



River Management Forecasting Overview

Tom Zimmerman, PE
gtzimmerman@tva.gov
River Forecast Center
Lead Engineer
September 12, 2019



TVA's Commitment

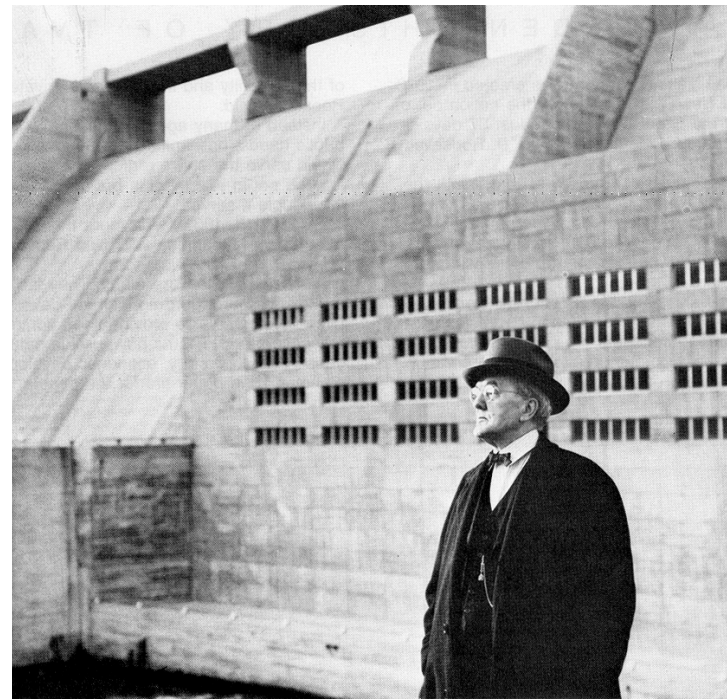
TVA is here to serve the people of Tennessee Valley to make life better

- **Affordable Energy**
 - Generate safe, clean, reliable, and affordable power
 - Flexible & renewable energy
- **Environmental Stewardship**
 - Natural resources stewardship, water quality
- **Economic Development**
 - New investments = New jobs
 - Recreation, Water Supply, Navigation, Flood Protection

Integrated Resource Management

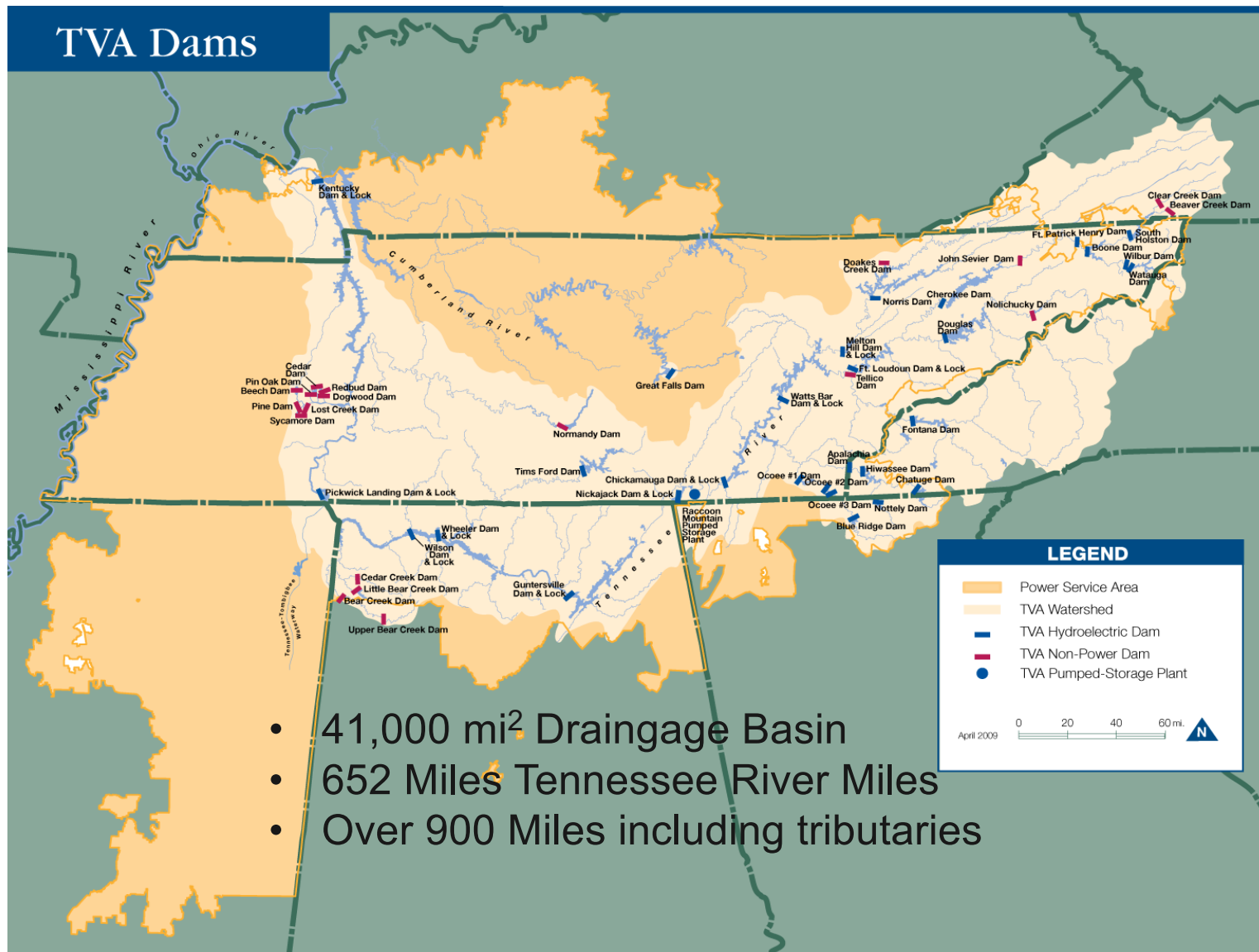
River system assigned multipurpose role through TVA Act in 1933

(section 9a) ...to regulate the stream flow primarily for the purposes of promoting navigation and controlling floods. So far as may be consistent with such purposes, ...for the generation of electric energy...



