Total Maximum Daily Load for Fecal Pathogens in Buffalo Bayou and Whiteoak Bayou

University of Houston
PBS&J

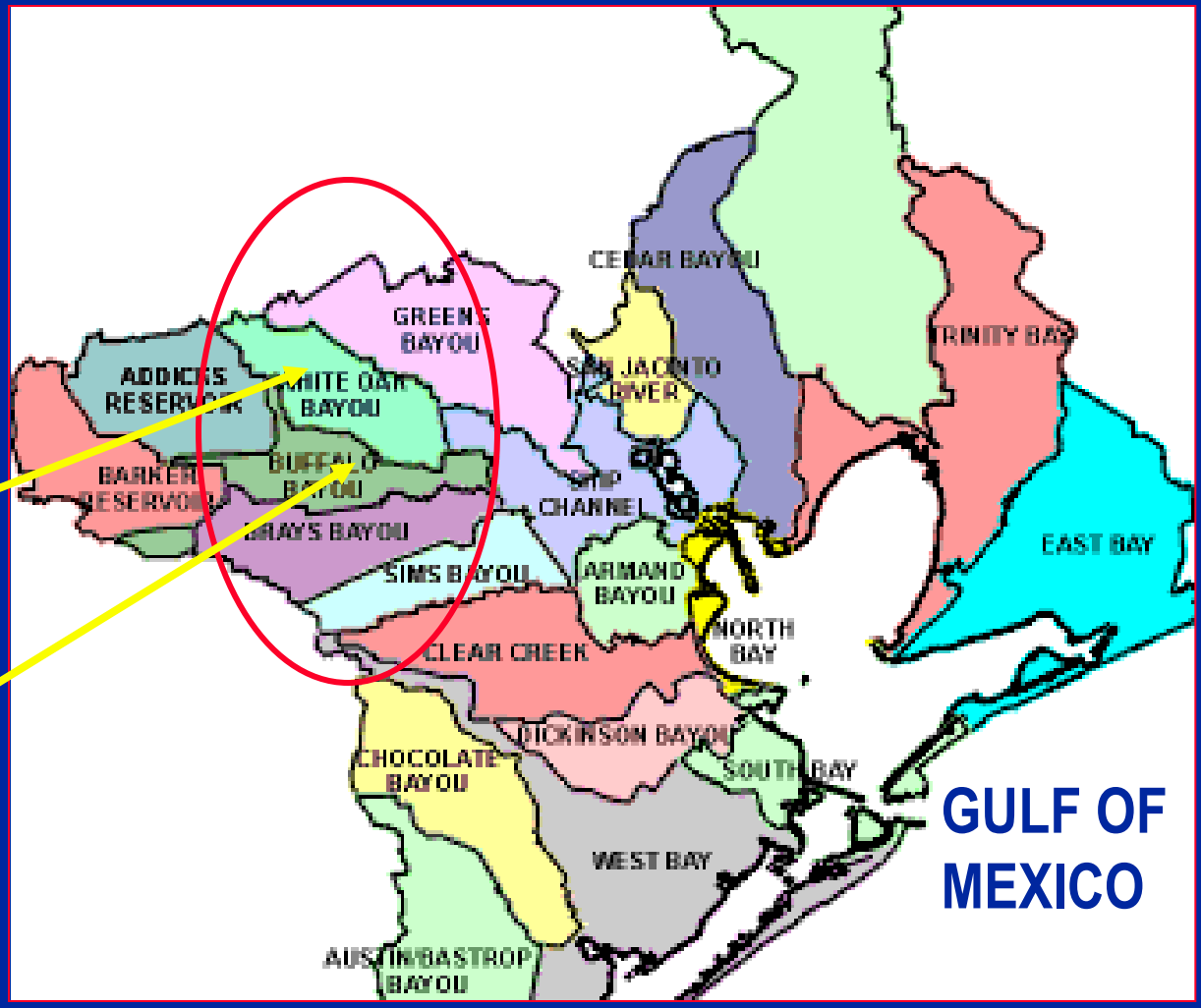
Major tasks

- Stakeholder/Public education and involvement
- Assess current levels and trends of bacterial indicators of fecal pathogens in the bayous
- Assess major sources, transport, and fate of bacterial indicators of fecal contamination
- Apply models to elucidate the sources and major processes controlling observed levels of FC
- TMDL allocation analysis

Buffalo and Whiteoak Bayous

Whiteoak Bayou

Buffalo Bayou



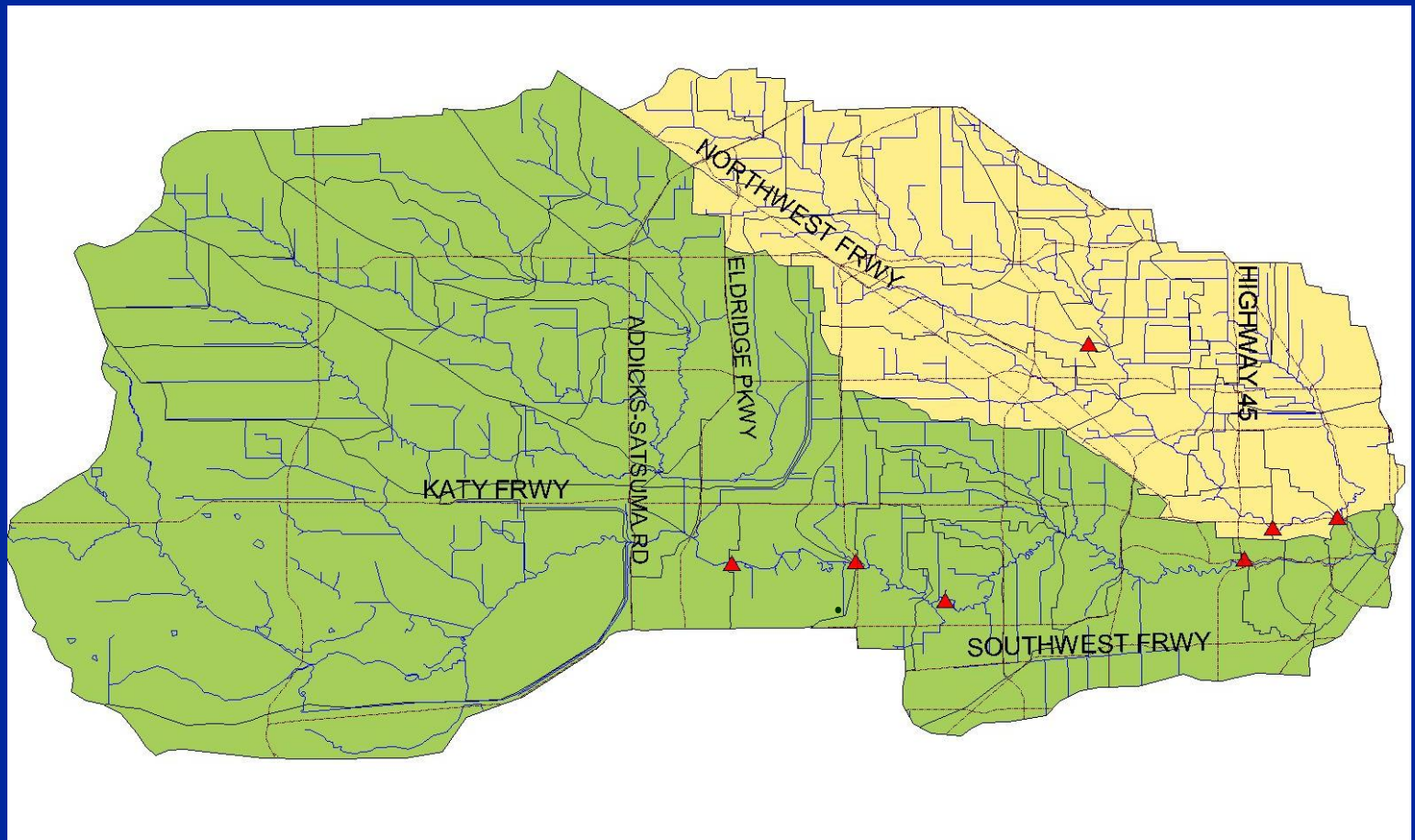
Assess current levels and trends of indicator bacteria in BB and WO

1. Assess bacteria levels resulting from moderate rainfall runoff events

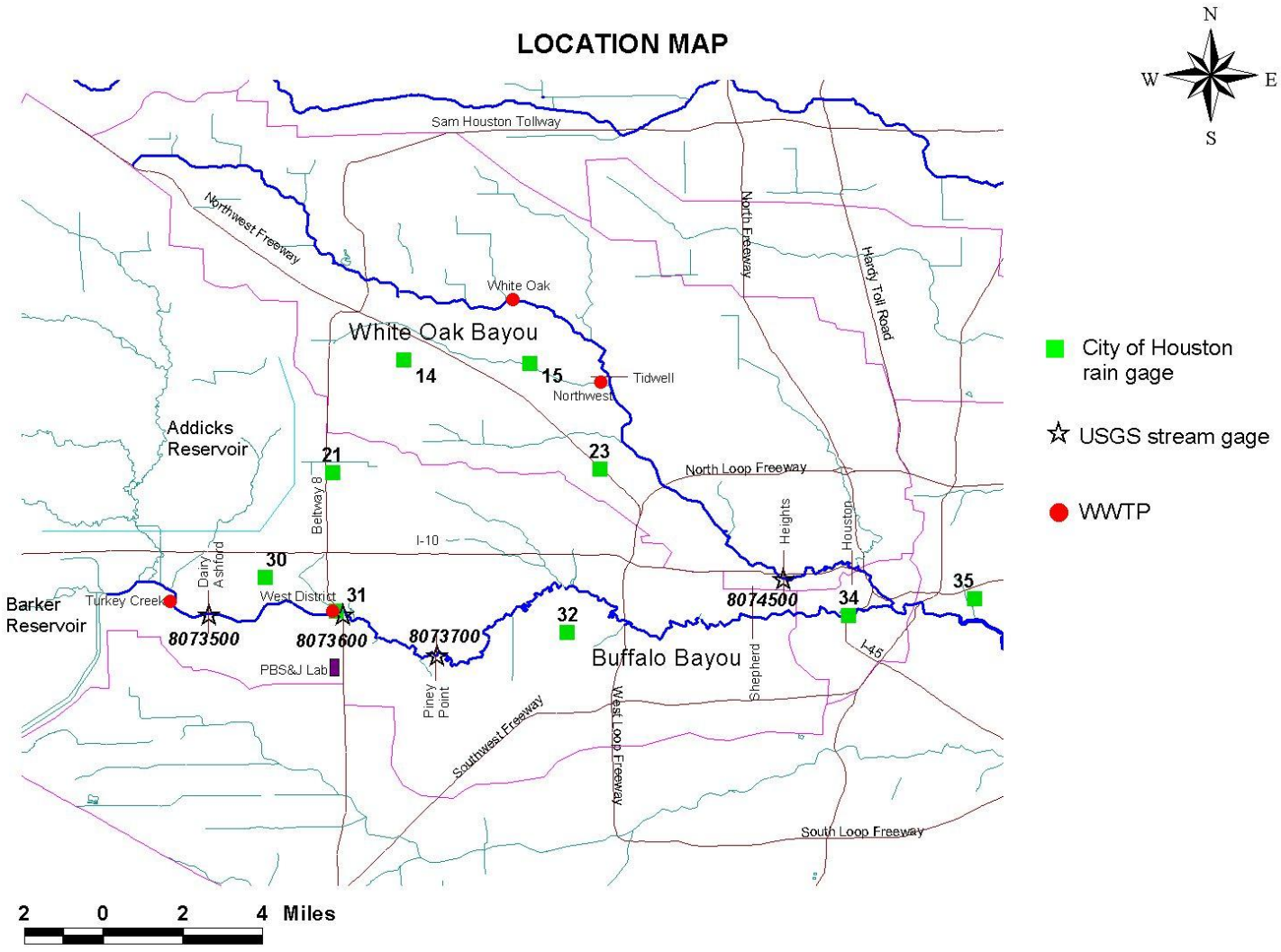
2. Assess dynamics of bacteria within the bayous

Bacteria from rainfall runoff events

- Two runoff events: Aug 7-9 & Aug 28-30, 2001
- 4 BB stations, 2 WO locations, & 1 WO tributary



