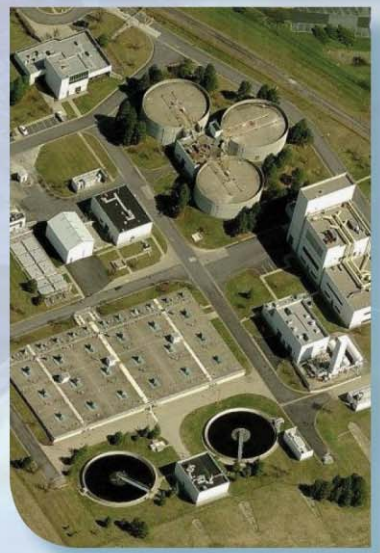

Lehigh County Authority

Allentown
City without limits.

LCA & City of Allentown Wastewater Capacity Program Sewage Facilities (Act 537) Plan

Project Status Update

Monday, November 9, 2015

ARRO AECOM

AGENDA

- Background
- TDS Issues
- Land Application Studies
- Source Control Study
- Conveyance Studies
- Kline's Island Studies
- Path Forward

IPP and Kline's Island WWTP
Evaluation of Alternatives

Parallel Effort – Effluent Limits and Facility Profiling

- Present Worth of Alternatives: **November 2013**

$ Millions	Kline's Island	Land Application	Jordan Creek	Lehigh River
CAPEX	62.5	71.2	59.3	96.2
OPEX (PW)	10.5	14.2	10.1	10.6
PW	73	85.3	69.4	106.8
TDS Removal			**33**	
PW			**102.4**	

- Uncertainties:
  - Kline's Island 4 MGD Conveyance Cost (included, but needs validation)
  - Cost Reduction Potential for Land Application (~ $20 million PW reduction)
  - TDS Impact on Land Application
  - Lower Cost TDS treatment – Source Control, Lime softening
  - Potential to further reduce KI Cost – Phasing, New Technology, Split Flows (2 MGD Land App, 2 MGD KI)

IPP and Kline's Island WWTP
Evaluation of Alternatives

November 2013

- Shifting Focus:
  - Evaluate cost-reducing potential for "Living Filter" approach
  - Develop New Hybrid Scenarios for KI, KI+LA split

- *Action Items for Consideration:*
- Evaluate TDS impact on Land Application
- Develop Kline's Island Model
- IPP Supplemental Sampling – Cation Concentrations
- Preliminary assessment of Source Control
- Proceed with Collection System Simulations

AGENDA

- Background
- **TDS Issues**
- Land Application Studies
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TDS DATA

Sampling Period	Average Concentration (mg/L)	Concentration Range (mg/L)	Comment
October 2009-August 2010	1325	1083 - 1568	Steady increase
June 15 – July 17, 2013	1800	1527 - 2219	Less variability; little or no trend
Jan 23 – Mar 8, 2014	1610	1410 - 1830	No Trend
August – Sept 2015	1423		Higher Flow

At ~ 1500 mg/L

3x Drinking Water Standard of 500 mg/L

TDS PLAN

- TDS greater than 1000 mg/L compromises agricultural use
- For Land Application, Assume 1000 can be achieved through source control
- In Parallel –
  - Evaluate Land Application with dilution to 500 mg/L
  - Evaluate Source Control

AGENDA

- Background
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- **Land Application Studies**
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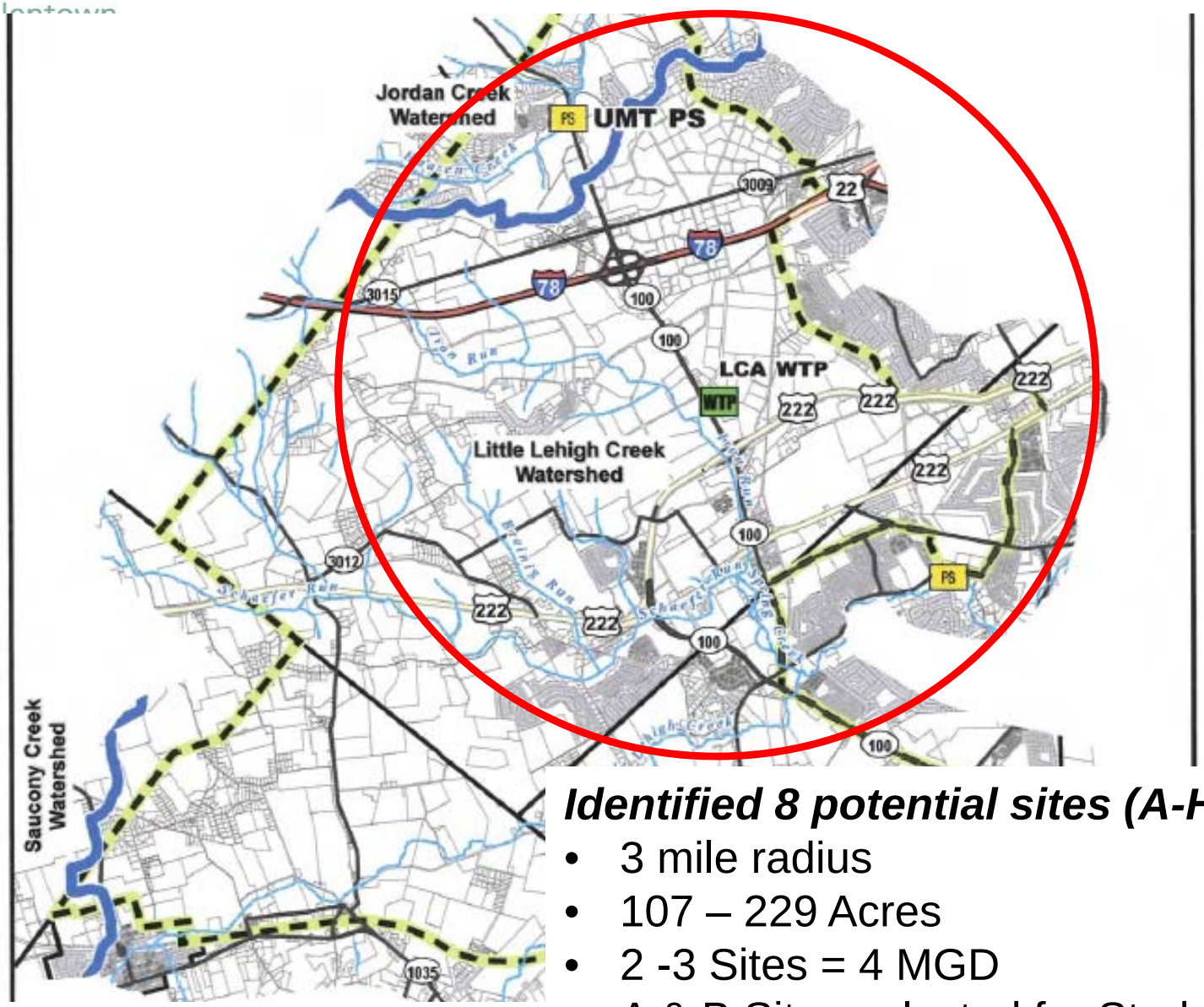
PSU Living Filter