“Father of TVA,” Senator George Norris

TVA Dams



- 41,000 mi² Drainage Basin
- 652 Miles Tennessee River Miles
- Over 900 Miles including tributaries

Integrated Tennessee River System Provides Multiple Benefits



Navigation



Water Supply



Flood -Damage
Reduction



Recreation



Power
Generation

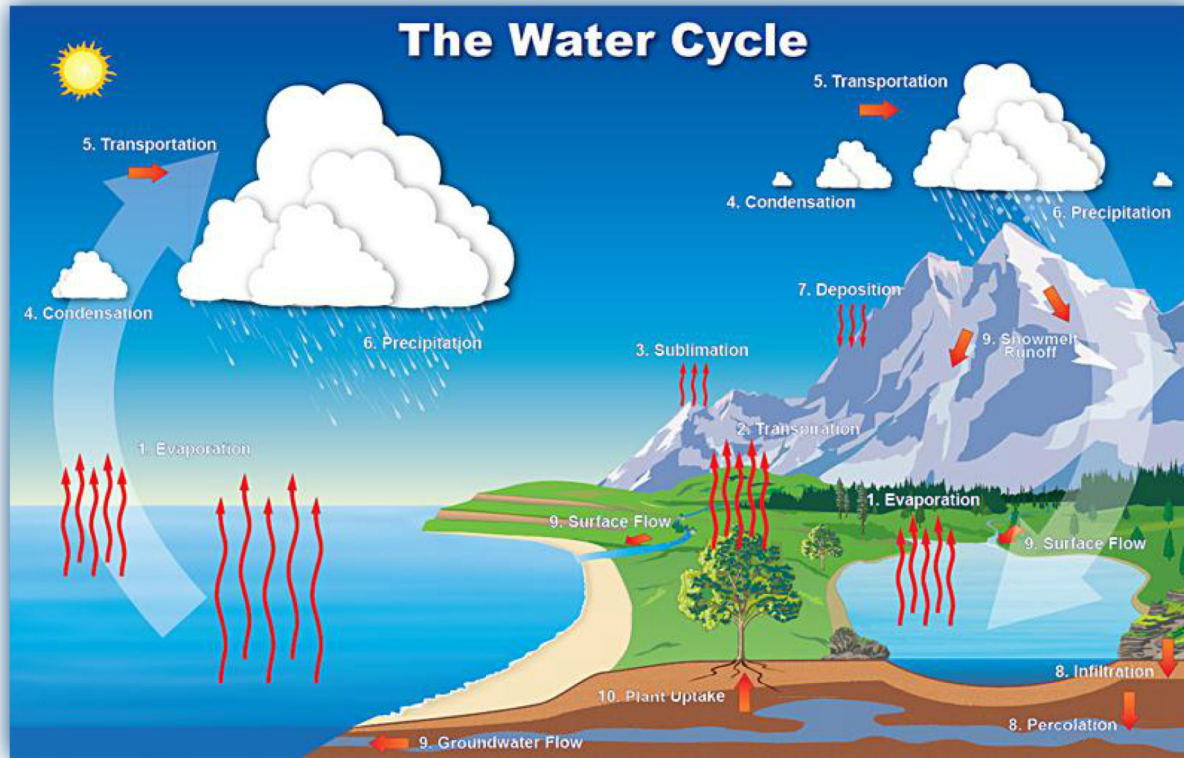


Water Quality

The River Forecast Center

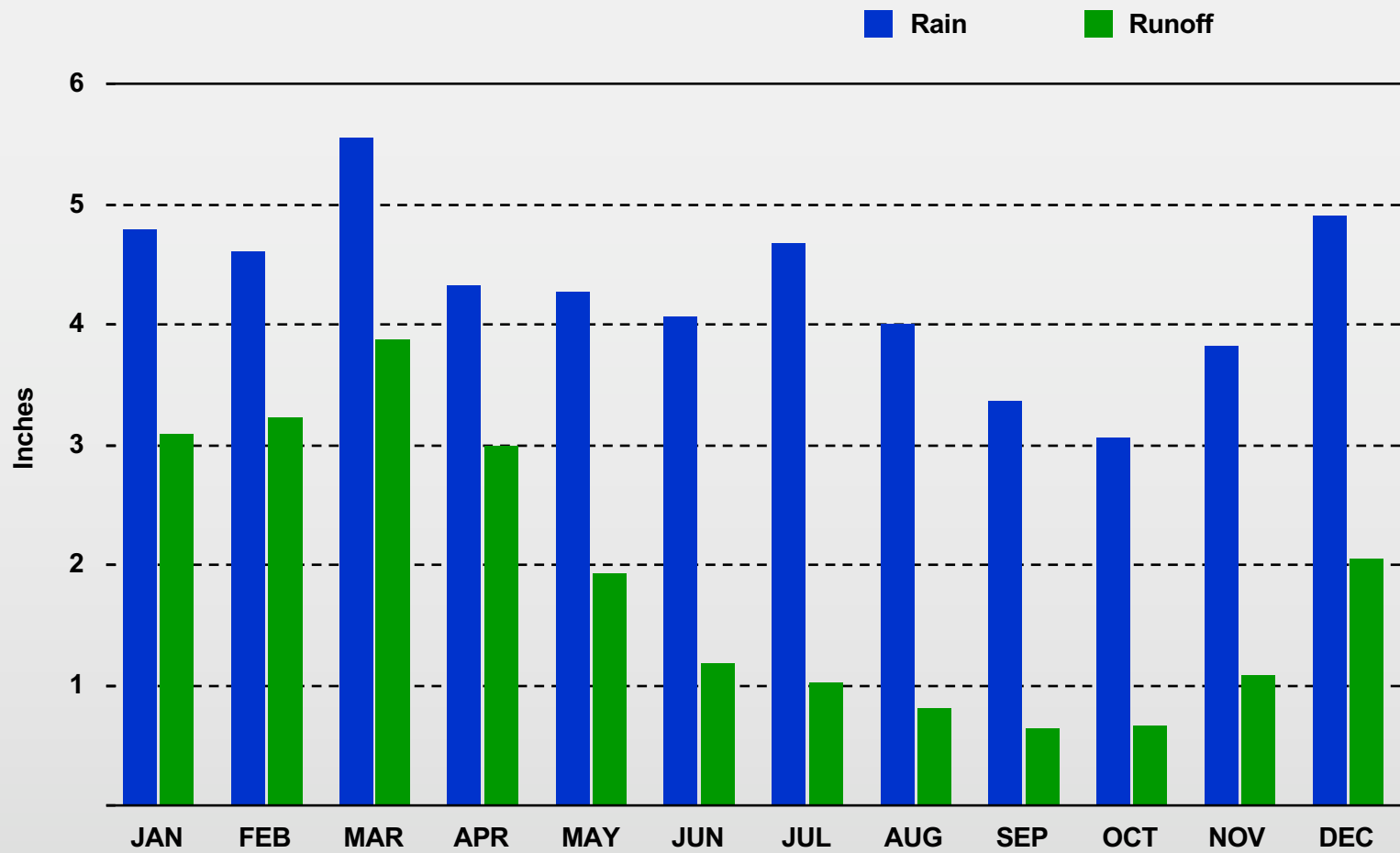
- Staffed 24/7/365
- Teams issue 2-4 forecasts per day
- Data validation
- Modeling
- System monitoring
- Emergency response
- Hydropower scheduling
- Interaction with stakeholders





- Average annual rainfall is about 51 inches
- Average annual runoff is about 22 inches
- Approximately 60 percent of the average annual runoff occurs from January through April

