INTEGRATING CLIMATE CHANGE WHILE ADAPTING FOR NPS IMPLEMENTATION IN LAKE CHAMPLAIN BASIN (VT)

NORTHEAST NONPOINT SOURCE CONFERENCE

FREEPORT, MAINE

APRIL 2015
PRESENTATION OUTLINE

STAGE SETTING - VERMONT BACKDROP
CLIMATE CHANGE INFLUENCE TMDL DEVELOPMENT
NPS IMPLEMENTATION
ACKNOWLEDGEMENTS

US EPA REGION 1
ERIC PERKINS

VERMONT DEC
KARI DOLAN
ERIC SMELTZER
VERMONT & LAKE CHAMPLAIN BASIN

VERMONT POPULATION: 626,630
OVERALL AREA: 9,609 SQ. MILES
PERENNIAL RIVER/STREAM MILES: 7,100
WETLAND ACRES: 300,000
LAKE/POND ACRES: 230,927

VT LAKE CHAMPLAIN ACRES: 174,175
TOTAL LAKE CHAMPLAIN ACRES: 278,400
VT AREA DRAINING TO LAKE: 56%
# WATER QUALITY ISSUES

## NPS MANAGEMENT

## TMDL

<table>
<thead>
<tr>
<th>WATER QUALITY</th>
<th>NPS</th>
<th>TMDL</th>
</tr>
</thead>
<tbody>
<tr>
<td>90% RIVER/STREAM MILES MEET WQS</td>
<td>319: ABOUT $1.1M PER YEAR</td>
<td># DEC PREPARED/EPA APPROVED TMDLS: 119* (SINCE 2002)</td>
</tr>
<tr>
<td>13% LAKE/POND ACRES MEET WQS</td>
<td>319 (1990-2014): $29.3M</td>
<td>TMDLS UNDERWAY TODAY: 16</td>
</tr>
<tr>
<td>IMPAIRED SEGMENTS:</td>
<td>STATE FUNDING – ERP ($2.3M PER YEAR)</td>
<td>TYPES OF POLLUTANTS ADDRESSED: PHOSPHORUS, E.COLI, PH, STORMWATER</td>
</tr>
<tr>
<td>NEED TMDL 13 L/P &amp; 68 R/S</td>
<td>AGRICULTURE, RUNOFF FROM IMPERVIOUS AREAS/SURFACES, RIVERBANK INSTABILITY, ATMOSPHERIC DEPOSITION, FLOW ALTERATION, FLOODING/CHANNEL IMPACTS, INVASIVE EXOTICS</td>
<td>FLOWS, MERCURY, SEDIMENT</td>
</tr>
<tr>
<td>NO TMDL NEEDED: 1 L/P &amp; 9 R/S</td>
<td></td>
<td>(*) 9/119 = LAKE CHAMPLAIN</td>
</tr>
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VERMONT CLIMATE ASSESSMENT (UVM, 2014)

CLIMATE CHANGE: HISTORICAL TRENDS

• RISING TEMP – AVE TEMP INCREASE 1.3F SINCE 1960 (45% SINCE 1990)
• INCREASE PRECIP – AVE ANNUAL INCREASE 5.5 IN. SINCE 1960 (48% SINCE 1990)
• FREEZE-THAW – GROWING SEASON CHANGES OBSERVED LAST 40 YEARS
• FLOODING – INUNDATION & EROSION; FLASHY FLOWS MORE COMMON

CLIMATE CHANGE: PROJECTED (VS PREDICTED) TRENDS

• WARMING TEMPS – 3F BY 2050 /5F BY 2099
• INCREASE PRECIP – HIGHER ELEVATIONS; WINTER SNOWS TO RAIN IN 50 YR
• WEATHER EXTREMES - HIGH TEMPS
• JET STREAM PATTERN - INTENSE RAINFALL EVENTS OR DRY SPELLS
IMPACTS OF CLIMATE CHANGE IN VERMONT
(UVM, 2014)

