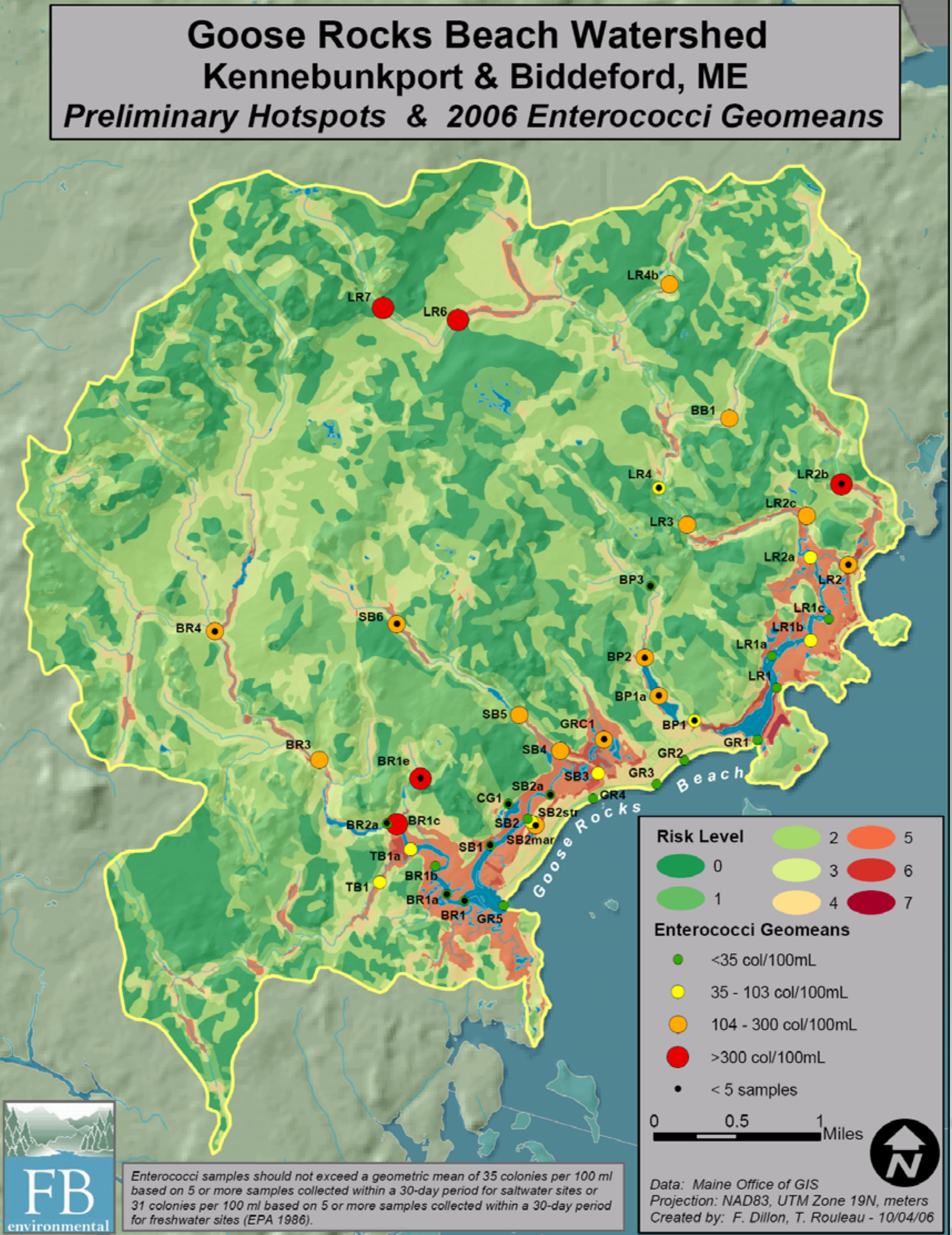


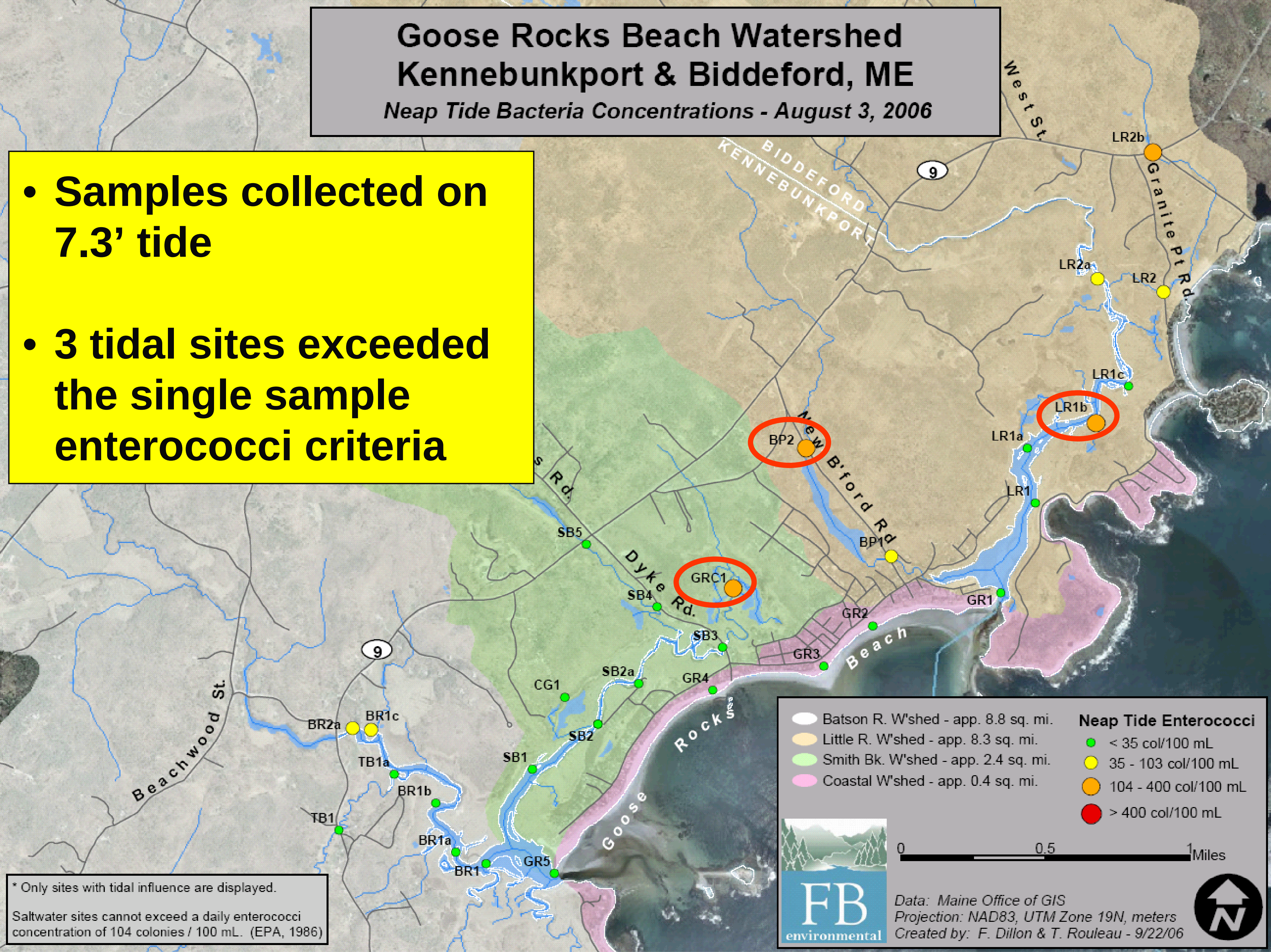
Hotspots + Enterococci

- General correspondence between high risk areas and high bacteria concentrations

Goose Rocks Beach Watershed