Monthly Average Rainfall and Runoff



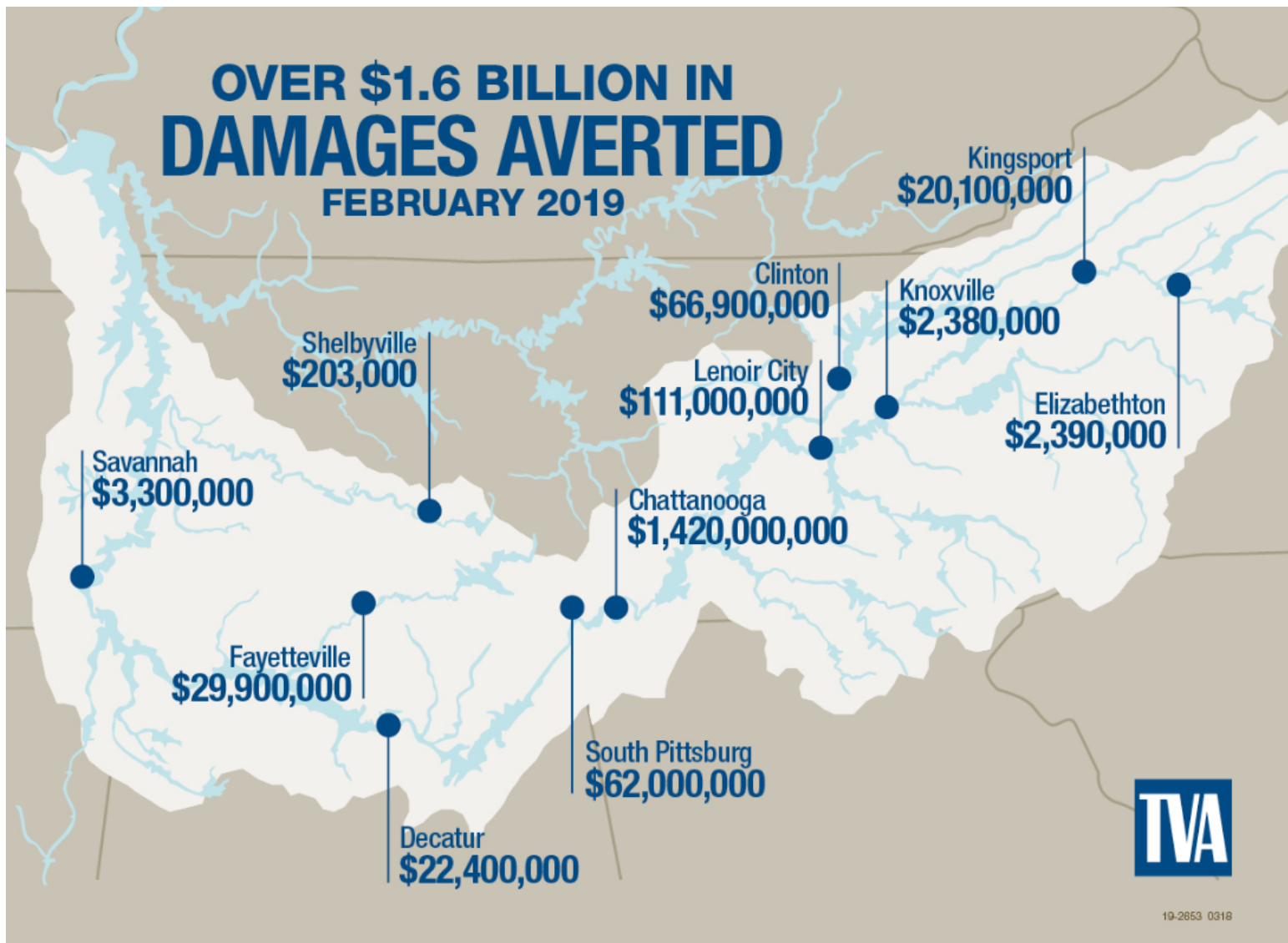
Flood Control



- Use tributary dams to store water during flood to reduce downstream flooding
- TVA's River Forecast Center issue flood forecasts for major areas along the Tennessee River through partnerships with the National Weather Service
- Release water at non-flood rate once levels below dams have receded
- Annual average flood damages averted are \$280 million (\$8.6 billion to date)
