



# Integrating Multi-Resolution Lidar-derived DEMs into the National Elevation Dataset

**Presented by:**

**Lori Phillips - USGS**

**Co-authors:**

**Karen Adkins, PMP - ATA Services, Inc. under contract to the U.S.  
Geological Survey**

**Dr. Samantha Arundel - USGS**

# Overview

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- **The National Elevation Dataset (NED)**
- **High-resolution data and the NED**
- **NED processing changes**
- **The Toolkit: Lev8**
- **Future of the NED**

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# THE NATIONAL ELEVATION DATASET

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# The NED

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- **USGS raster product**
    - National – conterminous U.S., AK, HI, PR, U.S. Territorial Islands
    - Mexico, Canada (partial coverage)
  - **Consistent**
    - Seamless products over very large areas
    - Consistent datum, elevation units, coordinate reference system
  - **Trusted source for elevation data**
    - Used by many for wide range of purposes
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# The NED

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- **Seamless**

- 1/3 arc-second (~10m)
- 1 arc-second (~30m)
- 2 arc-second (~60m, Alaska)
- 1 degree block tile in GRID, GRIDFLOAT and IMG format

- **Project-based**

- 1/9 arc-second (~3m)
  - May have overlapping projects/tiles
  - 15'x15' tile in IMG format
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# HIGH-RESOLUTION DATA AND THE NED

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# Source data for the NED

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- **Historic source**
  - **DEMs produced from 1:24K cartographic contours**
    - predominant source (1/3, 1 and 2 arc-second)
    - Error introduced through production of topographic maps, DEMs
- **Other source DEMs**
  - **Photogrammetrically-derived**
    - Various resolutions
  - **SRTM**
    - 1 arc-second, Aleutian Islands

# Source data for the NED

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- **Newer source digital elevation models (DEMs)**
    - **Lidar**
      - Geospatial Products and Services Contract, partner, contributed
      - Various resolutions including sub-meter
    - **Ifsar**
      - Alaska Statewide Digital Mapping Initiative
      - 5 meter
    - **Bathymetric data**
      - Lidar, sonar, other collection methods
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# Improved Source

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- **New sensors**
  - Direct observation of true ground elevation
  - Producing DEMs from true ground elevation
- **Better processing methods**
  - Lower error introduced – direct import of DEMs
  - Comparison with point cloud
- **Lidar Base Specification v1.1**
  - New quality targets

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# NED PROCESSING CHANGES

# Volume

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- **FY14**
  - ~98K square miles in-house for QA
  - ~49K square miles in editing queue
  - ~47K square miles upcoming projects
    - 20K square miles proposed
- **More coming...**
  - 3DEP - 2TB per 1,000 square miles for Quality Level 2 data (nominal 0.7 points per meter)
  - Alaska Ifsar - collection through 2016

# NED Processing System

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- Update to support high volume of high-resolution data from 3DEP
  - Centralized storage & servers
  - Increased automation
- Improved tools
  - Custom off-the-shelf software (COTS)
  - Custom development to support

# Data Management & Distribution

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- **Centralized cataloguing for distributed products**
  - USGS data catalog
- **Project tracking from acquisition through distribution**
  - **Project Tracking System (PTS)**
  - **System communicates with internal PTS & distribution**

# Challenges

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- **New system & process**
  - Not starting with existing tools – total redesign
  - New development & testing
- **Implementation timeline**
  - NED and source resolution by 4/1/14
  - No impact to user - transparent

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# THE TOOLKIT: LEV8

# Design

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- **Software**
    - ArcGIS for Desktop 10.1
    - ArcGIS for Server 10.1
    - ArcGIS Workflow Manager (WMX) 10.1
    - ArcSDE (mosaic dataset database)
  - **Data management**
    - Mosaic dataset (not ArcSDE raster)
  - **Tracking**
    - PTS – project level tracking
    - WMX – job level tracking
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# Mosaic Datasets

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- Esri's geodatabase data model for managing raster data
  - Centralizes user access
- Catalog of raster datasets of various resolutions
  - Source Mosaic Dataset
  - Master Mosaic Dataset

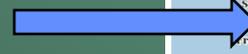
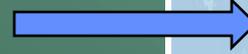
# Workflow Manager

- Control steps for processing
- Communication with PTS

Conveyance - Received data

Featherweight - NED Processing Complete

Transformer - NED Release to Public



USGS Home  
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Product Tracking System (PTS)

