Use of LiDAR to Develop Breach Inundation Maps for Watershed Dams

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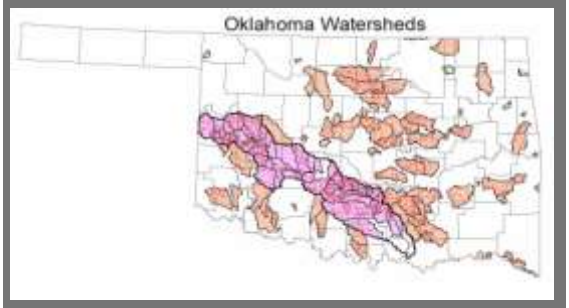
OKLAHOMA CONSERVATION COMMISSION

NRCS Natural Resources Conservation Service

USDA Small Watershed Program has been important to Oklahoma for over 60 years

$83 million in benefits each year



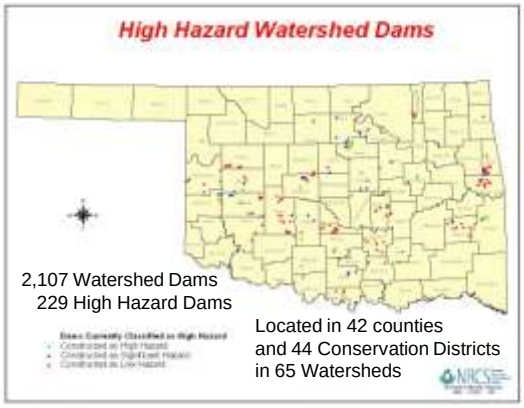
2,107 Dams in 129 Projects
(20% of the national total)

Public Safety Threats

Downstream development has put people in harms way

Watershed Dam Can Fail!

Impacts can be devastating to people, the local economy, and the environment



Watershed Dam Assessment Project

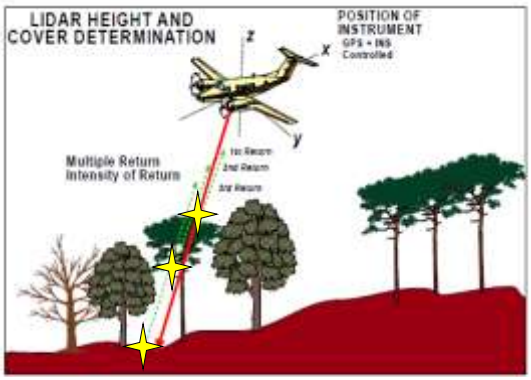
- Assessment of 147 high hazard dams in Oklahoma
- October 1, 2009 – September 30, 2011
- NRCS – OCC agreement
- 26 additional breach maps being prepared in 2012

Breach Analysis

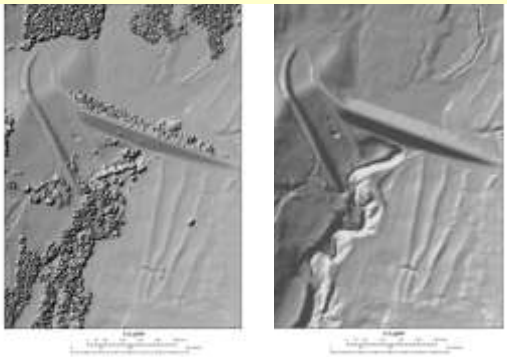
- Verify hazard classification
- Determine area inundated if the dam should fail
- Identify at-risk properties

