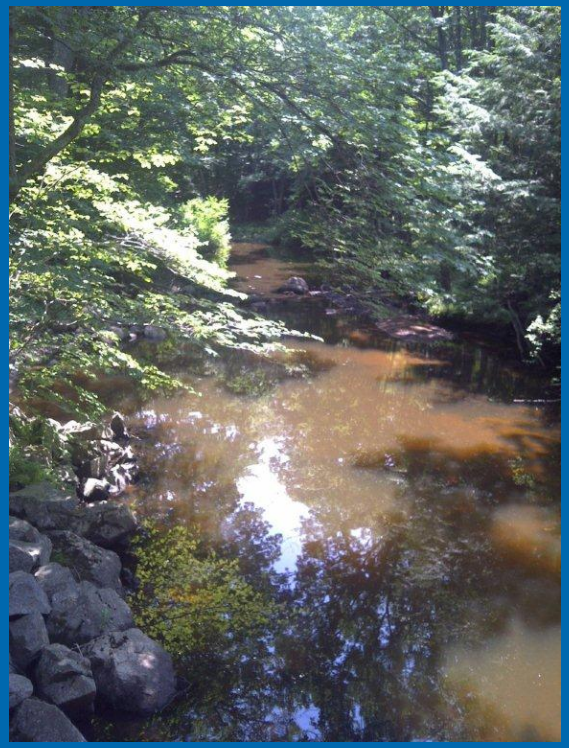
Cape Neddick River Water Quality Restoration Plan



Progress Meeting with Stakeholders
March 2013

Consultant Team Introductions

- John MacKinnon, Watershed Solutions, Inc.
  - *Co-owner and Consulting Environmental Engineer*
  - *Registered Professional Engineer*
- Matt Reynolds, Drumlin Environmental, LLC
  - *Principal and Senior Hydrologic Engineer*
  - *Registered Professional Engineer*
  - *Certified Geologist*
- Albert Frick, Albert Frick Associates
  - *President and Senior Consulting Soil Scientist*
  - *Certified Soil Scientist*
  - *Licensed Site Evaluator*

Project Scope Review

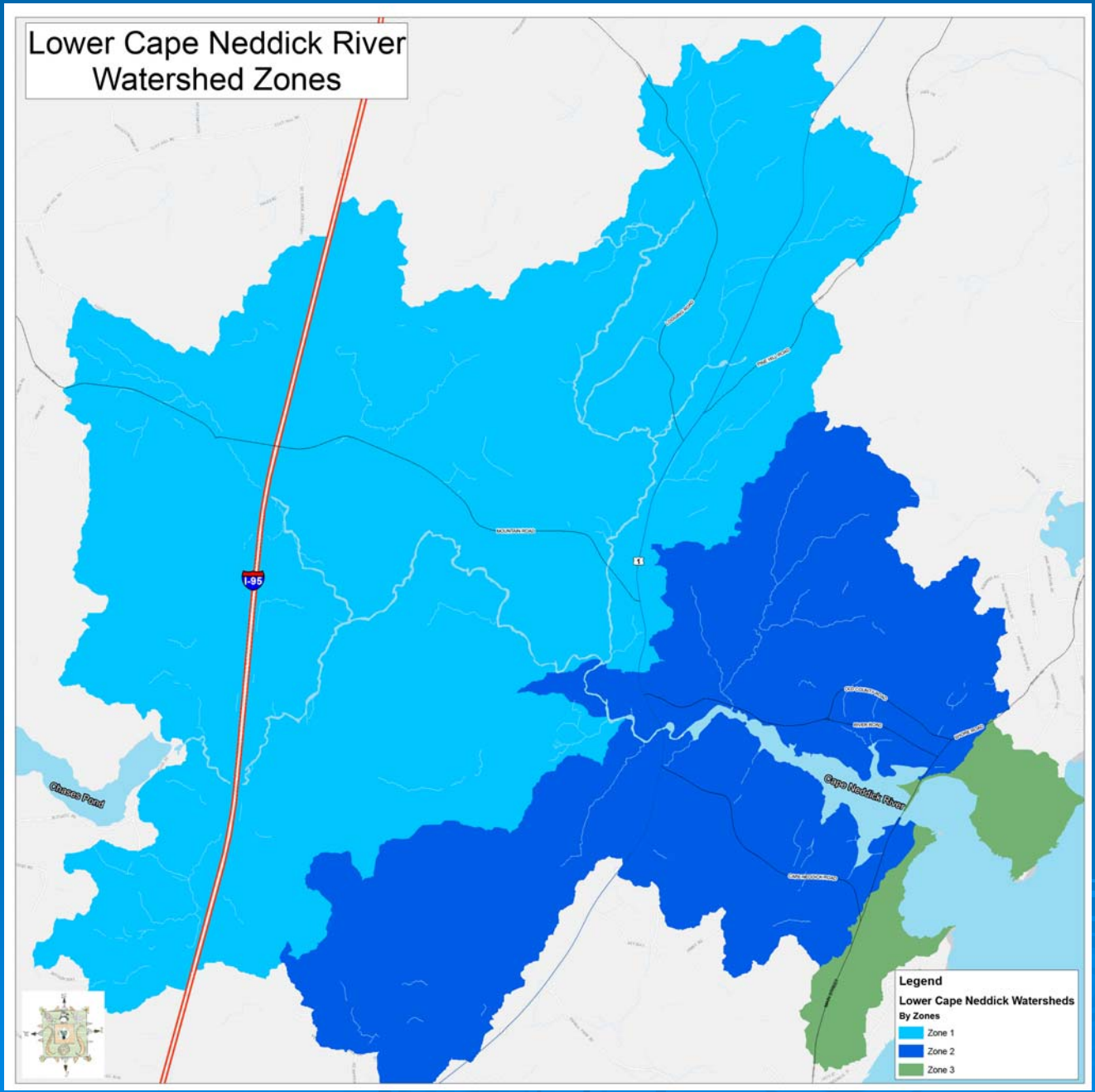
- *Conduct baseline assessment – complete*
- *Involve stakeholders – ongoing*
- *Conduct water quality testing – complete*
- *Estimate bacteria load and calculation of load reduction target – complete*
- *Identify high priority sources – preliminary*
- *Develop preliminary bacteria mitigation measures*
- *Devise monitoring plan for measuring effectiveness*
- *Prepare Watershed-Based Plan for water quality restoration to be eligible for Section 319 (Clean Water Act) non-point source funding*