- Add'l \$17M averted on the Ohio and Mississippi Rivers

OVER \$1.6 BILLION IN DAMAGES AVERTED

FEBRUARY 2019

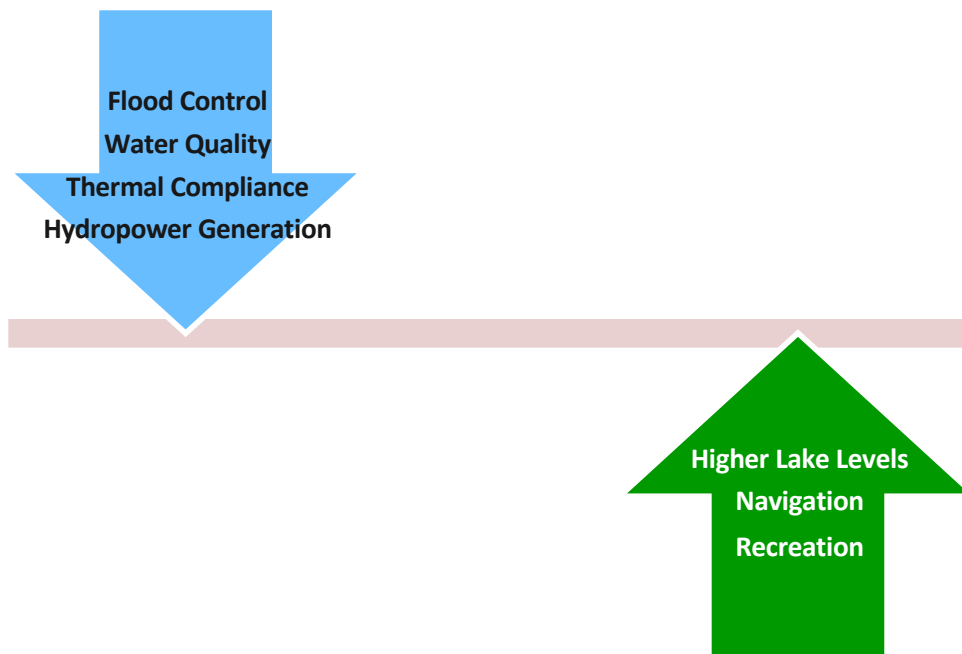


19-2853 0318



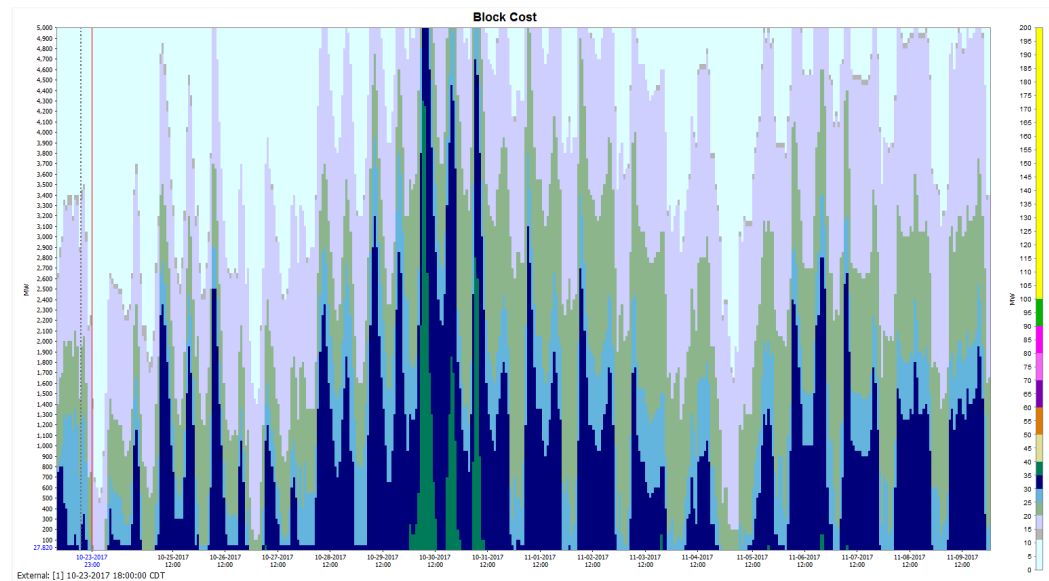
Challenges

- Balancing the competing demands on the system and the overall value to the public
- Understanding of the trade-offs associated with various scenarios
- Example: Can you keep my reservoir higher, longer?