Utilize : HEC-RAS 4.1
HEC-GeoRAS 4.2
Arcview 9.3
LiDAR

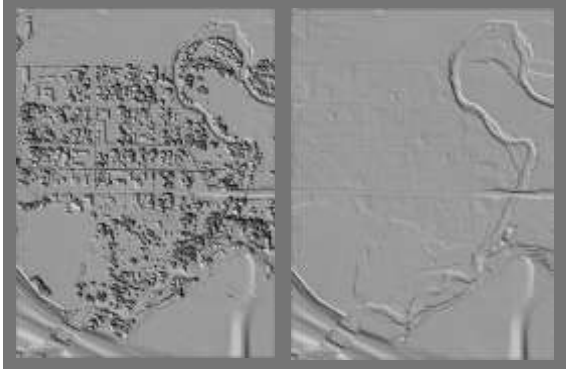
LiDAR – Light Detection And Ranging

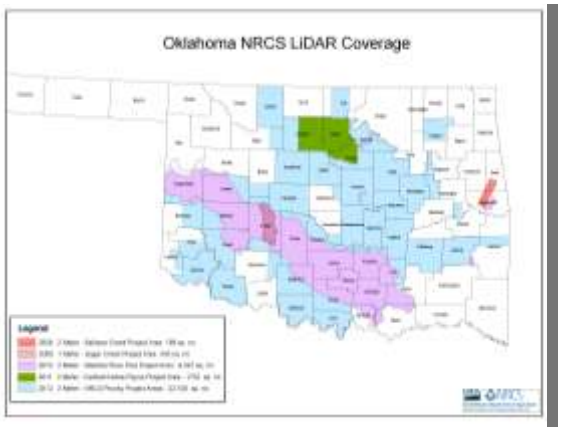


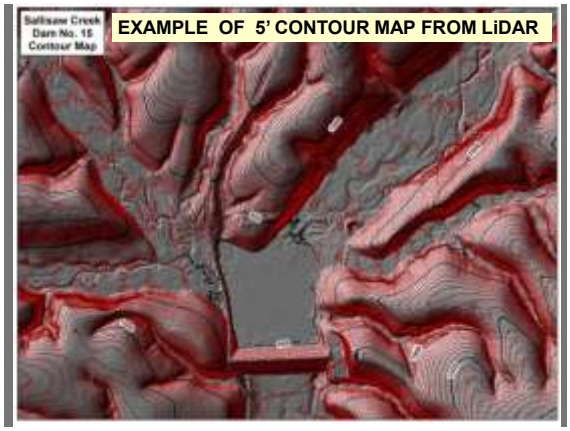
EXAMPLE FROM SALLISAW 2M LiDAR
SHOWING FIRST RETURN Vs BARE EARTH HILLSHADES

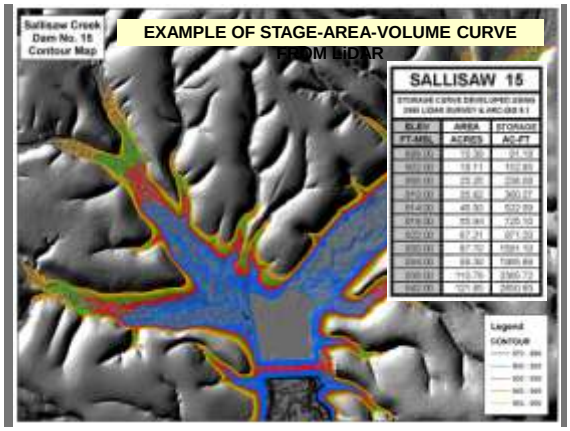


FIRST RETURN Vs BARE EARTH

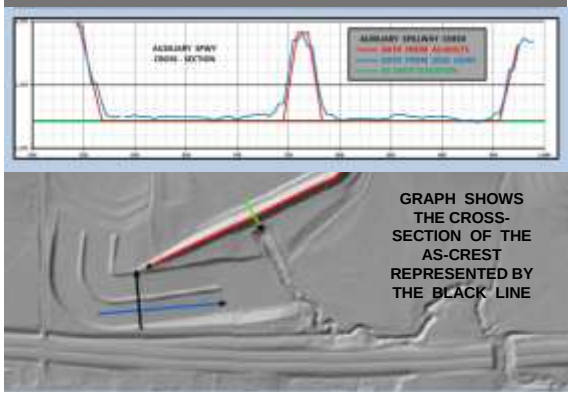






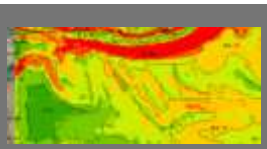


EXAMPLE OF A XS/PROFILE CUT FROM LiDAR

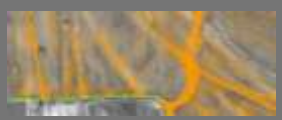


Other LiDAR Data Products

Slope Maps

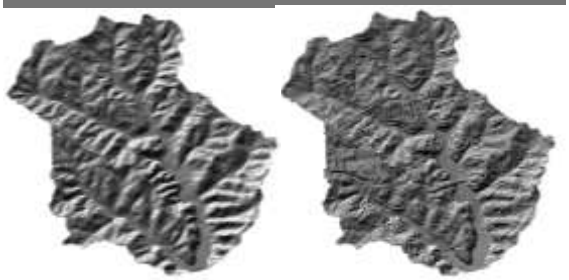


Detailed Contour Maps



