N. outfall for discharge
Prioritize Evans outfall for discharge
Prioritize Fitch outfall for discharge

→ Alternative combinations

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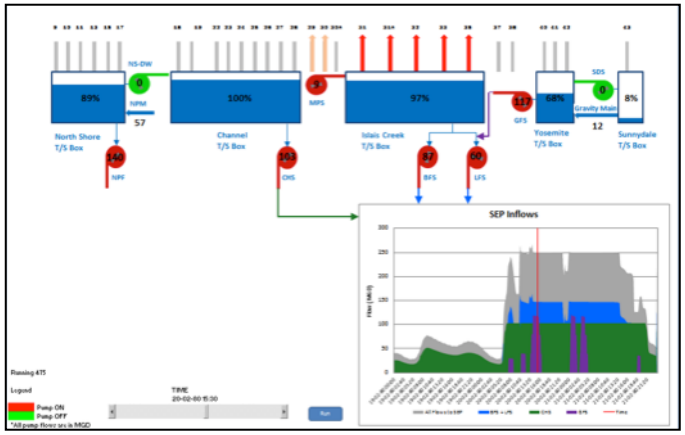
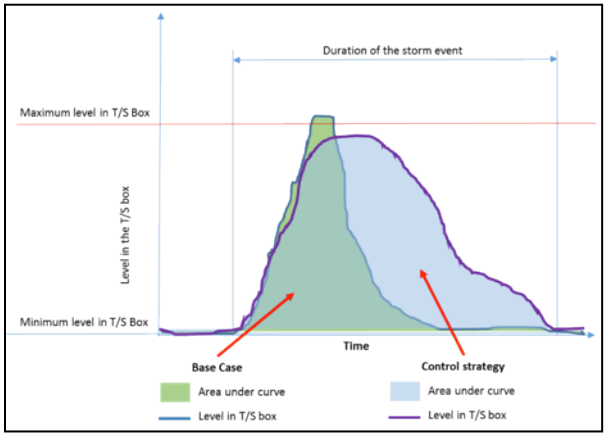
Summary

- System Characterization provides understanding and tools to conduct optimization evaluations
- Use modeling tools to identify and evaluate alternatives
- Watch out for potential adverse impacts
- Develop output format to facilitate comparison of alternatives





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Thank You

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May 14, 2015

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