Phase 1 – Modeling and Development of Flow Duration Curves (FDC 1 Project)

Holistic Watershed Management for Existing and Future Land use Development Activities: Opportunities for Action for Local Decision Makers

Task 2A. Kickoff Meeting

Prepared for

U.S. EPA Region 1

Prepared by:

Paradigm Environmental

Great Lakes Environmental Center

Support for Southeast New England Program (SNEP)
Communications Strategy and Technical Assistance

Nov 9, 2020

Project Elements/Sub-Tasks	Deliverables
Task 0: Work Plan, Budget, and Schedule	
Draft work plan, budget, and schedule	11/6/2020
Final work plan, budget, and schedule	11/20/2020
Task 1: Prepare Quality Assurance Project Plan	
Prepare draft QAPP	11/6/2020
Final QAPP	12/31/2020
Task 2: Project Management and Administration	
Kickoff call	11/9/2020*
Kickoff meeting and summary	11/13/2020
Monthly progress calls and summaries	Monthly
Task 3: Technical Steering Committee Meetings	
Kickoff call	TBD
TSC Meeting 1: Completion of Subtask 4A - Draft Technical Scope Outline	12/17/2020*
TSC Meeting 2: Completion of draft Task 5 technical memorandum	4/22/2021*
TSC Meeting 3: Completion of draft Task 6 technical memorandum	6/24/2021*
TSC Meeting 4: Completion of draft Task 7 technical memorandum	9/23/2021*
Task 4. Coordinate with TSC to Finalize Phase 1 Project Approach	
4A: Draft Technical Scope Outline	
Draft technical approach outline	12/11/2020
4B: Final Technical Scope	
Final technical approach memo	12/31/2020
Task 5. Compile Available Data/Information for Taunton River Watershed Modeling Analyses	
5A: Data/Information Assessment	
5B: Past, Current, and Future Climate Data Analysis	
5C: Baseline Unit-Area Modeling Analysis	
5D: Develop Hydrologic/Streamflow and Water Management Modeling Approach for Taunton River Sub-watershed Analyses	
Draft technical memo and fact sheets	4/16/2021
Final technical memo and fact sheets	4/30/2021
Task 6. Phase 1 Hydrologic Streamflow Modeling Analyses	
6A: Adapt Models for Flow Duration Curve Analyses for Pilot Sub-watersheds	
6B: Adapt R1 Opti-Tool for Stormwater and FDC Management Analyses	
Draft technical memo	6/18/2021
Final technical memo	6/30/2021
Task 7. Phase 1 Stormwater/Hydrologic Management Optimization Analyses	
Draft project report and outreach materials	9/17/2021
Final project report and outreach materials	9/30/2021
Task 8. Phase 1 Project Webinar to SNEP Region	
Draft presentation slides	9/27/2021
Webinar presentation	9/30/2021*

*=tentative, to be finalized in consultation with EPA
TBD=to be decided
As needed, 1 call each month

Delivered

Technical Steering Committee and Project Partners

- **Tom Ballestero**, Director, University of New Hampshire Stormwater Center (Water Resource Engineering);
- **Jeff Barbaro**, U.S. Geological Survey (HSPF Model);
- **David Boutt**, Associate Professor, Department of Geosciences, UMass Amherst (Geology / Hydrogeology);
- **Sara Burns**, The Nature Conservancy (Water Resource Policy and Science);
- **Naomi Detenbeck** – EPA Office of Research and Development (ORD), Atlantic and Ecology Division, Narragansett, RI (Water Resource Management/Ecology; WMOST model);
- **Blaine Hastings and Padraic Monks**, Vermont Dept. of Environmental Conservation
- **Jamie Houle**, UNHSC (GI/SW Management);
- **Kim Groff**, The Southern New England Program (SNEP) Technical Assistance Network (Water Resource Engineering);
- **Scott Jackson**, Dept of Environmental Conservation, UMass Amherst (Integrated Research);
- **James Kilduff**, Rensselear Polytechnic Institute
- **Michael Kline**, Fluvial Matters Consulting, University of Vermont, (Fluvial Geomorphology);
- **Bill Napolitano**, Southeastern Regional Planning and Economic Development District, Lead Environmental Planner;
- **Gretchen Rabinkin**, Boston Society of Landscape Architects, Chapter President;
- **Allison Roy**, Research Assistant Professor**,** US Geological Survey's (USGS) Massachusetts Cooperative Fish and Wildlife Research Unit, UMass Amherst (Stream Ecology);
- **Laura Schiffman**, Massachusetts Department of Environmental Protection; and
- **Viki Zoltay**, Massachsetts Department of Conservation and Recreation (WMOST, hydrology)