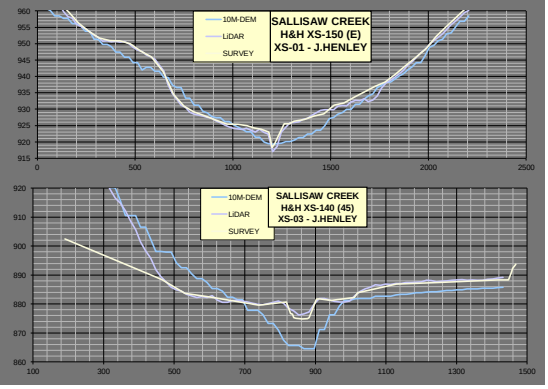
Flow Direction
Flow Accumulation
Catchment Areas
Drainage Patterns

COMPARISON OF 10 METER DEM WITH LiDAR USING ARC-GIS HILLSHADE PRODUCT



10 METER DEM **1 METER LiDAR**

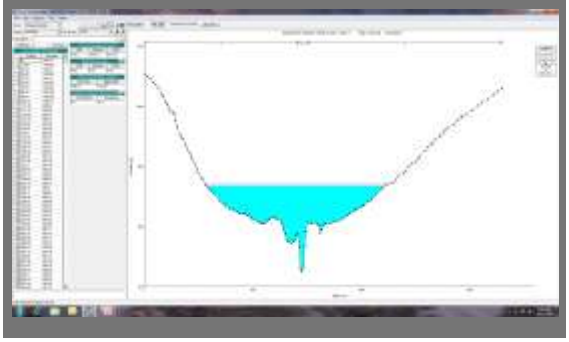
COMPARE XS's: 10M-DEM Vs LiDAR Vs SURVEY



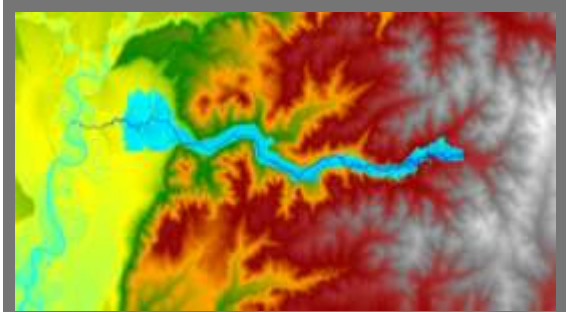
Locate cross-sections
to represent the flood plain

Watershed is modeled using the
best available digital elevation model
(LiDAR or 10 meter DEM)

Complete unsteady flow routing
Review elevation grids



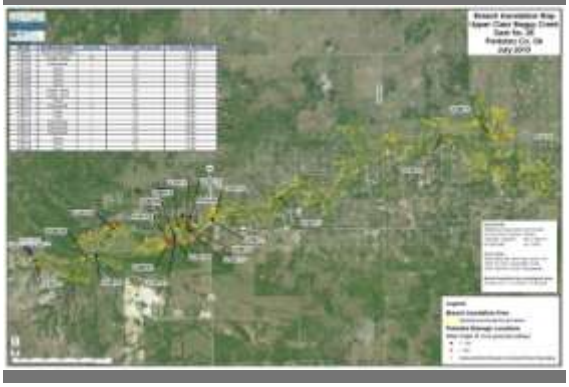
Elevations & inundation depths
Are displayed using RASMapper