Meeting Goals

- *Prioritize subwatersheds and associated source areas based on their respective bacteria loading to CNR*
- *Identify potential mitigation measures for existing and future bacteria sources*
- *Screen mitigation measures for implementability and cost/benefit*
- *Preliminary plan for meeting water quality standards*
- *Identify organizations/agencies that would be involved in implementing restoration plan*
- *Identify potential funding sources*

Conceptual Watershed Model

- *Historical results were used to construct a Conceptual Model that splits the watershed into three zones:*
  - ***Zone 1*** *consists of the upper watershed from Chases Pond to near Hutchins Lane bridge and is characterized by a lack of development and relatively low bacteria levels*
  - ***Zone 2*** *consists of the lower watershed from near Hutchins Lane bridge to the Shore Road bridge and is characterized by denser development and correspondingly higher bacteria levels (dry weather testing shows bacteria levels two to three times higher in Zone 2 compared to Zone 1)*
  - ***Zone 3*** *consists of the estuary seaward of the Shore Road bridge where the Beach contamination may be more a consequence of nearby bacteria sources rather than from sources located upstream in Zone 2.*


Lower Cape Neddick River
Watershed Zones
I-95
Chases Pond
Cape Neddick River
Legend
Lower Cape Neddick Watersheds
By Zones
Zone 1
Zone 2
Zone 3

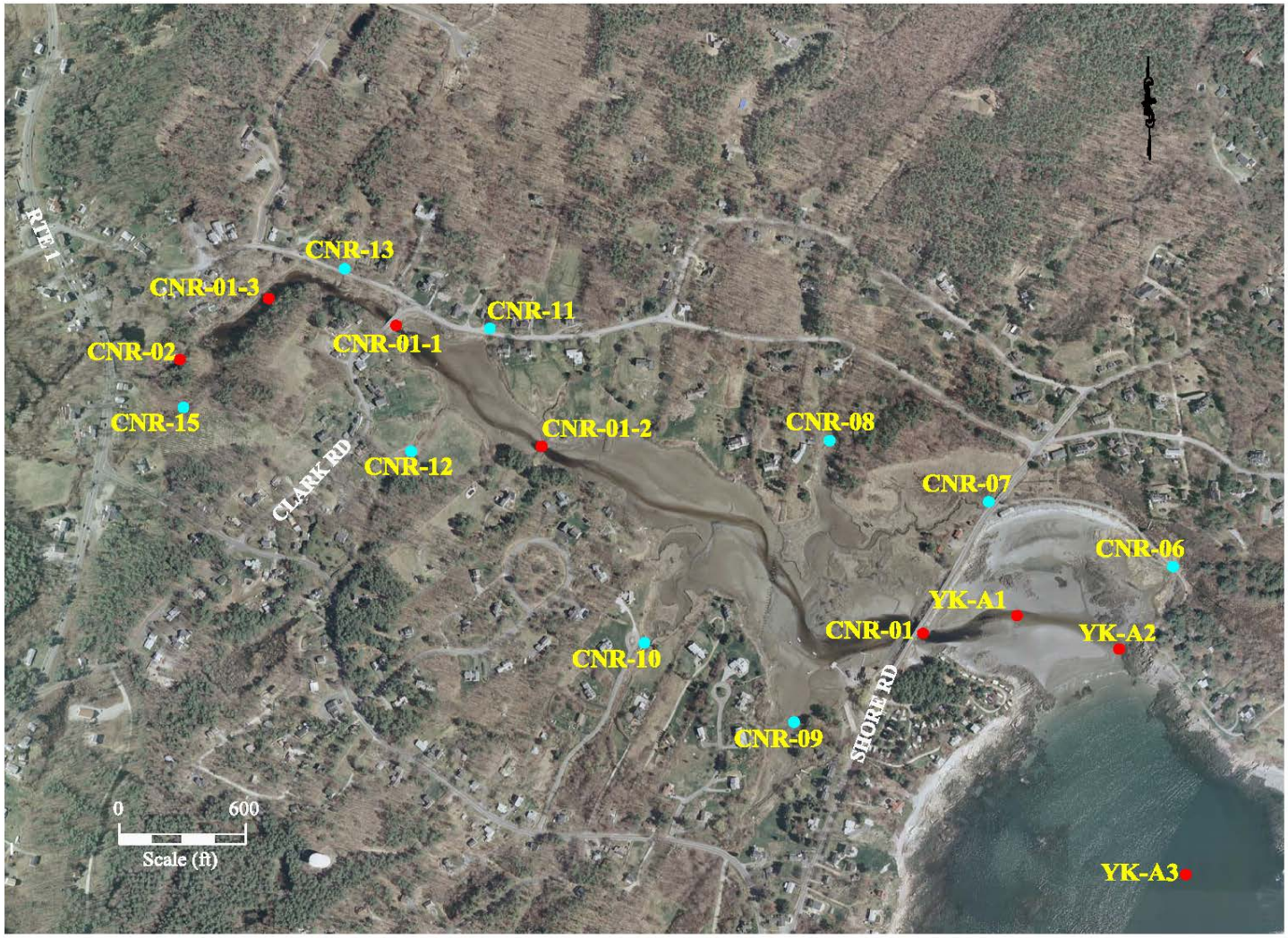
2012 Water Quality Testing Goals

- *<u>Sampling Goal A</u>: Create a sampling approach that reduced the variability of conditions and reflected river aspect as much as possible.*
- *<u>Sampling Goal B</u>: Examine the relative influence of the primary tributaries on the water quality in the main stem of the river.*
- *<u>Sampling Goal C</u>: Gather data to assess the role of potential point sources.*

2012 Water Quality Testing Approach

- *Sample the main stem at low tide, when the river water is most likely to predominate.*
- *Establish four new sampling locations on the main stem so that the potential influence of tributaries can be bracketed with upstream and downstream data.*
- *Sample at the York Sewer District outfall and near commercial activities near Shore Road.*

