THE ROCKY MOUNTAIN NATIONAL PARK
AIR QUALITY INITIATIVE:
AIR QUALITY CONTROL COMMISSION
ANNUAL BRIEFING

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Interagency effort addresses air pollution issues in RMNP
- Focus on nitrogen deposition trends
- CDPHE, EPA, NPS
- Nitrogen Deposition Reduction Plan (2007)
- Contingency Plan (2010)
RMNP AQ Initiative: Background

- Agencies support collaborative, preventative approach in lieu of legal/regulatory mechanisms that could be triggered
  - Air Quality Related Values (AQRV) impairment declaration
  - Prevention of Significant Deterioration Increment consumption
- Stakeholder review of research, identified information needs and discussed options for improving conditions
- “Weight of the evidence” approach considers:
  - Monitoring/trends
  - Attribution studies
  - Planned reductions
Large body of evidence indicates nitrogen deposition has affected and continues to cause harmful effects on sensitive ecosystems within the park.

- Current wet deposition monitored at \( \sim 3.3 \) kg N/hectare/year (rolling 5-year average - 2010-2014)
- Natural background estimated at 0.2 kg N/hectare/year

Specific, published (peer-reviewed) research has shown that wet deposition levels at the time harmful effects started to occur was \( \sim 1.5 \) kg N/ha/yr.
Rocky Mountain National Park: Continuum of Impacts to Ecological Health

- Current N deposition in Rocky Mtn. NP: 3.3/5.0
- Target Load: Park Natural Resource Goal: 1.5/2.3
- Natural background N deposition: 0.2/0.3

Potential future ecosystem impacts if N deposition increases:

- “Weight of evidence” of ecosystem health decline on east side of park

Change in alpine plant species:
CL = 3.0 kg/ha/yr total N

Change in aquatic plant species composition:
CL = 1.5 kg/ha/yr wet N

Increases in “weedy” lichen species:
CL = 3.1 kg/ha/yr total N

Soil N saturation/leaching:
CL = 4.0 kg/ha/yr total N

Forest decline (acidification effects on trees):
CL = 8.0 kg/ha/yr total N

Effects on aquatic animals (episodic acidification) begins:
CL = 4.0 kg/ha/yr total N

Solid line text box = observed effects; Dotted line text box = potential effects
Nitrogen Deposition Reduction Plan & Contingency Plan

- Original NDRP endorsed by NPS, EPA and CDPHE and the Colorado Air Quality Control Commission on August 16, 2007
  1) Management approach based on collaborative process
  2) Voluntary approach, no mandatory requirements or standards
  3) Sets long-term (25-year) resource management goal
  4) Sets timeline and interim (5-year) milestone goals intervals to achieve nitrogen reduction goal by 2032
  5) Strategies to achieve goal
  6) Identifies options that can be implemented on a voluntary basis

- Contingency Plan endorsed by NPS, EPA and CDPHE and the Colorado Air Quality Control Commission on June 22, 2010
  - Adaptive management approach consisting of 5 elements
    1) Data Tracking Plan
    2) Triggering Mechanism
    3) Recommending & Implementing Contingency Measures
    4) List of Potential Contingency Measures
    5) Public Outreach & Participation
Assessment of multiple evidence types

Two identified questions:
- 2012 Nitrogen Deposition Interim Milestone met? No.
- Will the RMNP Nitrogen Deposition Contingency Plan be triggered? No.

Quantitative and Qualitative Factors

Therefore, the MOU agencies conclude that the 2012 interim milestone has not been achieved. However, the RMNP Nitrogen Deposition Contingency Plan shall not be triggered at this time.
Has nitrogen deposition decreased at RMNP or other sites in the region?

- Long-Term Statistical Trend (1984-2014):
  - No trend in wet nitrogen deposition (went from increasing to stable) as of 2010
  - Ammonium is increasing at 4 out of 5 sites
  - No trend in nitrate

- Short-Term 5 or 7 year Statistical Trends (2010-2015 or 2008-2015):
  - Wet nitrogen deposition is increasing at 1 out of 5 sites
  - No trend in ammonium
  - No trend in nitrate

- Co-located site (2009 - 2013)
- Passive ammonia samplers
Historically, nitrogen deposition increased at the park largely due to increasing ammonium.

Some Good News
- Long-term trend in nitrogen deposition shifted from increasing to stable at Loch Vale.
- Short-term trends in nitrate are stable (at a lower level) after several years of decreases.
- General short-term trends in ammonium are stable in the region.