The Value of Forecasts to TVA

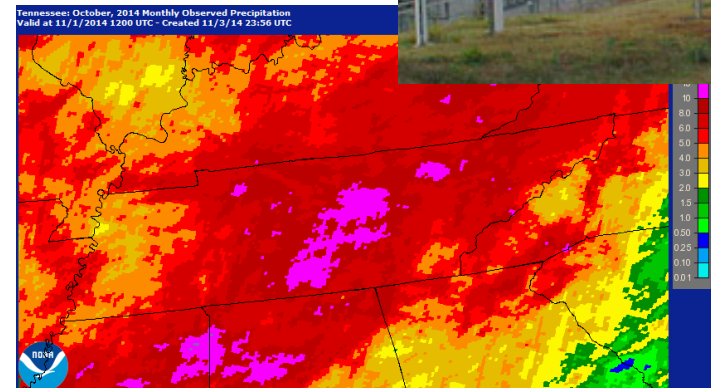
- TVA is a forecast-driven agency due to the expensive and long-term nature of our capital investments
- We forecast
 - Load growth
 - Gas prices
 - Coal prices
 - River flows
 - Budget spends
 - Equipment life....



- For TVA, better forecast = lives saved, more \$\$\$, better decisions.

Forecasting & Decision Support

- 200 Rain Gages
- 60 Stream Gages
- Data Management (FEWS)
- Inflow and Runoff Modeling (SAC-SMA)
- Reservoir Storage Routing and Simulation (Riverware)
- Hydraulic Modeling (HEC-RAS)
- Hydropower Optimization (Riverware)
- Information Dissemination (Varies)



Decision Horizons and Tools

Historic

Observed Values
(-) 14 Days

Today

Real-time data, Hourly Models, radar

2 Days

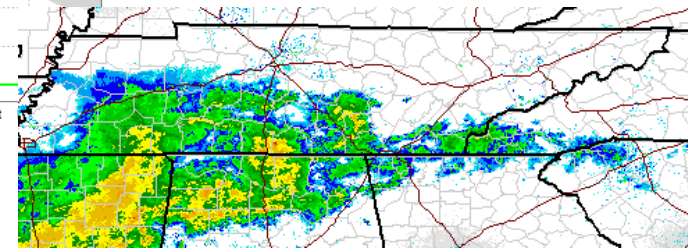
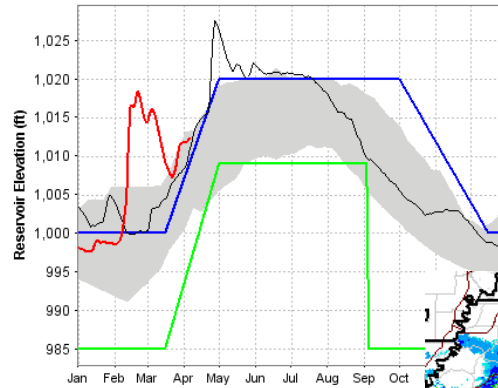
Hourly Economic Modeling, Hourly Reservoir Simulation, 6-hour Reservoir Simulation

14 Days

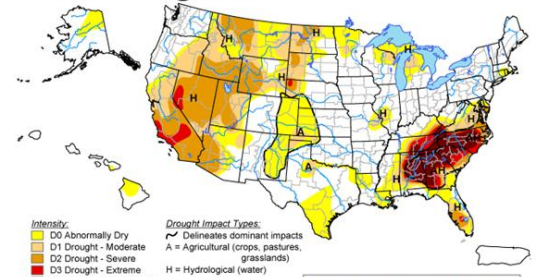
6-hourly Reservoir Simulations & Optimization, Economic Models, Load Forecasts, NWS QPF, Planned Constraints

Planning Models, Long-term power studies, Capacity Constraints, Resource Strategy

Months - Years



U.S. Drought Monitor December 25, 2007
Valid 7 a.m. EST



Intensity:
 D0 Abnormally Dry
 D1 Drought - Moderate
 D2 Drought - Severe
 D3 Drought - Extreme
 D4 Drought - Exceptional

The Drought Monitor focuses on broad-scale conditions. Local conditions may vary. See accompanying text summary for forecast statements.

<http://drought.unl.edu/dm>

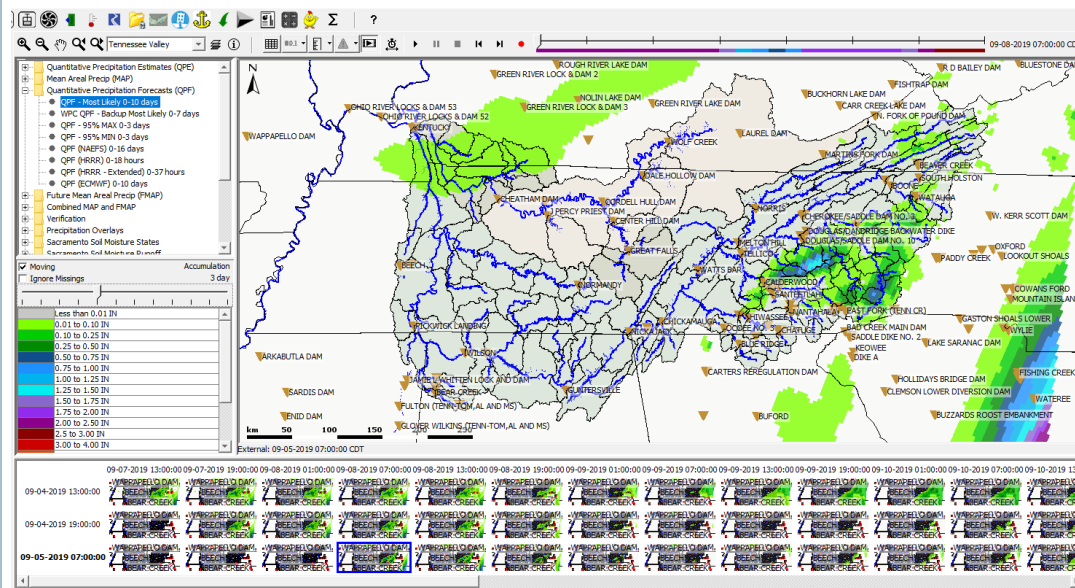
Released Thursday, December 27, 2007
 Author: Richard Heim, NOAA/NESDIS/NCDC