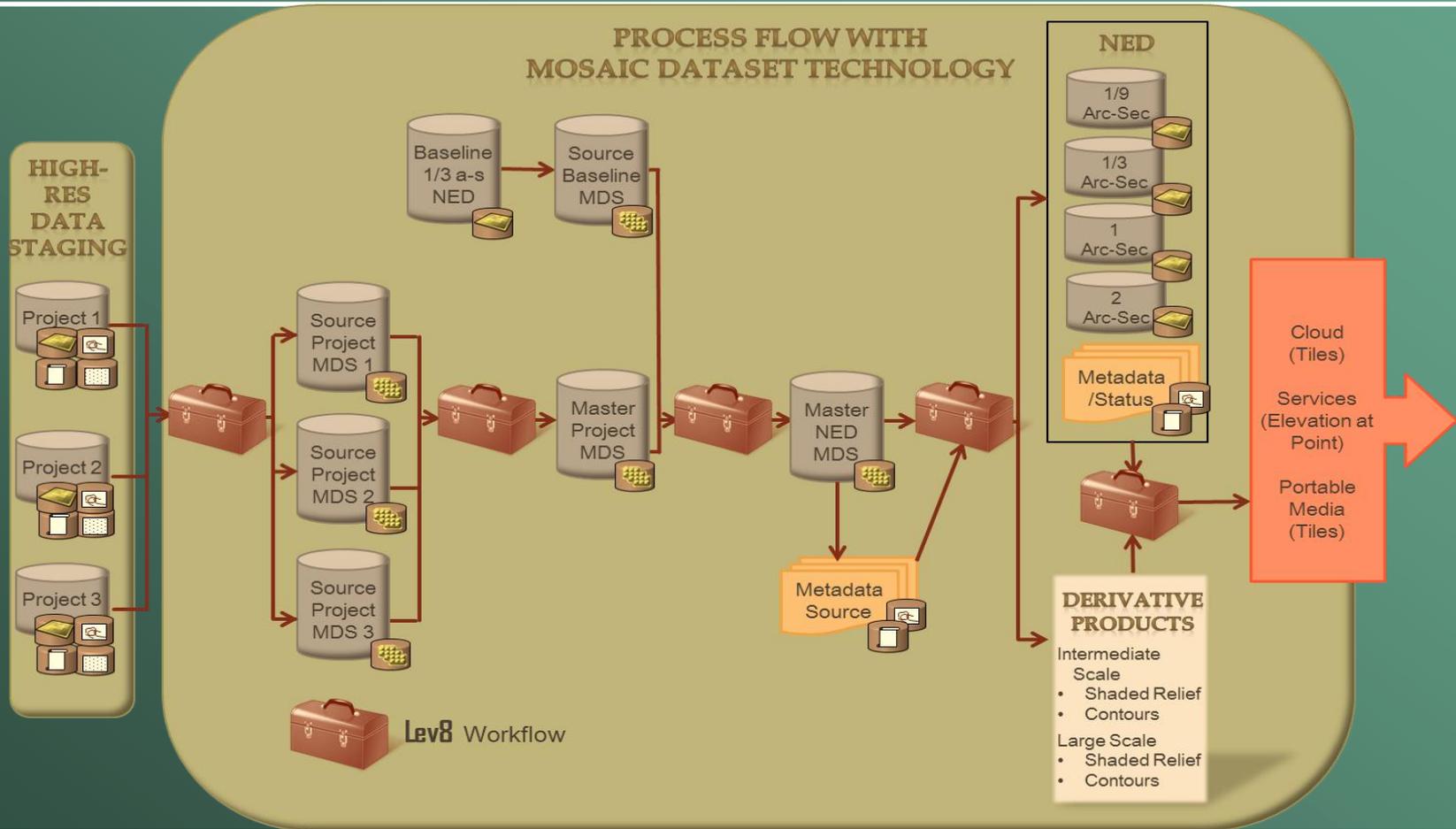
HOME QUERIES CREATE ADMIN

USGS Product Tracking System (PTS)