PSU Living Filter

Land Application
Castle Valley Report, Feb 2012



Identified 8 potential sites (A-H)

- 3 mile radius
- 107 – 229 Acres
- 2 -3 Sites = 4 MGD
- A & B Sites selected for Study

A and B SITES
DETAILED FOLLOW UP STUDIES

- Favorable Topographic, Soil, Geologic and Hydrogeologic Settings
- Close Proximity to IPP
- Augmented Recharge in Carbonate Aquifer Groundwater Basin
- Options For Demonstration Project
- Favorable Sites For Effluent Storage Lagoons

BENEFITS OF SPRAY IRRIGATION OPTION

- Less Costly Construction than Buried Lines
- Allows Agricultural Activity Necessary To Remove Nutrients
- Spray Line Schedules Can Be Adjusted to Manage Storm flows
- More Uniform Distribution of Effluent
- Less Chance of Overloading Soils
- Preservation of Open Space Allowing For Alternate Uses

CONSTRAINTS

- 4 MGD Effluent Volume
- High TDS In Industrial Effluent
  - 1500 - 1800 mg/L
- DEP TDS Groundwater Limit 500 mg/L
- NO3 Limit 9 mg/L (Three Monthly Samples)
- Large Acreage Required
  - 100-Foot Buffer For Property Lines
  - 400-Foot Buffer For Homes
  - Wind Drift Issues, Icing of Roads
  - Time To Establish Woody Borders

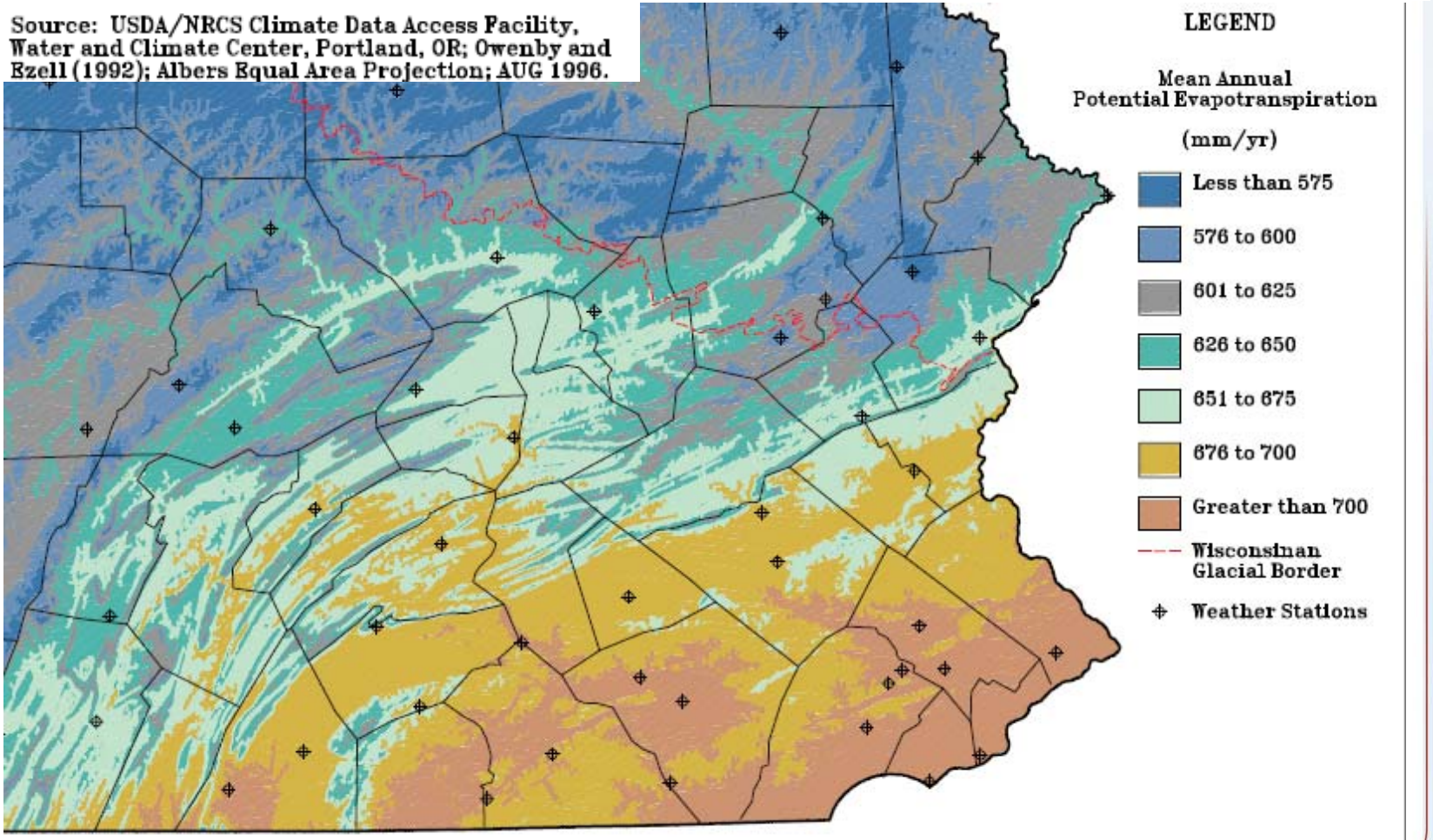
CONSTRAINTS (Continued)

