

Assessing the Impact of Wet and Dry Nitrogen Deposition as an Ecosystem Stressor at Marine Corps Base Camp Lejeune (MCBCL), North Carolina

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INTRODUCTION

This project is part of a larger effort, the Defense Coastal /Estuarine Research Program (DCERP; <http://dcerp.rti.org/>) funded by the Strategic Environmental Research and Development Program, to identify significant ecosystem stressors and develop conceptual and mechanistic ecological models that will lead to effective management guidelines for the long-term sustainability of military training at MCBCL near Jacksonville, N.C. Specific DCERP goals are: 1) development of conceptual and mechanistic ecological models to guide research, monitoring, and adaptive management feedback loops; 2) identification of significant ecosystem stressors, their sources, and their level of impact on MCBCL's ecological systems; and 3) incorporation of stressor and other ecological indicator information into models, with an aim to develop more effective management guidelines for sustainable ecosystems.

N DEPOSITION HYPOTHESES

1. Atmospheric deposition (both wet and dry) represents the dominant source of new nitrogen (inorganic and organic nitrogen species) into the terrestrial and aquatic ecosystems of MCBCL.
2. Local influences, and national trends in N emissions to the atmosphere suggest that N-loading may continue to increase with time at MCBCL, having a direct impact on the sustainability of the terrestrial and aquatic ecosystems.

MARINE CORPS BASE CAMP LEJEUNE

MCBCL occupies over 60,000 ha in eastern North Carolina and extends from the Atlantic Ocean inland for ~ 24 km. MCBCL also constitutes a significant fraction of the New River watershed, which flows through the middle of the base. The MCBCL was chosen as the DCERP site for a variety of reasons, not the least of which was the variety of ongoing military operations at the MCBCL that will enable researchers to examine military training impacts on a broad range of ecosystems, from upland pine savannas to aquatic/estuarine waters to coastal barriers.