2012 Lower CNR Sampling Locations



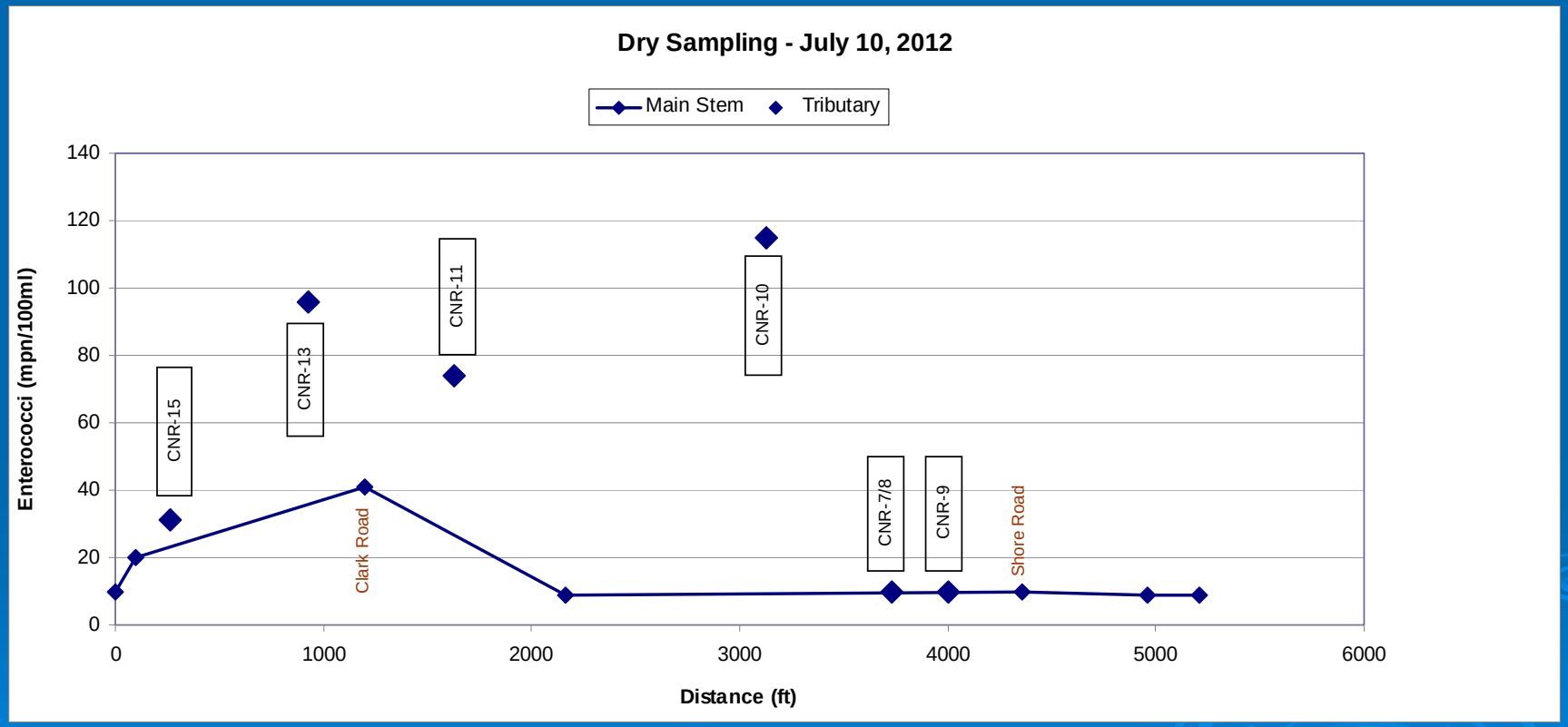
2012 Sampling Activities

- *Samples collected at low tide on May 9, June 12, July 10, and September 6*
- *Sampled for enterococci bacteria from 7 main stem and 9 tributaries, plus York Sewer District outfall and upper watershed*
- *Sampling included salinity and dissolved oxygen data*
- *Sampling in May and July included non-bacterial parameters (metal and nutrients)*