Rain and flow gage locations



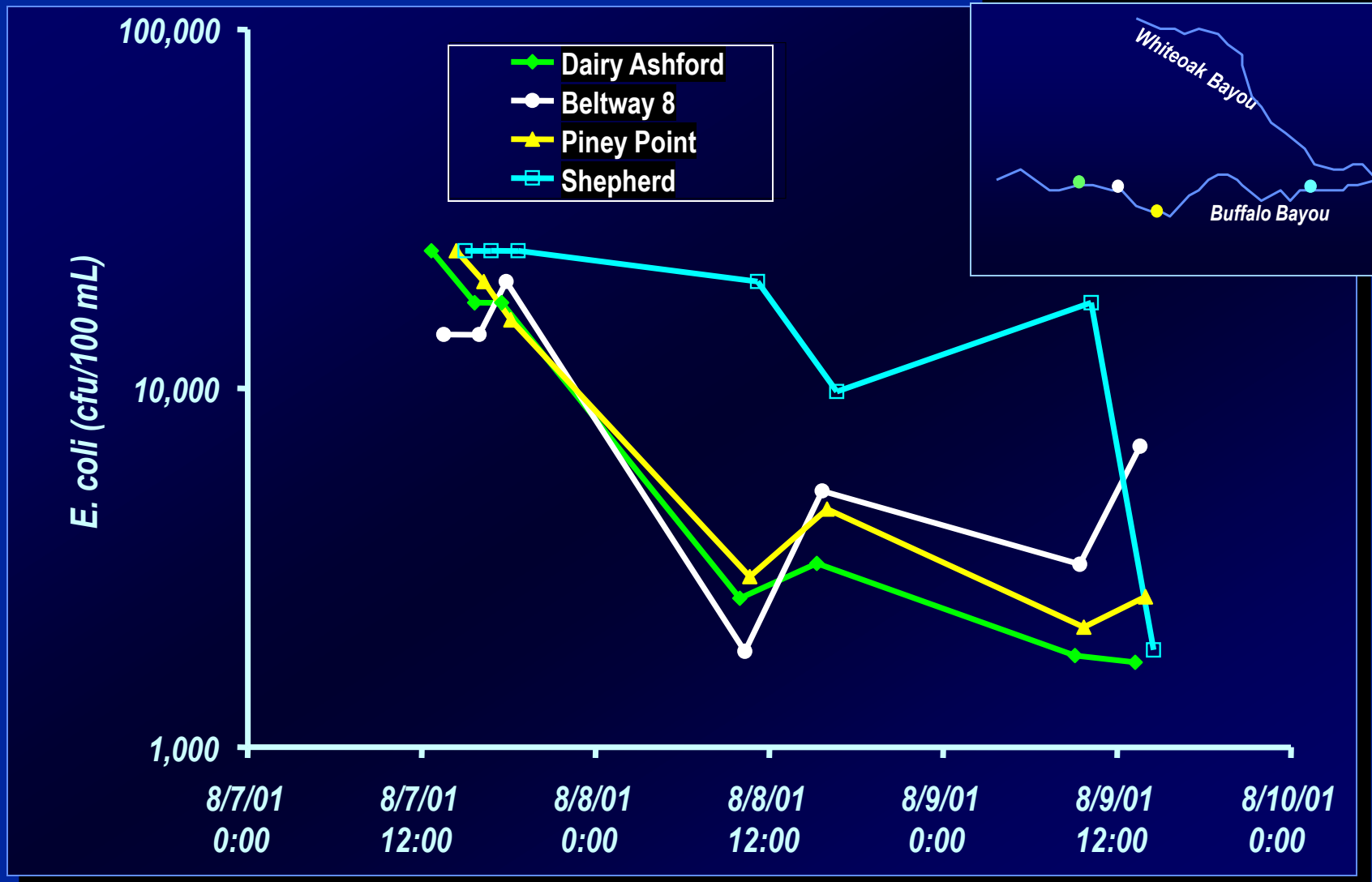
Daily rainfall data

	Date	RG15	RG30	RG31	RG34
Event 1	8/6/01	0.84	1.28	0.65	0.00
	8/7/01	0.11	0.00	0.02	0.28
	8/8/01	0.13	0.00	0.00	0.35
	8/9/01	0.05	0.00	0.00	0.00
Event 2	8/27/01	0.12	0.59	0.34	0.63
	8/28/01	0.16	1.74	0.39	0.51
	8/29/01	1.00	1.00	1.12	0.75
	8/30/01	1.36	1.12	1.09	1.76
	8/31/01	2.15	2.00	2.37	2.29

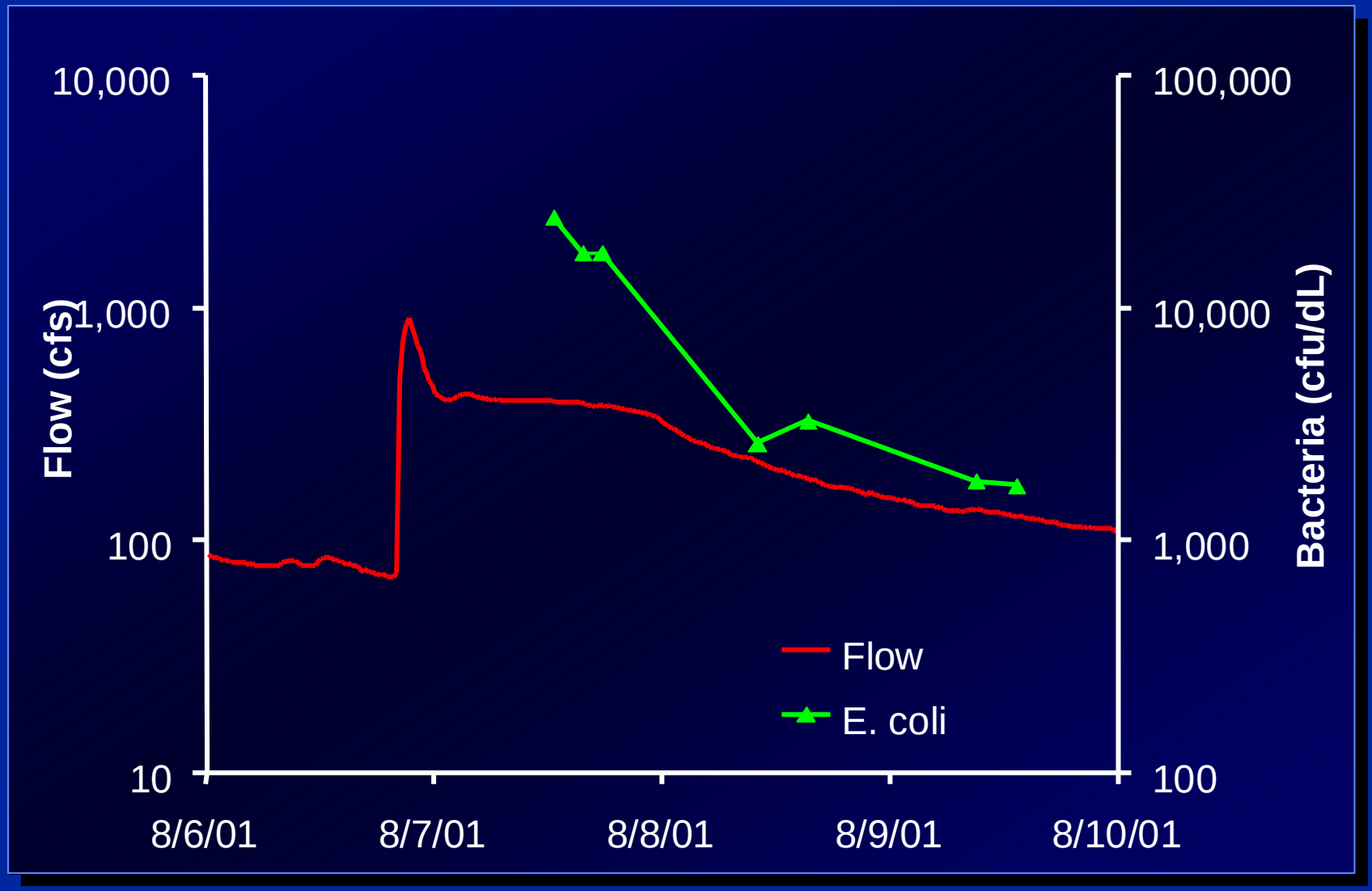
24 hr-rainfall data (inches)

Relating City of Houston rain gages to sampling sites: RG15 (Cole Creek); RG30 (BB@Dairy Ashford); RG31 (BB@Beltway 8 & Piney Point); RG34 (BB@Shepherd and WO@Heights & Houston)