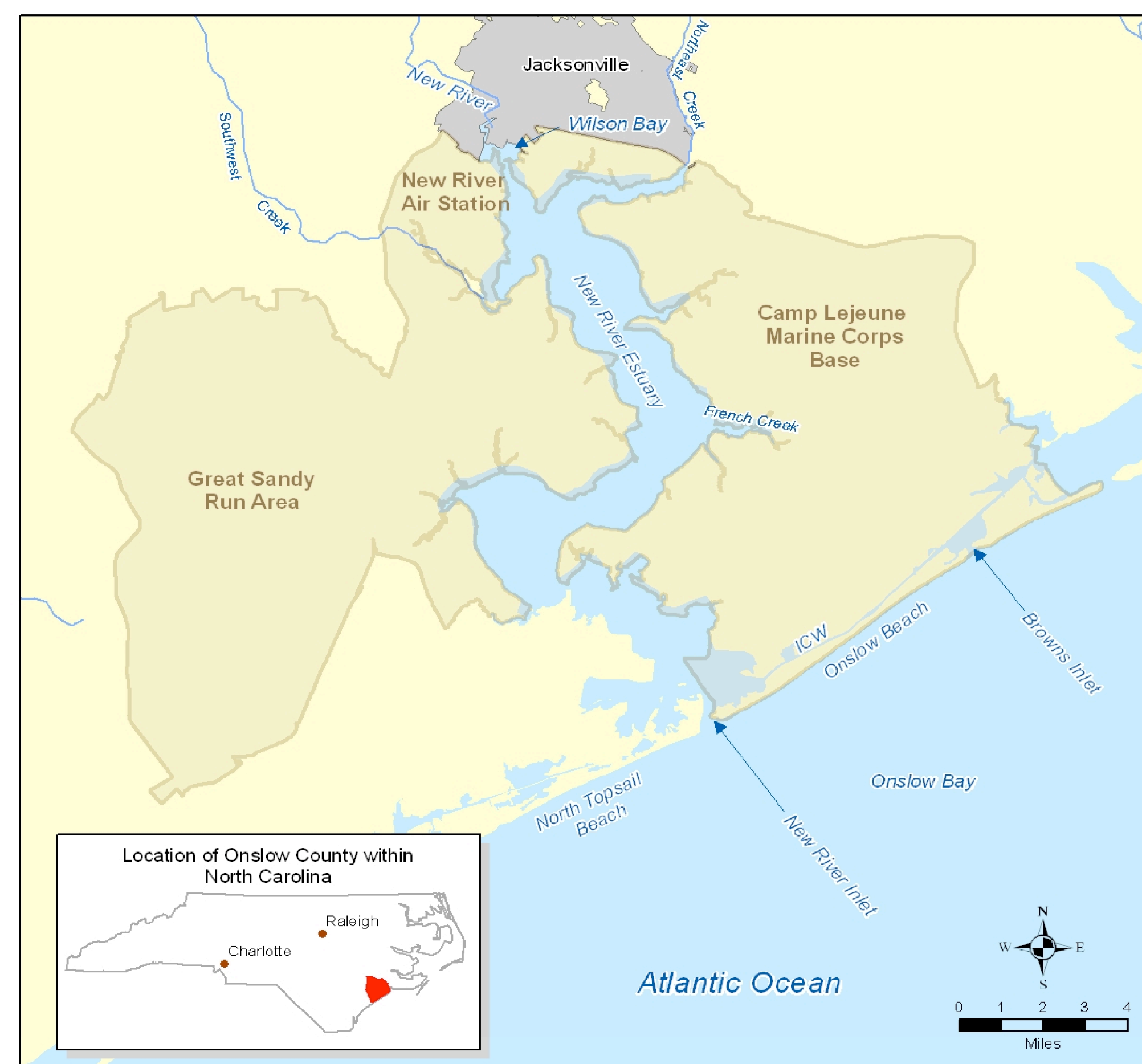


FIGURE 1. MCBCL ecosystems are used extensively for coordinated land, air and sea training.

WET AND DRY N DEPOSITION MEASUREMENTS

Four National Atmospheric Deposition Program (NADP) style collectors will be used to measure wet deposition (Fig. 2). Sample collection, preservation and analysis will follow NADP guidelines, except that total dissolved organic-N will also be determined in all samples. Dry deposition of reduced and oxidized N species will be indirectly determined using throughfall /stemflow measurements within representative vegetative canopies (pine flatwoods, dry longleaf pine-wiregrass savanna, hardwoods) (Fig. 4,5). These measurements will be supplemented with a network of tipping bucket gauges to measure rainfall amount across MCBCL (Fig. 3). Repeated measures analysis will be used to assess concentration data and then combined with response surfaces generated from tipping bucket data to produce nutrient deposition maps. Concentration of gaseous N species (NH_3 and NO_2) will be monitored at throughfall/stemflow sites using passive samplers (Fig. 6).

