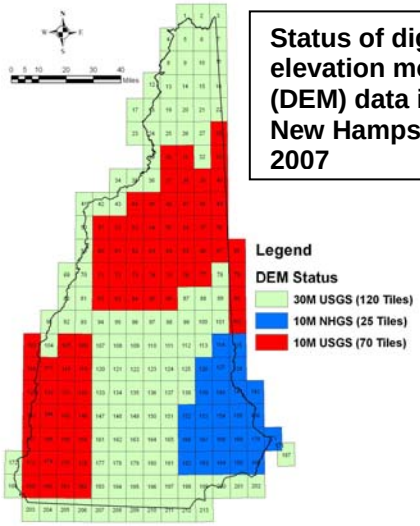
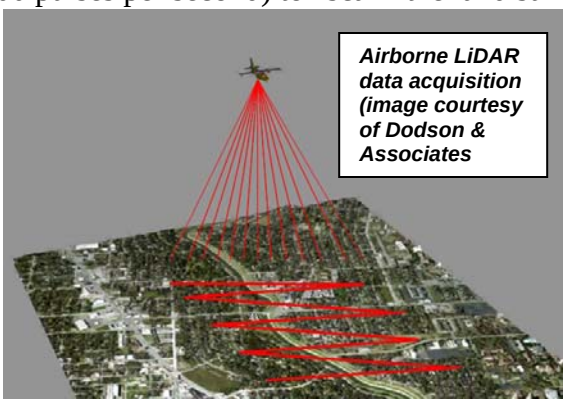
AN ENHANCED STATEWIDE ELEVATION DATASET FOR NEW HAMPSHIRE: THE CASE FOR LIDAR

The NH Geographic Information System (GIS) Strategic Plan identifies the need to develop statewide high-quality topographic data to replace the existing mixed resolution data for NH (statewide 30-meter and partial 10-meter digital elevation models) available as part of the US Geological Survey (USGS) National Elevation Dataset. The cost associated with a project of this scope together with the recognition that a variety of GIS users have the potential to benefit significantly from the availability of an enhanced topographic dataset, suggest that a number of funding partners should be engaged in any development effort. Perhaps the most critical use of these data has been highlighted by recent flooding events in the state. A recently published report by the National Academy of Sciences (*Elevation Data for Floodplain Mapping, 2007*) (http://www.nap.edu/catalog.php?record_id=11829 – Hidden) points out the deficiencies of available land surface elevation data to support modernization of floodplain maps under the National Flood Insurance Program administered by the Federal Emergency Management Agency (FEMA). The report states that "FEMA needs land surface elevation data that are about ten times more accurate than data currently available for most of the nation."

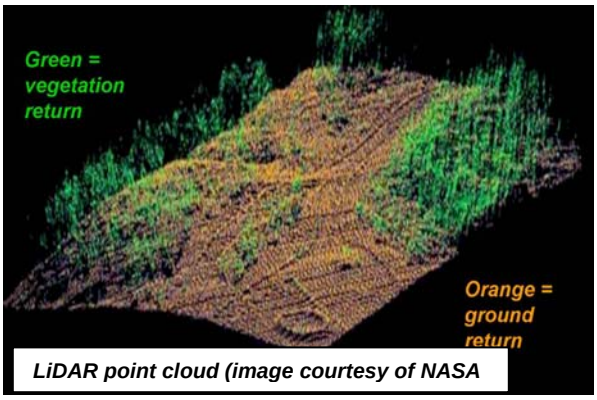


Status of digital elevation model (DEM) data in New Hampshire, 2007

Airborne LiDAR (Light Detection And Ranging) technology is recommended as the preferred method for acquiring data of sufficient accuracy and resolution. This method uses laser pulses (between 5,000 and 50,000 pulses per second) to "scan" the land surface. The LiDAR sensor detects the travel time of reflected



Airborne LiDAR data acquisition (image courtesy of Dodson & Associates



LiDAR point cloud (image courtesy of NASA

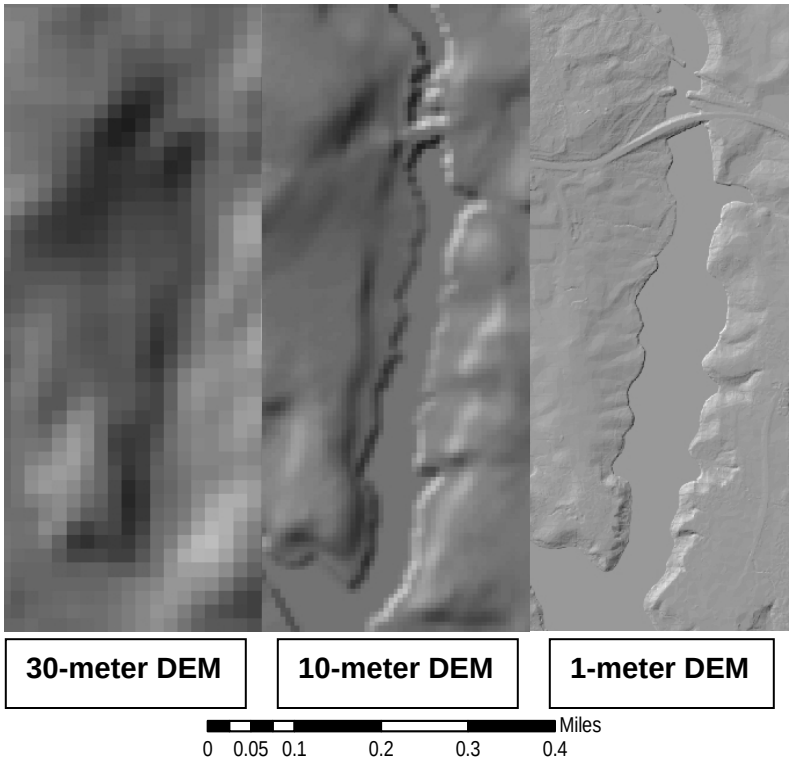
energy from each pulse, including a 'first return" for the first reflective surface in its path, but also potentially records multiple returns as the light beam penetrates to different "soft" surfaces at lower levels within a vegetated area. Post-processing of the collected data is then performed to extract a bare earth terrain model, but also can be used to derive vegetation characteristics (such as forest canopy height and density) and/or to extract structural features within the built environment.