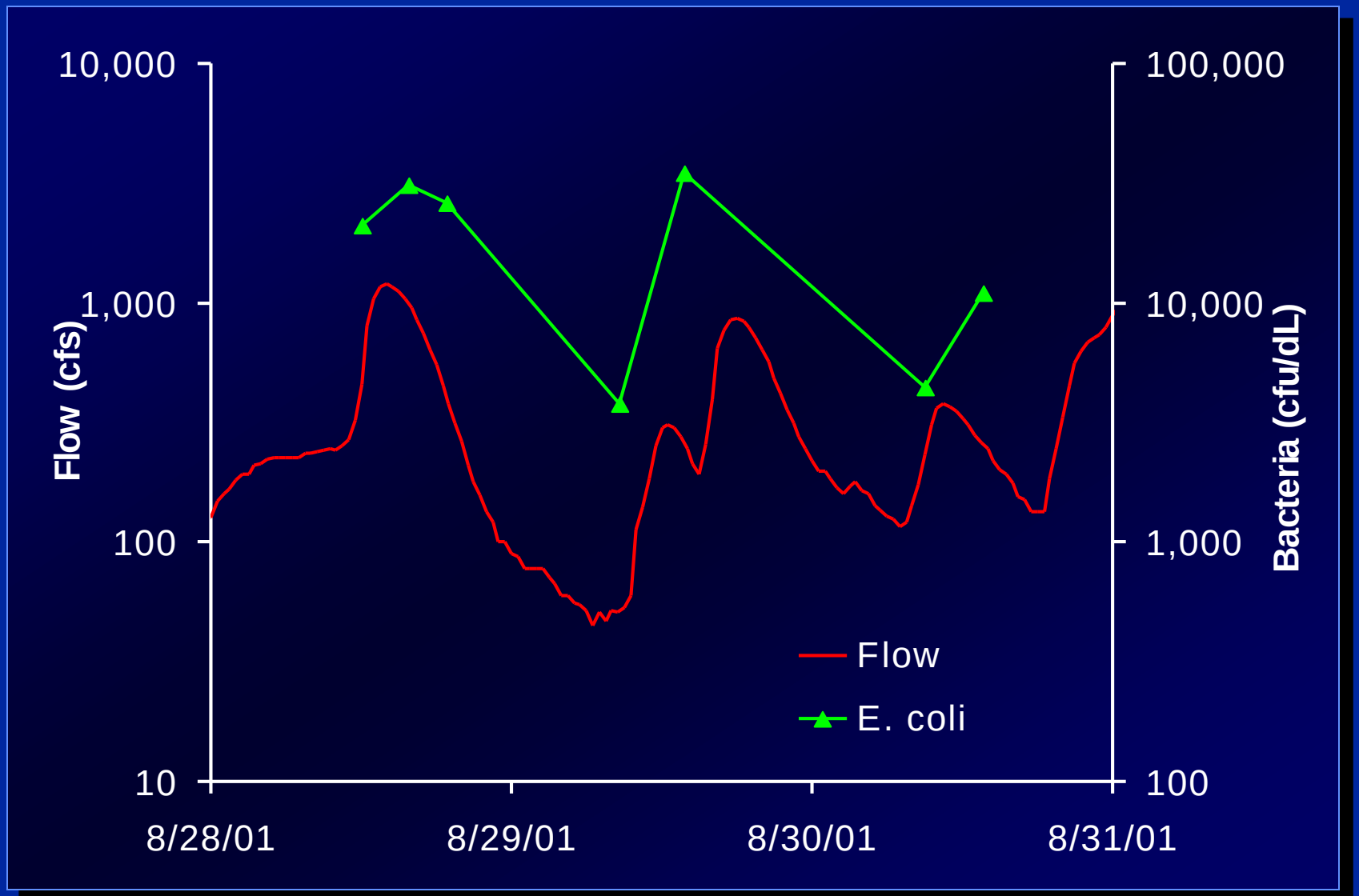
EC Data in BB from 7-9 Aug, 2001 Event



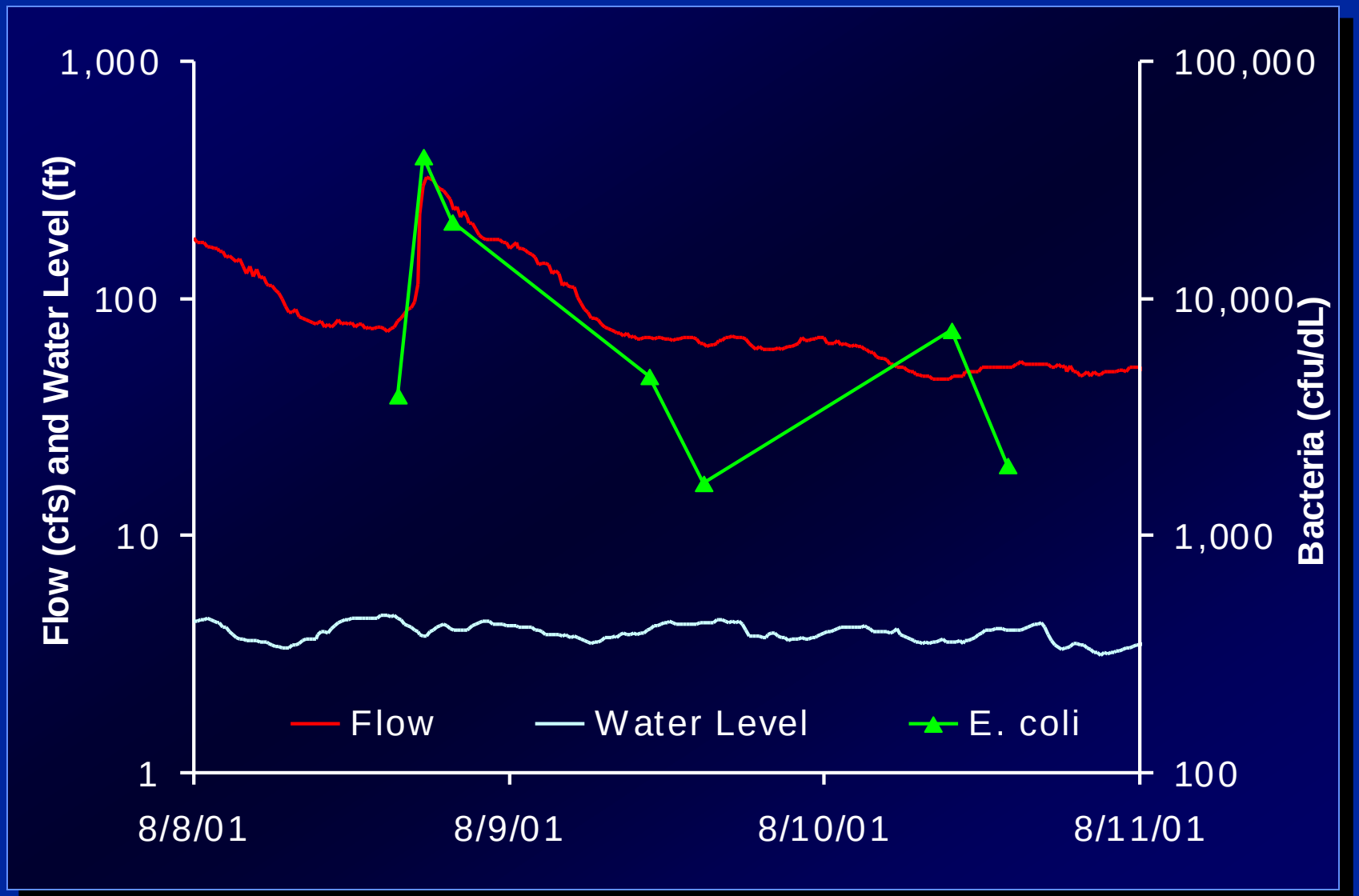
Runoff study – BB at Dairy Ashford



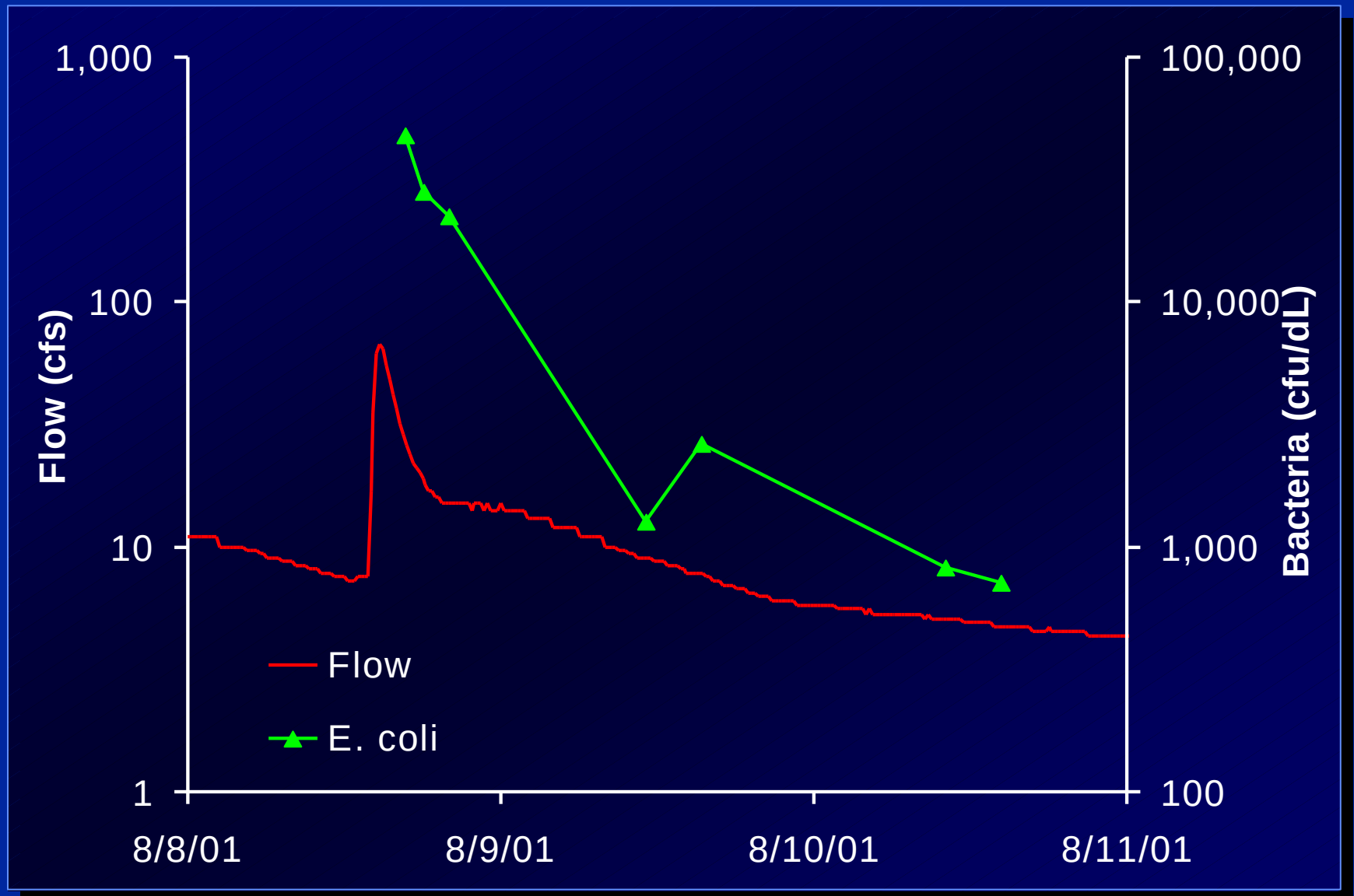
Runoff study – BB at Beltway 8



Runoff study – WO at Houston



Runoff study – Cole Creek at Deihl



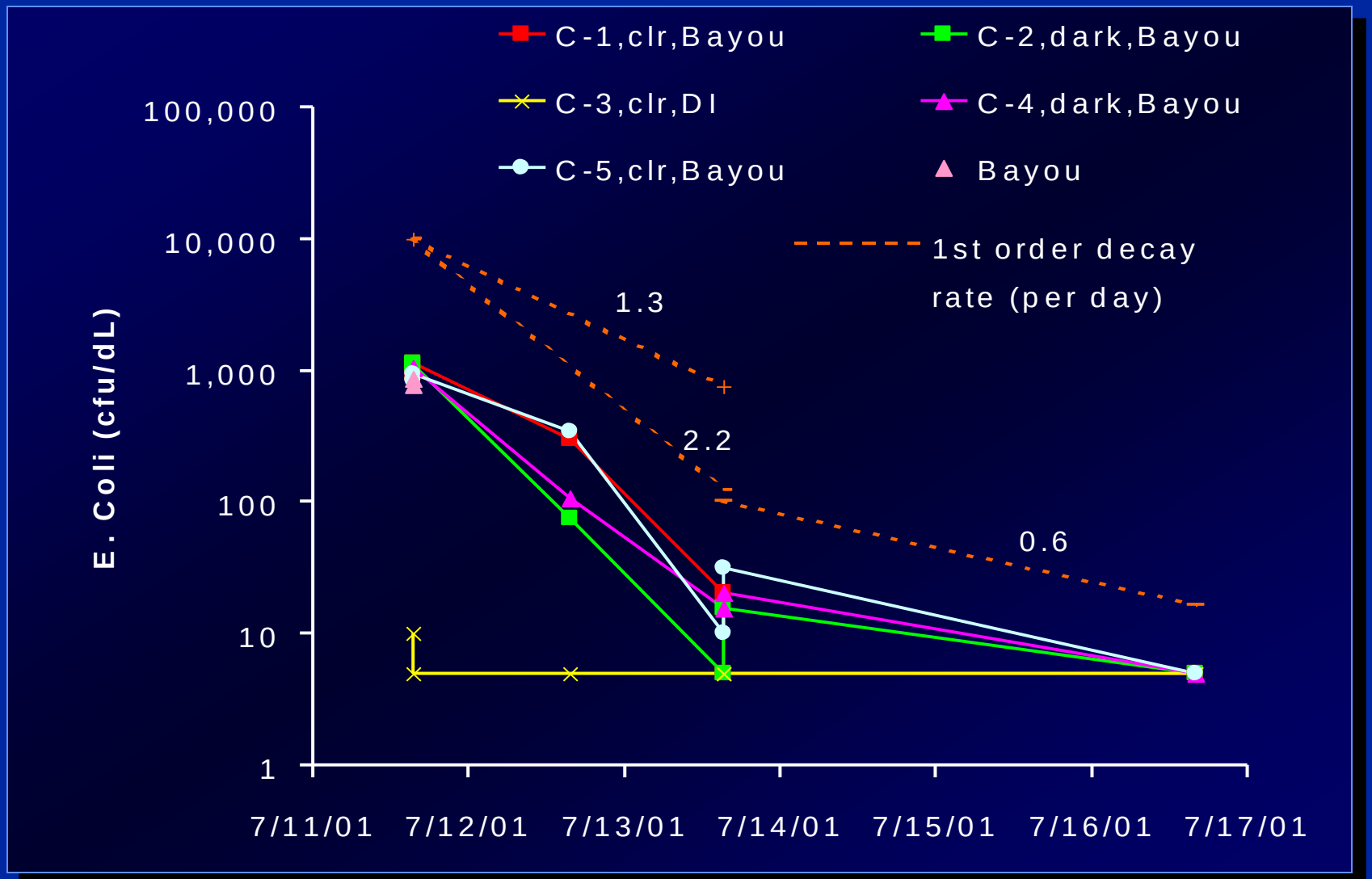
Dynamics studies

- Population change (light/dark chambers)
- Regrowth
- Resupply

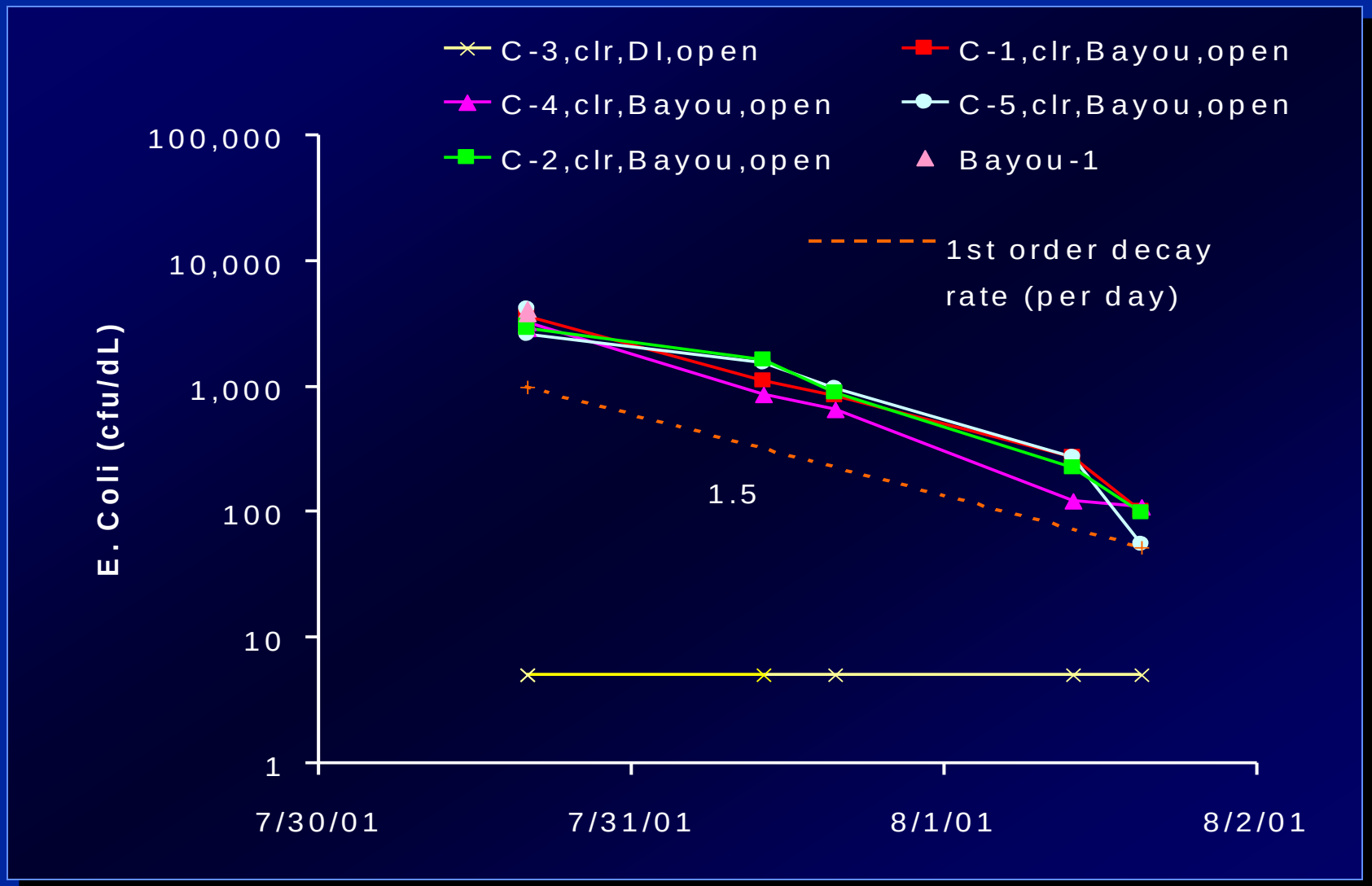
Light/dark dynamics results

	Initial EC (cfu/dL)	EC die-off rates (1/day)		
		Covered clear	*Covered dark*	*Open*
BB – 7/11-16 (Beltway 8)	836-1145	1.3	2.2	