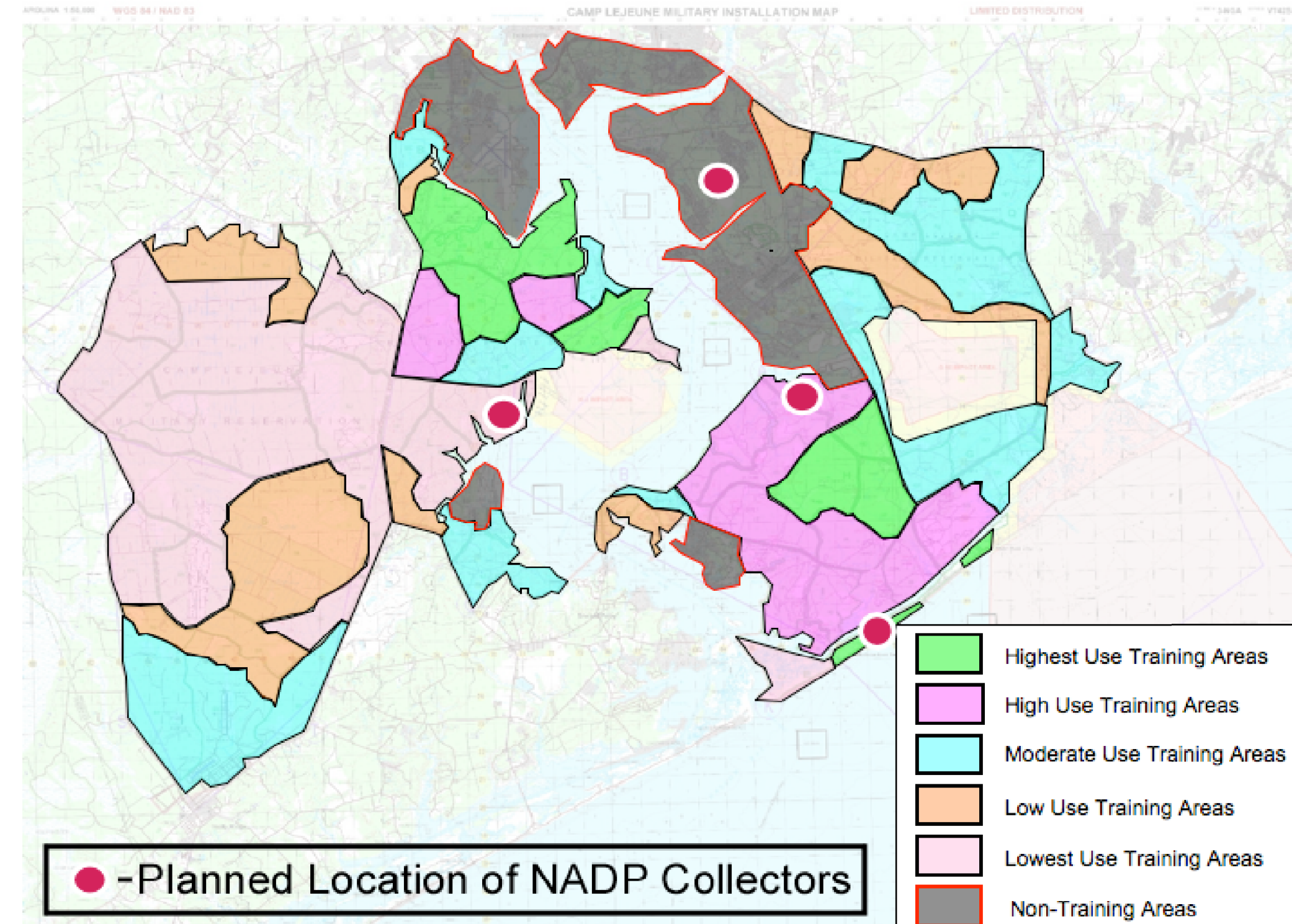


FIGURE 2. Planned deployment of NADP wet deposition collectors. Color-coded areas identify land-use patterns across MCBCL.