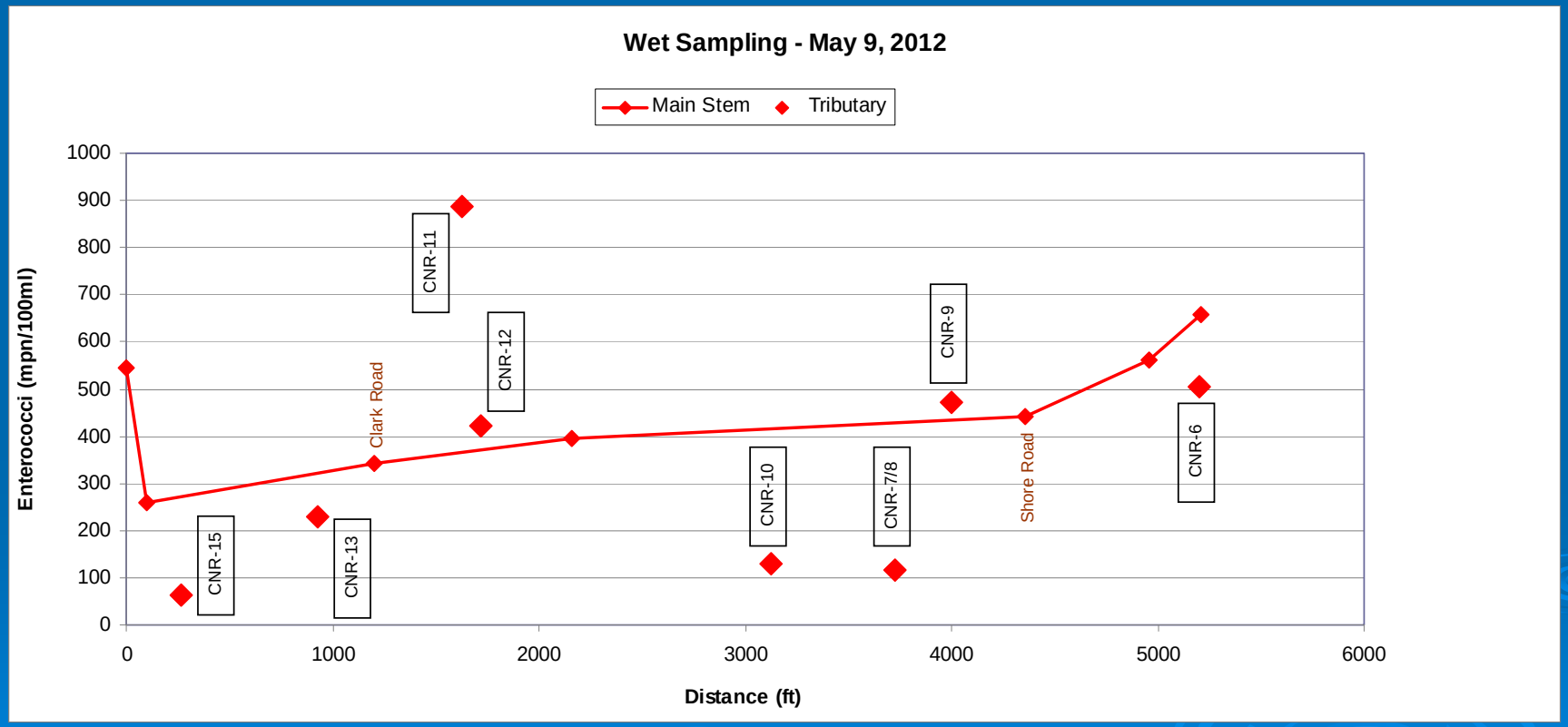
2012 Discussion of Non-Bacteria Results

- *Main Stem below head-of-tide is brackish to salt except during "wet" event.*
- *Dissolved Oxygen (DO) typically meets criteria on main stem of the river. Low DO readings were measured on several tributaries as flows decreased*
- *Phosphorous (P) concentrations were low (non-detect) in the majority of locations on main stem & tributaries. Possible minor phosphorous input from CNR-09 & -07*
- *Nitrogen (N) concentrations were generally low on main stem & tributaries. Several tribs had moderate levels but are not anticipated to have negative effects.*
- *Mitigation of bacteria impacts will also lower nutrient (P & N) inputs and promote higher DO.*

Bacteria (Enterococci)Test Results - “Dry”



Bacteria Test Results – “Wet”

