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The 3D Elevation Program—Summary for Nevada

Introduction

Elevation data are essential to a broad range of applications, including forest resources management, wildlife and habitat management, national security, recreation, and many others. For the State of Nevada, elevation data are critical for infrastructure and construction management, natural resources conservation, flood risk management, geologic resource assessment and hazard mitigation, agriculture and precision farming, and other business uses. Today, high-density light detection and ranging (lidar) data are the primary sources for deriving elevation models and other datasets. Federal, State, Tribal, and local agencies work in partnership to (1) replace data that are older and of lower quality and (2) provide coverage where publicly accessible data do not exist. A joint goal of State and Federal partners is to acquire consistent, statewide coverage to support existing and emerging applications enabled by lidar data.

The National Enhanced Elevation Assessment (NEEA; Dewberry, 2011) evaluated multiple elevation data acquisition options to determine the optimal data quality and data replacement cycle relative to cost to meet the identified requirements of the user community. The evaluation demonstrated that lidar acquisition at quality level 2 (table 1) for the conterminous United States and quality level 5 interferometric synthetic aperture radar (ifsar) data (table 1) for Alaska with a 6- to 10-year acquisition cycle provided the highest benefit/cost ratios. The 3D Elevation Program (3DEP) initiative (Snyder, 2012a,b) selected an 8-year acquisition cycle for the respective quality levels. 3DEP, managed by the U.S. Geological Survey (USGS), the Office of Management and Budget Circular A–16 lead agency for terrestrial elevation data, responds to the growing need for high-quality topographic data and a wide range of other 3D representations of the Nation's natural and constructed features.

3DEP in Nevada by the Numbers

Expected annual benefits	$11.41 million
Estimated total cost	$36.95 million
Payback	3.2 years
Quality level 1 buy-up estimate	$23.51 million

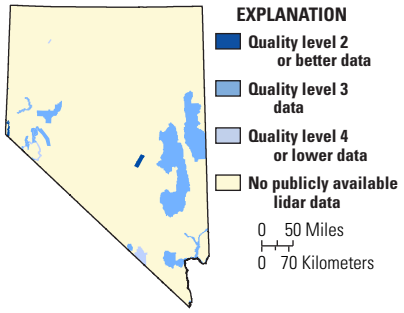

Figure 1. Map of Nevada showing publicly available lidar data. Information source is the United States Interagency Elevation Inventory, March 2015 (http://coast.noaa.gov/inventory/?redirect=301ocm#), which is updated annually. Quality level 2 or better data meet 3DEP requirements. See table 1 for quality level information.

3D Elevation Program Benefits for Nevada

The top 10 Nevada business uses for 3D elevation data, which are based on the estimated annual conservative benefits of the 3DEP initiative, are shown in table 2. The NEEA survey respondents in the State of Nevada estimated that the national 3DEP initiative would result in at least $11.4 million in new benefits annually to the State. The cost for such a program in Nevada is approximately $37 million, resulting in a payback period of 3.2 years and a benefit/cost ratio of 2.5 to 1 over an 8-year period. Because monetary estimates were not provided for all reported benefits, the total benefits of the 3DEP to Nevada are likely much higher. On the basis of the NEEA survey results, all levels of government and many organizations in Nevada could benefit from access to statewide high-resolution elevation data.

For Nevada, approximately 82 percent of the identified business use requirements will be met in infrastructure and construction management and natural resources conservation uses, as shown in table 2. The status of publicly available lidar data in Nevada is shown in figure 1. By enhancing coordination between 3DEP and various government and private organizations in Nevada, it may be possible to realize more than the cited conservative benefits and attain the higher potential benefits for many business uses.

The following examples highlight how 3DEP data can support business uses

3D Elevation Program

3DEP is a national program managed by the USGS to acquire high-resolution elevation data. The initiative is backed by a comprehensive assessment of requirements (Dewberry, 2011) and is in the early stages of implementation. 3DEP will improve data accuracy and provide more current data than is available in the National Elevation Dataset (NED). The goal of this high-priority cooperative program is to have complete coverage of the United States by the end of 2022, depending on funding and partnerships. 3DEP can conservatively provide new benefits of $1.2 billion/year and has the potential to generate $13 billion/year in new benefits through improved government services, reductions in crop and homeowner losses resulting from floods, more efficient routing of vehicles, and a host of other government, corporate, and citizen activities (Dewberry, 2011). A shared, common elevation dataset would foster cooperation and improve decision-making among all levels of government and other stakeholders.