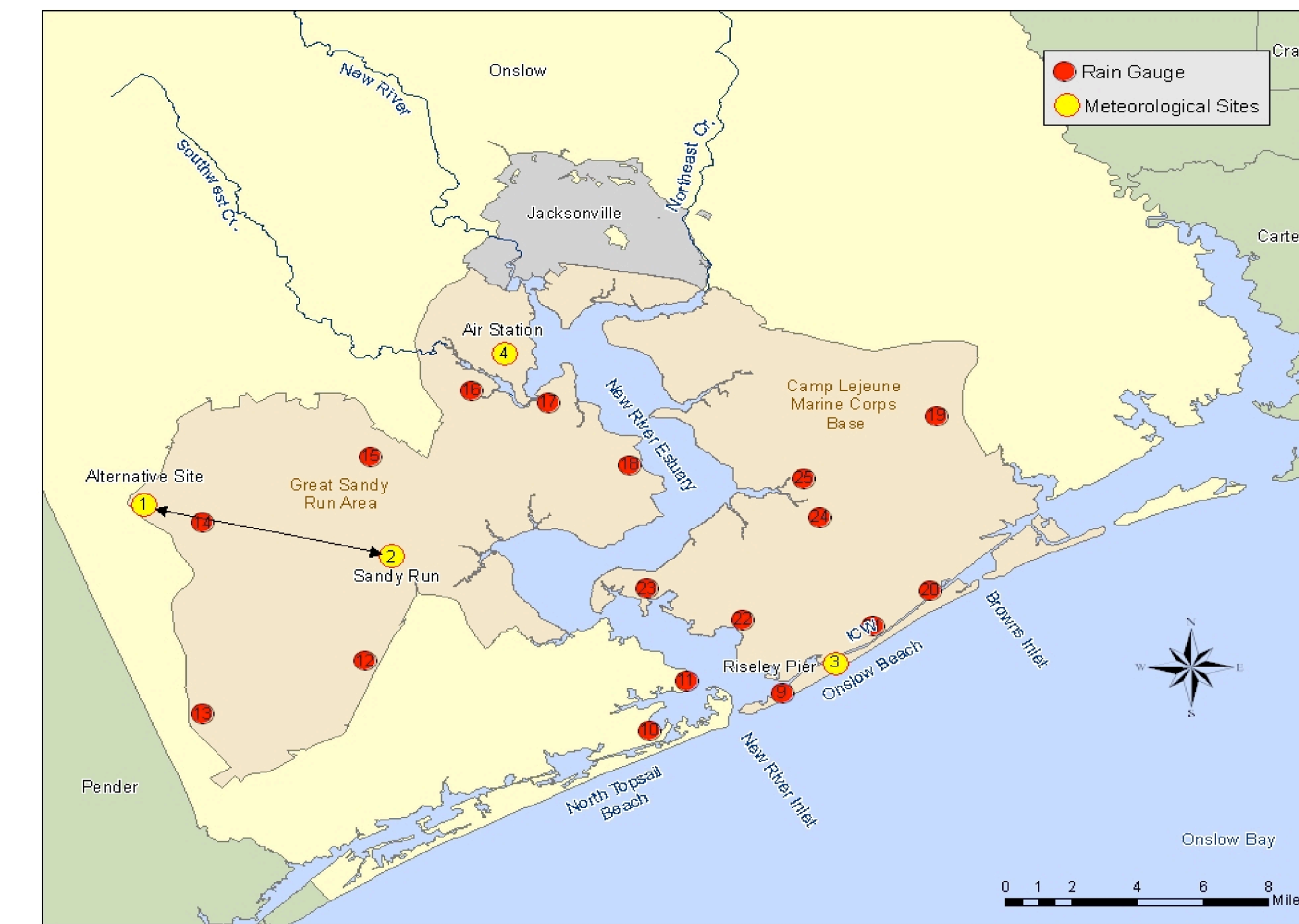


FIGURE 3. Planned deployment of tipping bucket gauges to measure rainfall amount across MCBCL.