Quantitative Precipitation Estimates

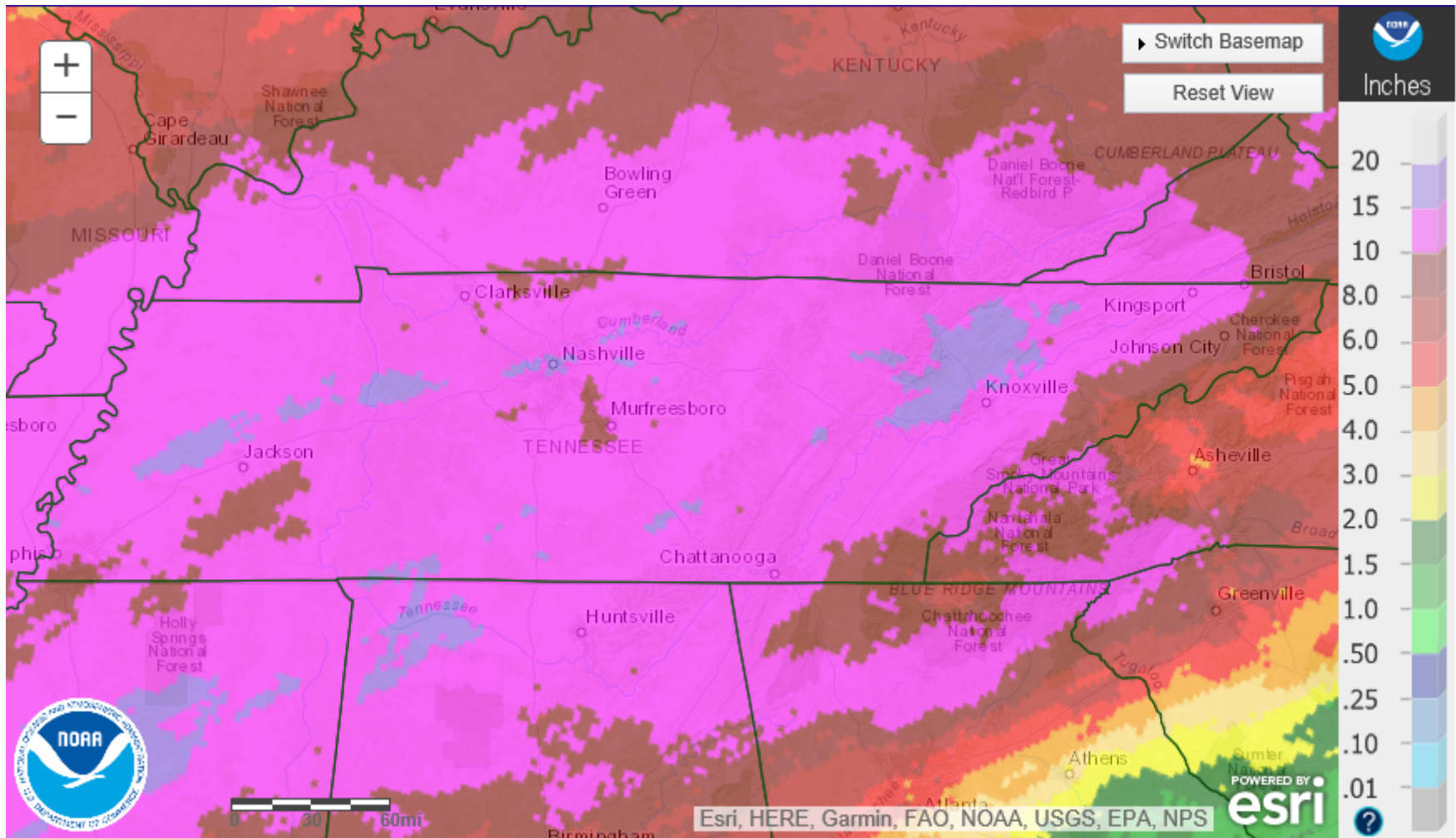
- NOAA Multi-Radar Multi-Sensor (MRMS)
- Lower Mississippi River Forecast Center (LMRFC)
- Station Based (TVA and USGS precipitation gages)