Challenges
- Nitrogen deposition is not yet decreasing and is departing further from glidepath.
- Ammonium continues to increase over the long-term.
RMNP Loch Vale Nitrogen Deposition & NDRP Glidepath

- Precipitation
- Annual Wet N Deposition
- Current Wet N Deposition (5 yr rolling avg)
- Glidepath
- Average Precipitation (1984-2014)

- 2006 MOU Signed (3.1 kg N/ha/yr)
- 2012 Milestone (2.7 kg N/ha/yr)
- 2017 Milestone (2.4 kg N/ha/yr)
- 2022 Milestone (2.1 kg N/ha/yr)
- 2027 Milestone (1.8 kg N/ha/yr)
- 2032 Resource Management Goal (1.5 kg N/ha/yr)

3.3 kg N/ha/yr (as of 2014)
Substantial portion of deposited nitrogen originates in Colorado
- Greater than 50% ammonia (NH$_3$) from Colorado
- Less than 50% nitrogen oxides (NO$_x$) from Colorado

During spring and fall upslope weather events, high concentrations of both types of nitrogen move from eastern urban & agricultural areas of Front Range to RMNP.

Regular summer upslope transport from mountain valley convection

Local sources of ammonia not significant contributors to deposition in RMNP.
April had the highest recorded month of N deposition (by a combination of high ammonium concentrations and high precipitation)

September flood rain contributed but low ammonium concentrations resulted in a lower deposition event.

Back trajectory analysis shows that the frequency of transport through eastern Colorado (a known source area of ammonium) was greater than average in April 2013.
Ammonia Monitoring & Research Projects

- Continuous ammonia monitors in Greeley (summer 2014) and Loveland (summer 2015) (NPS/CSU/NRCS/CDPHE)

- Additional monitor in RMNP (July 2014) (NPS/EPA)
  - Continuous ammonia, 3x/week wet dep of oxidized, reduced, and organic N

- USDA funded summertime ammonia network

- Testing improved instrumentation
  - Trace-level measurements
  - Bi-directional fluxes

- Direction ammonia sources from monitors (CSU)

- Comparison with Satellite Observations (CSU)

- Comparison with CAMx Model Simulations (CSU)
Research: Map of Ammonia Monitoring

Sites & Animal Counts

Benedict et. al, 2015

June - August 2010 - 2014
Early Warning System/
Agricultural Pollution Prevention Project

- Goal: demonstrate effectiveness of pilot-scale “early warning system” that alerts agricultural producers in advance of upslope weather event likely to transport ammonia & reactive nitrogen into RMNP
  - Producers alter or delay farm or manure management practices until weather event elapsed
- Agricultural producer participants: 53
- Non-producer participants tracking warnings: 25
- Number of meteorological warnings
  - 2014: 10 events total (majority in July/Sept) (13 days total)
  - 2015: 14 events so far (majority in April/Oct) (30 total days)
- Response rates ranged from 30 - 69% of affected producers
  - 58% of respondents changed practices for full warning period
  - Additional 16% changed for portion of warning period
- Number of fact sheets developed/distributed: 3
EWS Warnings vs. Nitrogen Deposition (2014)

2014 Loch Vale NADP Data (CO-98)

- Warning Issued
- ND - Deposition data not available

Credit: Colorado Livestock Association
NRCS National Air Quality Initiative (NAQI)

- 2008 Farm Bill authorized NRCS to assist producers in addressing agricultural air quality issues
- NAQI changed in FY2015 to:
  - Better address true agricultural air quality issues
    - Not just nonattainment
    - States have more flexibility and say
  - Address regional agricultural air quality issues
  - Encourage and prioritize partner participation
Recent & Upcoming Activities

- MOU Agencies Communication Plan
  - EPA Summer Interns
    - Draft Strategic Proposal (August) with Agency Input
    - Draft Inventory of State Air Quality Programs (Ammonia Emission Mitigation Strategies)
  - Workshop in January 2016
    - Agency roles
    - Data gaps/needs
    - Potential paths forward

- Ag Subcommittee
  - Separate plan drafted April 2015
  - Conduct workshops to refine strategy through next milestone, in cooperation with agriculture
  - Work closely with agriculture to fill data gaps
  - Support higher resolution ammonia monitoring
  - Conduct research to better understand deposition factors including conducting source apportionment, transport back trajectories
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Questions?

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RMNP Website: www.colorado.gov/cdphe/rmnpinitiative
Demographic trends show Front Range population and vehicle miles increasing while agricultural counts steady.

NO$_x$ emissions decreasing nationally and locally while ammonia emissions remain stable.

Efforts continue to improve Colorado’s nitrogen emission inventories.

Significant NO$_x$ reductions on the horizon expected to contribute to reduced nitrogen deposition in RMNP.

Ag Subcommittee and multiple ammonia-related research efforts promising:
- 5-year adaptive plan & Early Warning System pilot

In-Park emission strategies in place:
- Vehicle transportation systems
- Increases in fleet efficiency
- Environmental Management System
National Vehicle Standards

A HISTORIC LOOK AT THE STANDARDS

Fuel economy standards are set periodically to ensure that vehicles are keeping up with the times -- here's a snapshot of how fuel economy standards have changed over time.

- 1978: 18 MPG
- 1985: 27.5 MPG
- 2011: 30.2 MPG
- 2016: 35.5 MPG
- 2025: 54.5 MPG

Source: http://energy.gov/articles/infographic-road-fuel-efficiency