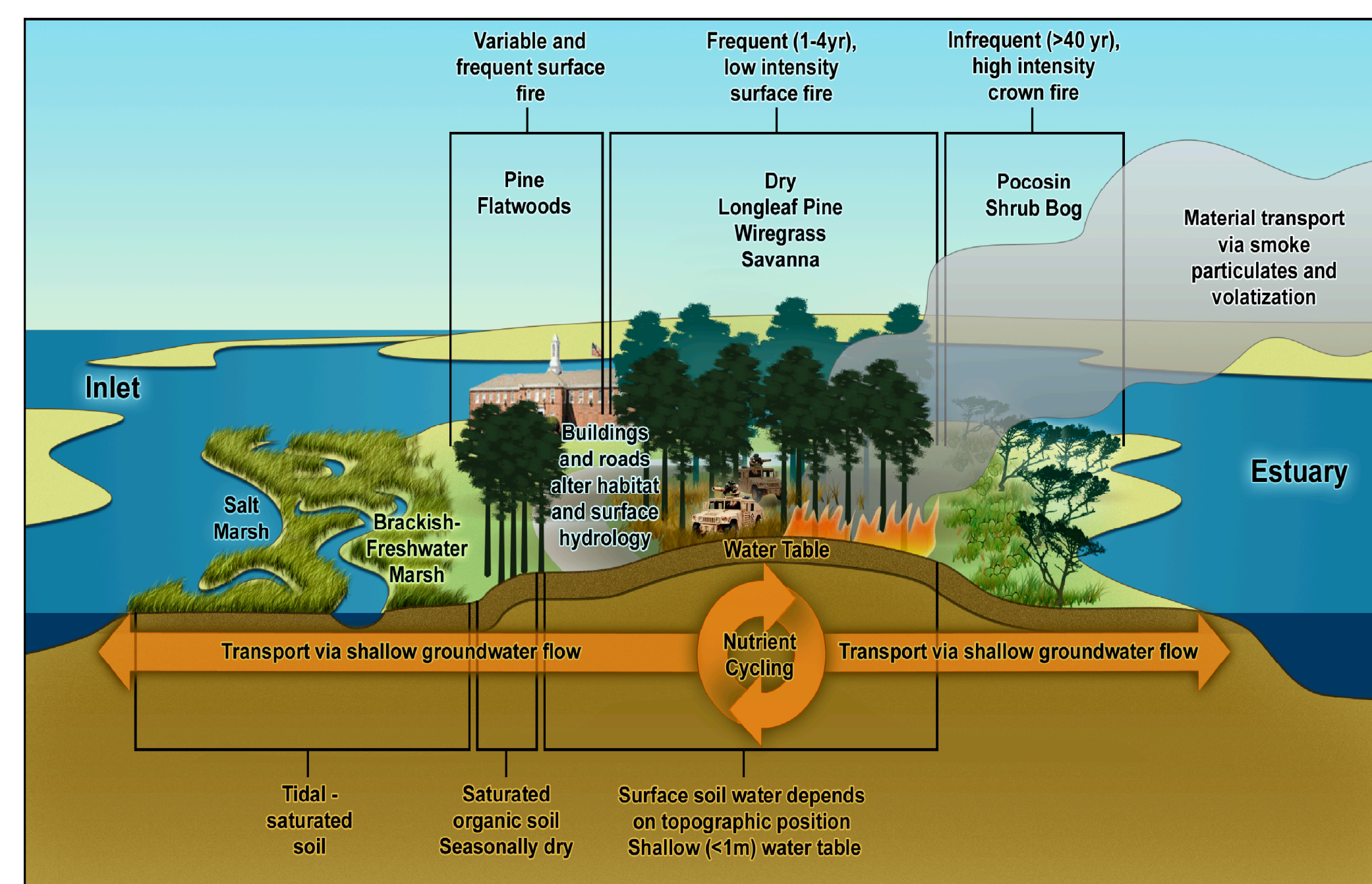


FIGURE 4. Survey work by Terrestrial research group will assist in selecting throughfall/stemflow sites.