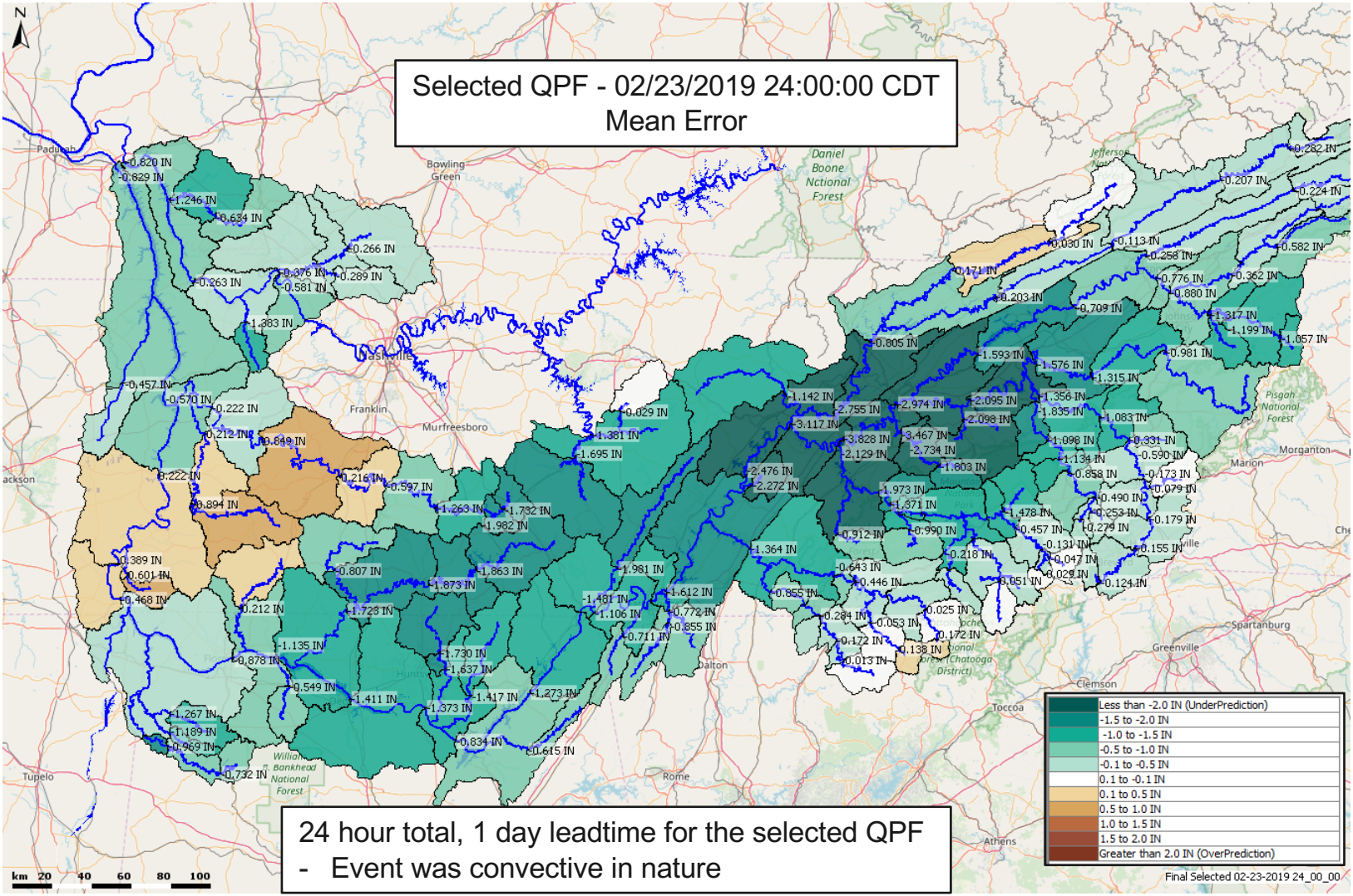
Quantitative Precipitation Forecasts

- NWS Weather Prediction Center (WPC) 0-10 Days
- WPC Backup 0-7 Days
- 95% Max and Min 0-3 Days
- NWS Weather Prediction Center (WPC) 0-10 Days
- North American Ensemble Forecast System (NAEFS) 0-16 Days
- NOAA HRRR 0-18 hours
- NOAA HRRR Extended 0-37 hours
- European Centre for Medium-Range Weather Forecasts (ECMWF) 0-10 Days