BB – 7/30-8/1 (Beltway 8)	2897-4082	1.4	1.4	1.5
WO – 8/1-3 (IH 610)	190-352	3.0	3.0	4.0
BB – 8/14-16 (Wilcrest)	426-565	1.6	1.6	
WO – 8/14-16 (IH 610)	379-452	1.6	1.6	

Light/dark effects, Buffalo Bayou



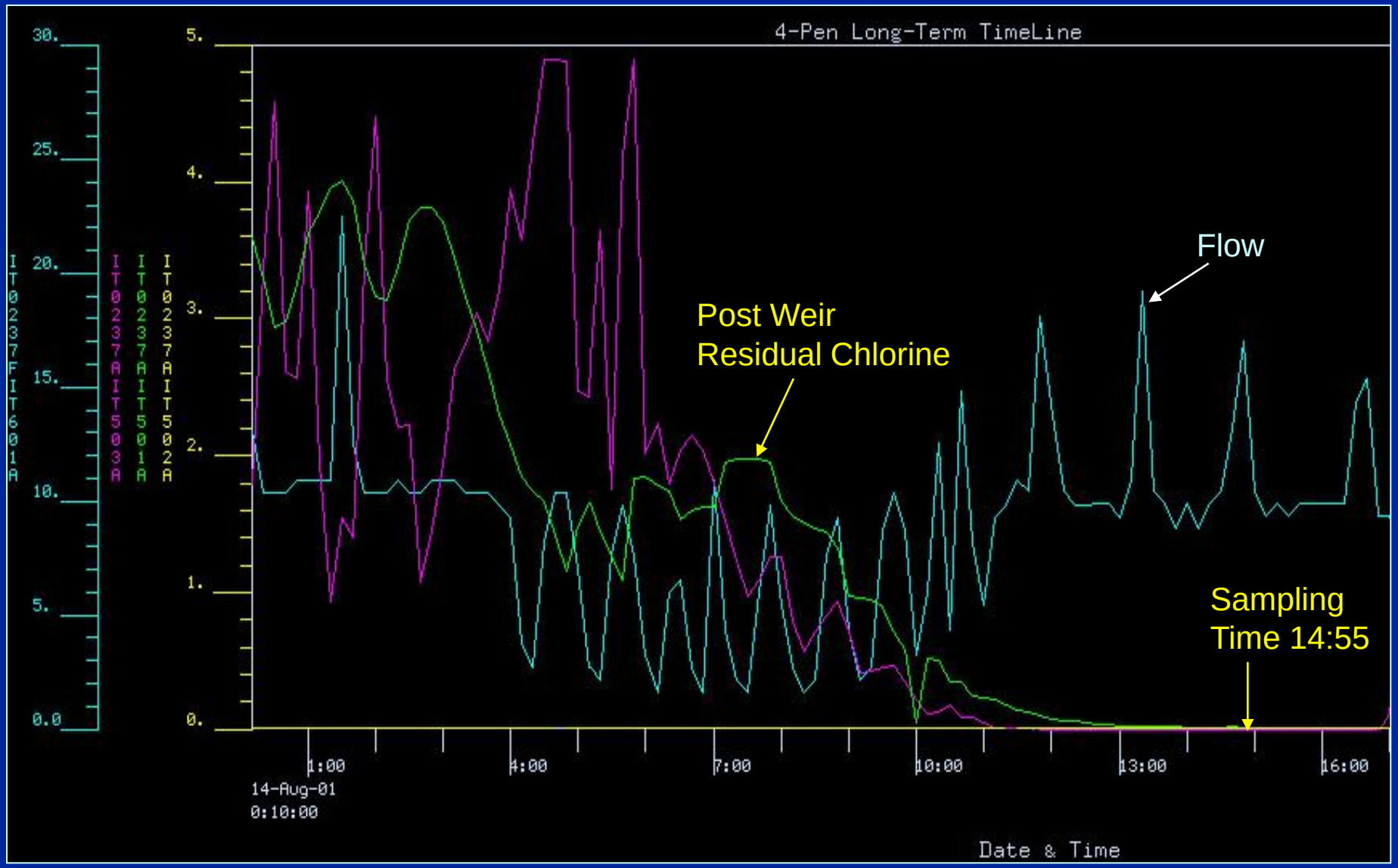
Light/dark Effects, BB, open chambers



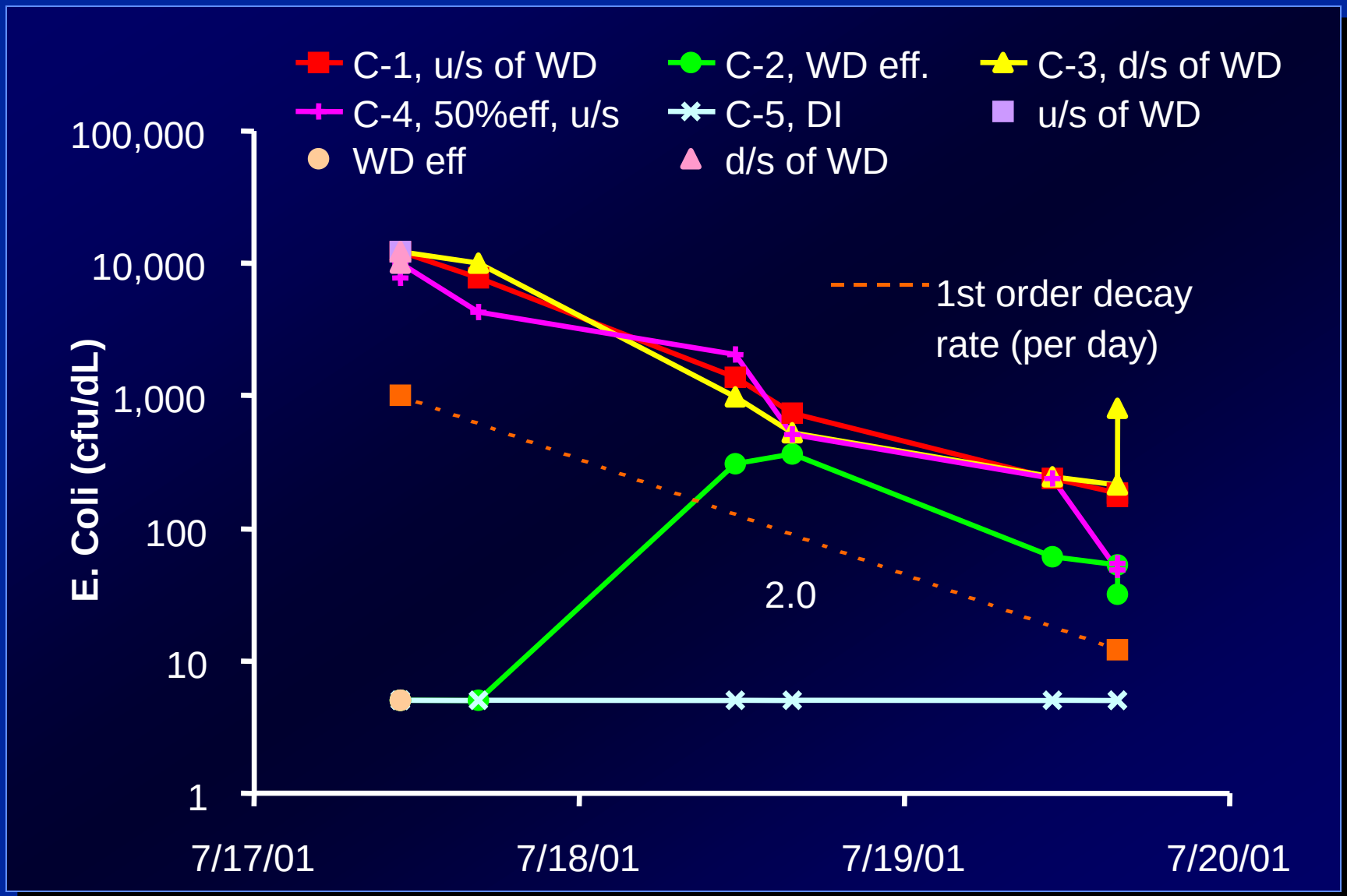
Regrowth results

WWTP	Initial EC (cfu/dL)	K (1/day)	EC regrowth
West District (Buffalo B., 7/17-19/01)	ND	2.0	yes
Turkey Creek (Buffalo B., 7/17-19/01)	ND	1.0	slight
Northwest (Cole Creek, 7/24-26/01)	5	1.4	yes
White Oak (WO B., 7/17-19/01)	15	1.4	neutral
West District (Buffalo B., 8/14-16/01)	19,863	0.9/4.5	no