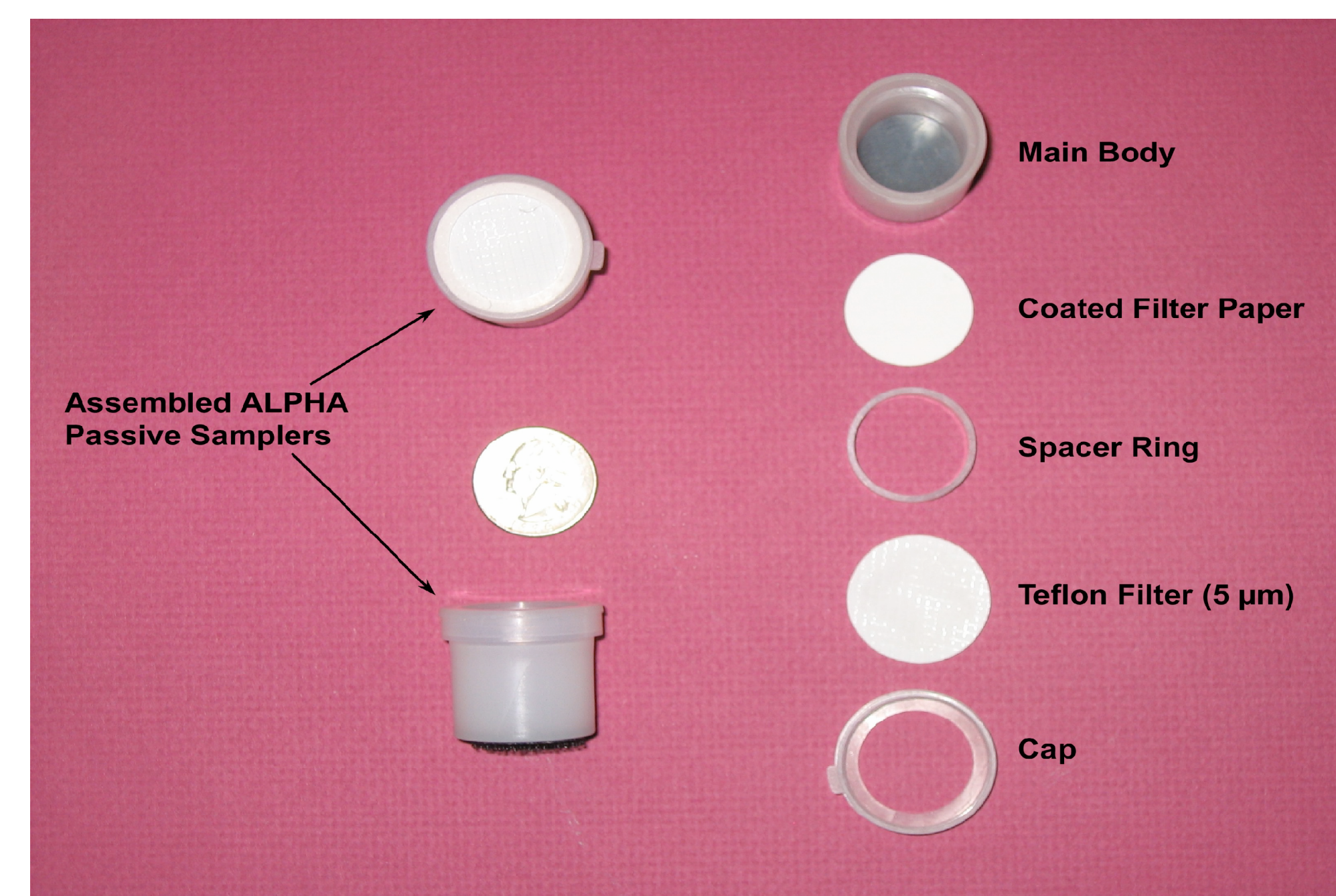


FIGURE 6. ALPHAtm passive samplers will provide integrated measures of NH_3 and NO_x atmospheric concentrations.