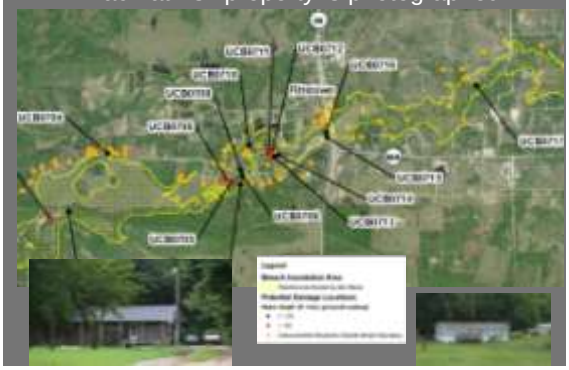
Shape file of the breach inundation area is
superimposed on 2010 aerial photography

Inundation depths can be color coded

At-risk properties are located



At-risk properties inundation depths color coded
Each at-risk property is photographed



At-risk properties with inundation depths are tabulated

PDI_ID	Residence/Business	Structures	Water Depth (ft. from ground)	Time to Peak Flow (hr MM)
UC00703	House-Double Wide	1	1.8	< 00:15
UC00702	Camper Trailer	23	0.8	< 00:15
UC00701	Commercial	1	1.7	< 00:15
UC00704	House	1	3.5	00:17
UC00705	House	1	11.1	00:29
UC00706	House	1	8.2	00:29
UC00707	House	1	3.3	00:26
UC00708	Mobile Home	1	4.9	00:30
UC00709	Mobile Home	1	5.3	00:30
UC00710	House	1	3.7	00:31
UC00711	Commercial	5	0.6	00:32
UC00712	Cabin	1	7.4	00:35
UC00713	Cabin	1	1.6	00:33
UC00714	Commercial	1	2.2	00:34
UC00715	Commercial	1	2.0	00:35
UC00716	Commercial	1	2.0	00:35
UC00717	House	1	1.0	00:44
UC00718	House	1	0.5	01:45
UC00719	House	1	1.4	02:06

Oklahoma "*DamWatch*"

- National Pilot of using "DamWatch" for NRCS-assisted Watershed dams
- NRCS funded – special national allocation
- Why Oklahoma?
  2,107 dams; lots of electronic data
- Contract signed in December 2010
- 2 year duration (adapting screens, loading data, testing)

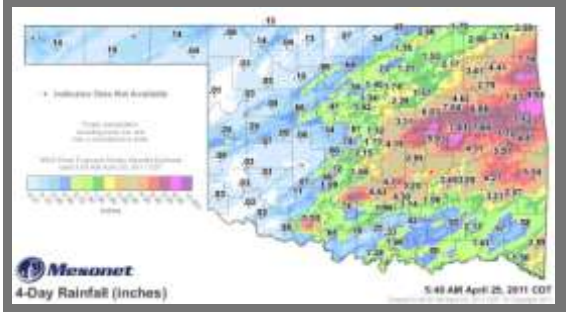
"DamWatch"

- USEngineering Solutions Corporation
  Hartford, Connecticut
- Patented Web-based Software
- 2009 Recipient of ASDSO's Regional Award of Merit for DamWatch Implementation

What does DamWatch do?

- Tracks real-time precipitation events and sends "alerts" to predetermined people
- Stores and retrieves dam data (breach inundation maps, as-builts, EAPs, photos, O&M inspections, pipe inspection videos, design data, etc.)
- Maintains "tickets" of actions needed to be addressed (information, monitoring, inspections, maintenance actions needed, emergencies)

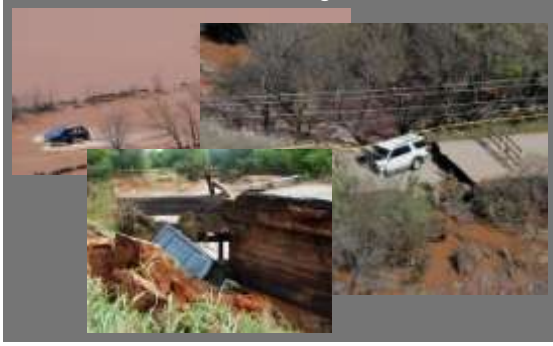
Easter 2011 Weekend Storm



When large storms hit, many dams are usually impacted

Knowing which dams to check out first can be a problem

Traveling to dams can be a problem in itself…. and even dangerous!