- Some Storage Required During Wet Weather
- Deed Restrictions to Address Groundwater Use
- Limited Detention Depressions on A SITE
- Large Land Requirement for 7:1 Dilution Factor Even If Effluent Concentrations Are Reduced to 1,000 mg/L

7:1 Dilution

- Lehigh Valley Avg Ann Rainfall ~ 40 inches/year
- Evapotranspiration ~ 25 inches/year
- Net Recharge ~ 15 inches/yr
- Spray Irrigation ~ 104 inches/yr
- To dilute from 1000 mg/L to 500 mg/L need equal contributions from Recharge and Irrigation
- **104 divided by 15 ≈ 7 x Area**

Evapotranspiration



WATER WELLS

- A & B SITES

  Domestic Wells Located Along Boundaries

- Authority Well on A SITE

A SITE

Site and Contiguous Area	**506.1 Acres**
Land North of Site to Surface Water Divide	
North-South Flow Line	**754.2 Acres**
Available Land	**Total 1260.3 Acres**

7:1 Dilution Requirement

Usable Acreage 157.5

B SITE

		Acres
Potentially Suitable For Irrigation		99.1
Dilution Source Area		325.76
	Total	**424.84**

7:1 Dilution Requirement

Irrigation Limit **53**

IRRIGABLE AREA SUMMARY

- **B TRACT 53 Acres**

  2 Ac-In/wk = **53,305 Gallons**

  $(5.3 \times 10^1)(5.33 \times 10^4) = 2.825 \times 10^6$ Gallons/wk

  0.4 MGD

- **A TRACT 157.5 Acres**

  2 Ac-In/wk = **53,305 Gallons**

  $(1.58 \times 10^2)(5.33 \times 10^4) = 8.396 \times 10^6$ Gallons/Wk

  1.2 MGD

S

Parizek Study Conclusion

Cost Implications of 1.2 - 1.5 MGD Land Application Program

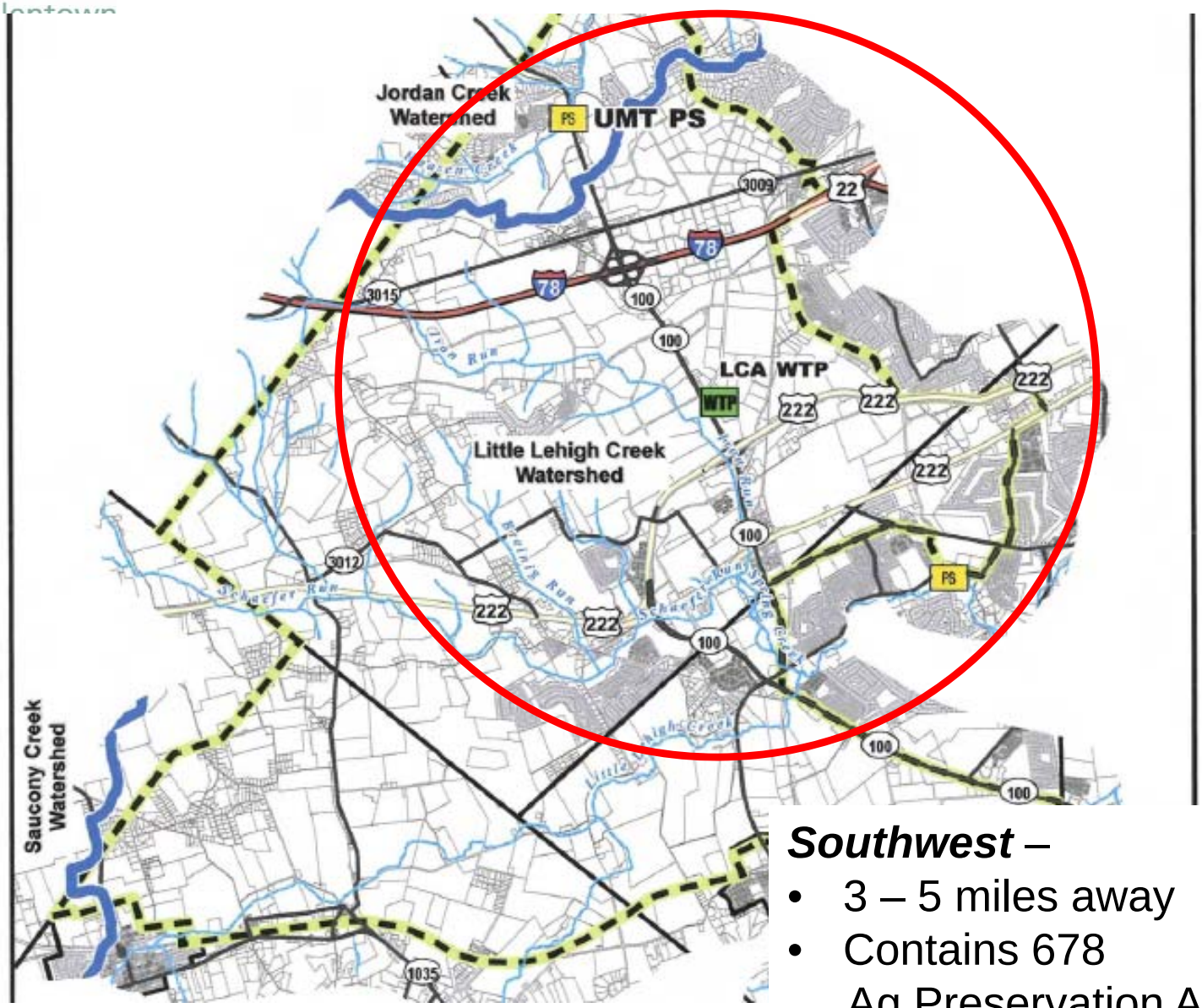
- Reference: **KI 4 MGD Expansion Capital Cost = $8.65/Gallon**
  - (Facility, Incremental Conveyance and Park Pump Station Capacity)
- **Assumes source-control program is successful in reducing Effluent TDS to ~ 1000 mg/L**
- A Site capital cost