- POLICY & COMMUNITY DEVELOPMENT – VULNERABILITY
- ENERGY – USE/DEMAND & INFRASTRUCTURE
- FORESTS
- AGRICULTURE
- RECREATION & TOURISM
- PUBLIC HEALTH
- TRANSPORTATION & HOUSING
- EDUCATION
- WATER RESOURCES
• 8,234 square mile watershed
  – 56% (VT); 37% (NY); 7% (Quebec)
  – Drains slightly over half the land area of Vermont
• USA’s 6th largest natural lake
• Drinking water source for 200,000 people in Vermont
• VT portion of basin home to:
  – 390,000 people
  – More than 100,000 dairy cows
POLLUTANT OF CONCERN: PHOSPHORUS

Impacts:
- Algae blooms
- Toxic blue-green algae blooms
- Fish kills
- Aesthetics
- Aquatic plant growth
- Loss in tourism & recreation
- Reductions in lakeshore property values
- Increased costs - drinking water treatment
- Increased costs - wastewater treatment
- Impacts to natural ecosystem
Phosphorus Sources in the Vermont Portion of the Lake Champlain Basin

- Agricultural Lands: 40%
- Stream Instability: 22%
- Forest Lands: 15%
- Developed Lands Including Paved Roads: 14%
- Unpaved Roads: 6%
- Wastewater Treatment Facilities: 3%
In-lake phosphorus levels are above allowable standard/criteria & rising.....

Vermont has taken a wide variety of important pollution control actions since 1970s, noteworthy in the last 10 years

Cleaning up the lake ecosystem is complex - recovery will take time….as in decades

A lot more needs to be done - on multiple fronts.
The amount of pollution the lake can receive and still meet water quality standards. Determined by data and modeling.

For Lake Champlain, targets will be expressed at the 9 lake segments level.

Achieved by federally required permits or other regulations.

Examples
- Wastewater discharges
- Construction stormwater
- MS4s
- CSOs
- CAFOs

Achieved by regulatory or non-regulatory methods. Requires “reasonable assurances.”

Examples
- Agricultural runoff
- Unregulated stormwater
- River channel instability
- Road drainage networks
- Forest runoff
- Wetlands protection

Could be expressed as some percentage of the TMDL.
LAKE CHAMPLAIN TMDL HISTORY
(AS PER EPA-I, 2013 & 2014*)

2002 LAKE CHAMPLAIN PHOSPHORUS-BASED TMDL APPROVED (VT & NY)

2008 CONSERVATION LAW FOUNDATION – LITIGATION & SETTLEMENT AGREEMENT

2010 EPA REVIEW OF CONTESTED ELEMENTS
   - AGGREGATION OF STORMWATER WLAS – SUFFICIENT
   - MOS – INSUFFICIENT
   - REASONABLE ASSURANCE THAT NPS LOAD REDUCTIONS WOULD OCCUR - INSUFFICIENT
   - CLIMATE CHANGE CONSIDERATIONS ASSOC W/ LOADING CAPACITY & HYDROLOGIC BASE YEAR – SUFFICIENT

2011 EPA DISAPPROVES VERMONT PORTION OF 2002 TMDL - BEGINS TMDL REVISION

2015* (TENTATIVE) EPA TO ISSUE REVISED TMDL
EPA MODELING OBJECTIVES

ESTABLISH LOCAL TECHNICAL WORK GROUPS

REVISE LAKE MODEL (BATHTUB) – RECALIBRATE TO REFLECT CURRENT CONDITIONS

DEVELOP P LOAD ESTIMATES FROM SUBWATERSHEDS & SOURCE CATEGORIES (SWAT)

ESTIMATE POTENTIAL P REDUCTIONS FROM NPS IMPLEMENTATION (SCENARIO TOOL)