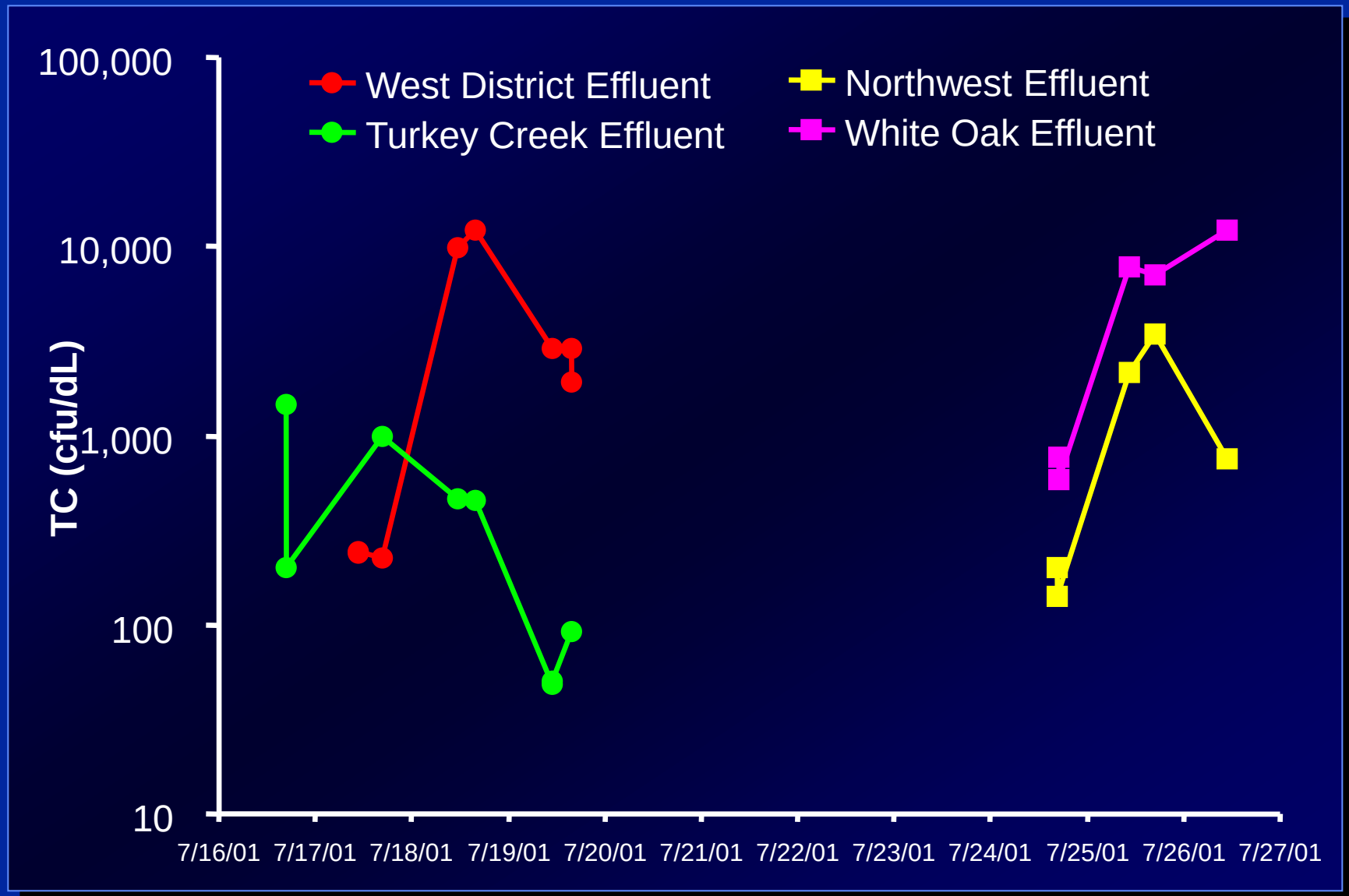
West District WWTP on 8/14/01



Regrowth – West District WWTP



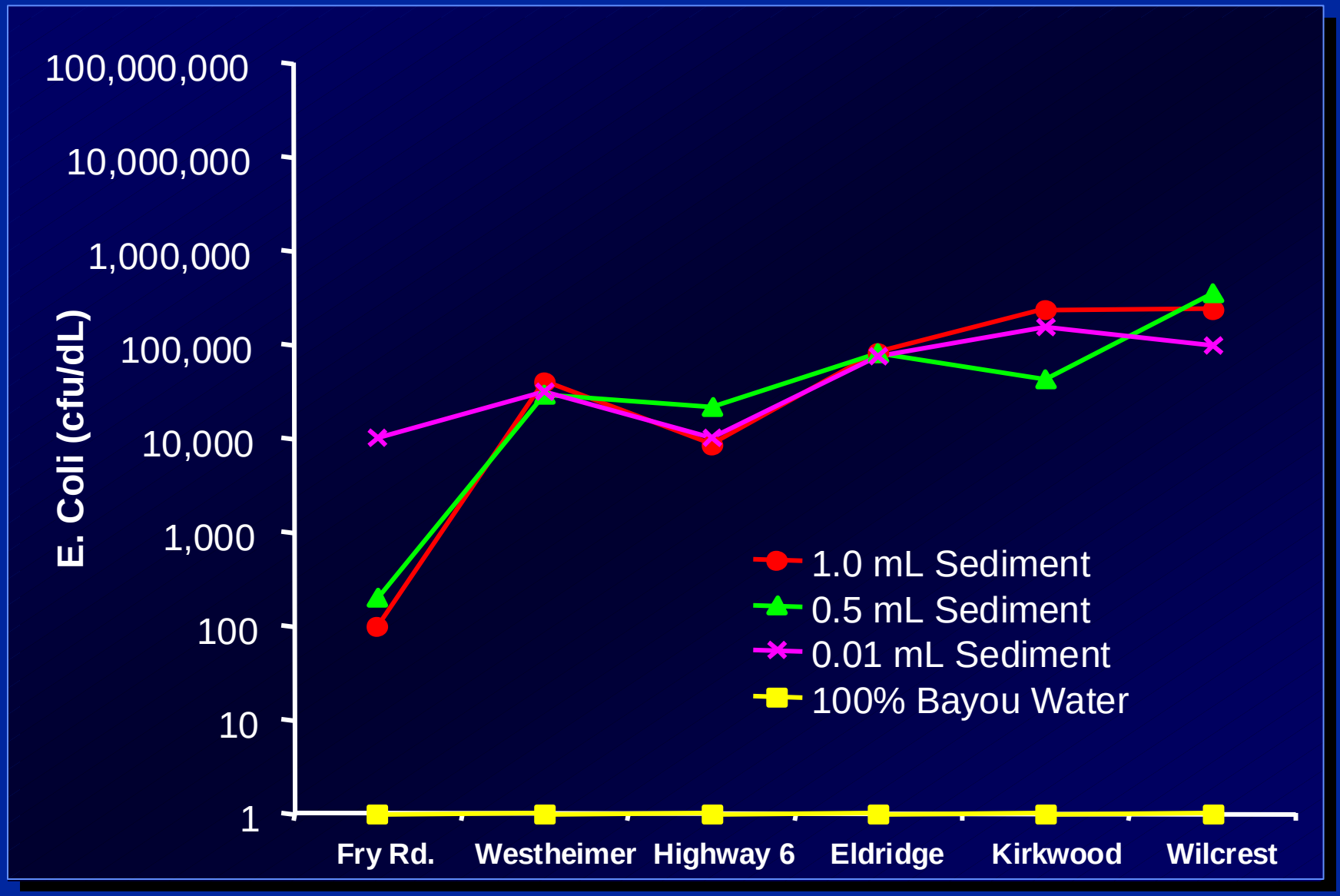
Regrowth of Total Coliform



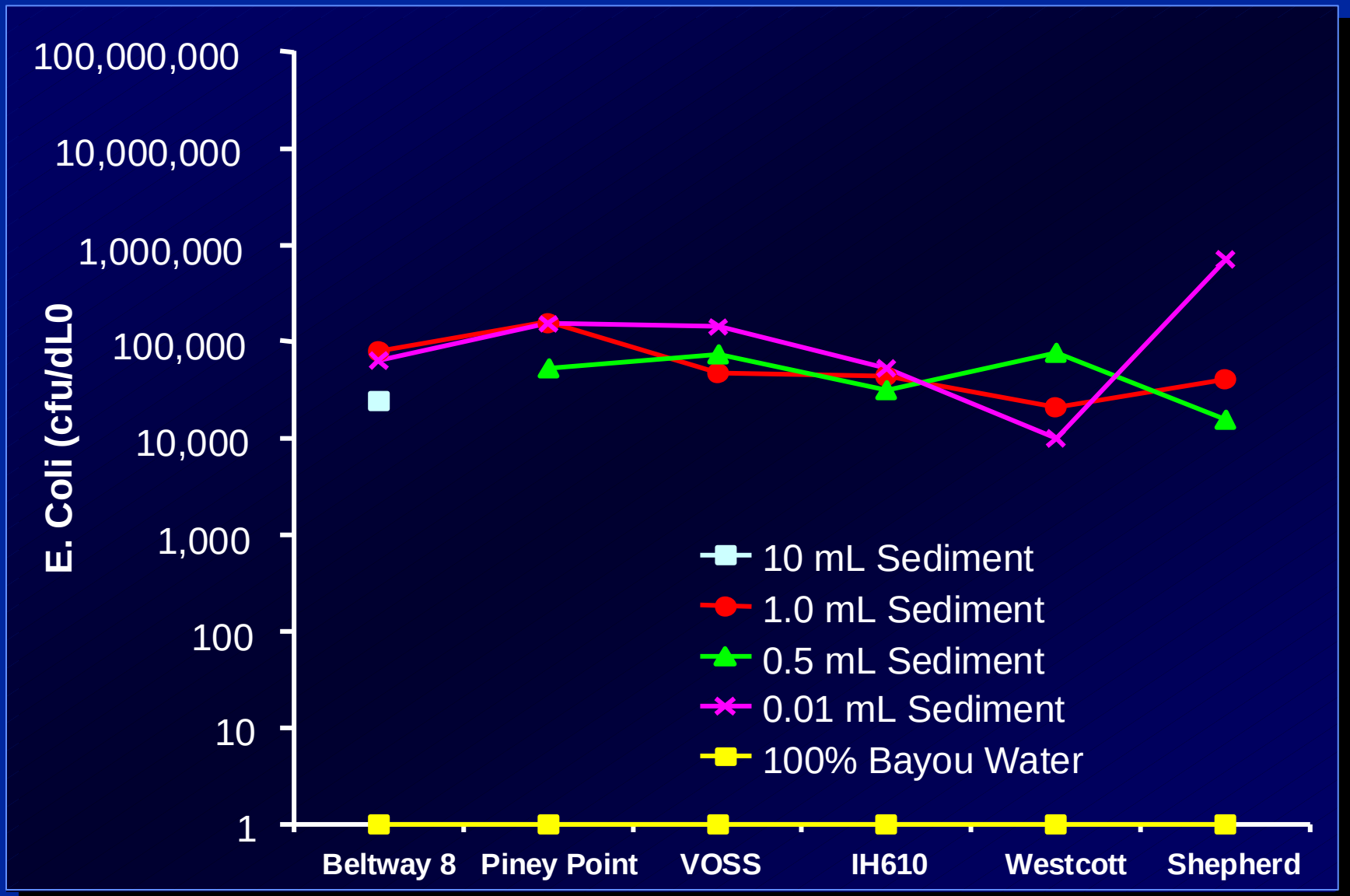
Sediment resupply

- Bacteria conc in sediments
- Resupply

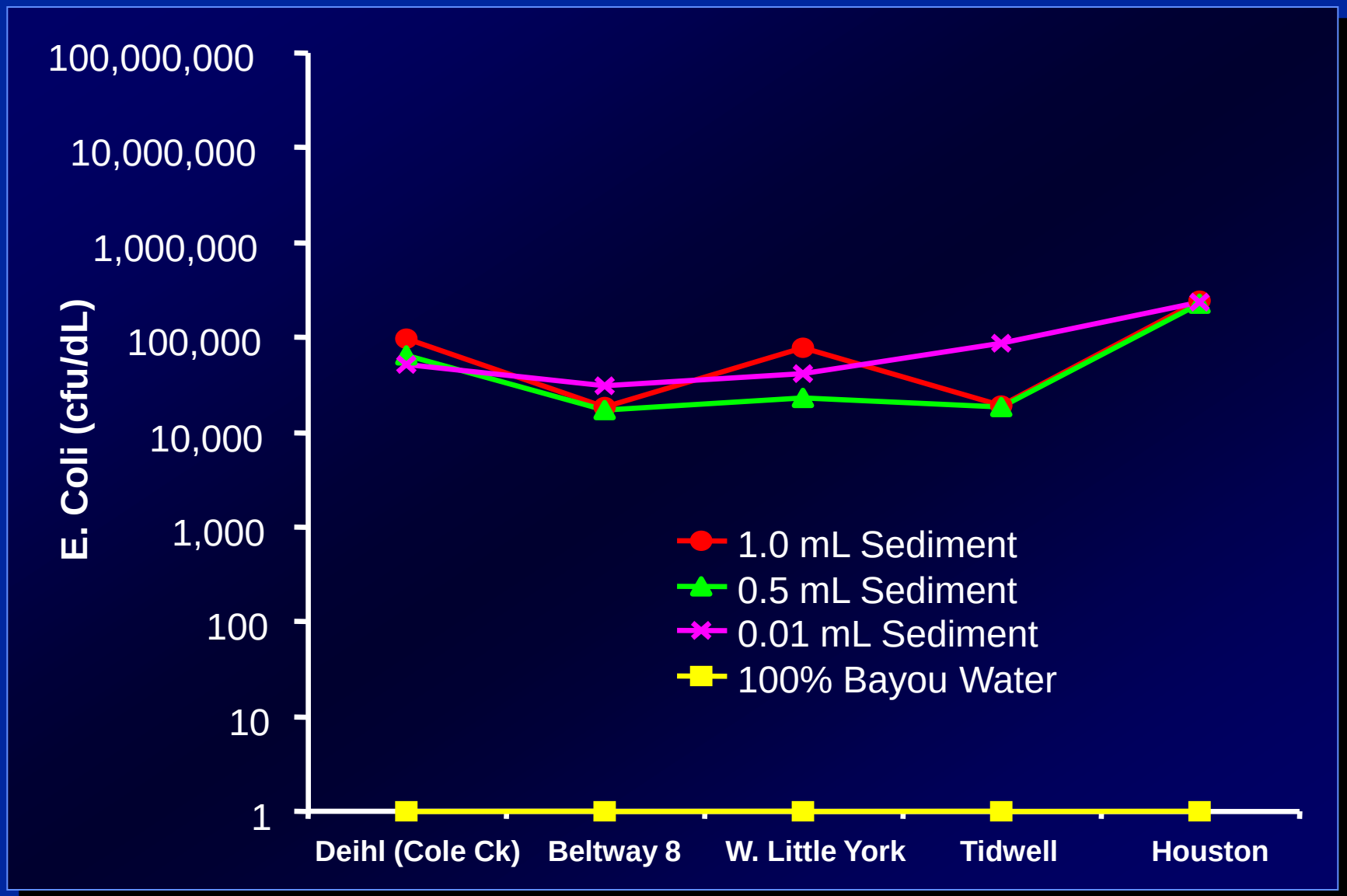