  $18.3 Million for 1.5 MGD
  - Castle Valley (FEB 2012 Report)

  = $12.17/Gallon
  - (Pump Station, Force Main, Storage, Spray Irrigation System)

No Driving Force for Phased Approach

Southwest Ag Preservation Area



Southwest –

- 3 – 5 miles away
- Contains 678 Ag Preservation Acres

Ag Preservation Lands Considerations

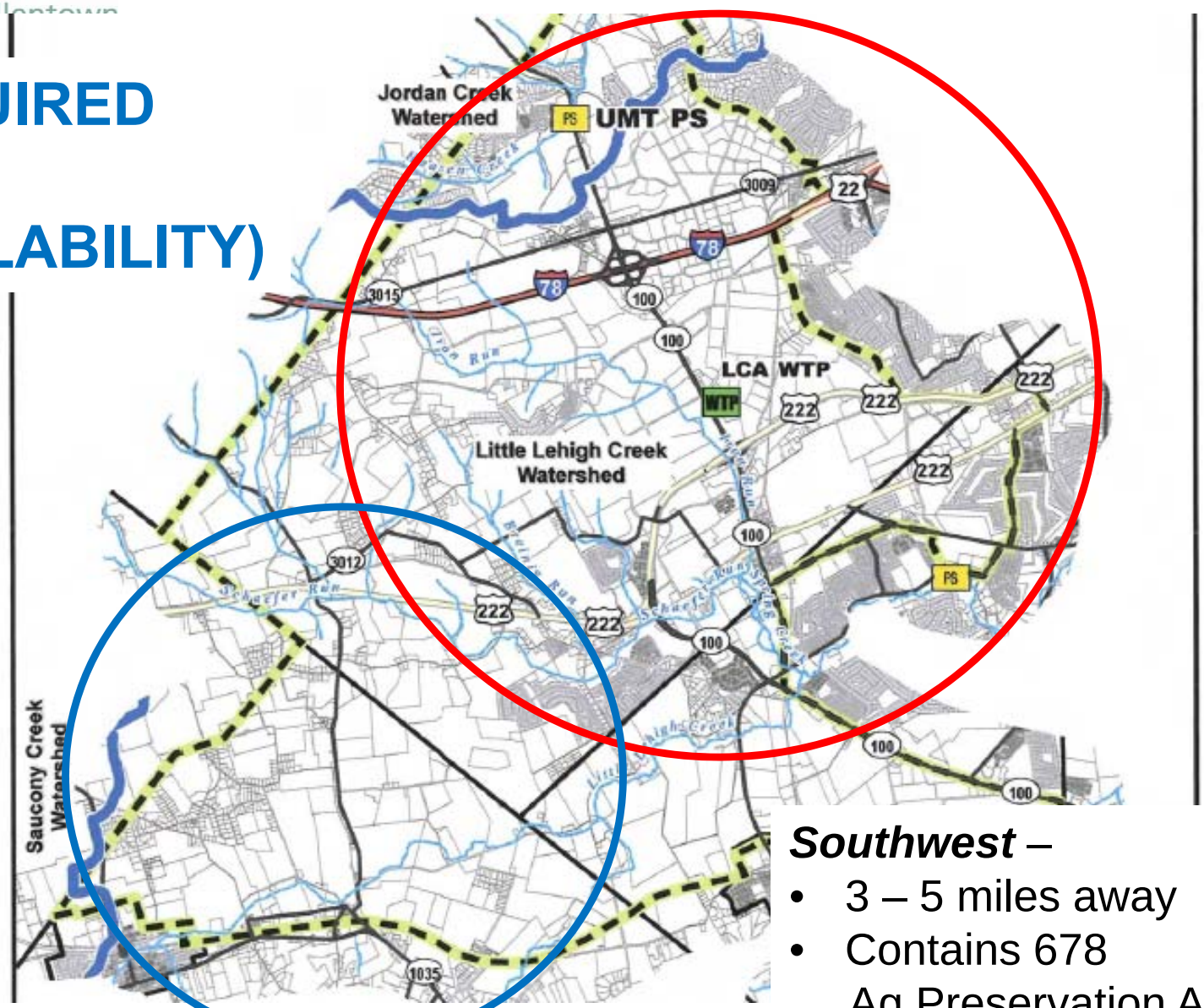
- 678 Acres Identified….*but*
- For **4 MGD** Need 3500 - 7000 acres
  - **7000 acres if TDS can't be reduced**
  - All under preservation/deed restriction
- Twice the conveyance distance: adds

  > $3Million to Capital Cost

Suspend investigation, pending Source Control Study

Southwest Ag Preservation Area

AREA REQUIRED FOR 4 MGD (100% AVAILABILITY)