Kennebunkport & Biddeford, ME

Neap Tide Bacteria Concentrations - August 3, 2006

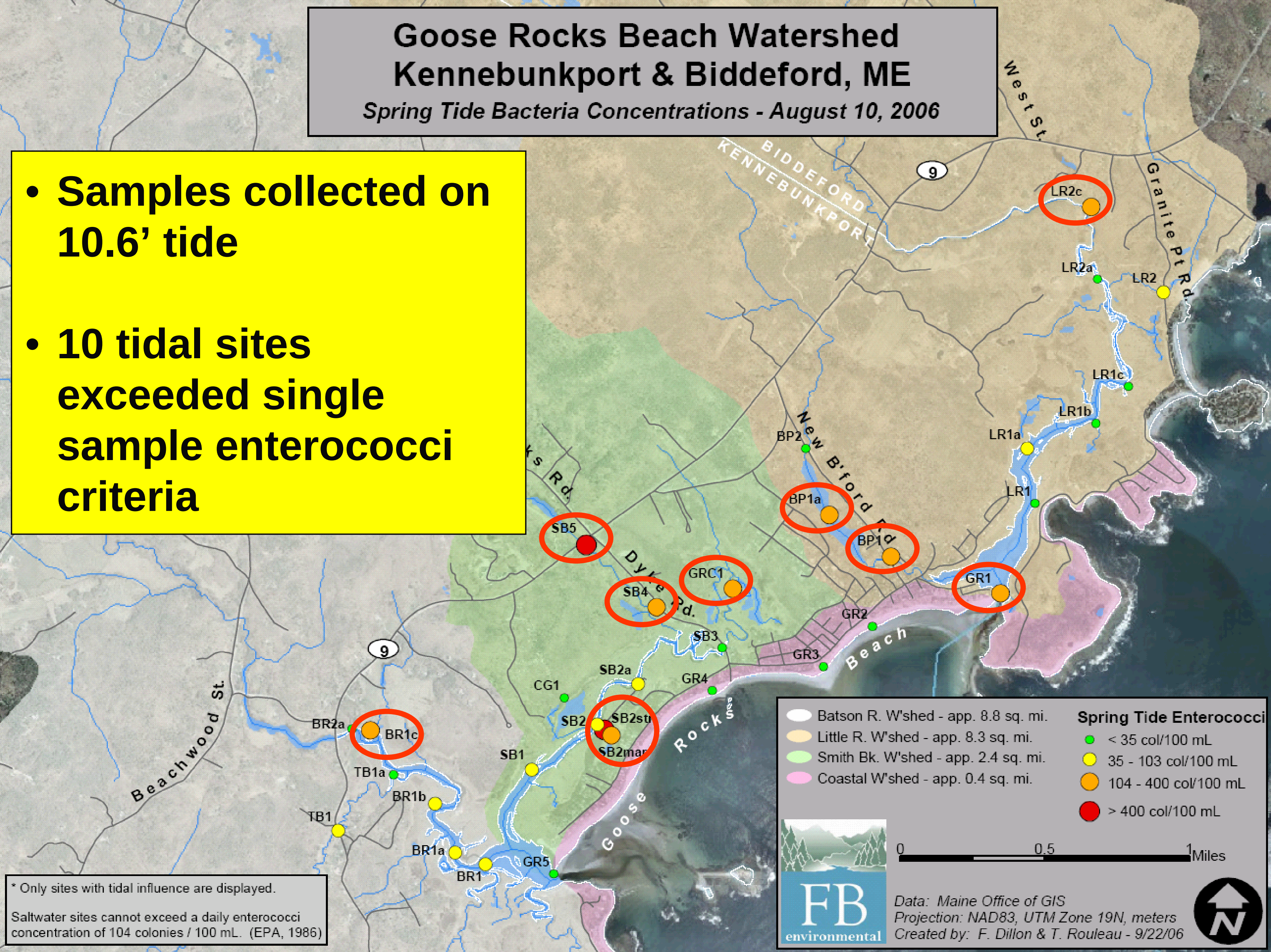
- **Samples collected on 7.3' tide**
- **3 tidal sites exceeded the single sample enterococci criteria**