Search Advanced

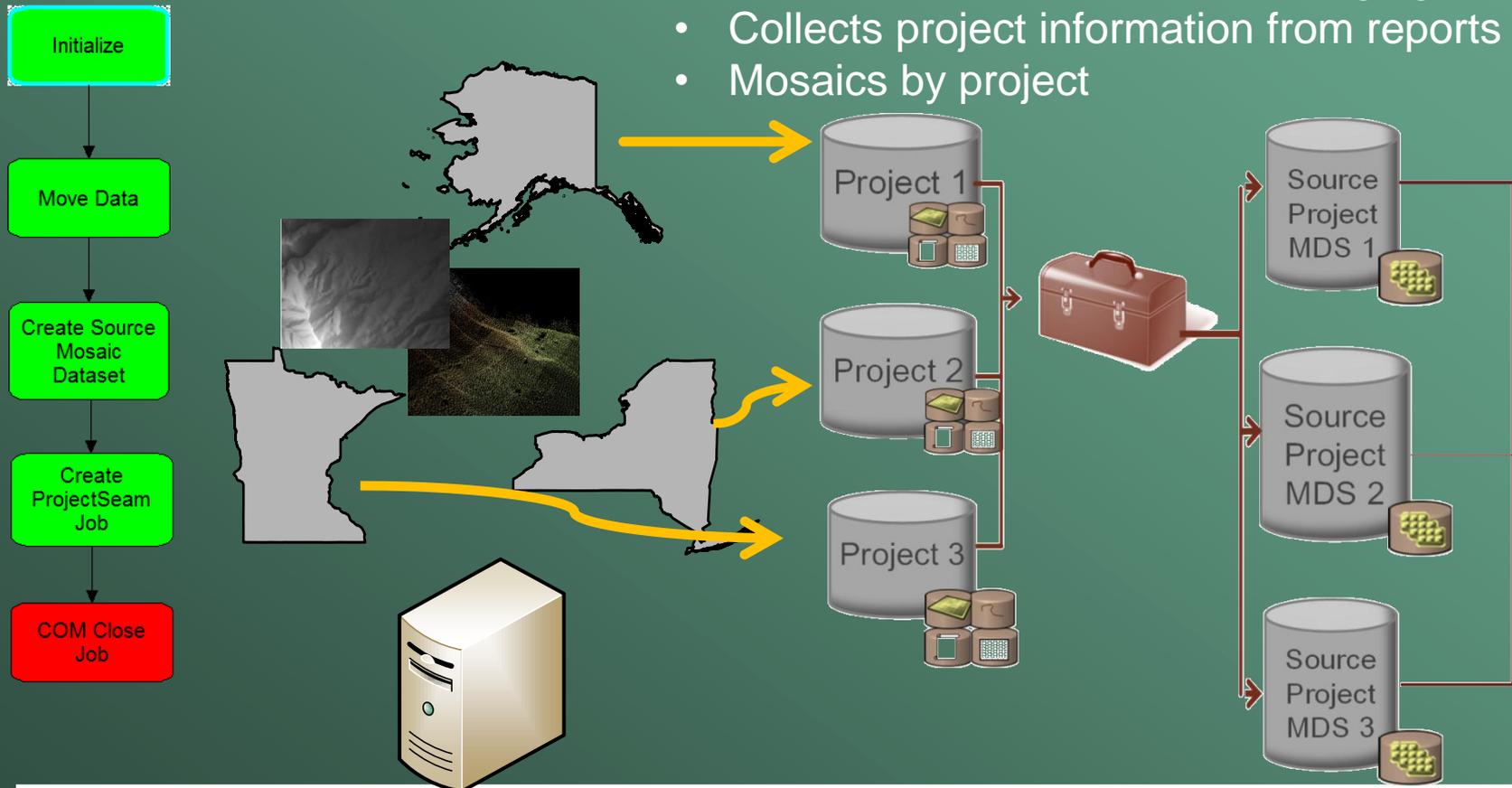
PTS v1.4.3

# Lev8



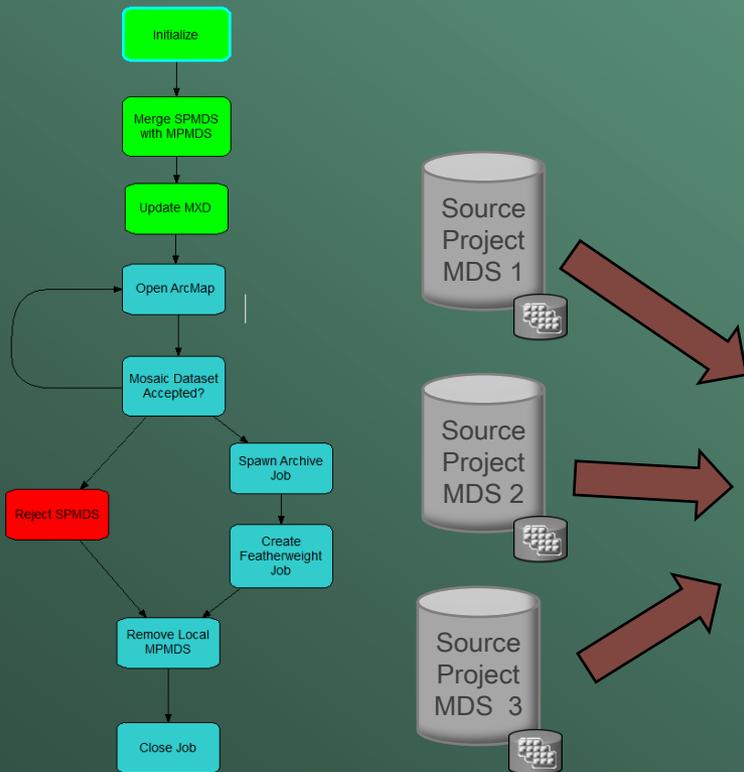
# Conveyance

- Moves data from QA to Lev8 staging
- Collects project information from reports
- Mosaics by project