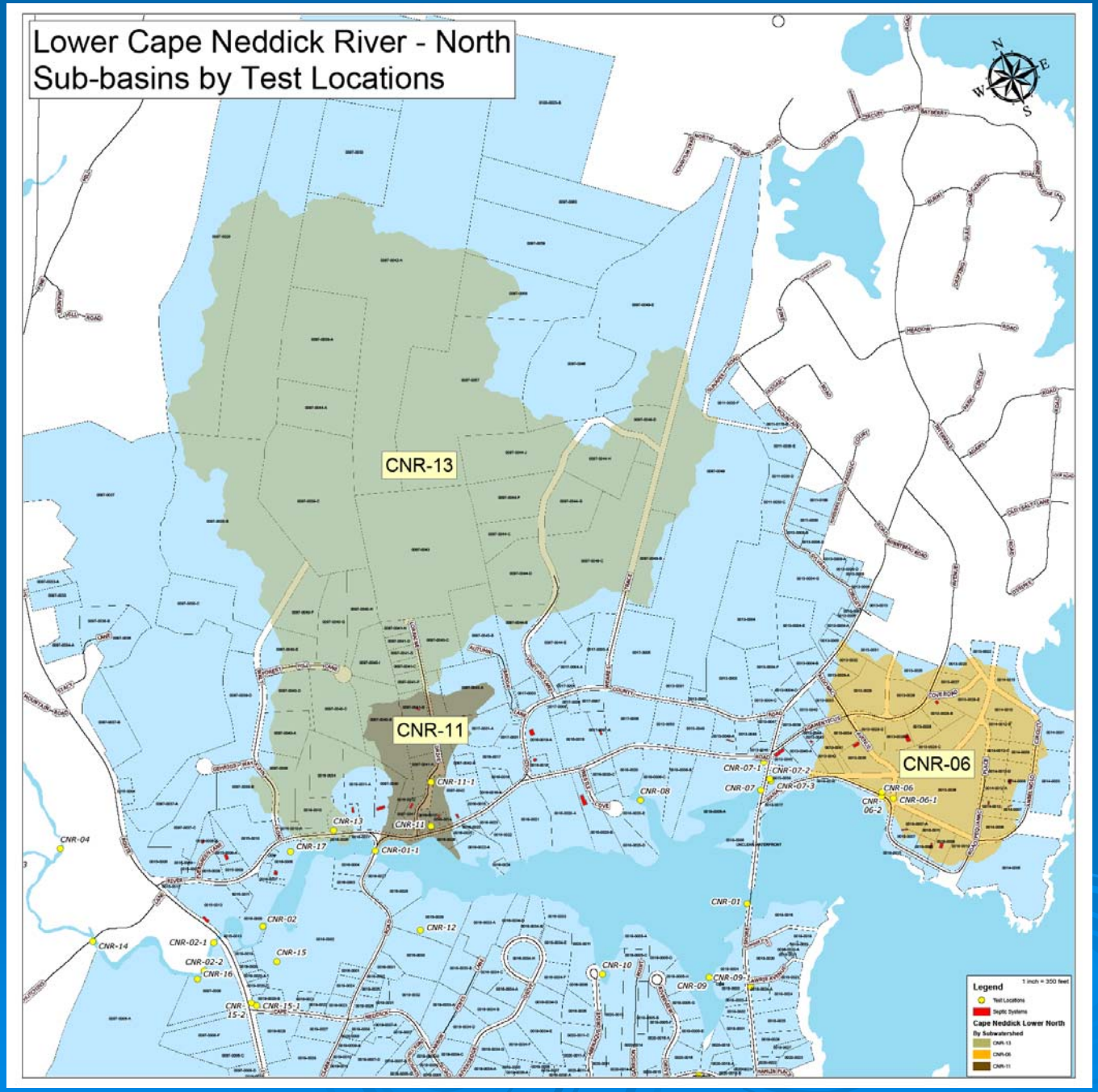


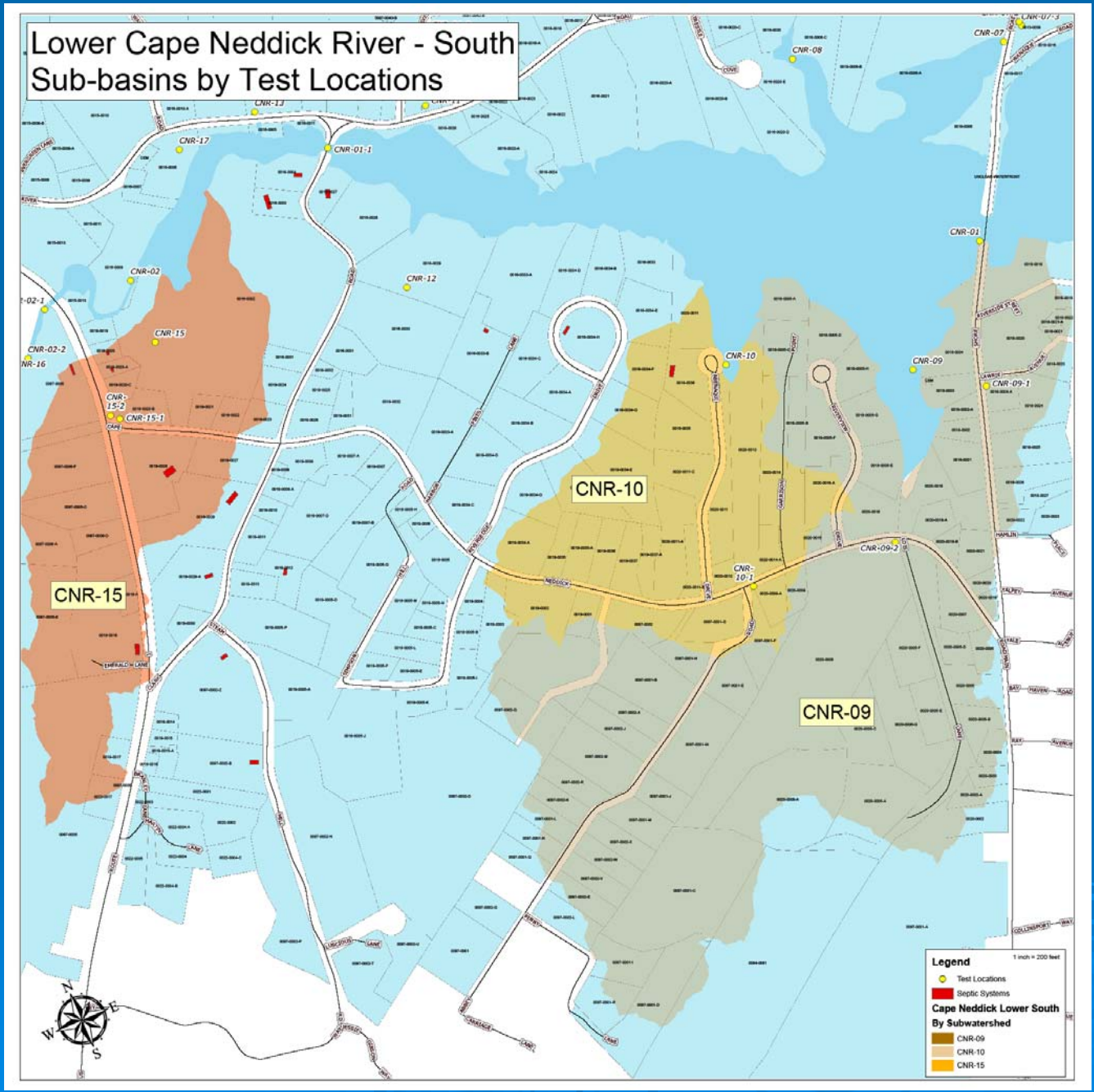
2012 Summary of Bacteria Data

- *May wet event caused high bacteria levels in both the main stem and tributaries. Bacteria levels increased downstream as more tributaries entered the main stem*
- *June & July dry events showed that the main stem of the river had low bacteria concentrations. Influence of tributaries appears to be limited due to low flux*
- *September event was similar to June & July, despite moderate rain 48 hours before sampling*
- *Data from the mouth of the river (YK-A2) and YSD outfall (YK-A3) didn't implicate YSD outfall as significant input*

Priority Subwatershed Identification
(Based on Flux & Enterococci)

Tributary ID	Annual Flux Range (gpm)		Enterococci (mpn/100ml)		Comments
	Low	High	Max	Geomean	
CNR-06	4	194	24,196	1706	Flows across beach, consistent high bacteria concentrations, low flux
CNR-09	8	378	473	19	Relatively large populated watershed, high concentrations during runoff
CNR-10	3	140	130	82	Fairly high concentration during wet and dry conditions
CNR-11	1	73	888	151	Small subwatershed but high concentrations during runoff
CNR-13	24	1,042	228	87	Large subwatershed, fairly high concentrations during wet and dry conditions
CNR-15	3	143	410	80	Smaller flow but historically contains high concentrations during runoff


Lower Cape Neddick River - North
Sub-basins by Test Locations
CNR-13
CNR-11
CNR-06
CNR-04
CNR-14
CNR-02-1
CNR-02-2
CNR-16
CNR-15-2
CNR-15-1
CNR-15
CNR-02
CNR-17
CNR-13
CNR-11
CNR-11-1
CNR-01-1
CNR-12
CNR-08
CNR-07-1
CNR-07-2
CNR-07-3
CNR-07
CNR-06
CNR-06-1
CNR-06-2
CNR-01
CNR-10
CNR-09-1
CNR-09
Legend
1 inch = 350 feet
Test Locations
Septic Systems
Cape Neddick Lower North
By Subwatershed
CNR-13
CNR-06
CNR-11


Lower Cape Neddick River - South
Sub-basins by Test Locations
CNR-17
CNR-01-1
CNR-02
CNR-12
CNR-15
CNR-02-2
CNR-15-2
CNR-15-1
CNR-08
CNR-07
CNR-01
CNR-10
CNR-09
CNR-09-1
CNR-09-2
CNR-10-1
CNR-10
CNR-15
CNR-09
Legend
1 inch = 200 feet
Test Locations
Septic Systems
Cape Neddick Lower South
By Subwatershed
CNR-09
CNR-10
CNR-15

Total Maximum Daily Load (TMDL)

- *TMDL is essentially a water pollution budget for a watershed (i.e., how much of a pollutant can be discharged and still meet water quality criteria)*
- *TMDL determination is required by the MDEP for Cape Neddick River estuary because water quality is impaired by bacteria*
- *TMDL study is intended to accomplish three major things:*
  1. *Identify sources of pollutants*
  2. *Quantify pollutant contribution from each source*
  3. *Determine pollutant reduction from each human & domestic animal source required to meet applicable water quality standards*

TMDL for Cape Neddick River

- *Statewide bacteria TMDLs for Maine use water quality criteria as numeric water quality targets*
- *Depends on waterbody's use classification and level of protection:*
  - *CNR use classification is recreational*
  - *CNR level of protection is SB (Estuary)*
- *Accordingly, between May 15th and Sept. 30th, Enterococcus of <u>human and domestic animal</u> origin shall not exceed a geometric mean of 8/100mL or an instantaneous level of 54/100mL*

Enterococci Concentration Reductions Necessary to Achieve CNR TMDL

Main Stem Site	Maximum	Geomean (4 events)	% Maximum Reduction to Instantaneous Std (54/100mL)	% Geomean Reduction to Geomean Std (8/100mL)
CNR-02	545	38	90%	79%
CNR-01-3	259	38	79%	79%
CNR-01-1	341	49	84%	84%
CNR-01-2	397	24	86%	67%
CNR-01	443	31	88%	74%
YK-A1	563	27	90%	70%
YK-A2	657	28	92%	71%

Note: Maximum and geomean concentrations shown are total enterococci from all sources. Water quality standards are only for enterococci from human and domestic animal origins. Therefore, percent reductions shown are “worst case” and assume that total enterococci does not include bacteria from wildlife origins, which is highly unlikely.