Southwest –

- 3 – 5 miles away
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AGENDA

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- **Source Control Study**
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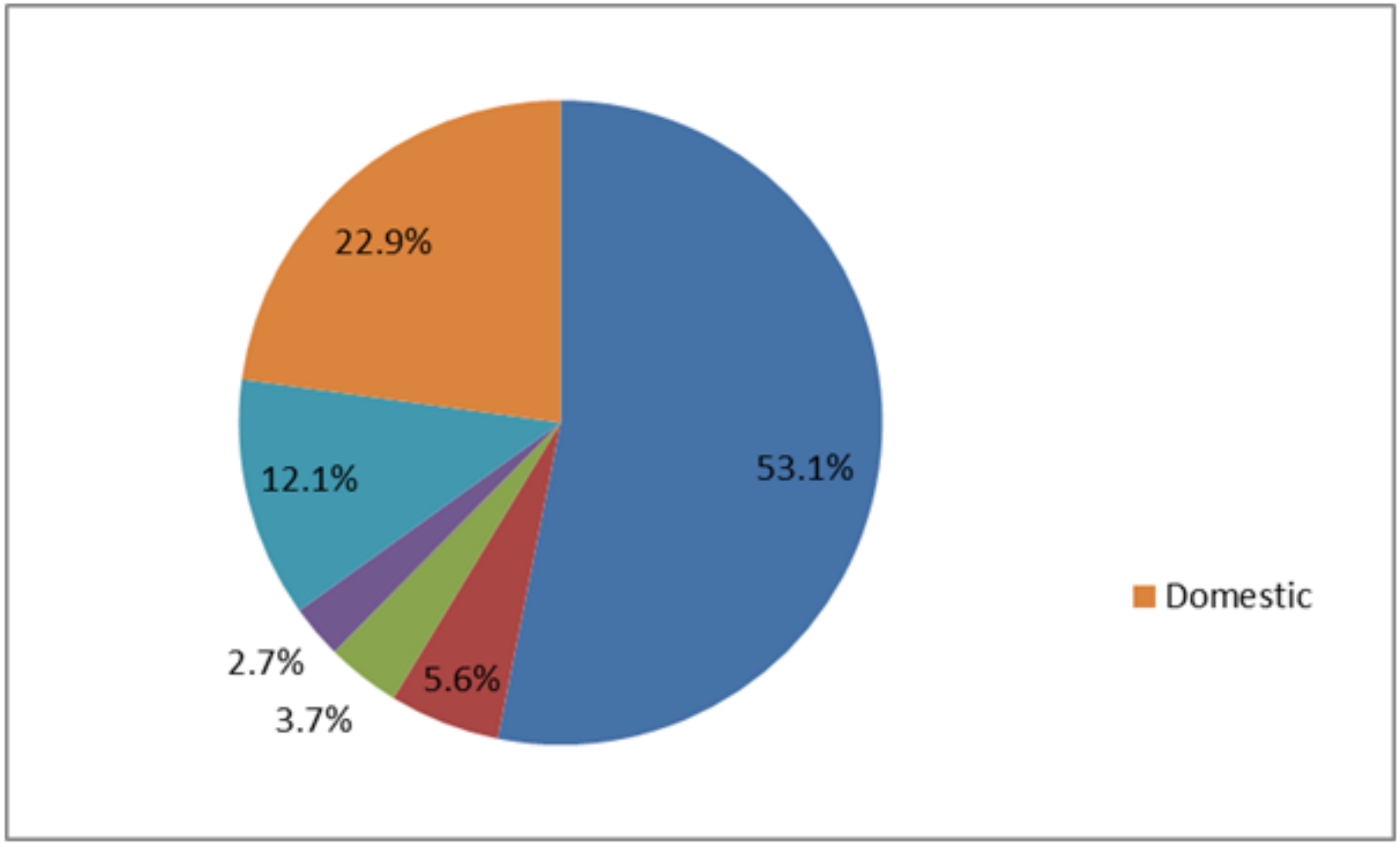
IND'L SOURCE MONITORING

TDS contribution by major industrial customers to the IPP



SOURCE CONTROL STUDY

Table 1: Summary of Additional Testing

Location	Flow	TDS		FDS			VDS		
-	mgd	mg/L	lb/d	mg/L	lb/d	% of TDS	mg/L	lb/d	% of TDS
Source Water	2.0	360	6011	162	2705	45%	198	3306	55%
Effluent	1.4	2463	28351	1253	14425	51%	1211	13936	49%
IPP Influent	4.2	1848	64743	1097	38414	59%	748	26207	40%
IPP Effluent	4.2	1423	49857	1084	37976	76%	342	11968	24%

Table 2: FDS Source Generation

38%

FDS Sources	Chemical	FDS	% of FDS
-	-	lb/d	-
Source Water	-	1866	13%
Water Softener	10% NaCl Brine	663	5%
CIP	50% NaOH	11208	77%
Pre Treatment	50% NaOH	844	6%

TDS/Land Appl'n Summary

- Low Probability of significantly reducing TDS in IPP effluent through Source Control
- High sodium further compromises agricultural use
- DEP: "No relief from 500 mg/L TDS Drinking Water Standard"
- Conclusion: Land Application likely requires Reverse Osmosis