EC in BB sediments



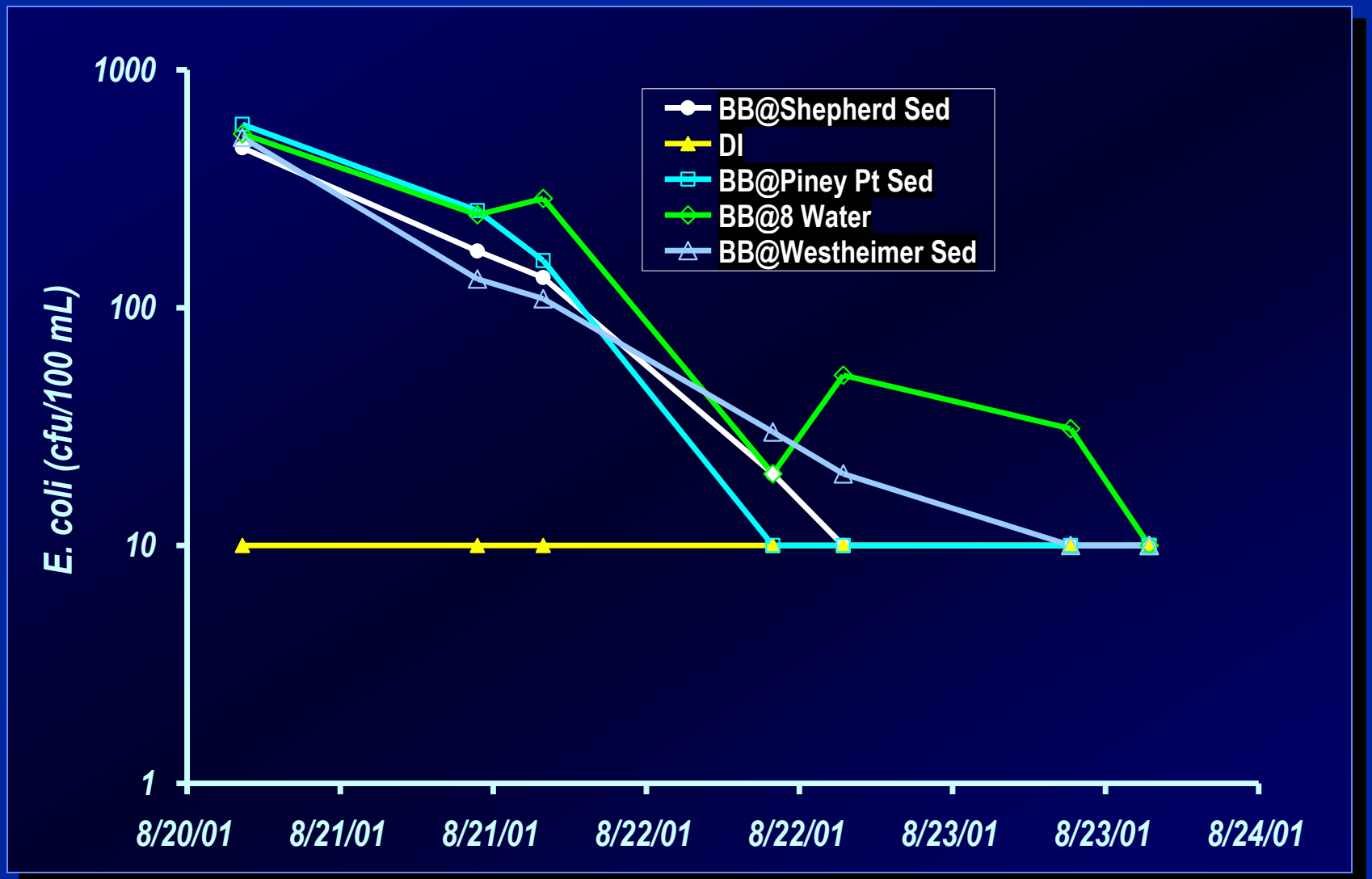
EC in BB sediments (cont'd)



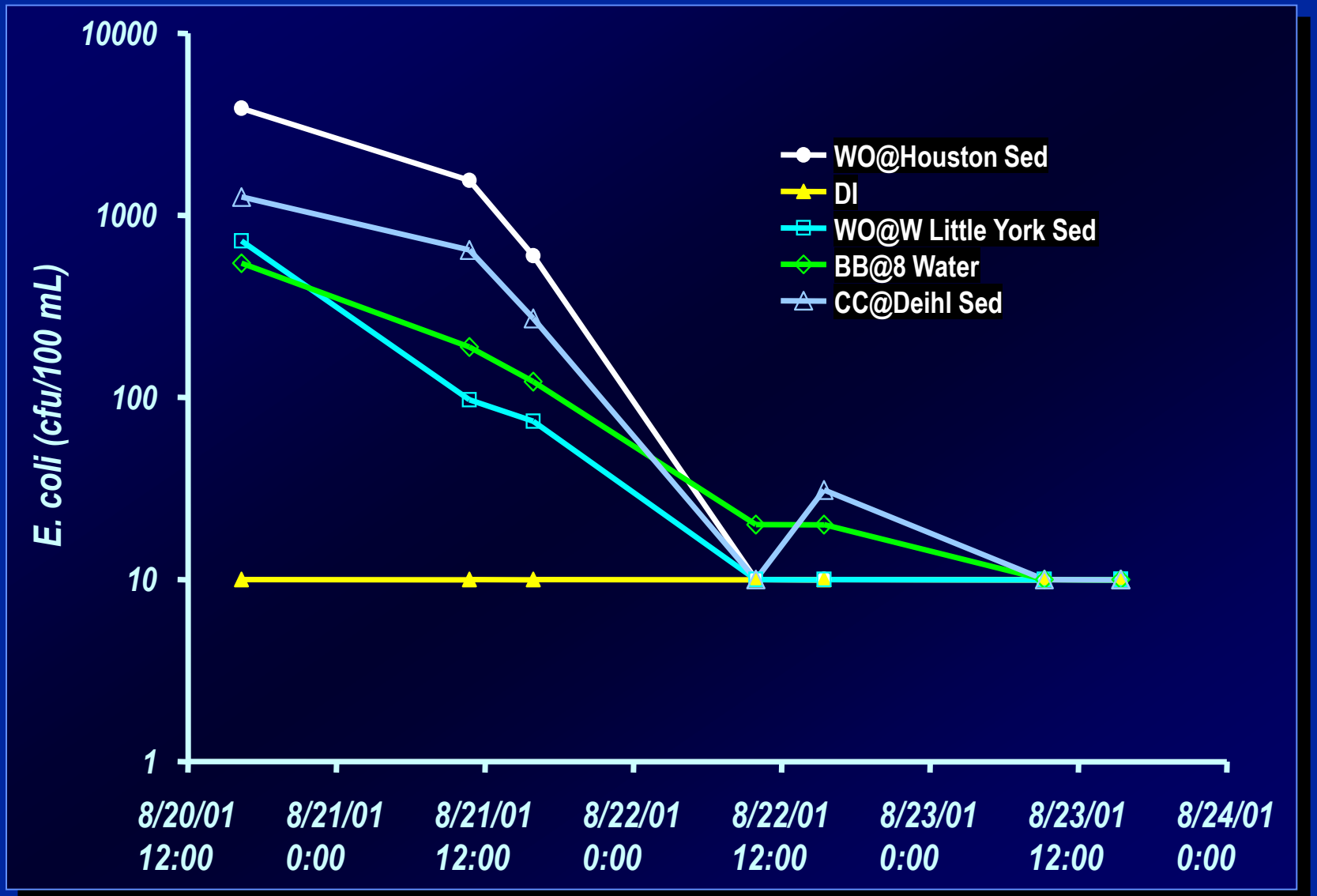
EC in WO sediments



BB sediment resupply



WO sediment resupply



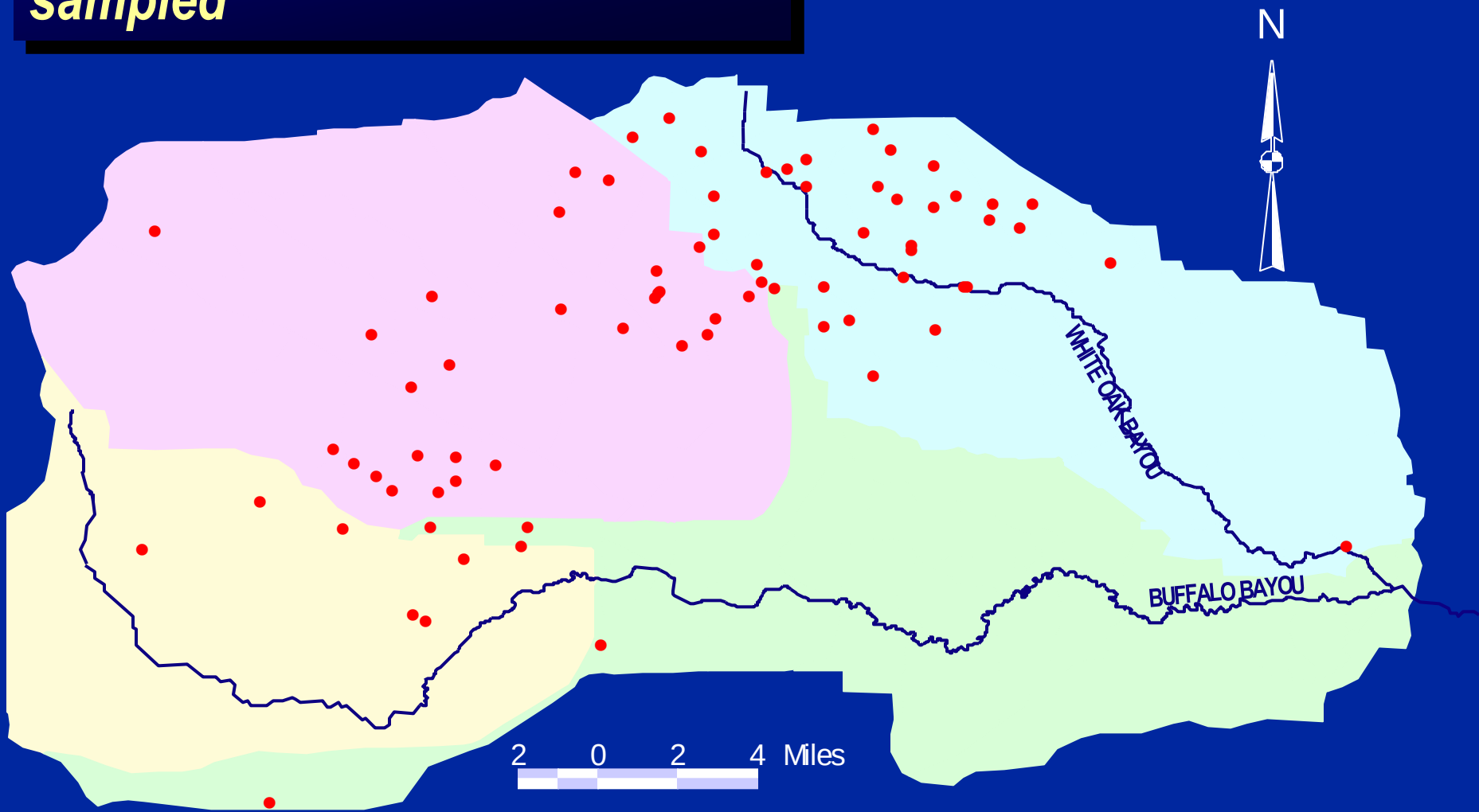
Assess major sources of bacteria in BB and WO