Enterococci Concentration Reductions Necessary to Achieve CNR TMDL
Dry Conditions

Main Stem Site	Maximum (3 events)	Geomean (3 events)	% Maximum Reduction to Instantaneous Std (54/100mL)	% Geomean Reduction to Geomean Std (8/100mL)
CNR-02	20	15	0%	47%
CNR-01-3	20	19	0%	57%
CNR-01-1	41	25	0%	68%
CNR-01-2	10	6	0%	0%
CNR-01	20	10	0%	20%
YK-A1	10	6	0%	0%
YK-A2	<10	5	0%	0%

Note: Maximum and geomean concentrations shown are total enterococci from all sources. Water quality standards are only for enterococci from human and domestic animal origins. Therefore, geomean percent reductions shown are “worst case” and assume that total enterococci does not include bacteria from wildlife origins, which is highly unlikely.

Factors Influencing TMDL Attainment

- *Bacteria from wildlife sources are suspected of being a major contributor to enterococci concentrations. Mitigation measures will target the fraction from human and domestic animal origin.*
- *Very high enterococci concentrations in the main stem are experienced only during storm events and for a 12- to 24-hour period thereafter. Therefore, mitigation measures will primarily target bacteria in runoff.*
- *Much lower enterococci concentrations in the main stem are experienced the majority of the time, during dry conditions. Taking enterococci from wildlife sources into account, the TMDL may already be achieved during dry conditions.*

Typical Sources of Bacteria Pollution

- *Point Sources:*
  - *Municipal and industrial plants that treat human waste*
  - *Unlicensed piped discharges from private residences*

- *Non-point Sources:*
  - *Failing septic systems*
  - *Agriculture/Livestock (including land-applied manure)*
  - *Domestic pets*
  - *Wildlife*
  - *Waterfowl*

Calculating Subwatershed Bacteria Load

- *Bacteria Source Load Calculator (BSLC) spreadsheet model (developed for Virginia)*
- *Used to examine contribution from different source types*
- *Model assumptions applied for CNR calculations:*
  - *All residential properties*
  - *1.6 year round residents per housing unit*
  - *Septic system failure rate (default values from the model):*

    Pre-1966 = 40%

    1966-1985 = 20%

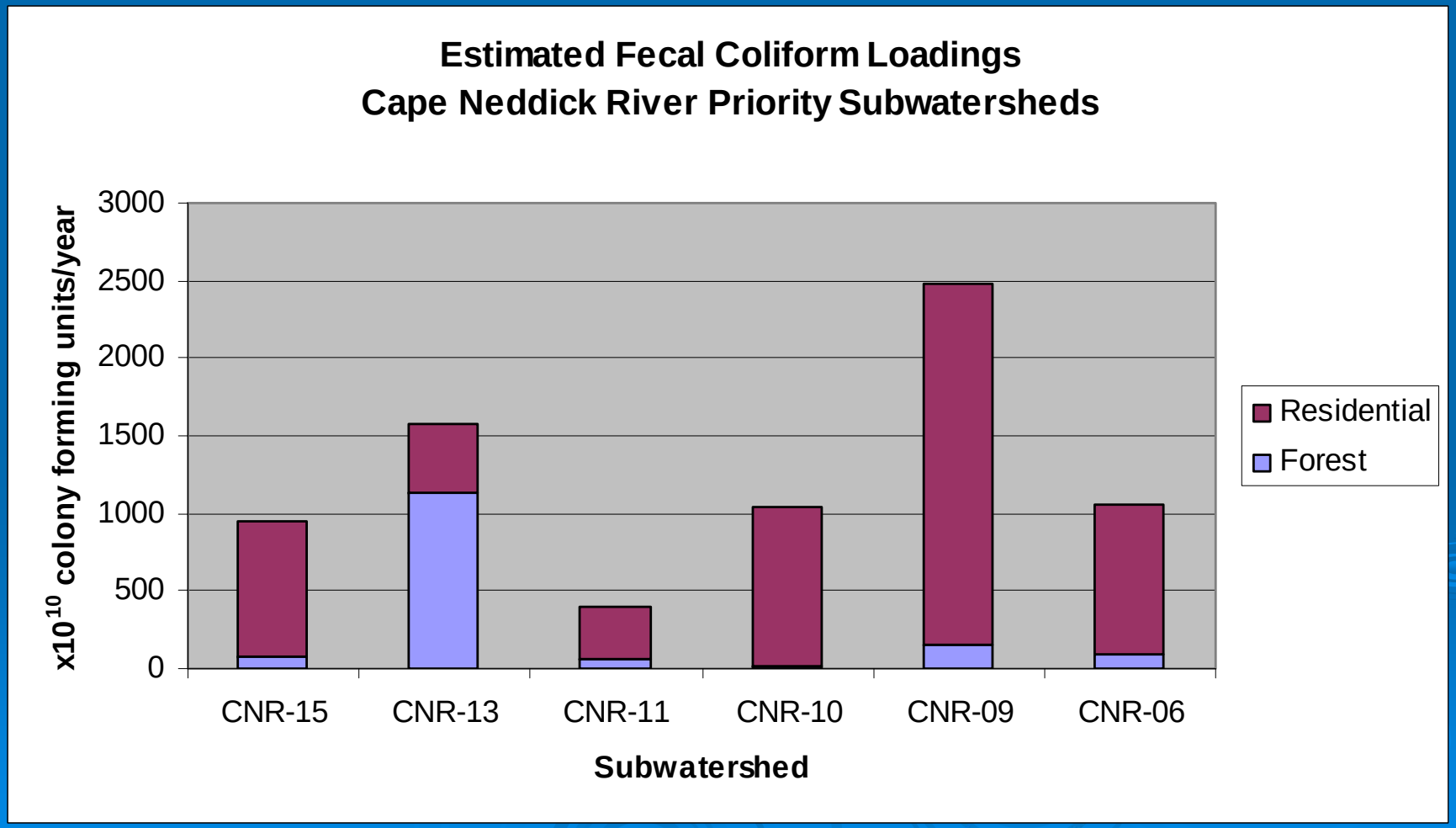
    Post-1985 = 3%

    (Note: Septic age is assumed as house age, or install date if available)
  - *Wildlife consists of deer, raccoons, and wild turkeys*