AGENDA

- Background
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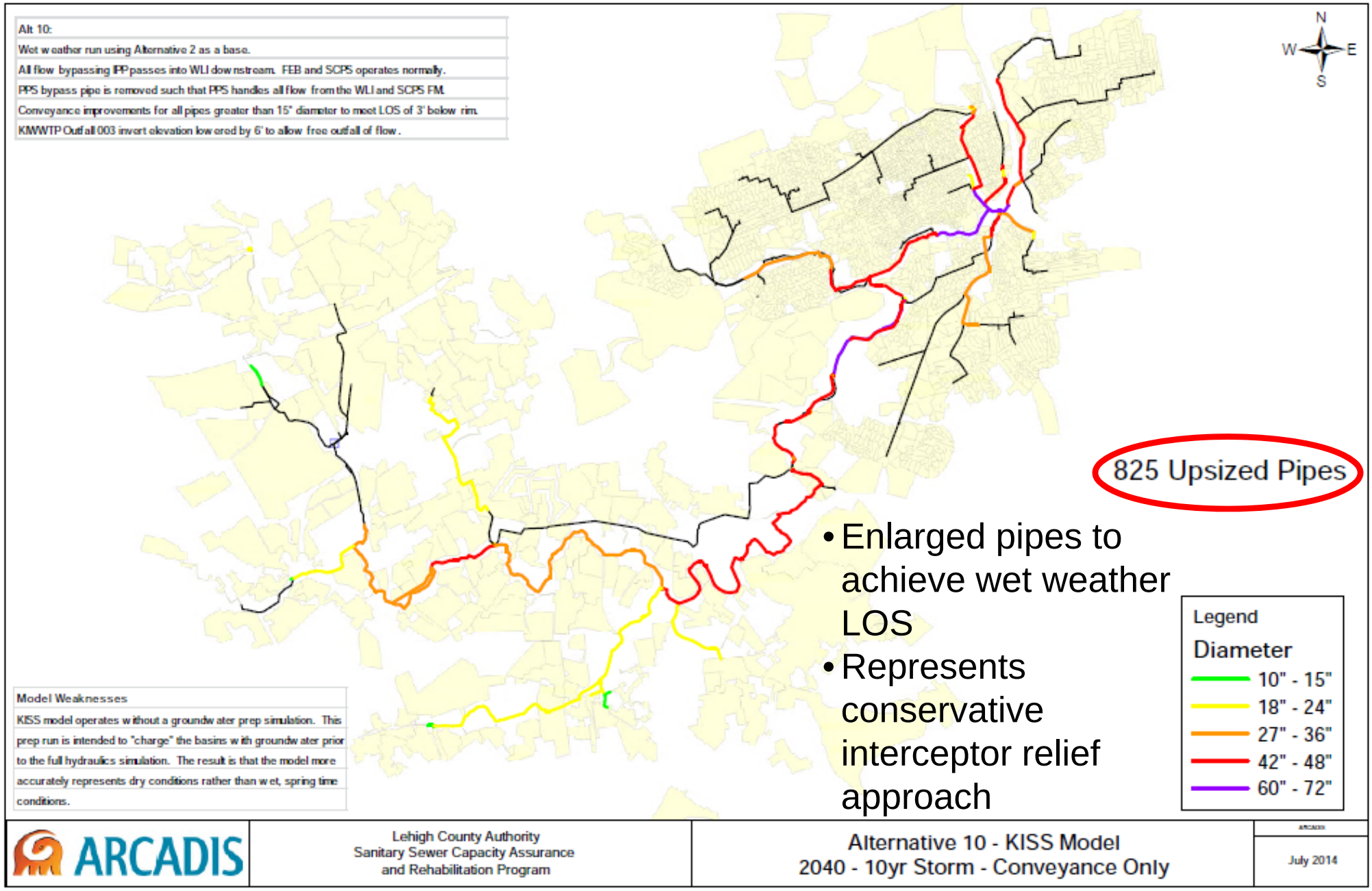
Conveyance Alternatives

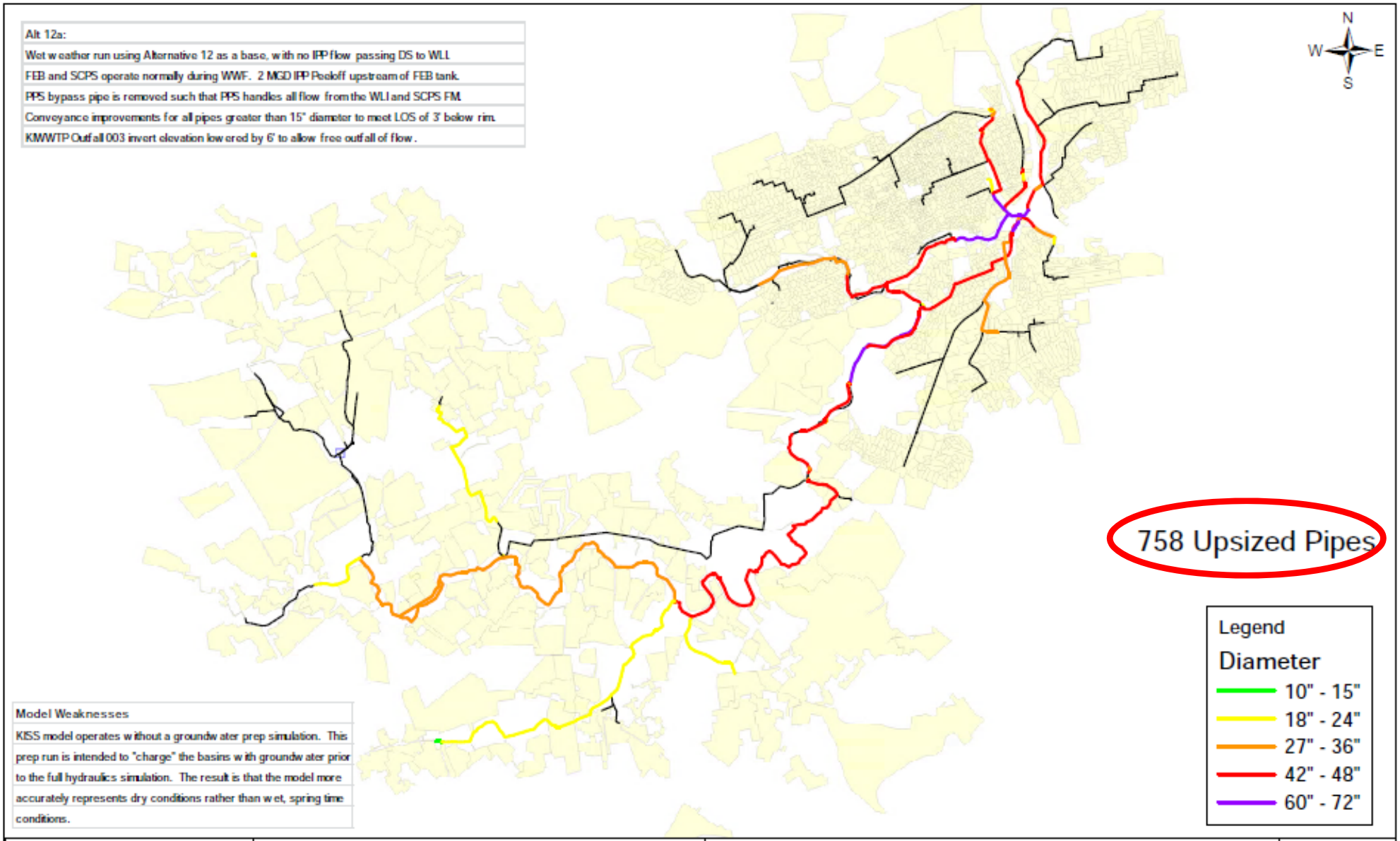
- BASIS = Meet wet weather Level of Service (LOS) criteria
- ARCADIS developed “KISS” Model (Combined LCA, Allentown and Signatories Systems)
- Requested “Bounding” Simulations:
  - Convey LCA + 4 MGD to KI (Alt. 10)
  - Diversion of ALL flows Tributary to IPP (Alt. 12a)
  - Diversion of ALL flows with upstream storage