1. Sample point source discharges during low flow conditions

2. Monitor storm sewers discharging to bayous during dry weather conditions to assess potential illicit discharges

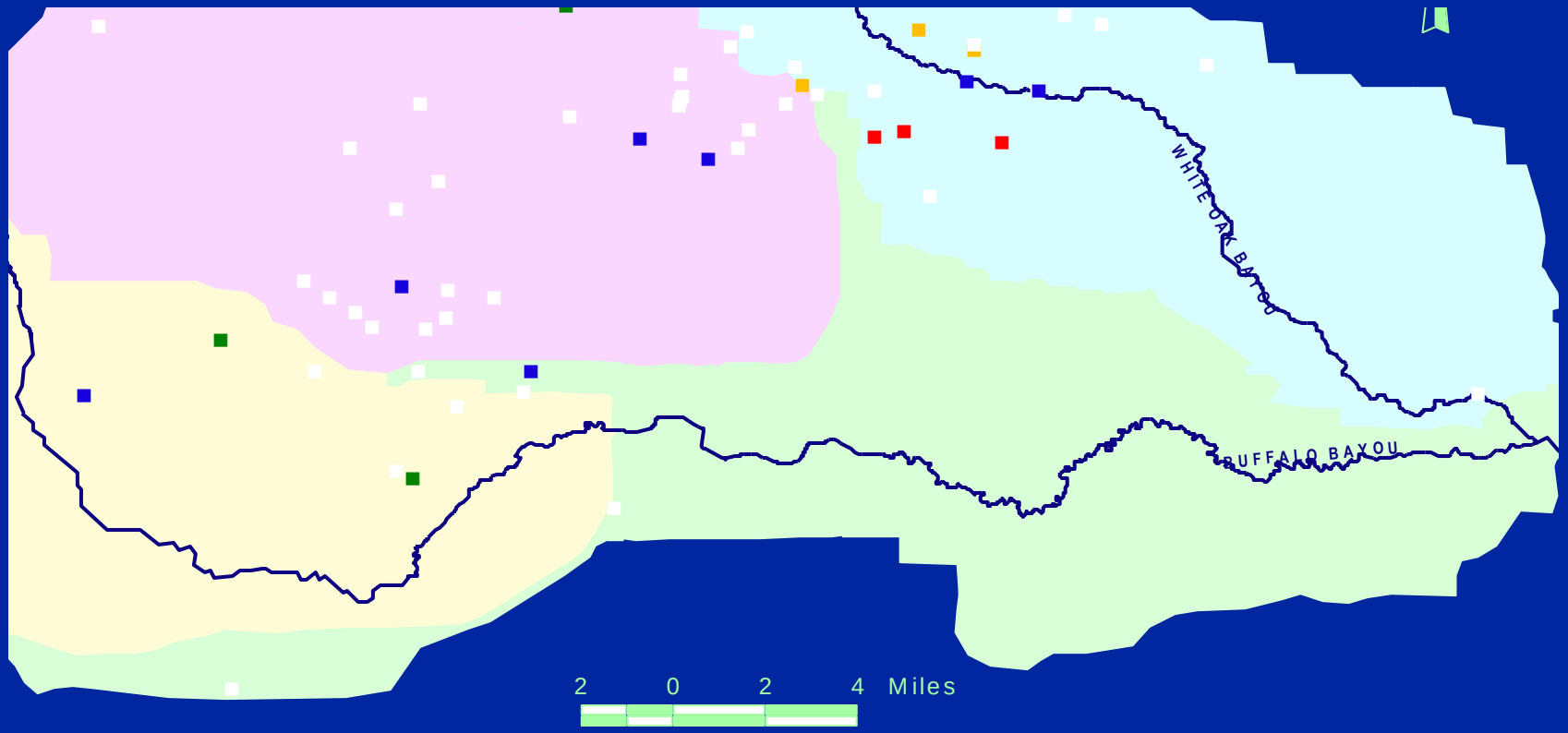
Point source sampling

A total of 76 WWTPs were sampled



EC data from point source sampling

- < 10
- 10-50
- 50-126
- 126-1,000
- >1,000 cfu/dL

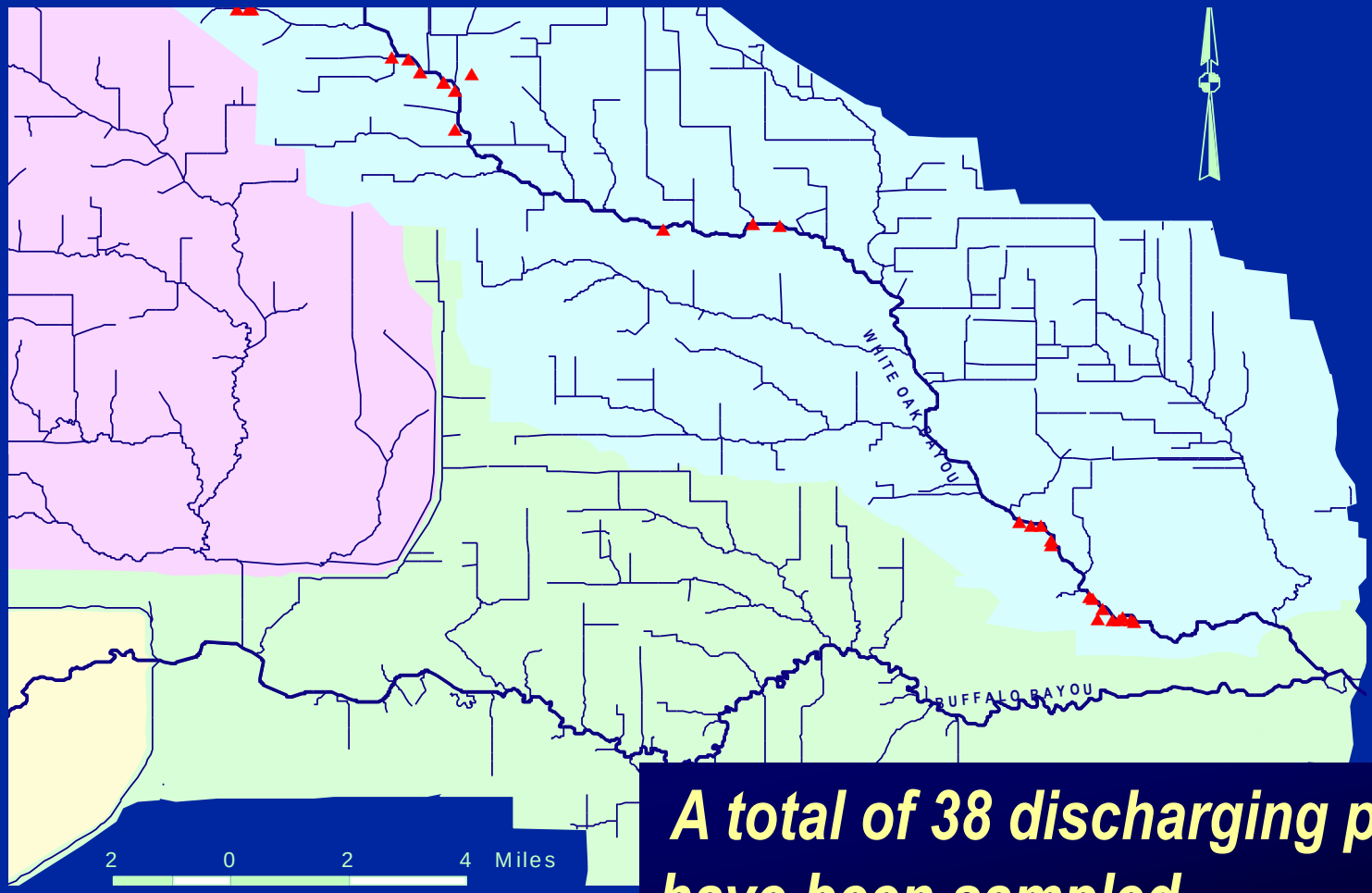


Summary of point source sampling

	All samples		Peak flow samples		Off-peak flow samples	
	EC	FC	EC	FC	EC	FC
Geomean	2.7	0.5	3.2	0.7	2.3	0.3
Range	0-2,347	0-5,000	0-2,347	0-5,000	0-759	0-150
% >std[1]	7.2%	2.0%	8.8%	3.8%	5.6%	0%

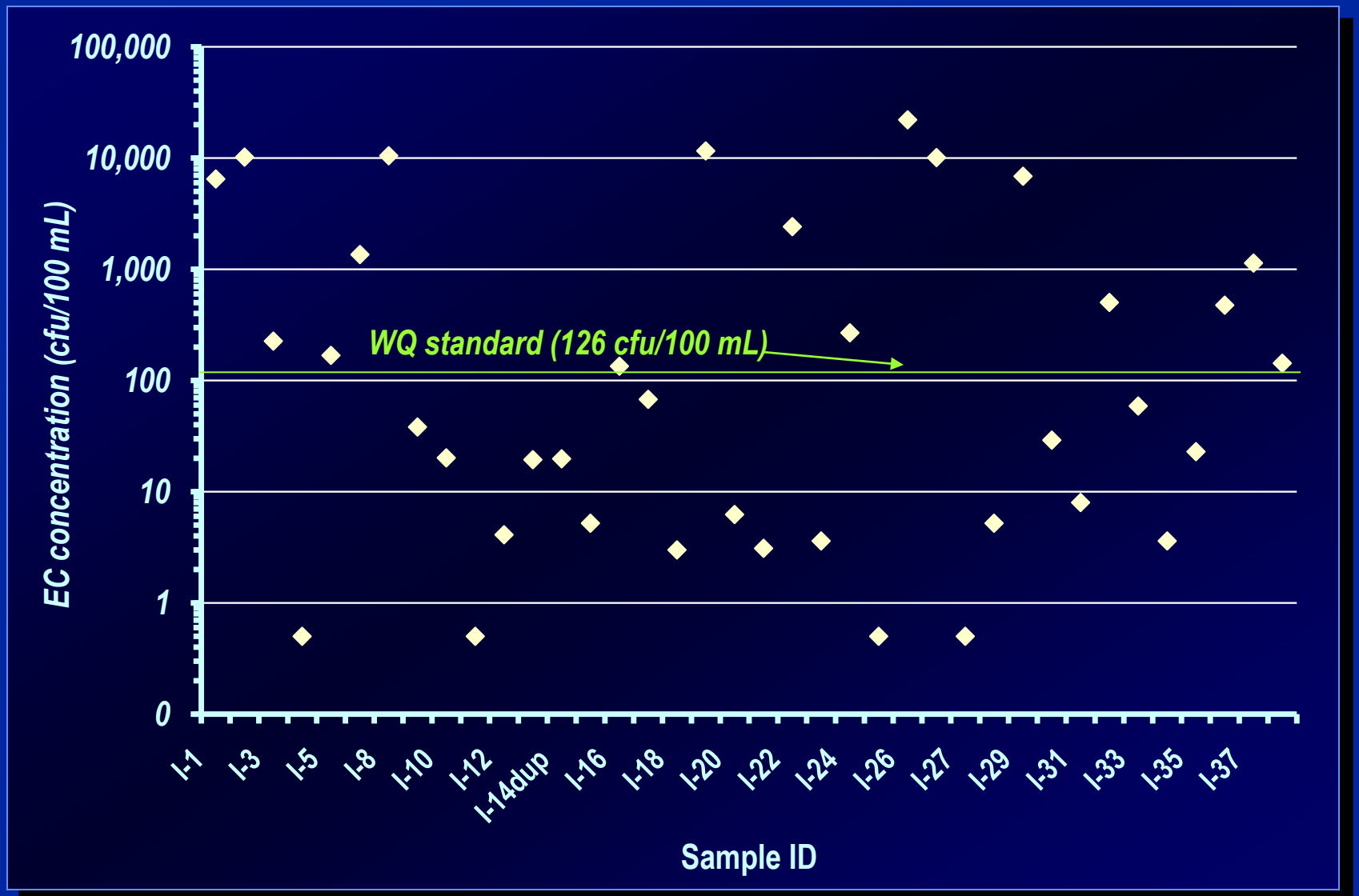
[1] regulatory limits: 126 cfu/dL for EC and 200 cfu/dL for FC
All the values given in cfu/dL