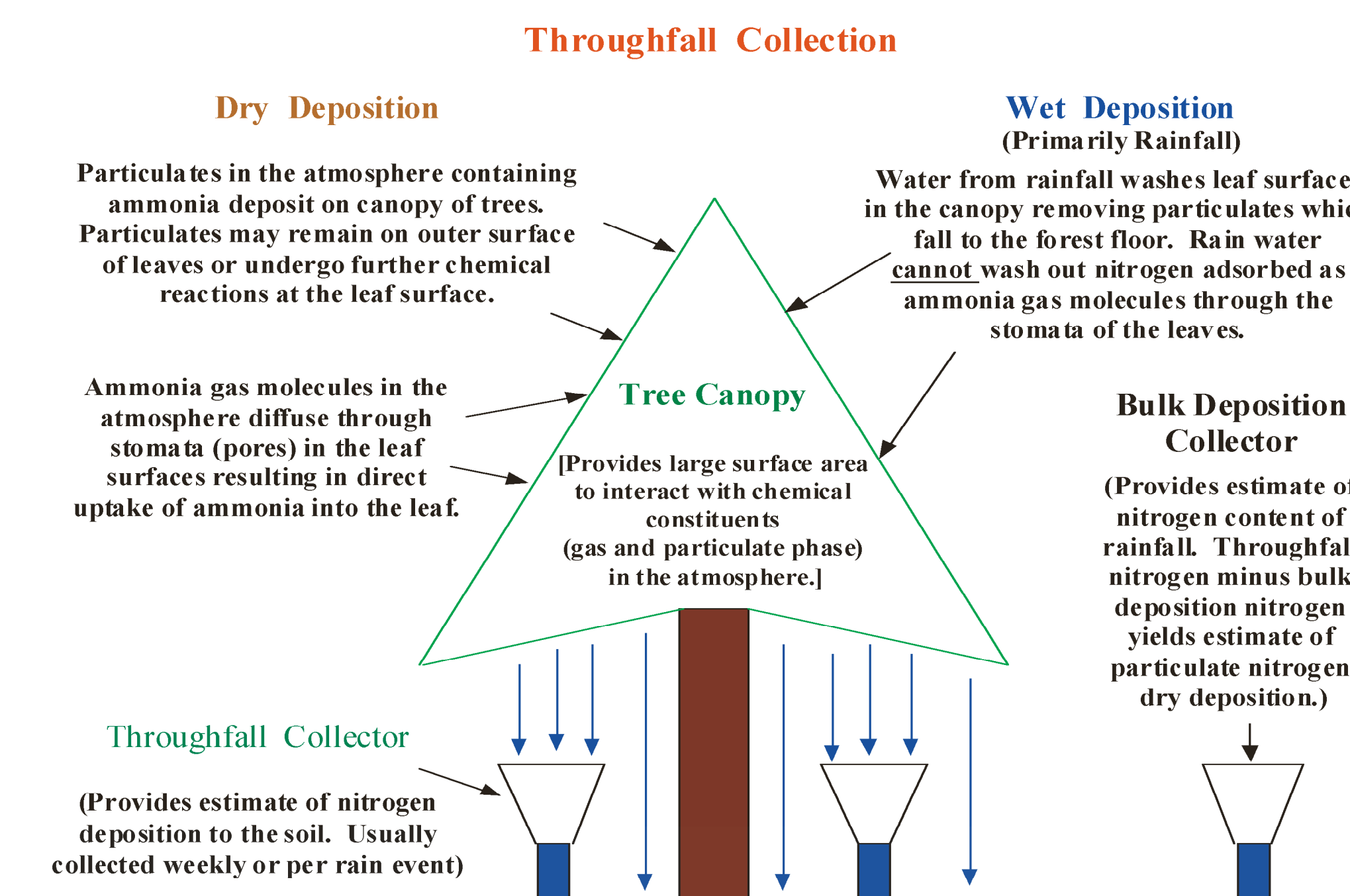


FIGURE 5. Schematic of throughfall collection. Net throughfall (throughfall minus bulk deposition) provides an indirect measure of dry deposition.



FIGURE 7. Measurements of N deposition will be contrasted to local remobilization and deposition of N as a result of prescribed burning.

OUTPUTS

Completion of this project will achieve the following:

- A. Assess the magnitude and temporal and spatial trends in wet/dry N deposition to the vegetative canopies and underlying soil-groundwater ecosystem across MCBCL;
- B. Estimate the fraction of organic-N prevalent in wet deposition occurring at MCBCL;
- C. Estimate the magnitude and temporal trends in N-deposition (wet deposition) to surrounding aquatic ecosystems at MCBCL;
- D. Complement efforts to characterize and model the impacts of prescribing burning on long term sustainability of terrestrial and aquatic ecosystems at MCBCL.

RELEVANCE TO MCBCL

Contributions from this project to the overall DCERP effort to ensure the sustainability of our nation's military training bases include:

- A. Planning successful replacement of existing tree species with those common to native forest ecosystems;
- B. Providing baseline data of atmospheric inputs into areas with federally protected species, allowing assessment of future changes in species densities with potential shifts in atmospheric deposition due to influences outside the confines of MCBCL;
- C. Providing an estimate of the extent to which forested canopies at MCBCL serve as sinks for various atmospheric species;
- D. Providing an estimate of variation (if any) in long term rainfall amounts and composition across MCBCL, presenting a platform for future monitoring plans or selection of areas for land use activities;
- E. Providing information on the applicability of current, relatively low cost, approaches (NADP-style rainfall collectors, passive samplers) to monitoring atmospheric deposition and ambient atmospheric composition;
- F. Assessing the suitability of "nearby" federal and state atmospheric monitoring stations (e.g. NADP collector NC29 at Hofmann Forest, Onslow Co.) to project atmospheric deposition at MCBCL.

ATMOSPHERIC PROCESSES AT MCBCL

This project is part of a larger effort (Fig. 8) to understand the dominant atmospheric processes (local and distant emission sources, transformations, deposition, impacts of prescribed burning on local air quality and remobilization of elements) that effect the ecosystems at MCBCL.