Task 4

Project Objectives

- Qualitative
- Quantitative

Task 5

Methodology

- Watershed Selection
- Modeling Approach

Task 3

Technical Steering Committee Meetings

Task 6

Model Development

- HSPF/LSPC
- Opti-Tool/SUSTAIN

Task 7

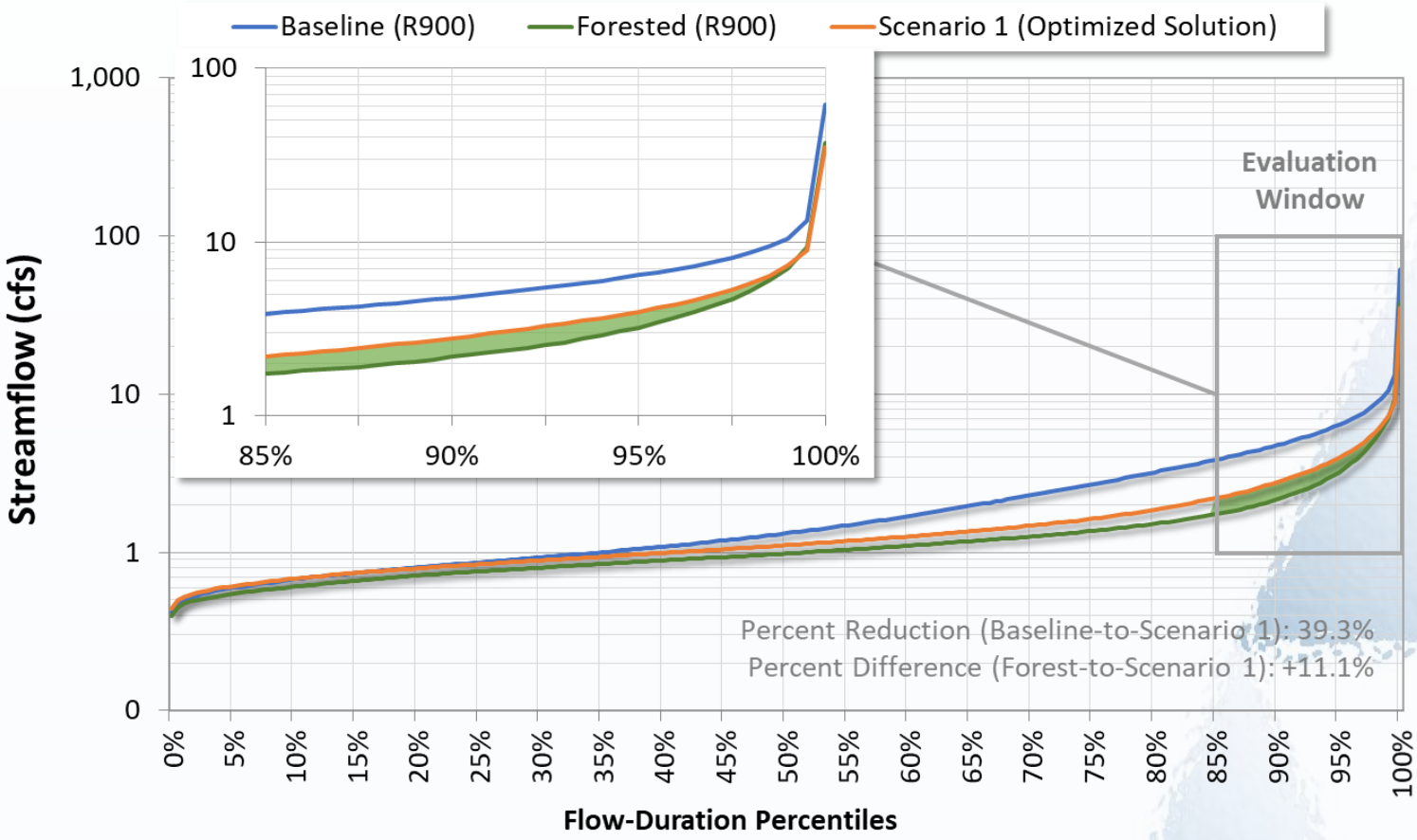
Optimization Analyses

- Run Baseline
- Run Scenarios

Task 4. Project Objectives

- Phase 1 is "Proof of Concept" Demonstration
  - **Impacts of increase impervious cover (IC)**
  - **Impacts of climate change**
  - **Benefits of management actions (GI SCM)**
- Flow Duration Curve
  - **Frequency/Magnitude/Duration**
  - **Flooding/Channel destabilization/Aquatic life**
  - **Relationship between FDC and IC change**
- Phase 2 Roadmap
  - **Next generation municipal ordinance and bylaws**
    - Conservation development practices
    - Landscape architecture
    - Preserve pre-development hydrological condition
- Project Outcome Transfer to SNEP Technical Assistance Network (STAN)

Flow Duration Curve



A flow duration curve (FDC) is the cumulative distribution function of daily, weekly or monthly stream flows at a site.