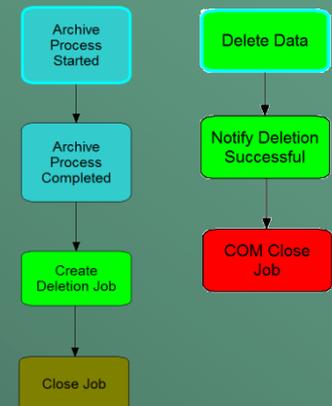


# ProjectSeam

- SPMDS merged with MPMDS
- First round review – accept/reject
- Editor can change variables for sorting

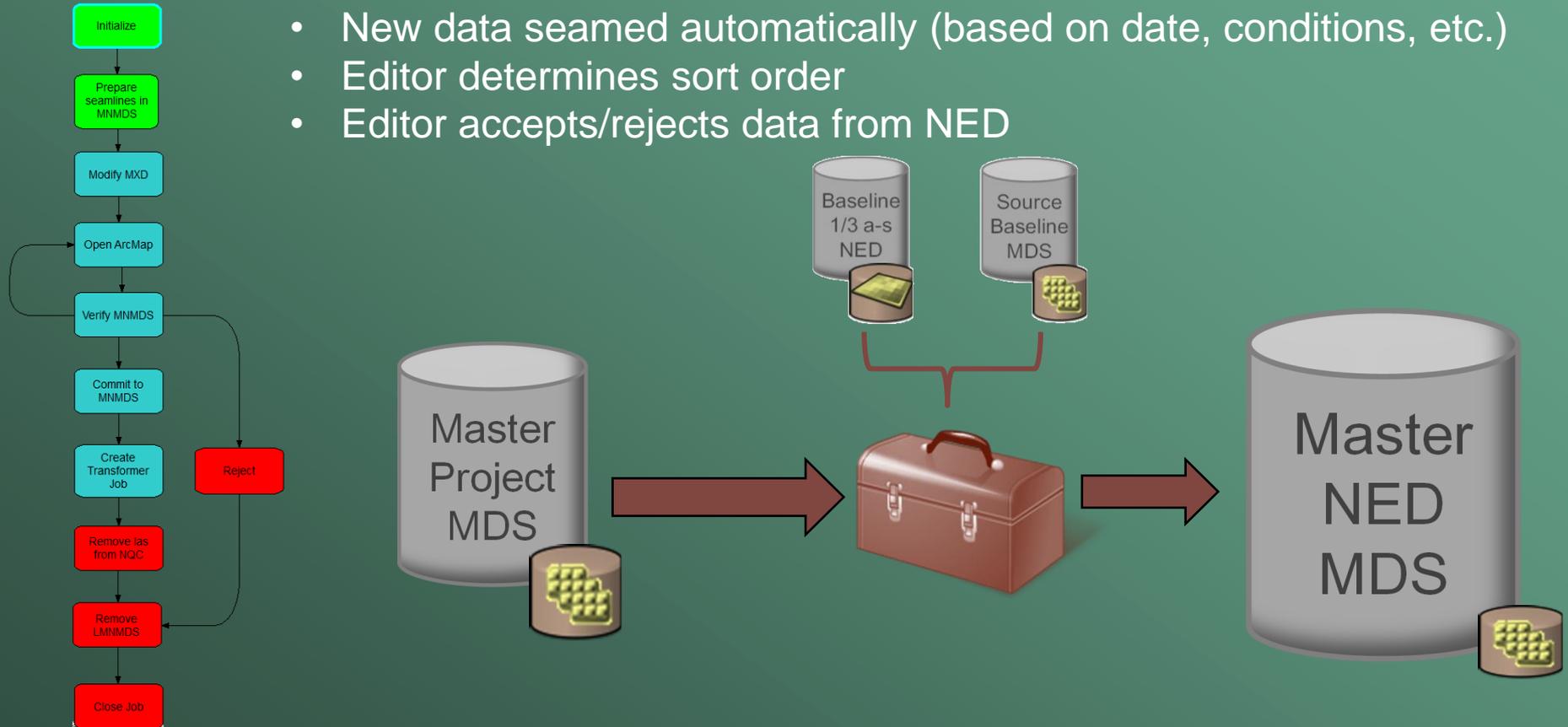