Storm sewer sampling



A total of 38 discharging pipes have been sampled

EC data from storm sewer sampling



Summary of storm sewer sampling

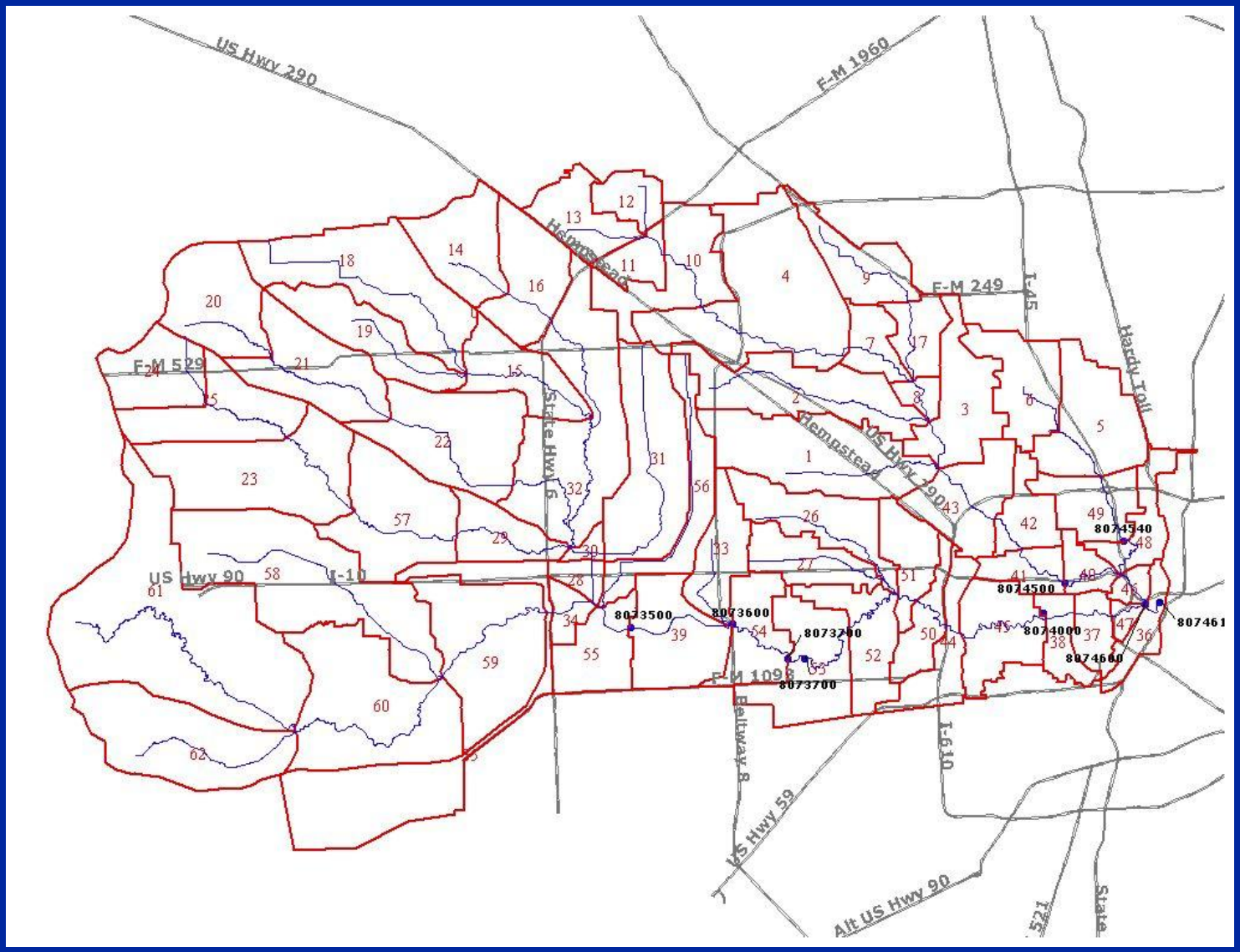
	EC (cfu/dL)	FC (cfu/dL)
Number samples	38	30
Geomean	73	16
Range	0-22,027	0-5,600
% Exceeding WQ criterion[1]	44.7%	26.7%

[1] regulatory limits: 126 cfu/dL for EC and 200 cfu/dL for FC

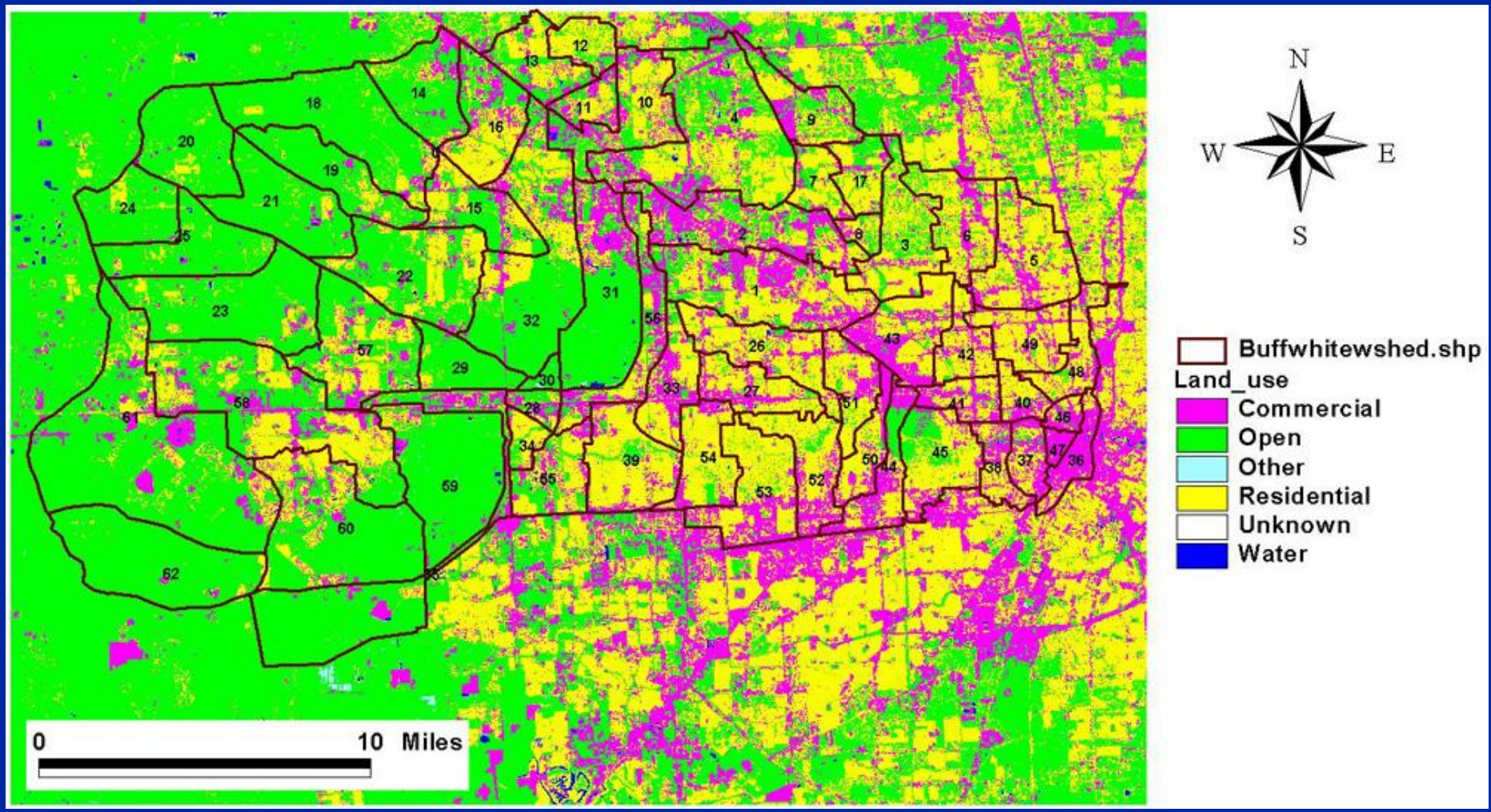
Modeling activities

1. Delineation of subwatersheds
2. Data preparation and compilation
3. Model development and calibration
4. Sensitivity analysis
5. Model runs → load allocations

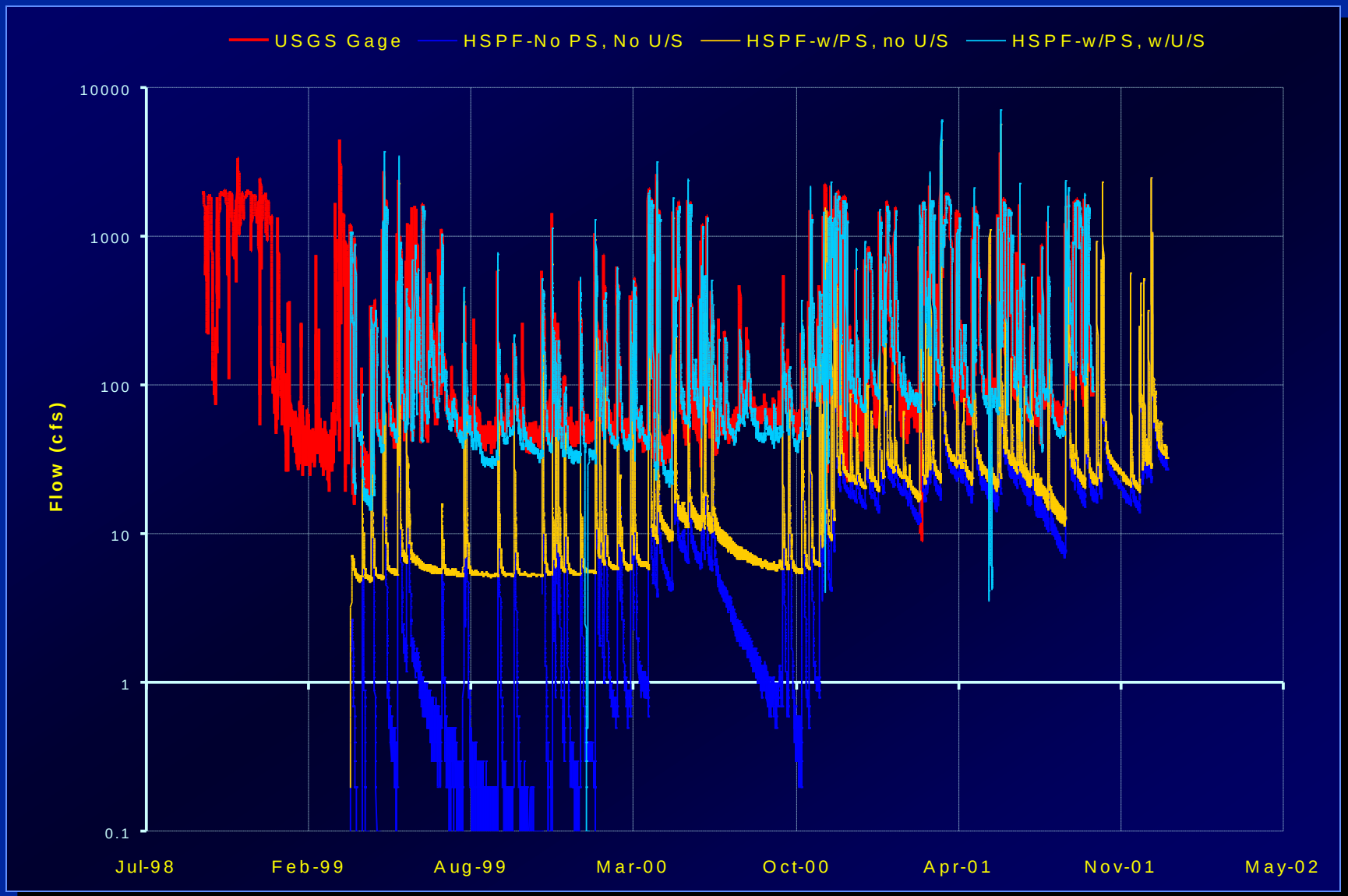
Delineation of subwatersheds



Compilation of input data



Preliminary Model Output – BB Flow @ Westbelt



Summary of Findings

Sources

- **Point sources: 11 out of 76 plants exceeded EC criterion while 3 out of 76 exceeded FC limit**
- **Storm sewer sampling showed higher EC and FC levels than WWTP monitoring**

Summary of Findings cont'd

Current levels

- Runoff exhibited high concentrations of EC
- Runoff concentrations appear to track with variations in flow

Summary of Findings cont'd

Dynamics

- High first-order die-off rates with no relation to light intensity
- Regrowth exists but may not be a major process
- Sediment resuspension when bayou flows increase may play significant role
- Quiescent conditions reduce EC levels rapidly

Future Tasks

- Complete HSPF modeling of bayou bacteria levels
- Apply the model to analyze alternatives
- Load allocations