Task 5. Methodology

- Data/Information Collection
  - Spatial data (landuse, impervious cover, soil, elevation, streams)
  - Temporal data (precipitation, temperature, stream flow, etc.)
  - Past, current, and future climate data (1980 to 2019)
- Literature Review
  - Critical flow regimes (flow metrics)
- Three Sub-watersheds Selection
  - 1st or 2nd or 3rd order stream drainage
  - <10%, 15%-25%, >30% impervious cover
- Modeling Approach
  - Watershed model (HSPF/LSPC)
  - Stormwater GI SCM model (Opti-Tool/SUSTAIN)
  - Model refinements and linkage
  - Stormwater/hydrologic management optimization approach

Task 5. Modeling Data

Data Type	Source
Land Use (1971, 1985, 1999, 2016)	NLCD/MassGIS/NOAA-CCAP
Land Cover	NLCD/MassGIS
Impervious Surfaces	MassGIS
Buildings	MassGIS
Soil	SSURGO/STATSGO/MassGIS
Elevation	NED/MassGIS
Streams, Watershed Boundaries	NHD plus
Flow Gage Data	USGS Monitoring Stations
HSPF Model (all files)	USGS
Precipitation	NCDC/NLDAS2/PRISM-Monthly
Temperature	NCDC
Future Climate Change Precipitation	WMOST