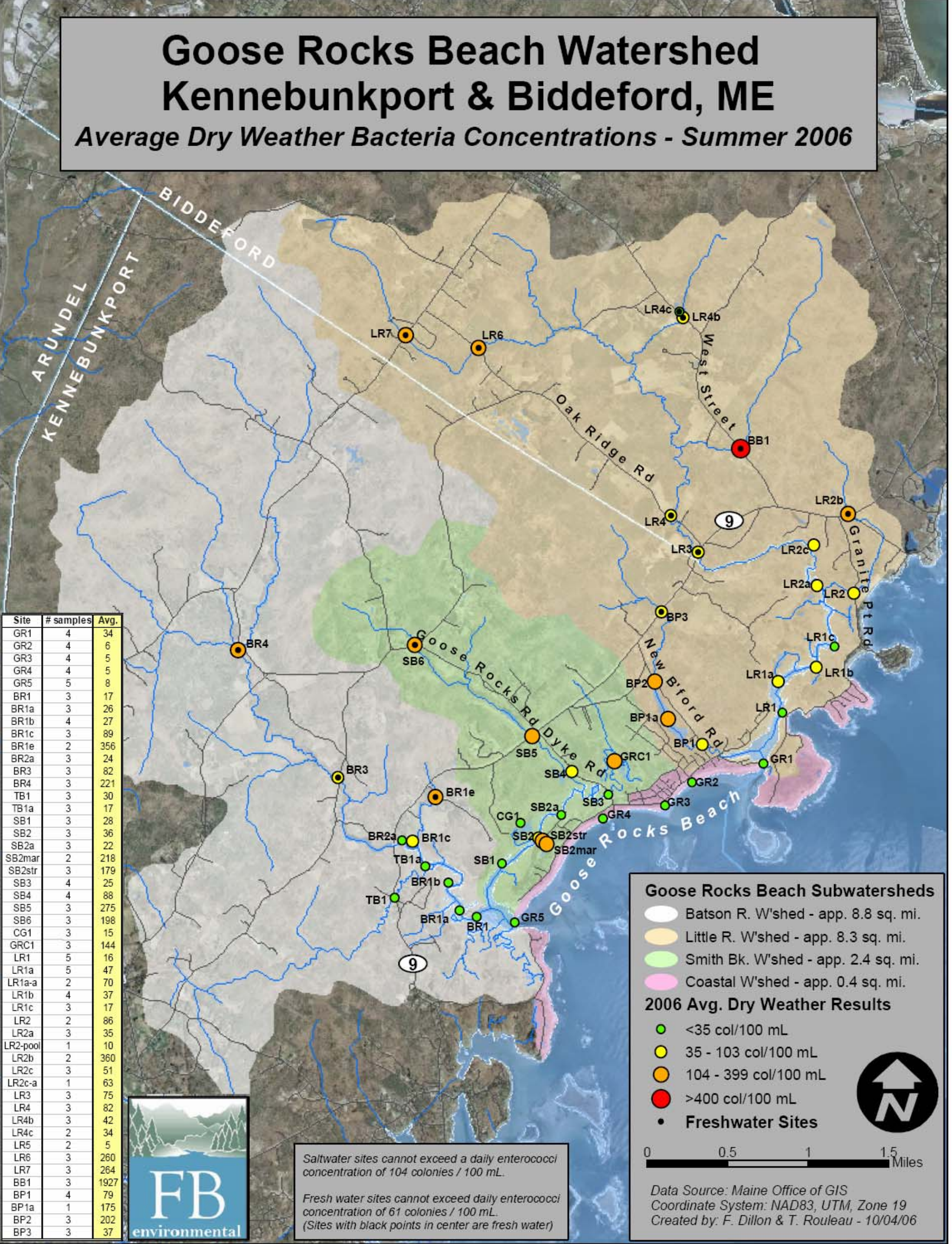


Goose Rocks Beach Watershed
Kennebunkport & Biddeford, ME

Spring Tide Bacteria Concentrations - August 10, 2006

- **Samples collected on 10.6' tide**
- **10 tidal sites exceeded single sample enterococci criteria**