## Background processes

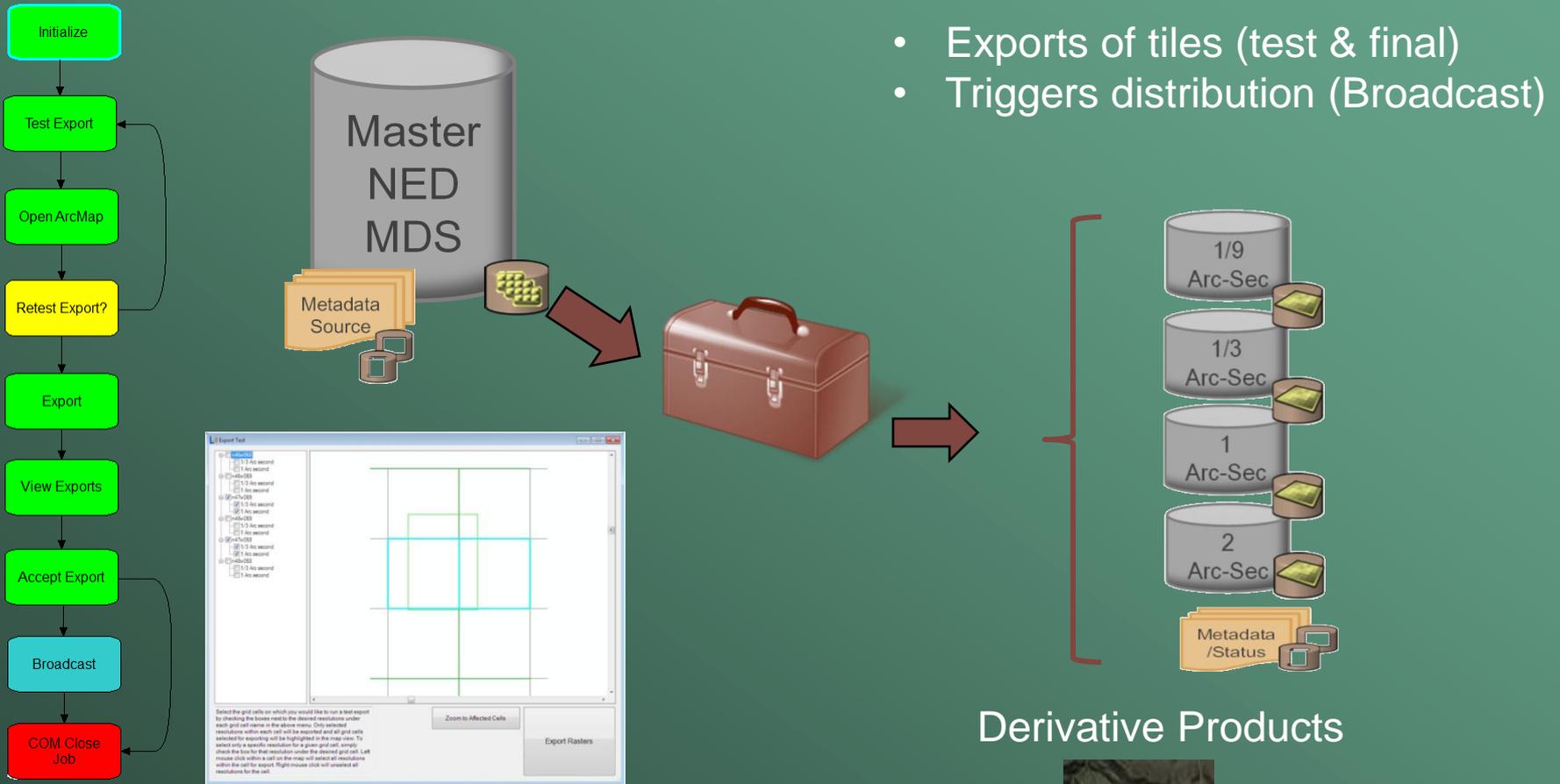


# Featherweight

- New data seamed automatically (based on date, conditions, etc.)
- Editor determines sort order
- Editor accepts/rejects data from NED