Task 5. Potential Study Area

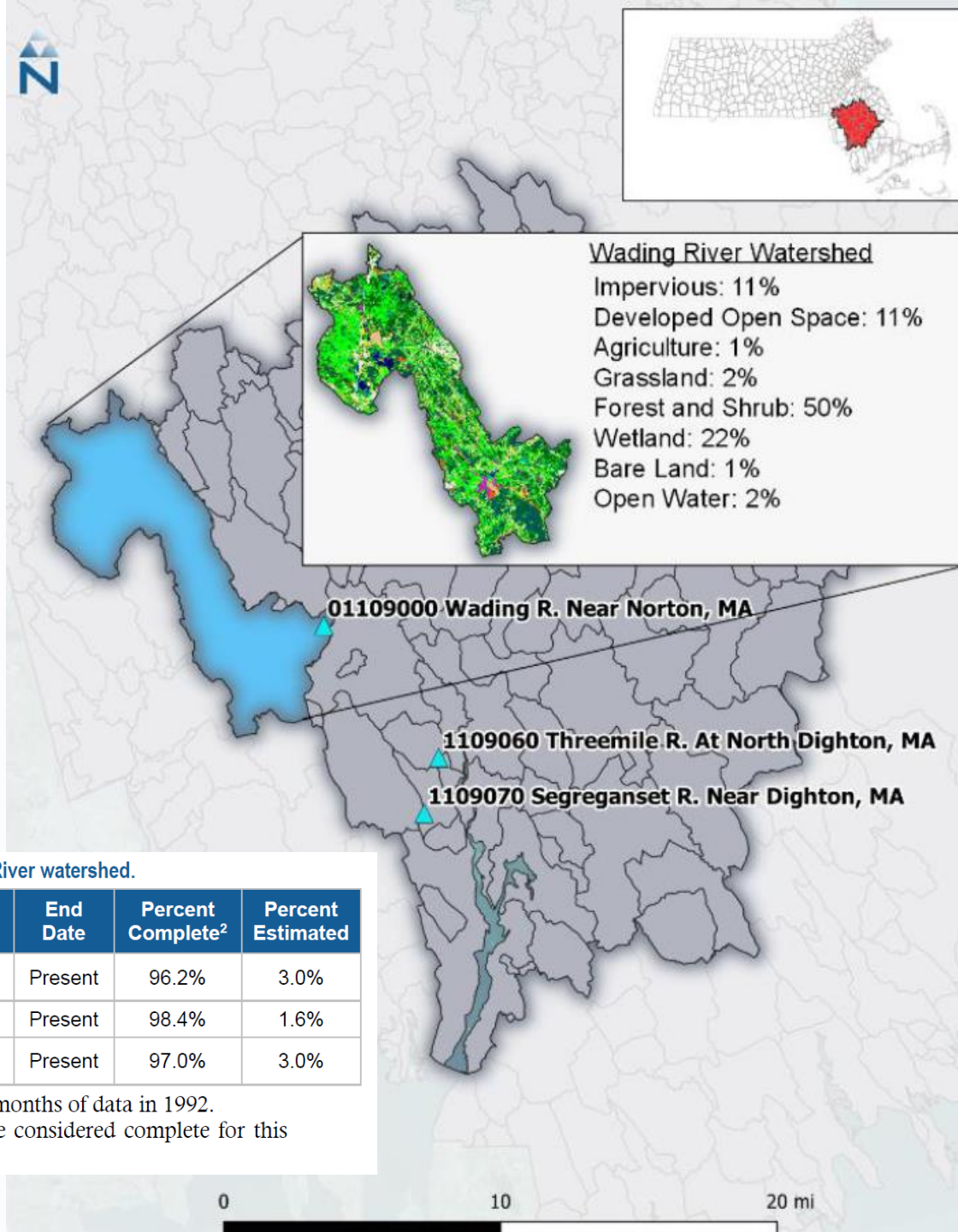


Table 1. Summary of active, long-term USGS gages located in the Taunton River watershed.

Location	USGS-ID	Drainage Area (mi^2)	Start Date	End Date	Percent Complete[2]	Percent Estimated
Segreganset River near Dighton, MA[1]	01109070	10.6	7/1/1966	Present	96.2%	3.0%
Wading River near Norton, MA	01109000	43.3	6/1/1925	Present	98.4%	1.6%
Threemile River at North Dighton, MA	01109060	84.3	7/1/1966	Present	97.0%	3.0%

1. The Segreganset River location is missing approximately five months of data in 1992.
2. Records flagged as provisional ("P") and revised ("A:R") are considered complete for this summary.

Task 6. Model Development

- Watershed Characterization
  - **Evaluate historic information to assess over time changes**
  - **Develop hydrologic response units (HRUs)**
- Model Refinements
  - **Convert HSPF to LSPC**
    - Adopt hydrology parameters from HSPF model
    - Adopt water quality parameters from Opti-Tool HRU-SWMM model
  - **Update Opti-Tool**
    - GI SCM groundwater recharge linkage to local surface water
    - FDC evaluation factors for GI SCM optimization
- Model Calibration/Validation
  - **Verify the model prediction at the instream gage using the long-term observed continuous flow data**