Benefits of a Funded National Program

- Economy of scale—Acquisition of data covering larger areas reduces costs by 25 percent.
- A systematic plan—Acquisition of data at a higher quality level reduces the cost of "buying up" to the highest levels needed by State and local governments.
- Higher quality data and national coverage—Ensure consistency for applications that span State and watershed boundaries and meet more needs, which results in increased benefits to citizens.
- Increase in Federal agency contributions—Reduces State and local partner contributions.
- Acquisition assistance—Provided through readily available contracts and published acquisition specifications.

in Nevada: (1) Enhanced elevation data would enable State, regional, and local governments to more effectively implement natural resources conservation practices such as habitat easements and restoration, wetland restoration, grade stabilization, dam safety, pipeline routing, wildland fire modeling, preservation of cultural resources, and vegetation surveys at a significant cost savings to the public. (2) Enhanced elevation data are used to support geologic mapping by the Nevada Bureau of Mines and Geology and the Nevada Division of Minerals. Lidar data facilitate a higher resolution delineation of the bedrock and surficial geology critical for the assessment of natural resources and hazards. Although Nevada is the third most seismically active State in the country, the number and location of active faults are not completely identified. Lidar is an ideal tool for finding and characterizing young faults (fig. 2). Geologic mapping with an emphasis on characterizing Nevada's natural resources, including geothermal energy and mineral deposits, can be performed more efficiently and accurately using enhanced elevation data derived from lidar. (3) Flooding, particularly flash floods from summer monsoonal thunderstorms, poses a significant hazard in the urbanized areas of the State, with a considerable loss of natural resources, life, and property in recent decades. Detailed mapping using a combination of aerial imagery and lidar will allow for a detailed analysis of flood hazards and provide critical data needed to mitigate the impacts of future floods.

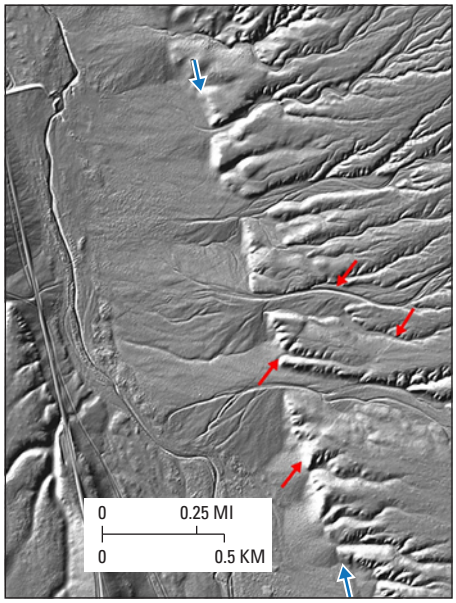

Figure 2. Active fault trace in Dixie Valley, Nevada, showing location of the 1954 earthquake and surface ruptures. The red arrows point to scarps, unrecognized prior to lidar availability, that are likely from the 1954 earthquake. Blue arrows point toward the Quaternary fault trace, which did not rupture in 1954. Lidar in conjunction with geologic mapping facilitates the identification of active faults and provides important data on the location, geometry, magnitude, and recurrence of past surface rupturing earthquakes. Lidar image courtesy of Nevada Bureau of Mines and Geology.

References Cited

Dewberry, 2011, Final report of the National Enhanced Elevation Assessment (revised 2012): Fairfax, Va., Dewberry, 84 p. plus appendixes, http://www.dewberry.com/Consultants/GeospatialMapping/FinalReport-NationalEnhancedElevationAssessment.

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Table 2. Conservative benefits estimates for the top 10 business uses of the proposed 3DEP data identified in the National Enhanced Elevation Assessment for Nevada (Dewberry, 2011).

Rank	Business use	Annual benefits (millions)
1	Infrastructure and construction management	$7.78
2	Natural resources conservation	1.52
3	Flood risk management	0.75
4	Geologic resource assessment and hazard mitigation	0.68
5	Agriculture and precision farming	0.23
6	Forest resources management	0.15
7	Renewable energy resources	0.12
8	Water supply and quality	0.06
9	River and stream resource management	0.05
10	Aviation navigation and safety	0.05
	Other	0.02
	Total	11.41

3D Elevation Program—Continued

The USGS and its partners will acquire quality level 2 or better (table 1) 3D lidar data over the conterminous United States, Hawaii, and the U.S. territories. Interferometric synthetic aperture radar (ifsar) data are being collected at quality level 5 (table 1) in Alaska. The data will be acquired over an 8-year period and will be made available to the public. By using this acquisition scenario a number of high-quality elevation-data products can be created to serve a wide range of business uses in government and the private sector.

Table 1. Data quality levels and related accuracies for the 3D Elevation Program (3DEP) initiative as provided on page 6 in USGS Circular 1399 (http://dx.doi.org/10.3133/cir1399). These data quality parameters for the 3DEP initiative approximate those used in the National Enhanced Elevation Assessment (Dewberry, 2011).

[$RMSE_{(z)}$, root mean square error in the z (elevation) dimension; n/a, not applicable]

Quality level	Nominal pulse spacing (meters)	Vertical error as $RMSE_{(z)}$ (centimeters)
1	0.35	10
2	0.7	10
3	1.4	20
4	n/a	139
5	n/a	185

Next Steps for Implementing 3DEP

Accomplishing the 3DEP initiative's goal of national coverage in 8 years depends on the following factors:

- Increased partnerships among Federal, State, Tribal, and local governments.
- Partnerships that acquire elevation data to the program's specifications across larger project areas.
- Increased communication about and awareness of the program's benefits and goals.
- Support for the program from government and other stakeholders.

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