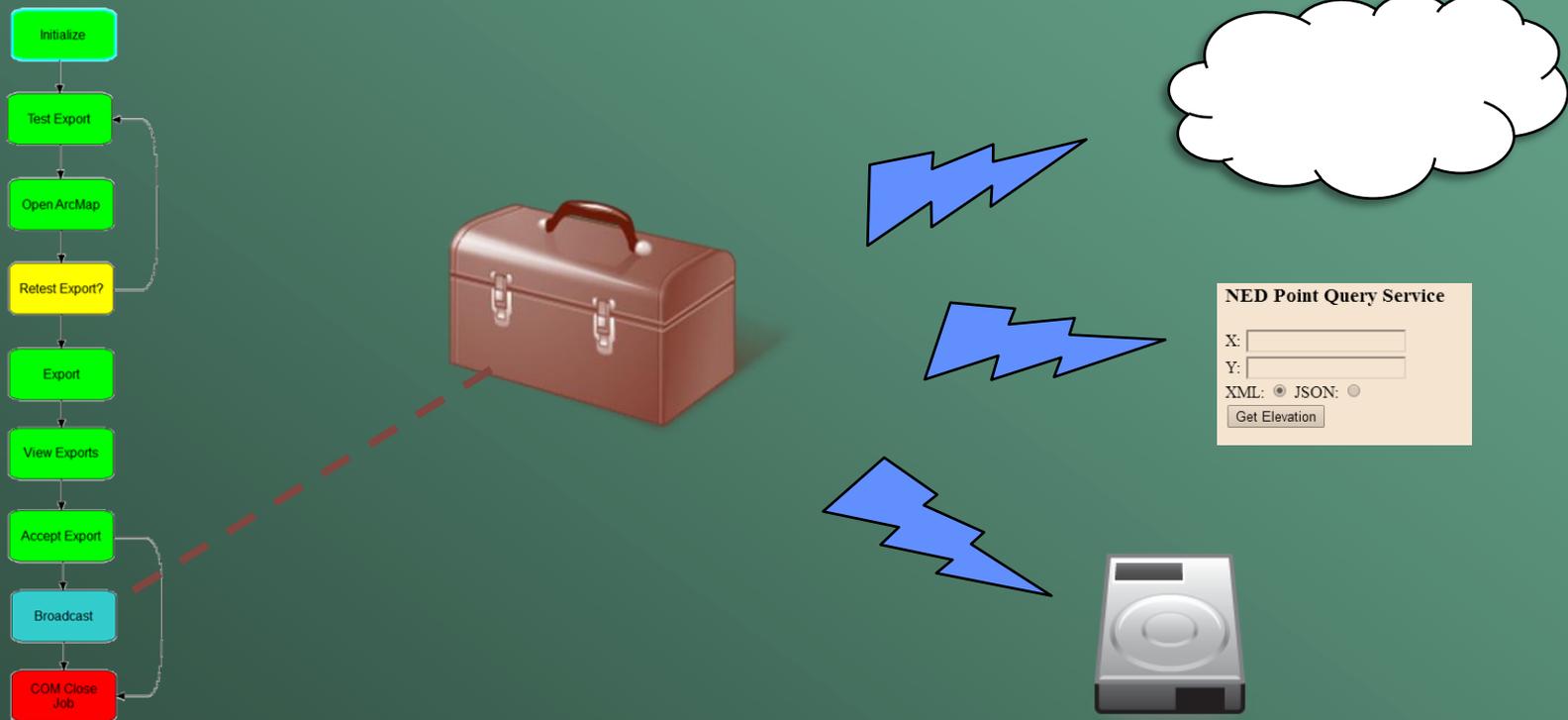


# Transformer



# Broadcast

No separate workflow - single step in Transformer



# Increased Accessibility

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- **Metadata modifications**
  - **Conformance to FGDC standard**
  - **Conformance to Exec. Order for Open and Machine Readable Information**
  - **Required for ScienceBase query and download**
  - **Automated Visualization Services**

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# FUTURE OF THE NED IN LIGHT OF 3DEP

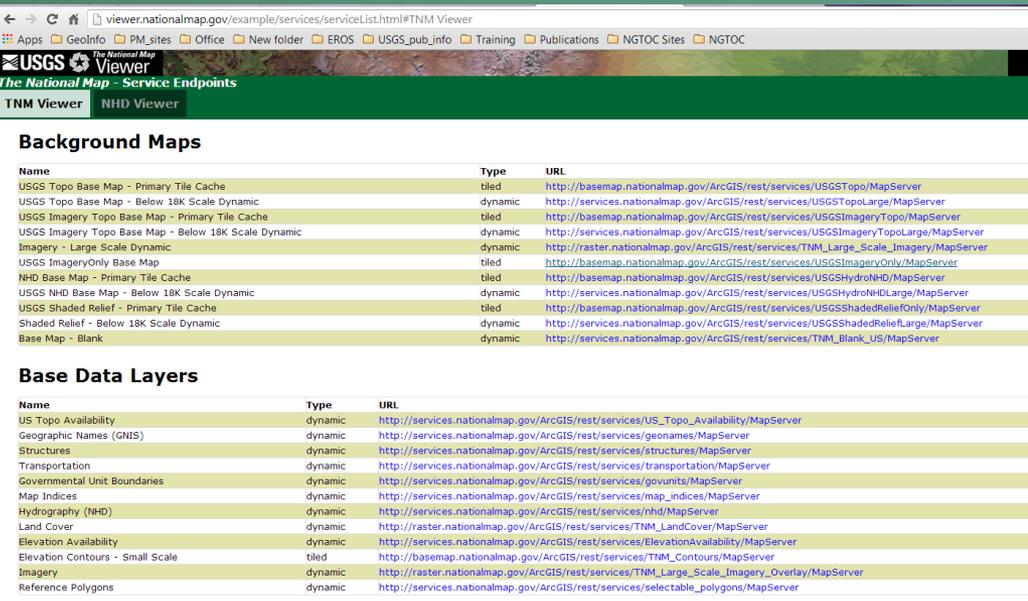
# Process Improvements

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- Lev8 supports processing growth
  - Multi-operator access
  - Concurrent production
- Upgrades
  - Automate/streamline review tools – incorporate feedback from editors
  - Migrate to 10.2

# User Experience

- Continual updates
  - Staff to support increase flow of source for the NED
- Online visualization and access
  - Point query service
  - Web map & feature services
  - Cloud distribution
- Original resolution



The screenshot shows the USGS TNM Viewer interface. The browser address bar displays the URL: viewer.nationalmap.gov/example/services/serviceList.html#TNM Viewer. The page title is "The National Map - Service Endpoints". Below the title, there are two tabs: "TNM Viewer" (selected) and "NHD Viewer". The main content area is divided into two sections: "Background Maps" and "Base Data Layers".