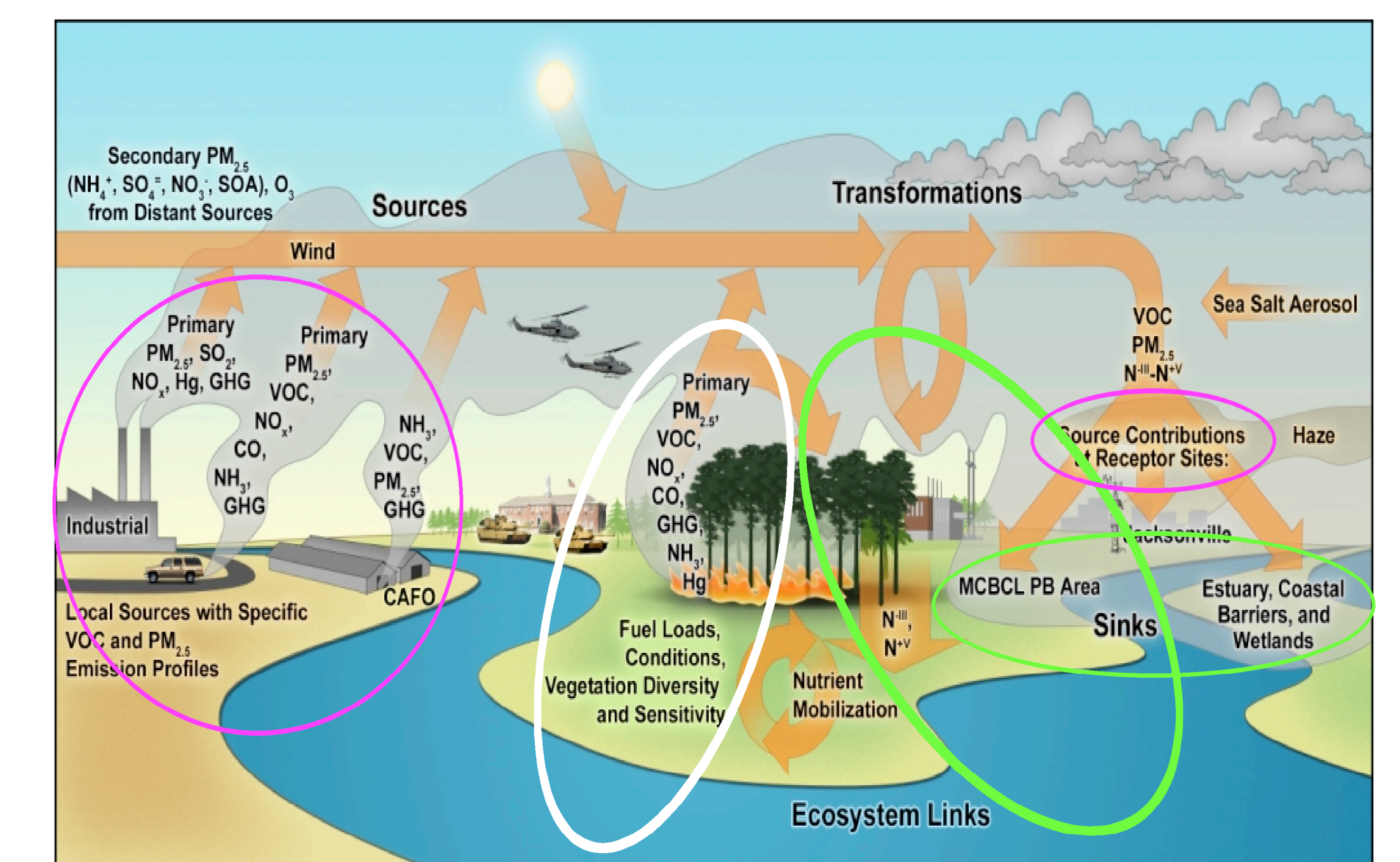


FIGURE 8. Conceptual model of atmospheric processes impacting MCBCL.

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