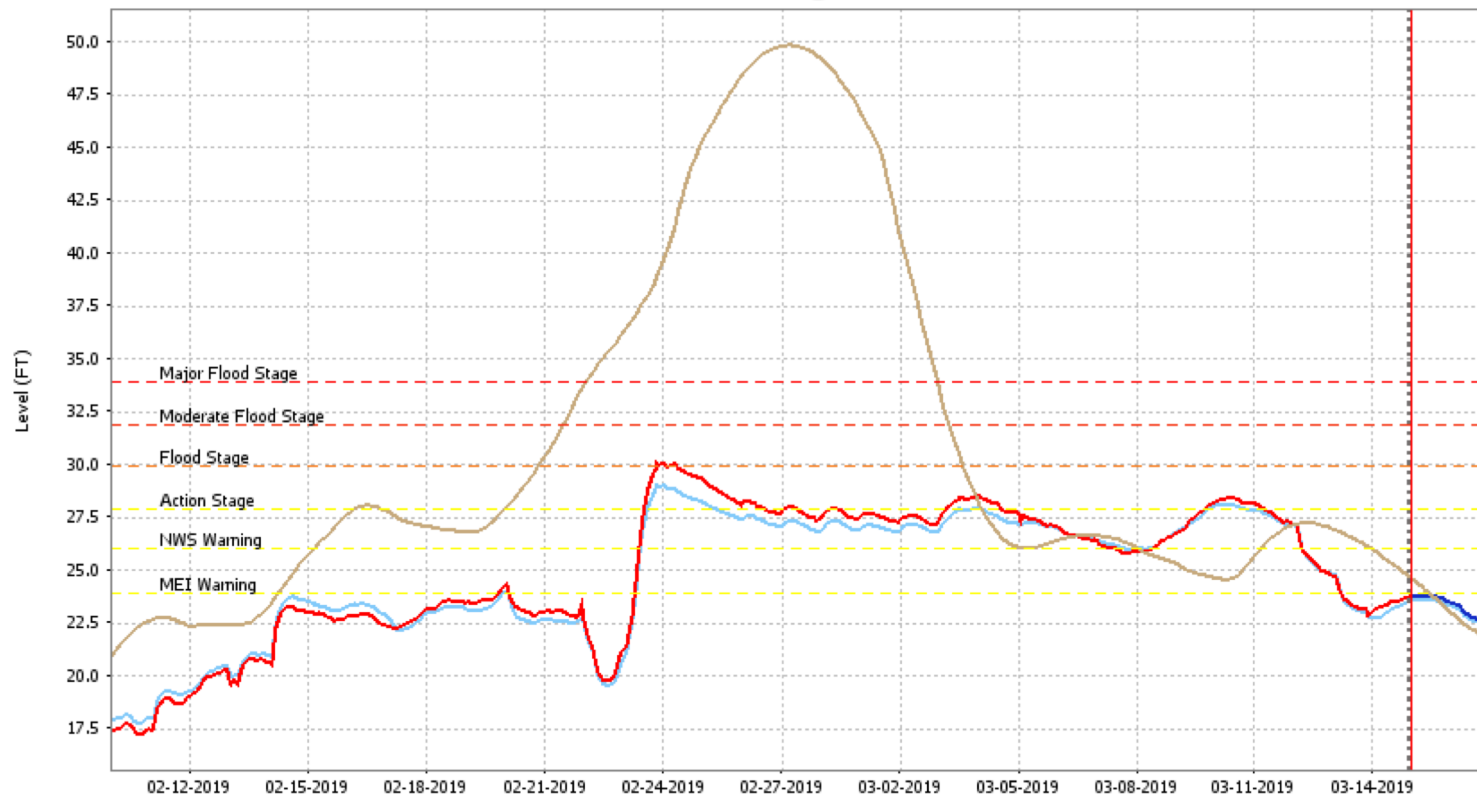
February Rain





River Stages

Chattanooga



RAS_All_Forecast: [1] Mainstem HEC-RAS 03-15-2019 11:00:00 CDT Current

Copy_Naturals_Forecast: [2] Show Naturals in RAS Plots 03-15-2019 11:00:00 CDT Local

— RAS HG [1] — Adjusted HG [1] — Observed HG — Naturals HG [2]



Tennessee Valley Authority @TVAnews · Mar 1

Management of the Tenn. River system using our integrated system of 49 dams across the region averted \$1.6 billion in flood damages. After the wettest February and fourth wettest month on record, we continue to manage high river and lake conditions to minimize flood impacts.



1:03 3,199 views

7 37 127

Show this thread



Tennessee Valley Authority @TVAnews · Feb 27

River Update: We are increasing releases out of tributary dams to recover flood storage in preparation for the next rain event, so you can expect to see above normal river flows below those dams. (1-3)



0:16 4,329 views

4 16 52



Tennessee Valley Authority @TVAnews · Feb 26

River Forecast Center Manager James Everett on the @weatherchannel discussing how we're managing the Tennessee River to reduce downstream impacts all across the Valley after a record-breaking month of rainfall.



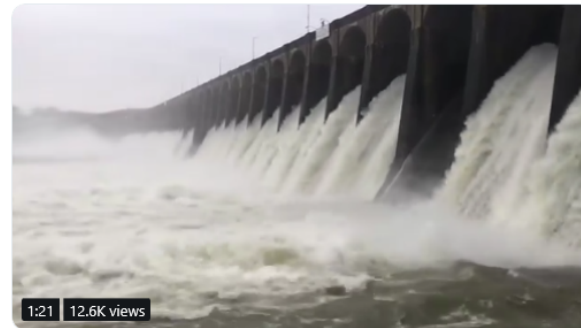
TVA SCRAMBLES TO CONTROL FLOODWATERS

1 7 28



Tennessee Valley Authority

Incredible site! Wilson Dam near second. Heavy rainfall has resulted in high water levels on the Tennessee River. We are storing water at tributary and main stem reservoirs to help reduce downstream flood levels. #ALWX #TNWX



1:21 12.6K views

9 134 276



Social Media Impact

Facebook:

Number of Posts: 35

Number of Impressions: **7,610,058**

Number of Users Reached: 2,755,040

Number of Link Clicks: 17,700

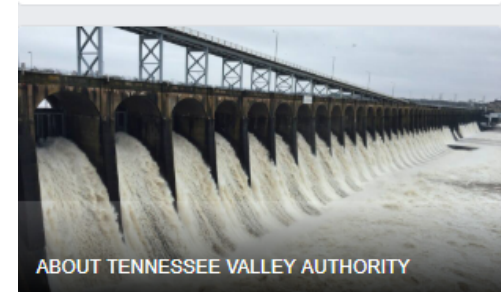
Number of Video Views: 2,210,756

Avg. Reach Per Post: **141,286.63** < Very impressive

Engagement Rate: **9.76%** (Compared to the national average of 0.17%)

Tennessee Valley Authority
Public Utility Company in Knoxville,
Tennessee

4.3 ★★★★★



facebook.com/TVA

We gained 9,387 Facebook followers over the 18 days a 9.85% growth. We now have 104,718 followers Facebook.

Twitter:

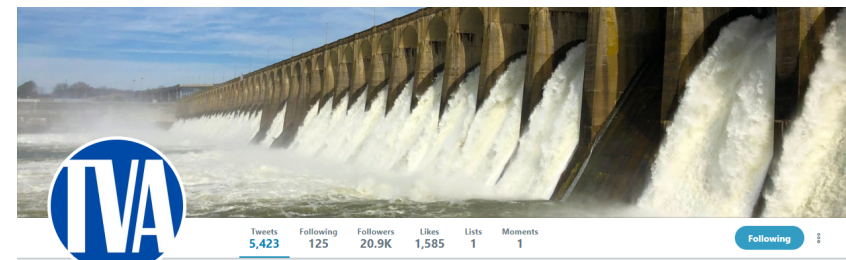
Number of Tweets: 88

Impressions: 996,400

Overall Reach **1,684,800**

Retweets 1,896

Engagement Rate: **4.1%** (National average is 0.05%)



[@TVAnews](https://twitter.com/TVAnews)

We gained 1,200 new Twitter follower over the period, a 6.26% growth. We now have 20,800 Twitter followers.





www.tva.com

- Release schedules
- Current reservoir elevations
- Operating guides
- Tailwater improvements
- Monitoring results

TVA Lake Info App



Tom Zimmerman
gtzimmerman@tva.gov



Thank You