When people are at-risk, timing is critical

Getting prepared prior to storms occurring is important

Tracks real-time precipitation events and sends "alerts" to predetermined people for each dam

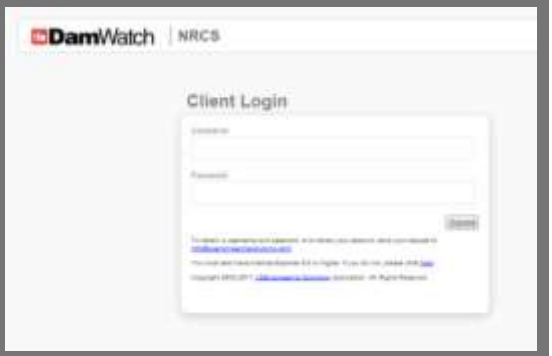
When the precipitation over the drainage area of a specific dam exceeds predetermined threshold values for that dam, an "alert" (email, call, or fax) is sent to the predetermined people for that dam

- Conservation district
- NRCS
- Oklahoma Conservation Commission
- State dam safety officials
- Emergency management officials

Oklahoma Alert Thresholds

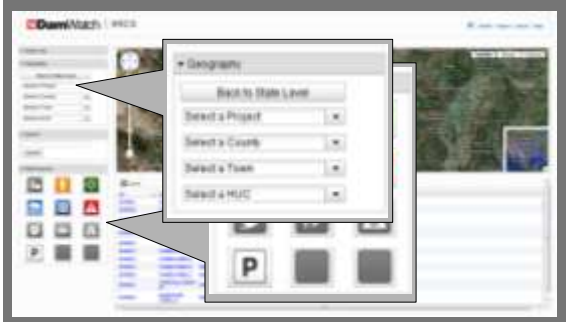
- Goal: to provide notice to DamWatch users of impending auxiliary spillway flows. Special notice given to high hazard dams.
- Two alert levels:
  - Level 1 alert: rainfall to produce detention storage runoff
  - Level 2 alert: rainfall for level 1 rainfall + 2 inches

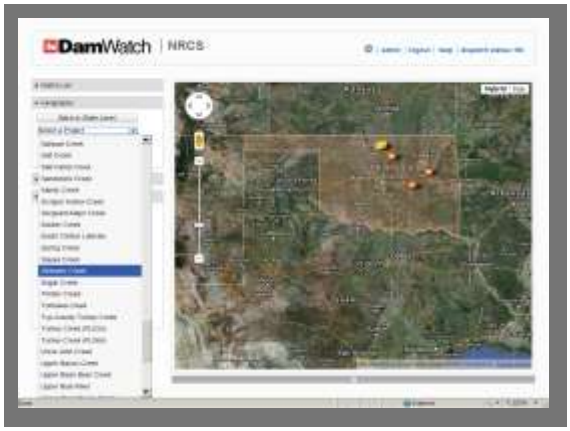
Rainfall needed to produce runoff to fill detention storage (initiate spillway flow)



Who Can Access DamWatch?