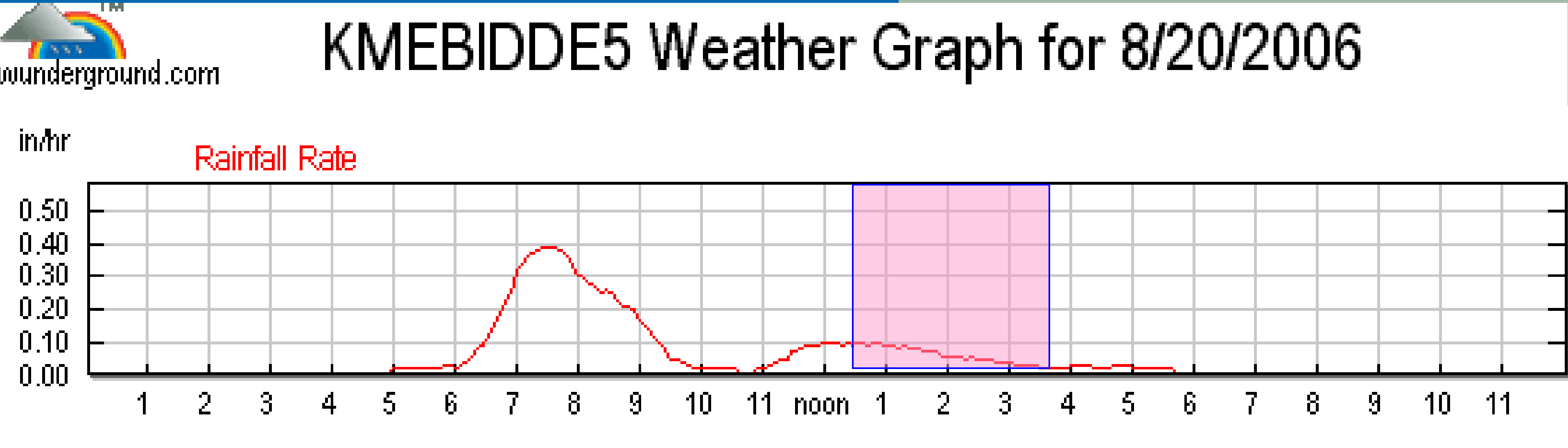


Site	# samples	Avg.
GR1	4	34
GR2	4	6
GR3	4	5
GR4	4	5
GR5	5	8
BR1	3	17
BR1a	3	26
BR1b	4	27
BR1c	3	89
BR1e	2	356
BR2a	3	24
BR3	3	82
BR4	3	221
TB1	3	30
TB1a	3	17
SB1	3	28
SB2	3	36
SB2a	3	22
SB2mar	2	218
SB2str	3	179
SB3	4	25
SB4	4	88
SB5	3	275
SB6	3	198
CG1	3	15
GRC1	3	144
LR1	5	16
LR1a	5	47
LR1a-a	2	70
LR1b	4	37
LR1c	3	17
LR2	2	86
LR2a	3	35
LR2-pool	1	10
LR2b	2	360
LR2c	3	51
LR2c-a	1	63
LR3	3	75
LR4	3	82
LR4b	3	42
LR4c	2	34
LR5	2	5
LR6	3	260
LR7	3	264
BB1	3	1927
BP1	4	79
BP1a	1	175
BP2	3	202
BP3	3	37

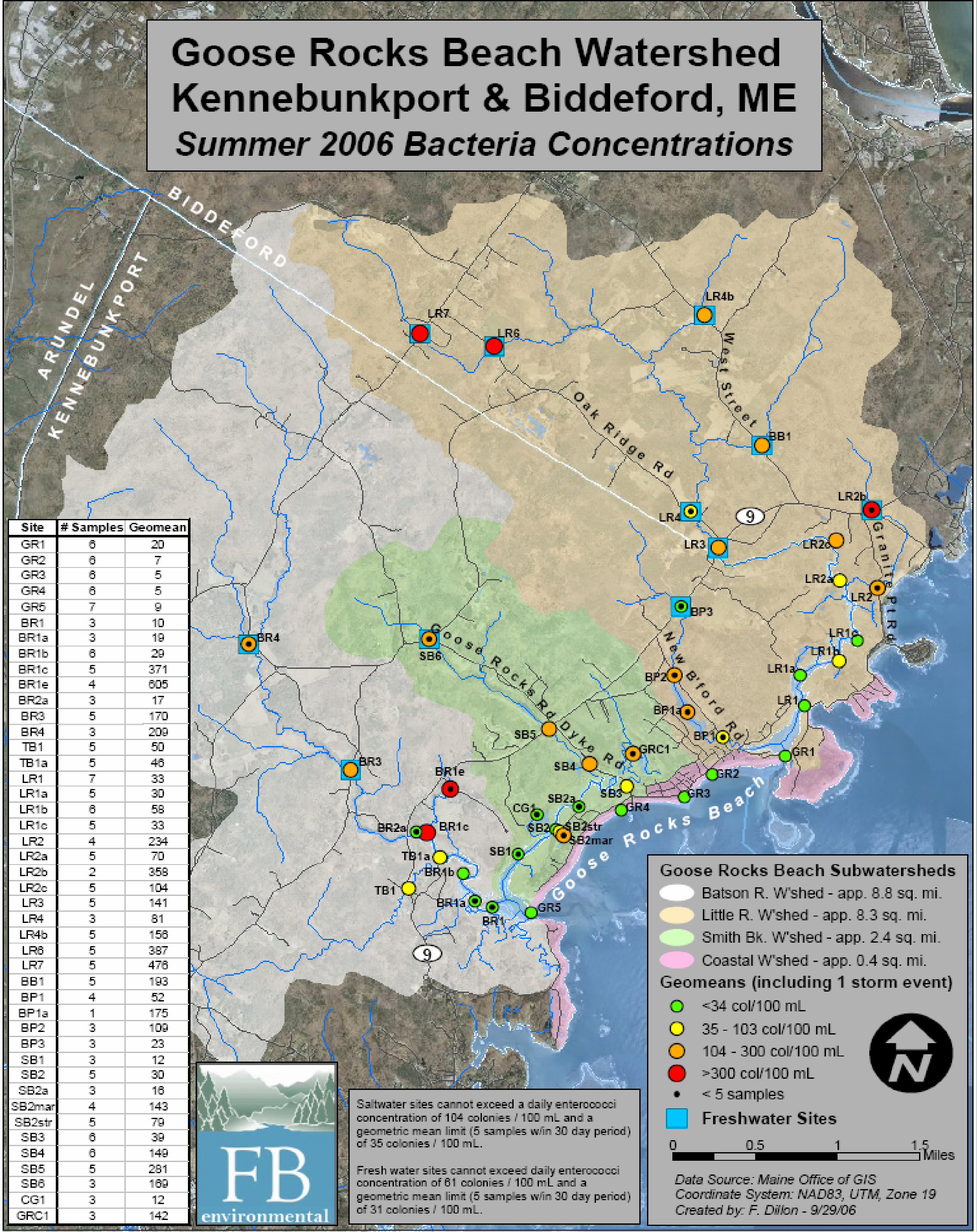
Dry Weather Sampling

- Base sampling 7/26, 8/3, 8/10, 8/17 & 8/24.
- Entero averages generally lower at sites closer to GRB
- 23 sites exceeded the single sample enterococci criteria at least once over sampling period
- Of these sites, 11 sites had 2 or more exceedances