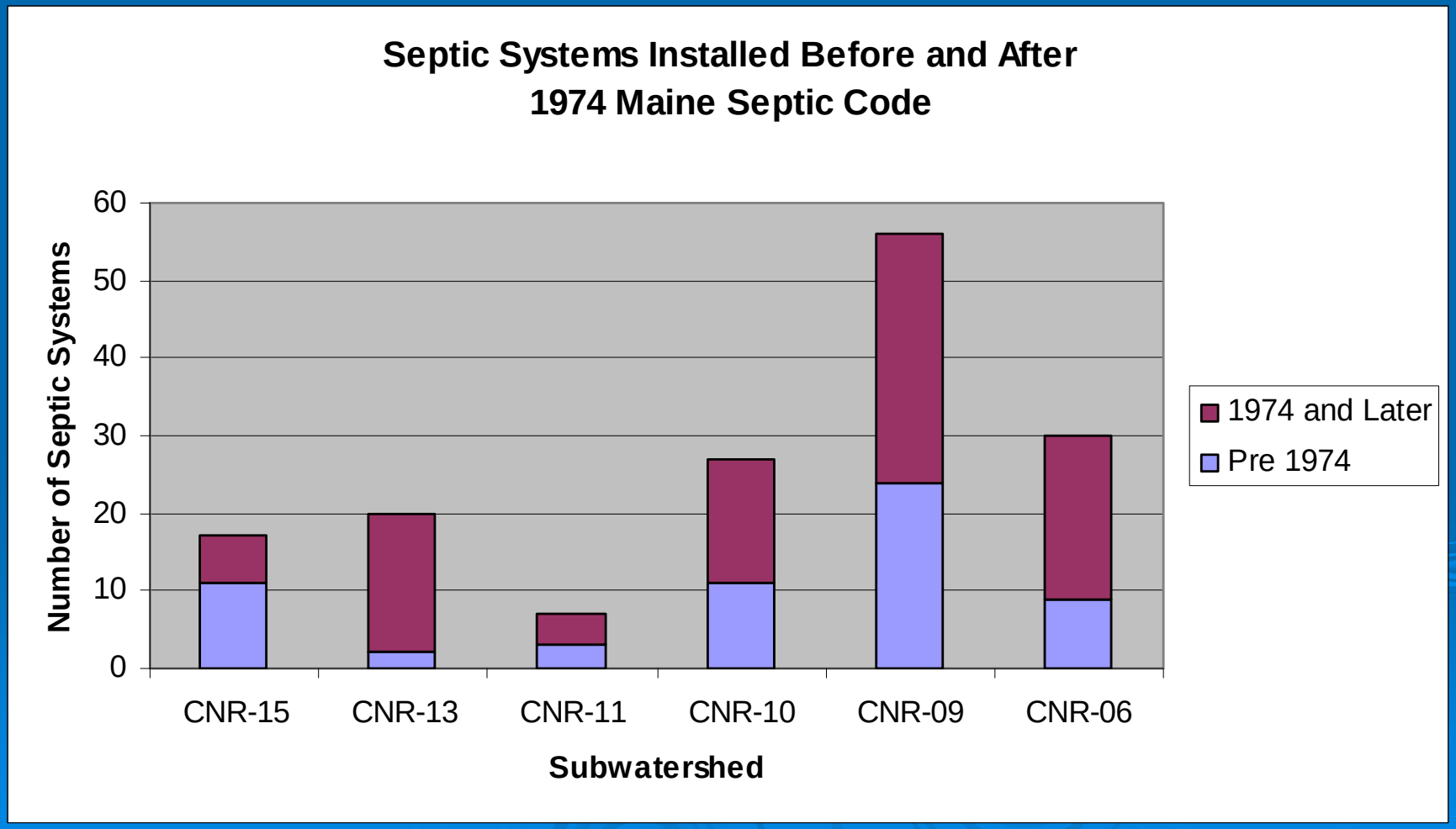
Steps Taken to Model Priority Subwatersheds

- *Estimated forested area in each subwatershed by subtracting residential acreage from total acreage. Forested acreage used to estimate wildlife populations.*
- *Identified wildlife species likely present in forested areas. Used animal densities from published sources. Note: Bacteria load from wildlife likely underestimated since waterfowl not included.*
- *Counted homes and businesses in each subwatershed (to estimate septic systems). Number of failing systems estimated from model defaults values based on age of structures, or septic installation date if available. Note: Businesses and multifamily counted as single family homes, so bacteria load from failing systems may be underestimated.*
- *Pet waste estimated from published sources as a function of the number of homes within each subwatershed.*

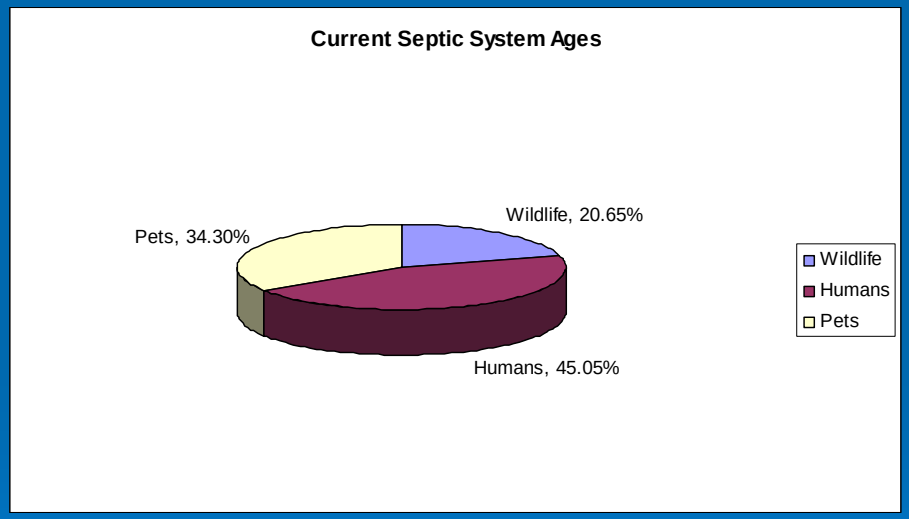
BSLC Bacteria Estimates for Priority Subwatersheds