Alternative 10 – Conveyance Only



- Enlarged pipes to achieve wet weather LOS
- Represents conservative interceptor relief approach

Alternative 12a – Full IPP Diversion



ARCADIS

Lehigh County Authority
Sanitary Sewer Capacity Assurance
and Rehabilitation Program

Alternative 12a - KISS Model
2040 - 10yr Storm - Full IPP Peel Off

July 2014

Pipe Size Increases by Alternative

Table 1. Lengths of Upsized Pipes by Pipe Diameter

Pipe Diameter (in.)	Length of New Pipe (ft.)			Difference (ft.)	
	Alternative 10	Alternative 12a	Alternative 12b	Alt 10-Alt 12a	Alt 10-Alt 12b
72	3,128	3,128	3,128	-	-
60	13,692	13,692	5,741	-	7,951
48	36,983	36,879	3,712	104	33,271
42	47,919	43,216	59,724	4,703	(11,805)
36	47,481	43,085	19,013	4,396	28,467
30	6,481	13,403	0	(6,922)	6,481
27	0	0	4,453	-	(4,453)
24	18,863	18,863	9,640	-	9,223
21	16,399	16,399	2,330	-	14,069
18	12,224	10,390	7,793	1,834	4,431
15	2,620	-	2,309	2,620	311
12	1,145	714	3,201	431	(2,055)
Total Length	**206,935**	**199,769**	**121,044**	**7,166**	**85,891**

Summary of Conveyance Findings

- Full diversion of flow at IPP will save no more than $7M in conveyance relief piping vs. sending all flow to KI
  - Actual savings likely to be less, as more cost-effective relief alternatives are developed
- Effluent force main for full diversion at IPP is $37.5 – 53M
  - Has Right of Way and Public Acceptance Issues
- Other incremental costs not likely to make up difference
- Conveyance savings for upstream storage would apply to both cases (diversion at IPP and all flow to KI)

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KI Innovative Technology

- "End of Pipe" Conventional Technology Previous Basis
- Sidestream Deammonification –
  - Ammonia Removal without Chemical Cost
  - Small Reactor , Low Energy
- Chemically Enhanced Primary Treatment (CEPT)
  - Diverts N to sidestream
  - Reduces load on Trickling Filters