Storm Event Sampling



- **13 sites exceeded the EPA criteria twice**



Site	# Samples	Geomean
GR1	6	20
GR2	6	7
GR3	6	5
GR4	6	5
GR5	7	9
BR1	3	10
BR1a	3	19
BR1b	6	29
BR1c	5	371
BR1e	4	605
BR2a	3	17
BR3	5	170
BR4	3	209
TB1	5	50
TB1a	5	46
LR1	7	33
LR1a	5	30
LR1b	6	58
LR1c	5	33
LR2	4	234
LR2a	5	70
LR2b	2	358
LR2c	5	104
LR3	5	141
LR4	3	81
LR4b	5	156
LR6	5	387
LR7	5	476
BB1	5	193
BP1	4	52
BP1a	1	175
BP2	3	109
BP3	3	23
SB1	3	12
SB2	5	30
SB2a	3	16
SB2mar	4	143
SB2str	5	79
SB3	6	39
SB4	6	149
SB5	5	281
SB6	3	169
CG1	3	12
GRC1	3	142

Summarized Data

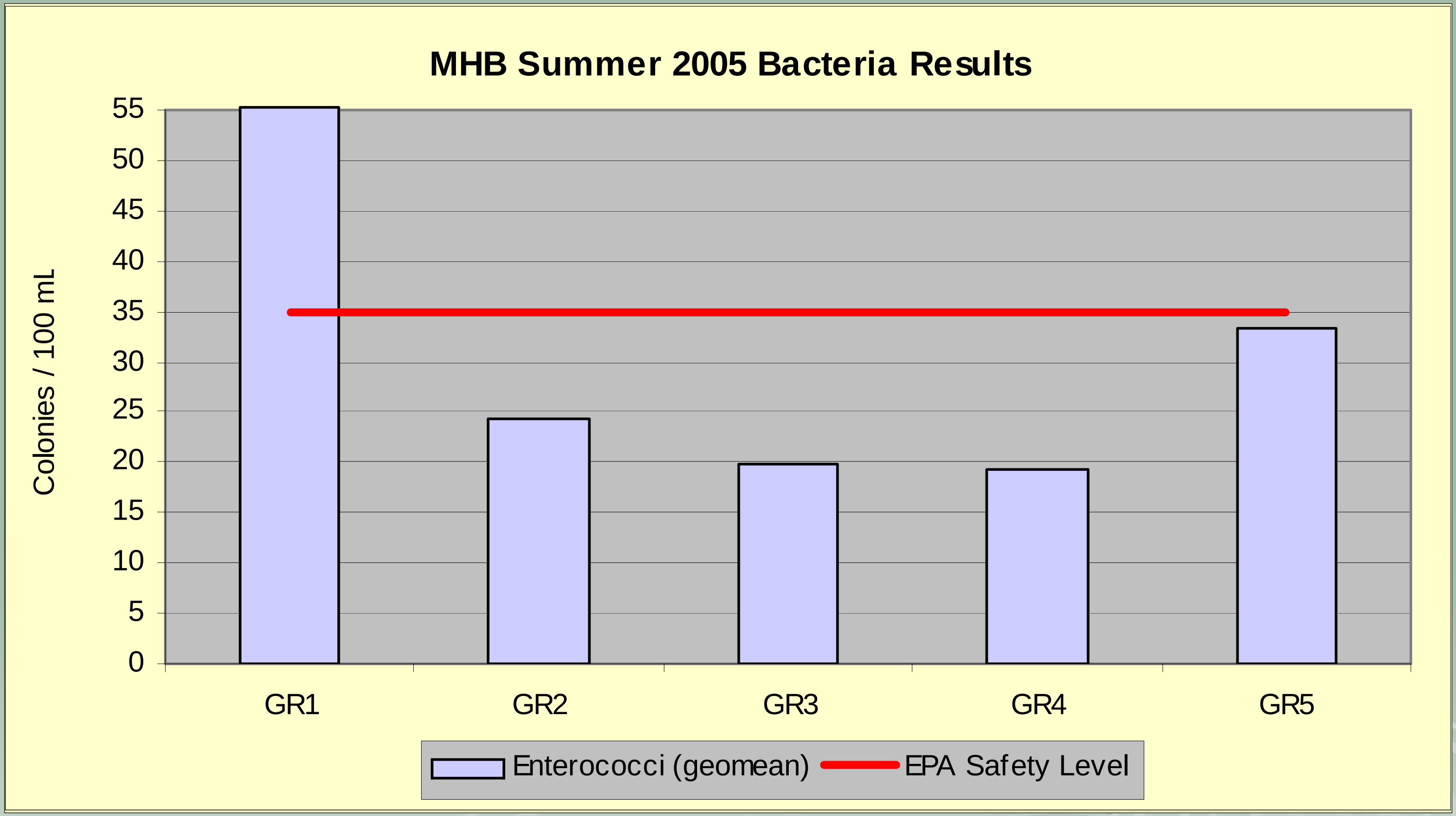
- **206 entero samples at 49 sites during July and August**
- **16 sites sampled 5 or more times w/in 30-day period AND exceeded EPA geomean criteria**
- **Geomean exceedances by watershed:**