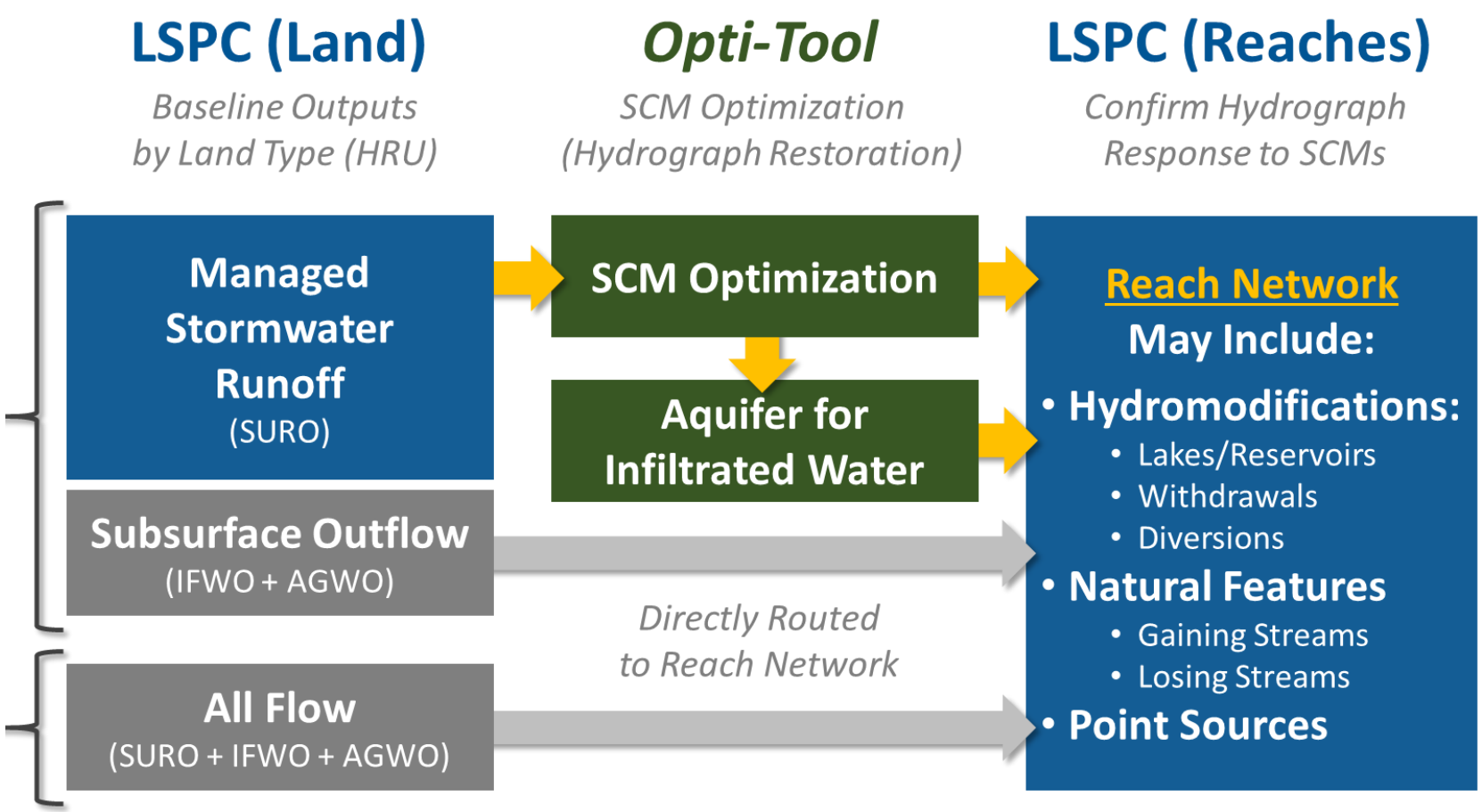
Task 6. Model Results

- FDC for Baseline (3 Sub-watersheds)
  - Pre-development
  - Historic development (if available)
  - Existing development conditions
- FDC for Future Climatic Condition (3 Sub-watersheds)
  - Pre-development
  - Historic development (if available)
  - Existing development conditions
- Quantify Impacts of IC Conversion
  - Critical streamflow regimes / metrics (e.g., flooding, channel scouring, baseflow depletion, etc.)
  - Stormwater runoff pollutant load export
  - Groundwater recharge
  - Evapotranspiration
  - Carbon sequestration and heat loss exchange

Task 7. Optimization Analyses

- Potential GI SCM Opportunities
  - **GIS based screening**
  - **Identify potential footprints and treated impervious areas**
- Management Scenarios
  - **Optimize GI SCM opportunities**
    - Evaluation factor: FDC critical regimes
    - Pre-development, historic development, and existing development conditions
    - Baseline and future climatic conditions
    - Three selected sub-watersheds
- Results
  - **FDC for each management scenario**
  - **Quantify benefits for critical streamflow regime/metrics**
  - **Evaluate water quality long-term cumulative benefits**
  - **Assess benefits for carbon sequestration and heat loss exchange**

LSPC and Opti-Tool Linkage



FDC 1 Project Outcomes

- Final Report
  - **Phase 1 outcome**
  - **Phase 2 linkage**
- Outreach Materials
  - **Factsheets**
  - **Graphics, summary tables**
  - **Key findings**
- Webinar
  - **Present phase 1 study results**
  - **Technical transfer to SNEP Technical Assistance Network (STAN)**

Action Items

- Update Work Plan/QAPP/Schedule
- Data Request (Person of Contact)
- Technical Steering Committee
- Other