As the availability of LiDAR data has increased through statewide initiatives (i.e. North Carolina, New Jersey, Florida, Pennsylvania, New York) and more localized projects, the number and range of demonstrated uses and experimental applications has grown tremendously. A high-resolution bare-earth digital elevation model (DEM) supports the detailed classification of landforms. These data in turn serve as the framework for ecological and habitat assessments used to prioritize land conservation and restoration efforts, but also enable geologic hazards, such as potential landslides, to be mapped. Many of the uses are

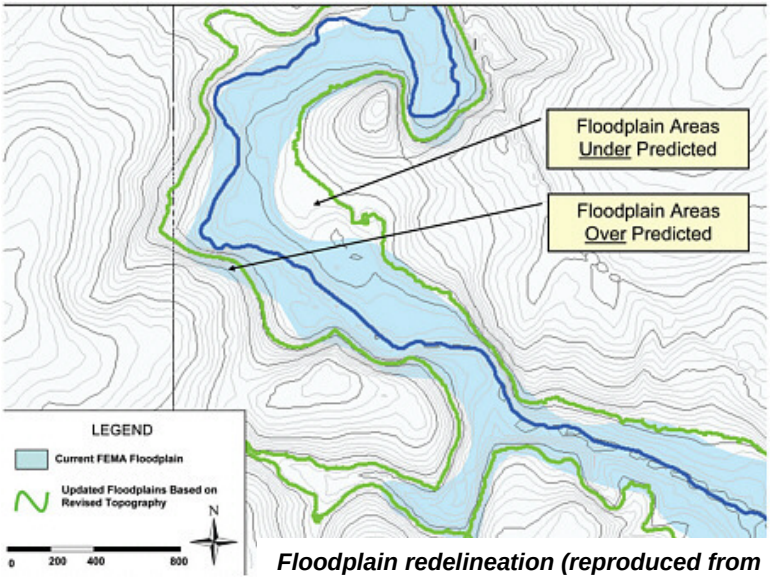
focused on activities related to the assessment and management of water resources, such as watershed delineation, floodplain mapping, stormwater management, water quantity and quality modeling within watersheds, land cover/ land use mapping, etc. Other potential applications exist in the areas of transportation, forestry, agriculture, and emergency management.

The NH GIS Strategic Plan also identifies a critical need for statewide high resolution orthoimagery, with repeat coverage at some specified time interval in order to enable changes in land use/land cover to be monitored. An accurate digital terrain model (DTM) is required to orthorectify the original aerial photographs so that the resulting imagery can support detailed spatial analyses. Although this process can be performed with elevation data that have been derived photogrammetrically, a DTM created from LiDAR has the potential to support additional applications that benefit from higher resolution elevation data. Therefore, a certain economy could be realized by investing in LiDAR data as an integral part of any program to acquire high resolution orthoimagery. Because of this potential to achieve mutual benefits, advocates for developing one dataset might be enlisted to promote development of the other dataset.

Comparison of terrain models for Fresh Creek, Strafford County, NH: NED 30-meter and 10-meter DEMs versus 1-meter LiDAR



While FEMA clearly is an important stakeholder given the utility of LiDAR for updating and refining flood hazard maps, other significant interests could be served through a cost-sharing data development initiative. The "Elevation for the Nation" (http://lidar.cr.usgs.gov/downloadfile.php?file=Harding_Elev4Nation_2-15-07_small.pdf) initiative recently unveiled by the USGS is evidence of the overall importance and broad applicability of this dataset. This announcement identifies USGS as a prime advocate for a statewide LiDAR project, if not as a potential funding partner. Funding should also be solicited from other entities that would benefit directly from such a project, assuming that data acquisition and processing could be specified and coordinated in order to meet their needs.



Floodplain redelineation (reproduced from the National Academies Press, 2007)

The following summary of organizations and some of their related business needs is intended as a starting point for building the necessary partnerships:

- U.S. Environmental Protection Agency – enhanced terrain data should improve the accuracy of watershed models used to assess total maximum daily loads by better defining flow pathways across the landscape.

- U.S. Forest Service – multiple return data from LiDAR surveys can be used to determine tree canopy height and stand density (or total biomass) and also support fire fuel mapping; bare earth digital terrain models can assist with the layout of road networks for timber harvests.

- Natural Resources Conservation Service – detailed topographic data are useful for high intensity soil surveys and for designing erosion control structures or defining best management practices for minimizing erosion.

- National Oceanic and Atmospheric Administration – storm surge modeling to mitigate flood inundation and coastal erosion hazards; shoreline delineation and monitoring of sea-level rise.

- NH Department of Transportation – design of new roads and stormwater drainage systems; improved estimation of volumes of material involved in cut and fill operations.

- Various state agencies and private non-profit organizations whose mission involves environmental conservation and resource management.

- Private sector telecommunications companies – siting of cell towers to minimize gaps in coverage due to interferences from terrain and trees depend on highly accurate terrain models and forest land cover assessments.

- Private sector wind energy producers – siting of wind turbines to maximize exposure.