- Each Conservation District
- Each NRCS Field Office
- All NRCS Resource Engineers
- OCC Staff
- NRCS State Office
- Selected Emergency Managers




DamWatch
NRCS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NRCS


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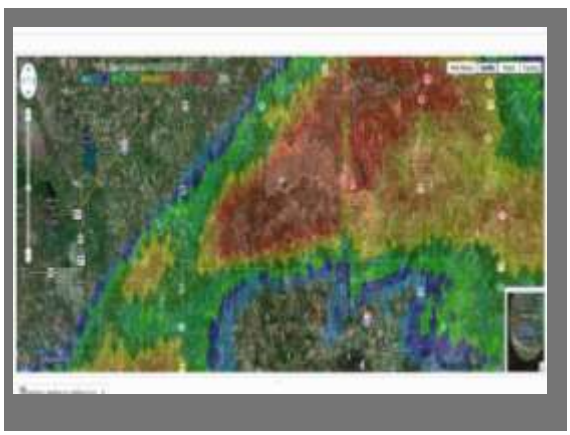
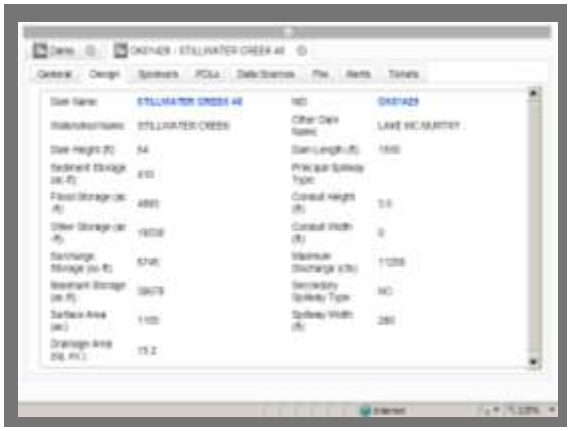
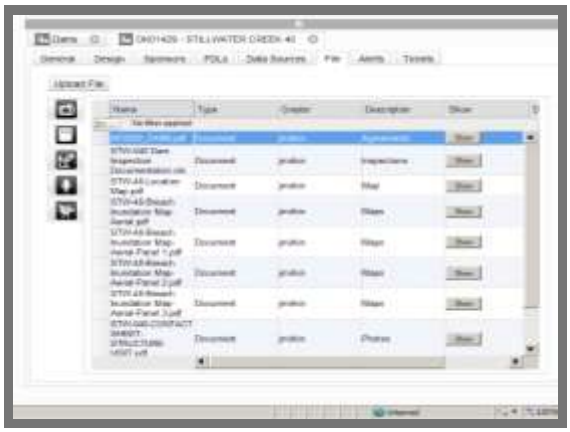
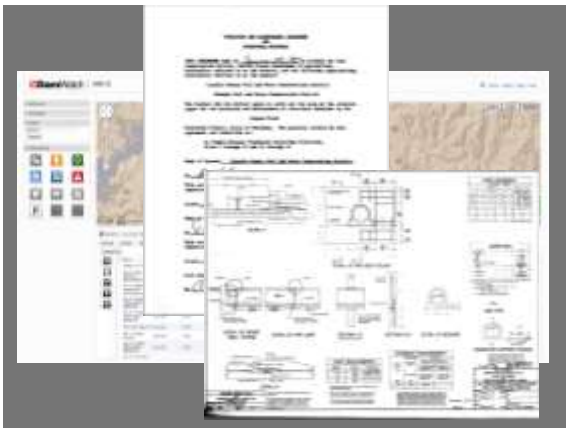





DamWatch | NRCS



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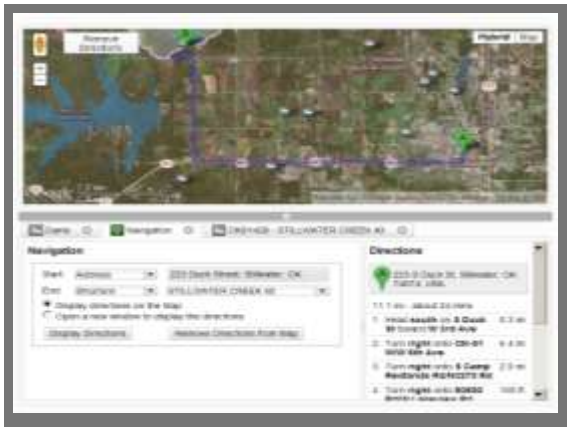

Oklahoma's Strong Watershed Partnership

Private, Local, State, Federal