➢ ***Batson River** watershed:* BR3, TB1, TB1a, BR1c

➢ ***Little River** watershed:* LR2a, LR2c, LR3, LR4b, LR4c, LR6, LR7, BB1

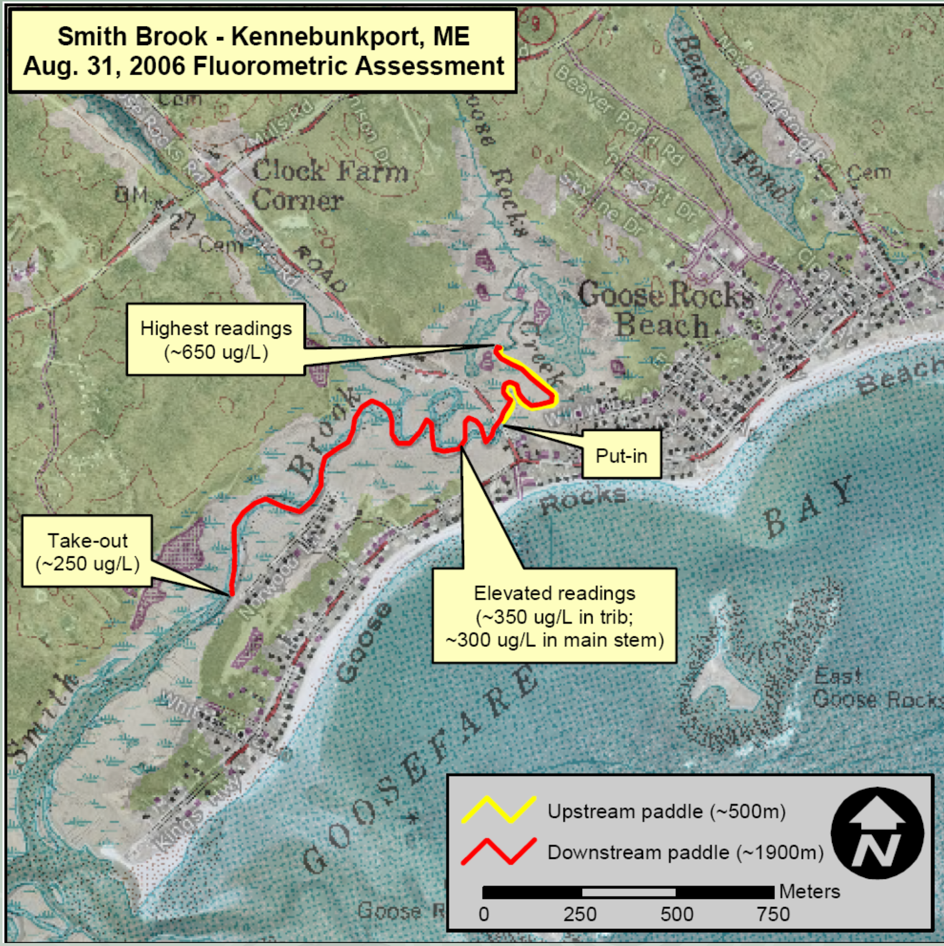
➢ ***Smith Brook** watershed:* SB2str, SB3, SB4, SB5

Summer 2005- 2006 MHB (and some FBE) Goose Rocks Beach

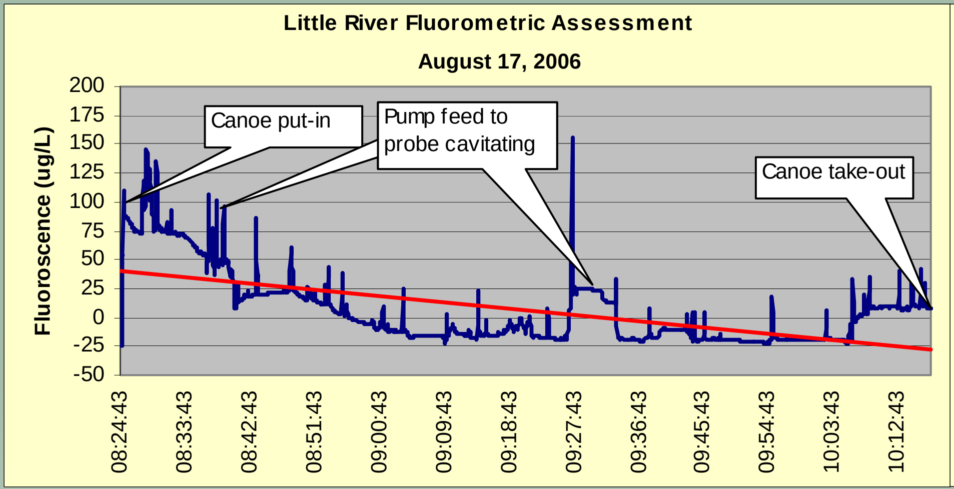


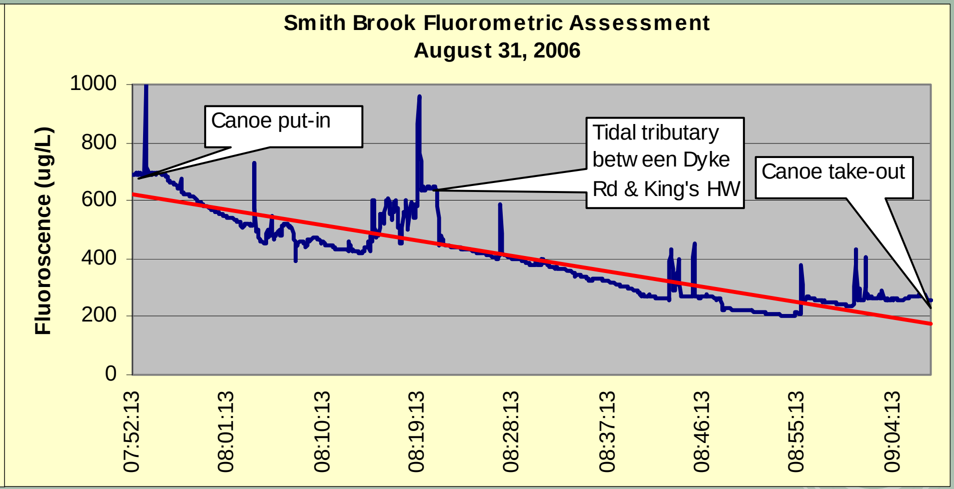
Field Fluorometry

Field Fluorometry Sites



Field Fluorometry Results





Fluorescence Analysis & Conclusions (S Jones)