Name	Type	URL
USGS Topo Base Map - Primary Tile Cache	tiled	http://basemap.nationalmap.gov/ArcGIS/rest/services/USGSTopo/MapServer
USGS Topo Base Map - Below 18K Scale Dynamic	dynamic	http://services.nationalmap.gov/ArcGIS/rest/services/USGSTopoLarge/MapServer
USGS Imagery Topo Base Map - Primary Tile Cache	tiled	http://basemap.nationalmap.gov/ArcGIS/rest/services/USGSImageryTopo/MapServer
USGS Imagery Topo Base Map - Below 18K Scale Dynamic	dynamic	http://services.nationalmap.gov/ArcGIS/rest/services/USGSImageryTopoLarge/MapServer
USGS Imagery - Large Scale Dynamic	dynamic	http://raster.nationalmap.gov/ArcGIS/rest/services/TNM_Large_Scale_Imagery/MapServer
USGS ImageryOnly Base Map	tiled	http://basemap.nationalmap.gov/ArcGIS/rest/services/USGSImageryOnly/MapServer
NHD Base Map - Primary Tile Cache	tiled	http://basemap.nationalmap.gov/ArcGIS/rest/services/USGSHydroNHD/MapServer
USGS NHD Base Map - Below 18K Scale Dynamic	dynamic	http://services.nationalmap.gov/ArcGIS/rest/services/USGSHydroNHDLarge/MapServer
USGS Shaded Relief - Primary Tile Cache	tiled	http://basemap.nationalmap.gov/ArcGIS/rest/services/USGSShadedReliefOnly/MapServer
Shaded Relief - Below 18K Scale Dynamic	dynamic	http://services.nationalmap.gov/ArcGIS/rest/services/USGSShadedReliefLarge/MapServer
Base Map - Blank	dynamic	http://services.nationalmap.gov/ArcGIS/rest/services/TNM_Blank_US/MapServer

Name	Type	URL
US Topo Availability	dynamic	http://services.nationalmap.gov/ArcGIS/rest/services/US_Topo_Availability/MapServer
Geographic Names (GNIS)	dynamic	http://services.nationalmap.gov/ArcGIS/rest/services/geonames/MapServer
Structures	dynamic	http://services.nationalmap.gov/ArcGIS/rest/services/structures/MapServer
Transportation	dynamic	http://services.nationalmap.gov/ArcGIS/rest/services/transportation/MapServer
Governmental Unit Boundaries	dynamic	http://services.nationalmap.gov/ArcGIS/rest/services/govunits/MapServer
Map Indices	dynamic	http://services.nationalmap.gov/ArcGIS/rest/services/map_indices/MapServer
Hydrography (NHD)	dynamic	http://services.nationalmap.gov/ArcGIS/rest/services/nhd/MapServer
Land Cover	dynamic	http://raster.nationalmap.gov/ArcGIS/rest/services/TNM_LandCover/MapServer
Elevation Availability	dynamic	http://services.nationalmap.gov/ArcGIS/rest/services/ElevationAvailability/MapServer
Elevation Contours - Small Scale	tiled	http://basemap.nationalmap.gov/ArcGIS/rest/services/TNM_Contours/MapServer
Imagery	dynamic	http://raster.nationalmap.gov/ArcGIS/rest/services/TNM_Large_Scale_Imagery_Overlay/MapServer
Reference Polygons	dynamic	http://services.nationalmap.gov/ArcGIS/rest/services/selectable_polygons/MapServer



# User Experience

The screenshot shows a web browser window displaying the USGS National Elevation Dataset (NED) website. The browser's address bar shows the URL <http://ned.usgs.gov/>. The page features the USGS logo and tagline "science for a changing world" in the top left. A navigation menu on the left includes links for Home, Background, Data, Resources, Publications, and FAQ. The main content area is titled "National Elevation Dataset" and contains a search bar, a descriptive paragraph about the NED, and three images illustrating different elevation data visualizations: a smooth color gradient, a wireframe mesh, and a point cloud. A footer section provides accessibility information, contact details, and the date of the last modification.

**USGS**  
science for a changing world

**National Elevation Dataset**

Home  
Background  
Data  
Resources  
Publications  
FAQ

## National Elevation Dataset

The National Elevation Dataset (NED) is the primary elevation data product of the USGS and serves as the elevation layer of [The National Map](#). The NED provides basic elevation information for earth science studies and mapping applications in the United States. Scientists and resource managers use the NED data for global change research, hydrologic modeling, resource monitoring, mapping, visualization, and many other applications. The NED is updated continually to integrate newly available, improved elevation source data. All NED data are public domain.