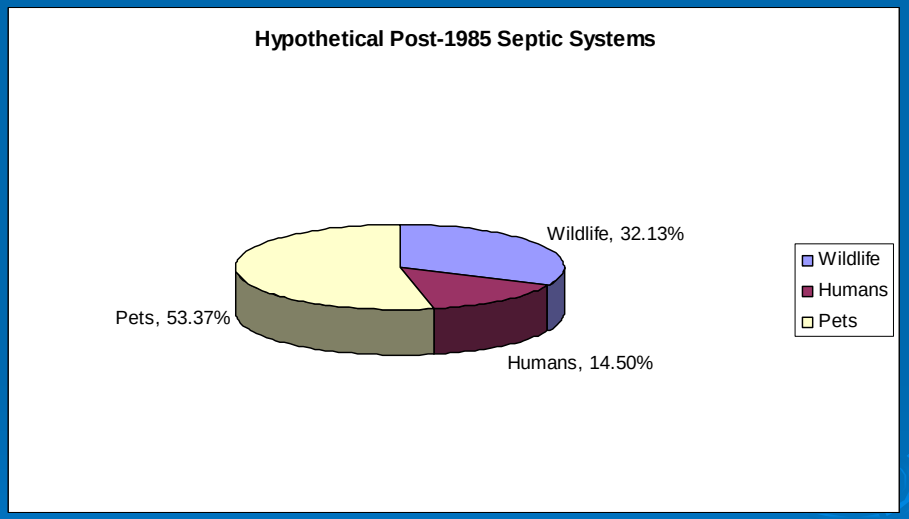
Septic System Age Relative to 1974 Maine Septic Code



Comparison of Bacteria Contribution Between Current Mixture of Existing Septic Systems and Hypothetical Condition with All “New” Septic Systems



Estimate of human-pet-wildlife contributions under current conditions



Estimate of human-pet-wildlife contributions with all newer septic systems

TMDL Study Conclusions

- *Highest bacteria loads occur during storm events, when runoff transports bacteria that has been deposited onto ground surfaces into the main stem.*
- *Significant reductions in bacteria loads from developed areas, failing septic systems, and pet waste would be necessary in order to meet the TMDL during storm events.*
- *Bacteria loads to the main stem are relatively light during dry weather conditions, indicating that the TMDL may already be achieved in the main stem for the majority of the time.*
- *In less developed (more forested) subwatersheds (e.g., CNR-13), BSLC Model points to wildlife as a major source of bacteria loads to the main stem.*
- *Waterfowl (not explicitly included in BSLC Model) are also likely a significant contributor to main stem bacteria loads.*
- *Failing septic systems and pet waste appear to be the largest development-related source of bacteria loads from priority subwatersheds except for CNR-13.*
- *BSLC Model identifies CNR-09 as the largest source of subwatershed bacteria loads*

Potential Bacteria Mitigation Measures

Options to Mitigate Existing Development-Related Sources:

- *Identification and replacement of failing septic systems*
- *Proper maintenance of septic systems (required per York septic pumping ordinance)*
- *Better management of pet waste*
- *Re-establish vegetated buffers along shorelines of streams and river (Comp Plan 5.2)*
- *Low Impact Development (LID) retrofits along ditches and at storm drain outlets (Comp Plan 5.6)*
- *Sewering some or all of the lower CNR (Comp Plan 5.2)*

Screening Bacteria Mitigation Measures

Mitigation Measure	Implementability	Cost/Benefit	Comments
Identification and replacement of failing septic systems	Identification of failing systems possible through detailed inspections and use of tests (e.g., dogs and dye). Replacement systems constructed according to Maine Septic Code.	Cost of inspection and testing is generally low. High replacement costs for individual owner but properly designed system is highly effective.	Town already has a program for collecting septic system information.
Proper maintenance of septic systems	Several pumping contractors are available. Voluntary participation has mediocre record.	Cost to resident is generally low and the benefit is high by preventing premature failure of the system.	Town already has a septic system pumping ordinance in effect.
Better management of pet waste	Easily implemented in public areas by ordinance and by making pet waste receptacles (i.e., baggies) available. Voluntary on private property.	Low cost to residents and Town. Benefits are high by removing waste from areas where it is exposed to runoff.	Public information campaign through signage and email notification can be effective.

Screening Bacteria Mitigation Measures (cont.)

Mitigation Measure	Implementability	Cost/Benefit	Comments
Aquatic buffers established along shorelines of streams and river	Buffers can be easily established either by planting or by simply allowing vegetation to grow in.	Low cost to residents and the Town. Buffers trap pollutants and infiltrate runoff before it reaches water bodies.	Added benefit of discouraging waterfowl from lawn areas.
Infiltration basins and trenches and other LID retrofits along ditches and at storm drain outlets	Will have to tailor LID to space and capacity of specific location (e.g., consider soil favorability for infiltration). Space can be a limiting factor if road ROWs are narrow. May require drainage easements.	Potentially high cost to the Town but certain LID systems can be highly effective approach to trap pollutants in runoff and replenish the underlying aquifer.	Construction of appropriate LID systems would likely be performed by Public Works or Town contractor.
Sewering some or all of the lower CNR	York Sewer District treatment plant located nearby. Plant currently operating at only up to 50% of capacity.	High cost for construction of sewer main and hook-up to residences. Various funding mechanisms to reduce costs to individual users are available.	Treatment plant is nearest to CNR-09 (largest subwatershed bacteria source). Force main anchors already in place on Shore Road bridge.

Potential Bacteria Mitigation Measures

Future Sources:

- *Improved regulation of impervious surfaces and buffer zones during site development or re-development (Comp Plan 5.6)*
- *Raise minimum lot size to reduce residential density*
- *Encourage community open space planning*
- *Acquire land for permanent conservation through easements and outright land purchase (Comp Plan 5.2)*

Implementability and Cost/Benefit:

- *Zoning changes have greatest affect on current landowners. Political resistance is biggest challenge. Restricting watershed imperviousness is a proven water quality management strategy.*
- *Open space planning and land acquisition can be accomplished through cooperation between the Town, land owners, and State and Local Land Trusts. Can be used to create or enhance aquatic buffers.*

Preliminary Plan for Meeting Bacteria TMDL

- *Prioritize priority subwatersheds according to bacteria loading*
- *Identify which mitigation measures are feasible for priority subwatersheds and remainder of lower CNR*
- *Discuss ways in which a restoration plan could be implemented*
- *Identify which organizations and/or agencies are best suited to implement a restoration plan*
- *Identify potential funding sources*

Next Steps

- *Refine mitigation measures including cost estimates and possible sources of funding*
- *Prepare a proposed schedule for implementation of mitigation measures*
- *Develop a monitoring plan for measuring improvement of water quality*
- *Prepare a Draft Water Quality Restoration Plan*
- *Convene final stakeholder meeting to discuss Draft Plan and to enlist stakeholder support and cooperation*