Optical Brighteners & Fluorescence

Fluorescent White Dyes used in detergents

Generally Found in Domestic Waste Waters

Causes of contamination based on bacteria & optical brighteners

	High bacteria	Low bacteria
High optical brightener	Human fecal contamination (failing septic/leaky sewer)	Gray water
Low optical brightener	Human or non-human contamination	No fecal contamination

Fluorescence Measurements

- Fluorescence at 410-610 nm in water samples was used to as an indicator of the possible presence of optical brighteners to help identify human sewage sources;

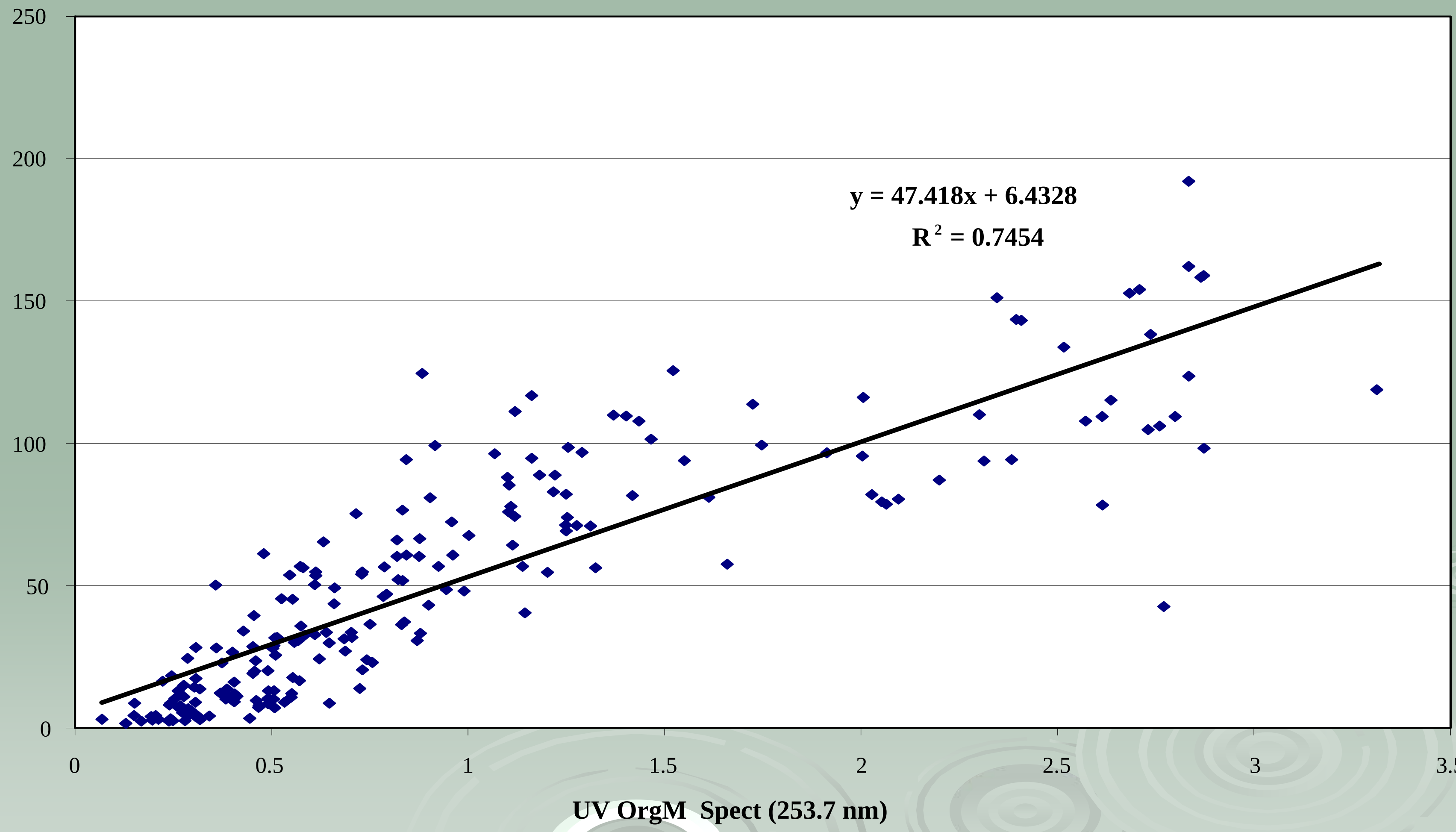
- Background interference from natural dissolved organic matter was widespread and complicated data interpretation.

Fluorescence Measurements: Overall Findings

- **No (0) water sample fluorescence reading provided unequivocal evidence of the presence of optical brighteners;**

- **Further analysis of fluorescence data using additional analyses suggested several areas of possible concern for human sewage contamination.**