The NED is generated at various horizontal resolutions to serve the needs of local, regional and nationwide applications. These various resolutions, referred to as NED layers, are stored and distributed in geographic coordinates at 1/9, 1/3, 1, and 2 seconds of arc. Each of these layers is derived from the highest quality DEMs available in the NED source database for any geographic location within the conterminous United States, Alaska, Hawaii, Puerto Rico, U.S. territorial islands, Mexico and Canada. The extent of geographic coverage varies by layer.

For the latest information on the NED visit our [Highlights](#) page.

Search NED

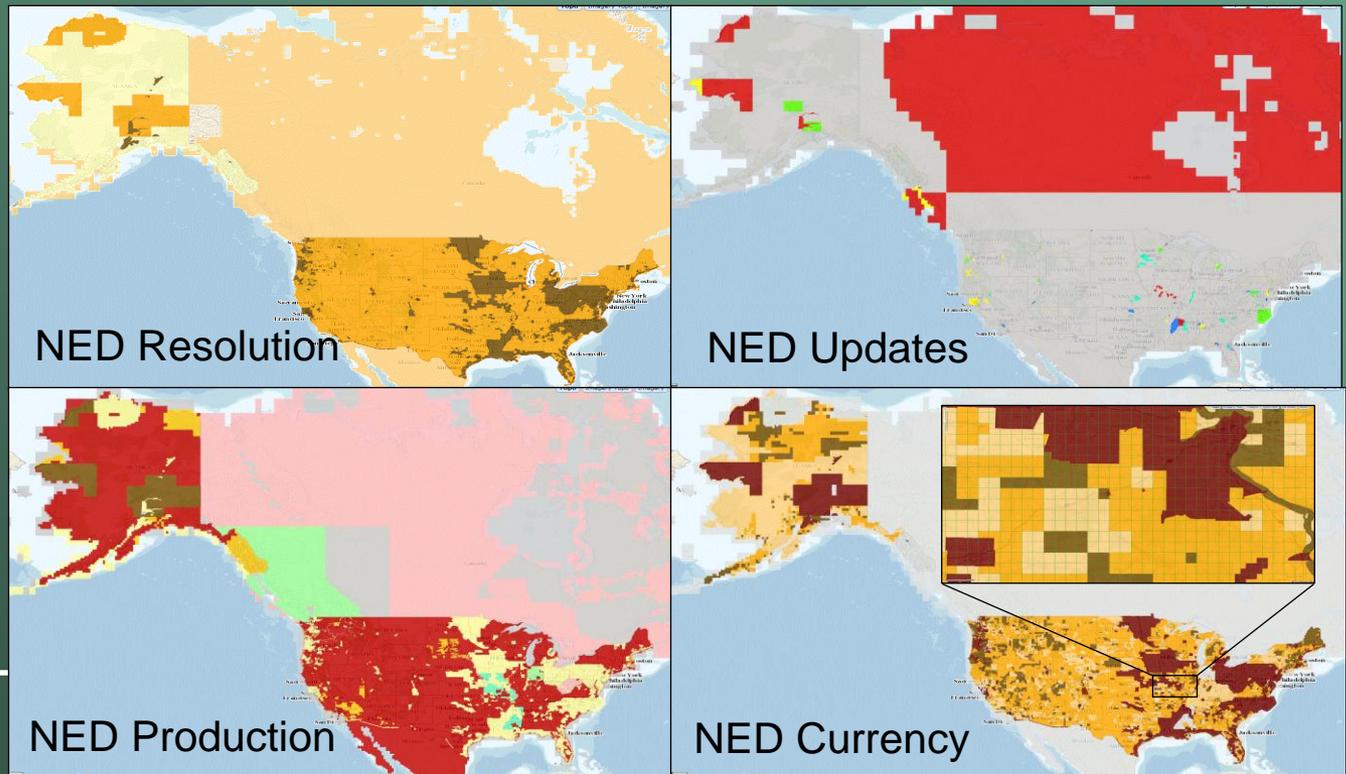
Accessibility FOIA Privacy Policies and Notices

U.S. Department of the Interior | U.S. Geological Survey  
URL: <http://ned.usgs.gov/index.html>  
Questions or Assistance: [Contact USGS](#)  
Last modified: Tuesday, 25-Mar-2014 17:15:19 EDT

USA.gov TAKE PRIDE IN AMERICA

# NED Web Pages - Status Graphics

- NED Status Web page will link to Viewer for display of most current status graphics
  - Status will be automatically updated every two weeks (initially)



# Summary

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The NED processing, data management and product distribution is improving to support the large volume of new high-resolution data that will be generated by 3DEP.



# Questions?

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Karen Adkins

[kadkins@usgs.gov](mailto:kadkins@usgs.gov)

303-202-4394

Sam Arundel

[Sarundel@usgs.gov](mailto:Sarundel@usgs.gov)

573-308-3562

Lori Phillips

[lphillips@usgs.gov](mailto:lphillips@usgs.gov)

573-308-3547

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