EVALUATE EFFECTS OF CLIMATE CHANGE
CLIMATE RESPONSE MODELING

OBJECTIVE – EVALUATE POTENTIAL EFFECTS OF CLIMATE CHANGE ON P LOADING

- USE PREVIOUSLY DEVELOPED EPA APPROACH – ORD-GCRP “20 WATERSHEDS STUDY” *
- RESPONSE TO FUTURE POSSIBLE CLIMATES EVALUATED FOR LC BASIN (2040 – 2070)
- 6 CLIMATE SCENARIOS (“PLAUSIBLE STATES”) EXAMINED TAKING INTO ACCOUNT UNCERTAINTIES
- GLOBAL CLIMATE MODELS (GCM) “DOWNSCALED” WITH REGIONAL CLIMATE MODELS (RCM) PRODUCING “MORE RELIABLE” LOCAL CLIMATE FORECAST

# CLIMATE SCENARIO RESULTS – LC BASIN

CHANGE (%) IN AVE. ANNUAL FLOW & LOAD
ALL 6 NARCCAP SCENARIOS
AVERAGE ACROSS ALL LC BASINS

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Minimum</th>
<th>Median</th>
<th>Mean</th>
<th>Maximum</th>
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</thead>
<tbody>
<tr>
<td>Flow</td>
<td>2.2</td>
<td>12.5</td>
<td>12.1</td>
<td>20.8</td>
</tr>
<tr>
<td>Total suspended solids</td>
<td>-8.6</td>
<td>12.6</td>
<td>10.5</td>
<td>21.3</td>
</tr>
<tr>
<td>Total phosphorus</td>
<td>12.7</td>
<td>29.8</td>
<td>29.6</td>
<td>45.6</td>
</tr>
</tbody>
</table>
AVE. ANNUAL FLOW VOLUME & TP LOAD
ALL 6 CLIMATE SCENARIOS, ALL LC BASINS

**Annual Average Flow Volume**
- Baseline
- CRCM_gccm3
- HRM3_hadc
- RCM3_gfdl
- GFDL_slice
- RCMS_gccm3
- WRFP_ccsm

**TP Load**
- Baseline
- CRCM_gccm3
- HRM3_hadc
- RCM3_gfdl
- GFDL_slice
- RCMS_gccm3
- WRFP_ccsm
EPA’S PROPOSED APPROACH TO ADDRESSING CLIMATE CHANGE IN THE LAKE CHAMPLAIN TMDL

• CLIMATE CHANGE ALLOCATION WILL NOT BE BUILT INTO TMDL EQUATION – BECAUSE:
  
  P LOAD PROJECTIONS CARRY SIGNIFICANT UNCERTAINTY

  P LOAD PROJECTIONS ONLY CAPTURE ONE PART OF POTENTIAL SYSTEM CHANGES – LOADING CAPACITY & IN-LAKE RESPONSE CONDITIONS NOT CURRENTLY AVAILABLE / COMPLEX STUDIES

  TIMEFRAME FOR PROJECTIONS ABOUT 50 YR – WELL BEYOND “LIFE EXPECTANCY” OF TMDL

• INSTEAD ACCOUNT FOR PROJECTED LOAD INCREASES IN IMPLEMENTATION PHASE BY IDENTIFYING PRACTICES EXPECTED TO PERFORM WELL GIVEN CLIMATE PROJECTIONS

• MULTIPLE BENEFITS TO INCORPORATING CLIMATE CHANGE CONSIDERATIONS INTO IMPLEMENTATION PLAN, INCLUDING MAJOR COST SAVINGS WITH POTENTIAL FLOOD DAMAGE
## Program Areas

<table>
<thead>
<tr>
<th>Program Areas</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agricultural programs</td>
</tr>
<tr>
<td>Stormwater management</td>
</tr>
<tr>
<td>- developed &amp; developing areas</td>
</tr>
<tr>
<td>- roads</td>
</tr>
<tr>
<td>Rivers management</td>
</tr>
<tr>
<td>Wetlands management</td>
</tr>
<tr>
<td>Lakes management</td>
</tr>
<tr>
<td>Forest / logging management</td>
</tr>
</tbody>
</table>
EXAMPLES OF PROPOSED COMMITMENTS
CLIMATE CHANGE - AGRICULTURE