Fluorescence Measurements: Organic matter interference

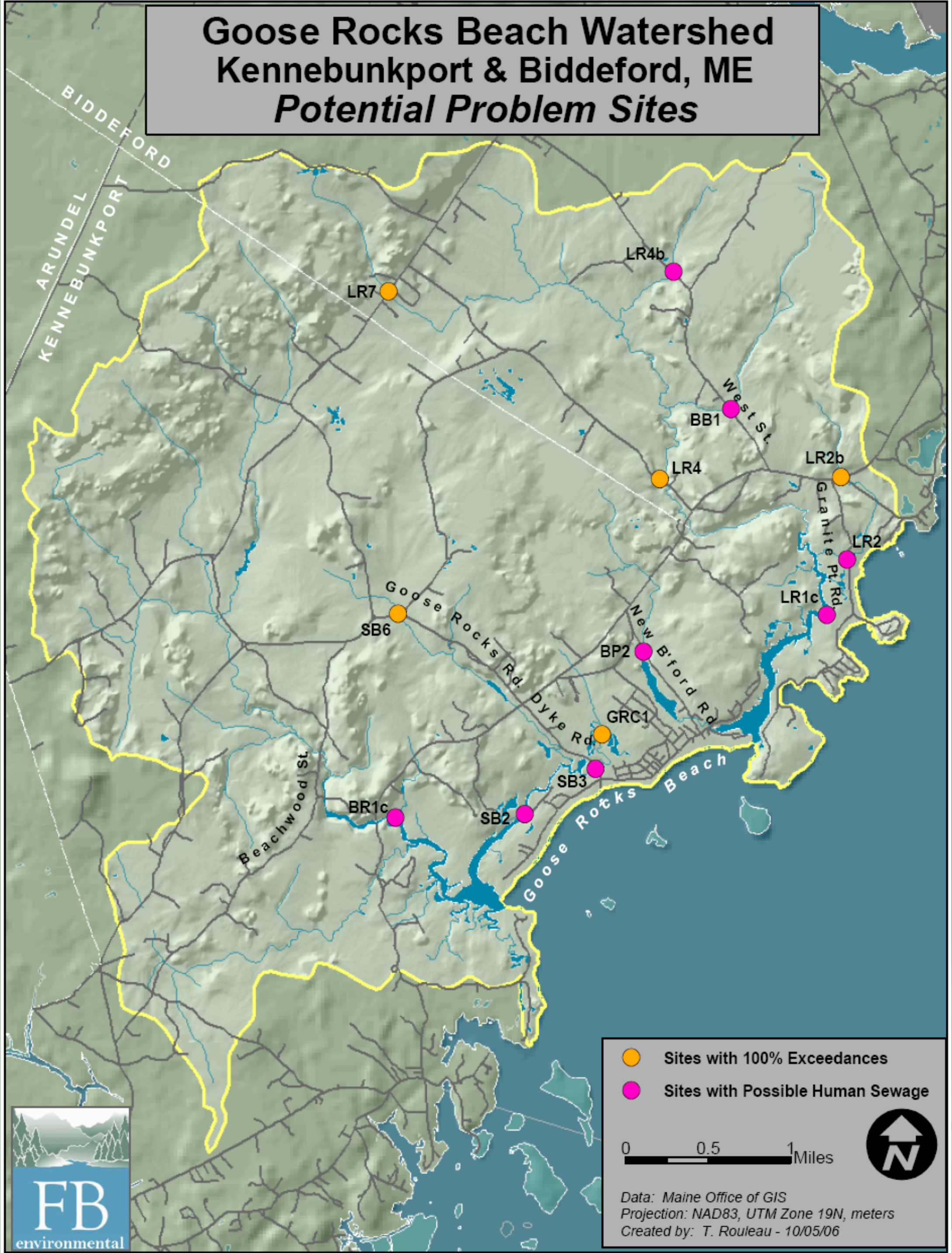


Fluorescence Measurements: Dissolved Organics (Color)

COLOR	Fluorescence reading HIGH	LOW	Organic (UV) constituents HIGH	LOW
Brown n = 18	83%	0%	89%	0%
Light Brown n = 83	18	17	17	7
Clear n = 107	0	90	0	56

Fluorescence Measurements: Sites with Possible Human Sewage

- **Several sites had elevated (>100/100 ml) enterococci concentrations, and elevated fluorescence readings, with diminished organic matter interference:**
  - **Little River watershed (5 sites)**
    - **LR1c, LR2, LR4b, BB1, BP2**
  - **Smith Brook watershed (2 sites)**
    - **SB2, SB3**
  - **Batson River watershed (1 site)**
    - **BR1c**



Potential Problem Sites

Human & Non-Human Sources of Sewage Pollution

- **Optical brightener detection is a low-cost indicator of human-borne sewage;**
- **Other methods are currently available for use that more accurately differentiate between human and non-human sources of fecal pollution;**
- **Non-human fecal pollution is also a public health concern;**
- **Successful management of beach water quality would benefit from identification of non-human sources.**

Additional Investigative & Research Recommendations

1. **Expanded Sampling Program – length, timing, coverage**

2. **Multi day analysis of storm event and impact on beach front**

3. **Continued Analysis of Potential Sources – septic system data**

4. **Microbial Source Tracking (Human vs. Animal)**

Treatment Recommendations (F Bell)

1. **Target Human Sources of Pathogens First**
2. **Attack Dry Weather Problems**
3. **Adapt Strategies for Unique Watershed Conditions**
4. **Progress from watershed to subwatershed to source**
5. **Correct existing sources**
6. **Prevent or treat future bacteria sources**

Management Recommendations

“ The success of a low density (watershed) strategy stands or falls on the ability to prevent septic system failure”

“Key prevention strategies in low density watersheds is to prevent residential septic systems from failing (maintain failure rate close to 0)”

Tom Schueler, Center for Watershed Protection from Microbes in Urban Watershed: Tools for Watershed Managers

Treatment Recommendations

- **Rehabilitate failing septic systems**
- **Connect failing systems to sewer**
- **Increase septic system clean outs**
- **Conservation Plans at hobby farms**
- **Pet Waste Management Program**

Our Next Steps

- **FBE & HAI Attendance at October 11 National Beaches Conference in NY. S Jones at International Conference in Malta (presentations of new research & investigate funding sources)**
- **Meet with Maine DEP in field on Oct 27 to discuss site specific issues and groundwater inputs**
- **Assist Town with 2 Grant outlines/applications for further research and assessment and/or implementation of management options**

Special Thanks to:

- **Project Consultants (donated time and resources)**
- **Town of Kennebunk – proactive approach – support of Judy Barrett**
- **Maine Healthy Beaches (sampling assistance, field fluorometer)**
- **US EPA (technical assistance)**
- **Academic Colleagues of Steve Jones (guidance)**