KLINE'S ISLAND SIMULATIONS

CALIBRATED MODEL

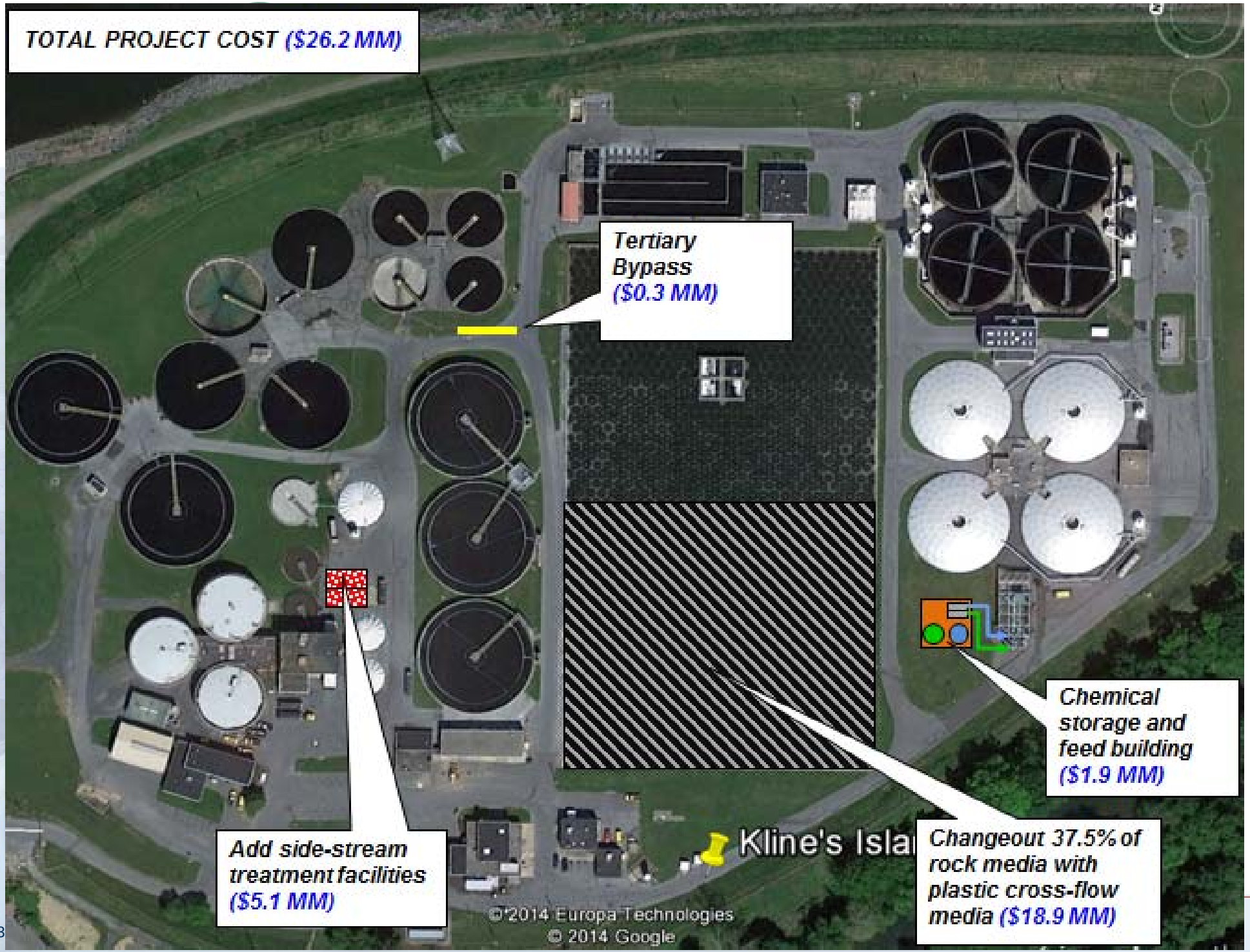
SIMULATION RESULTS WITH CEPT @ 85% TSS REMOVAL AND 90% REMOVAL OF SIDE-STREAM NH4-N

Number of RMTF Quadrants Changed to Plastic Cross Flow Media	*Overall Media Specific Surface Area (ft^2/ft^3)*	*Effluent NH4-N (mg/L)*			
		Annual Average Conditions	Coldest Max 7-Month Ave Conditions OCT-APR (DRBC Winter)	Coldest Max Month Ave Conditions NOV-APR (NPDES Winter)	Coldest Max Month Ave Conditions (Summer)
		(44 MGD @ 15.8°C)	(48.13 MGD @ 13°C)	(55.75 MGD @ 11°C)	(55.75 MGD @ 14°C)
			DRBC Limit = 746 lbs/d (1.9 mg/L)	NPDES Limit = 15 mg/L	DRBC Limit = 439 lb/d (0.94 mg/L) NPDES Limit = 5 mg/L
0	*17.0*	*3.2*	*6.4*	*12.5*	*7.7*
1	*24.8*	*0.1*	*1.7*	*8.4*	*4.6*
2	*32.5*	*0.03*	*0.04*	*2.0*	*0.28*
3	*40.3*	*0.03*	*0.03*	*0.06*	*0.03*
4	*48.0*	*0.03*	*0.03*	*0.03*	*0.03*
				TN = 6962 lbs/d	*TN = 6315 lbs/d*

37.5%

Projected to reach 44 MGD AA & 55.75 MGD MM in 2056 (geometric projection)

KLINE'S ISLAND UPGRADE TO 44 MGD



KI Study Summary

- Capital Cost Reduced from $36 to $26 Million
- Potential for Phasing -- $20 M initial project, $6 million full build-out later
- No TDS Issue

AGENDA

- Background
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- **Path Forward**

Economic Summary

$millions	All Flow to KI			Land Application			Jordan Creek		Lehigh River		
IPP Upgrades	$11.2	$12.2	$12.2	$34.5	$12.2	$12.2	$34.6	$37.7	34.5	$37.7	$37.7
IPP PS&ForceMain				$4.5	$8.20	$4.90	$19.9	21.7	56.2	37.7	37.7
Land App System				$27.4	$29.85	$29.85					
KI Wet Weather	$12.0	$13.1	$13.1	$12.0	$13.1	$13.1	$12.0	13.1	12	13.1	$13.1
KI Compliance	$5.4	$5.9	$5.9	$5.4	$5.9	$5.9	$5.4	5.9	5.4	5.9	$5.9
KI Expansion	$32.6	$26.2	$26.2								
KI Conveyance (KISS)*	$12.8	$13.9	$248.0								$241.0
Park PS (Increm)			$1.4								
Reverse Osmosis (RO)						10.0		10.0			
TOTAL CAPEX	$74.0	$71.3	$306.8	$83.8	$69.2	$75.9	$71.9	$88.3	$108.1	$94.4	$335.4
OPEX (PV)	$10.5	$11.4	$11.4	$14.2	15.5	16.8	10.1	11.0	10.6	11.5	11.5
RO OPEX (PV)						$23.0		$23.0			
Present Value		**$82.7**			**$84.7**	**$115.8**		**$122.3**		**$105.9**	
						>$241.0		>$241.0			
Present Value			**$318.2**			**>$356.8**		**>$363.3**			**$346.9**
2011 to 2014 Escalation		108.9%									

* Wet Weather LOS

537 Plan Path Forward

- Defer pursuit of alternatives other than Kline's Island expansion
- Integrate conveyance capacity increase with Wet Weather (AO) program
- Conduct public outreach to inform Stakeholders

537 Plan Path Forward

- Board Presentation **Nov 9, 2015**
- City Presentation **Nov '15**
- LCA Signatory Presentation **Nov '15**
- City Signatory Presentation **Dec '15**
- Stakeholder/Public Presentation

  1Q 2016