ENHANCE RULES FOR AGRICULTURE – AAPS

BUFFERS & GULLY STABILIZATION

NUTRIENT MANAGEMENT PLANNING & PLANS

COVER CROPS, CONSERVATION TILLAGE, ALTERNATIVE MANURE
APPLICATION / INCORPORATION

SMALL FARM (< 200 HEAD) CERTIFICATION

MORE RECENT EMERGING CONCERN – TILE DRAINAGE EFFLUENT!
EXAMPLES OF PROPOSED COMMITMENTS
CLIMATE CHANGE - STORMWATER/DEVELOPED LAND

• REQUIRE STORMWATER TREATMENT RETROFITS FOR AREAS/SITES NOT PREVIOUSLY SUBJECT TO STORMWATER REQUIREMENTS

• NEW PERMIT - VERMONT STATE ROADS

• NEW PERMIT - TOWN ROADS WHETHER PAVED OR UNPAVED

• REVISE VERMONT STORMWATER MGMT. MANUAL – UPDATE DESIGN REQ'T’S & EMPHASIZE LID / GI / GSI COMPONENTS
EXAMPLES OF PROPOSED COMMITMENTS
CLIMATE CHANGE - RIVER MANAGEMENT

• RIVER CORRIDOR EASEMENT PROGRAM – TARGETED AT PRIORITY NUTRIENT / SEDIMENT ATTENUATION REACHES
  PURCHASE OF CHANNEL MANAGEMENT RIGHTS

• STATE POLICY (2011) – MANAGE RIVERS / STREAMS TO ACHIEVE & MAINTAIN DYNAMIC EQUILIBRIUM (LEAST EROSIIVE, NATURALLY STABLE STREAM CONDITION).
  RIVER CORRIDOR & FLOODPLAIN MGMT. PROGRAM
  INTEGRATE NFIP & FEH, RIVER CORRIDOR, BUFFER PROTECTION & RIVER SCIENCE

• VT AOT ROAD & BRIDGE STANDARDS – AOT’S HYDRAULIC MANUAL (CROSSINGS) - BETTER ALIGNED WITH POLICY
  SIZING STREAM CROSSINGS BASED ON EQUILIBRIUM CONDITIONS TO MIN. EROSION, SCOUR, STRUCTURE FAILURE
EXAMPLES OF PROPOSED COMMITMENTS
CLIMATE CHANGE - OTHER CONSIDERATIONS

• ENHANCE WATER QUALITY RULES (AMPS) FOR LOGGING

• ENHANCE WETLAND PROTECTION / RESTORATION

• ESTABLISH LAKESHORE PROTECTION REQUIREMENTS
CLIMATE CHANGE – OTHER NPS CONSIDERATIONS

SOIL HEALTH (IMPROVEMENT) + WATER QUALITY -

INCREASE WATER INFILTRATION RATES
INCREASE SOIL WATER HOLDING CAPACITY
INCREASE NUTRIENT RETENTION IN SOIL

DECREASE OVERLAND FLOW TO SURFACE WATERS
DECREASE SOIL EROSION
DECREASE NEEDED NUTRIENT AMENDMENTS
CONCLUDING REMARKS

• TMDL ASSUREDNESS

• CLIMATE CHANGE - WITH ASSOCIATED UNCERTAINTIES - CAN BE ACKNOWLEDGED DURING POLLUTION BUDGETING
CONCLUDING REMARKS

- Climate uncertainties can offer WQ planners / states opportunities when addressing NPS
- Typical NPS management approaches may not be sufficient in light of NPS behavior & its close relationship to mother nature
- Climate vs weather