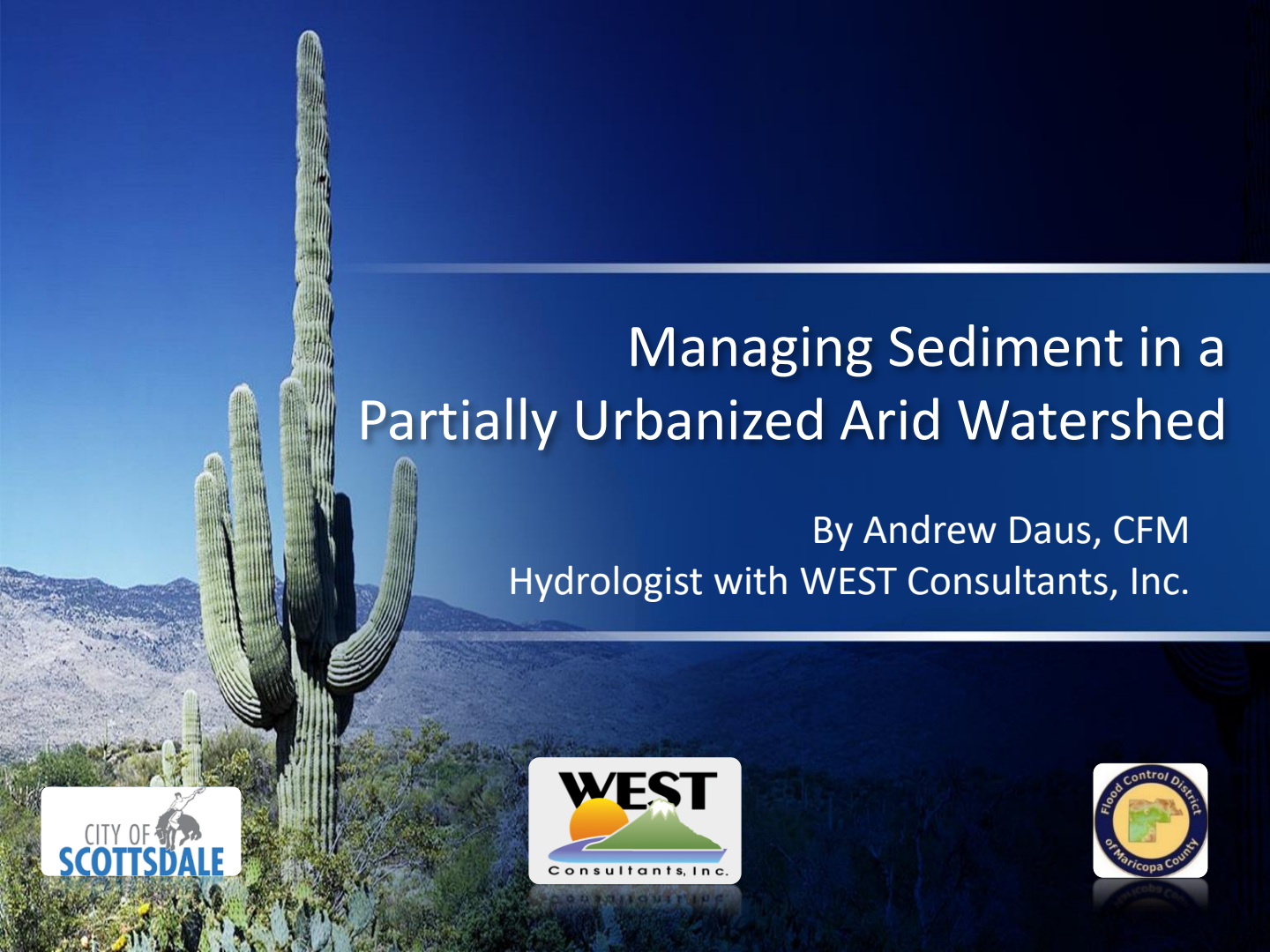


Managing Sediment in a Partially Urbanized Arid Watershed

By Andrew Daus, CFM
Hydrologist with WEST Consultants, Inc.

CITY OF SCOTTSDALE

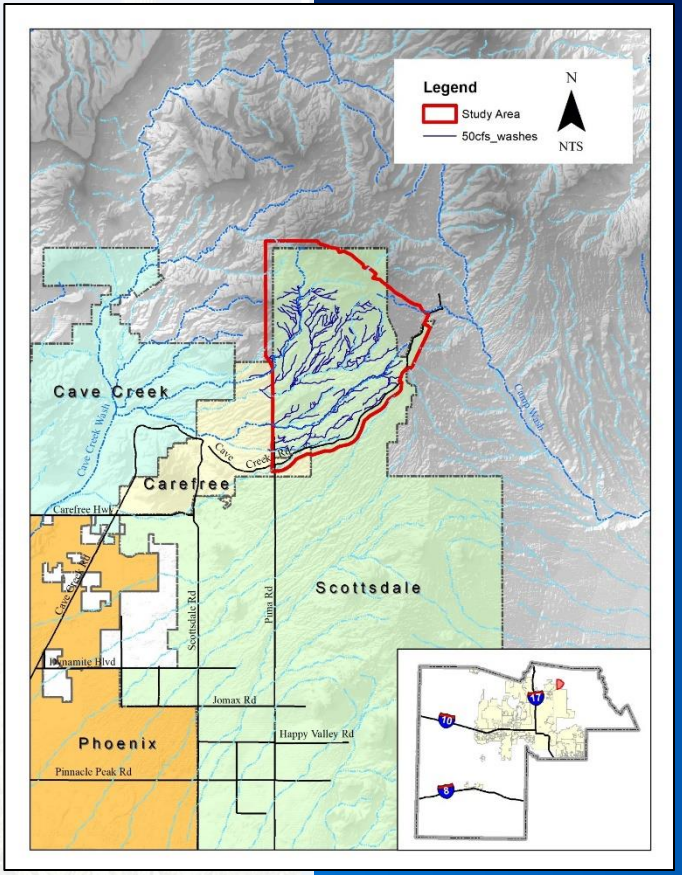
WEST Consultants, Inc.

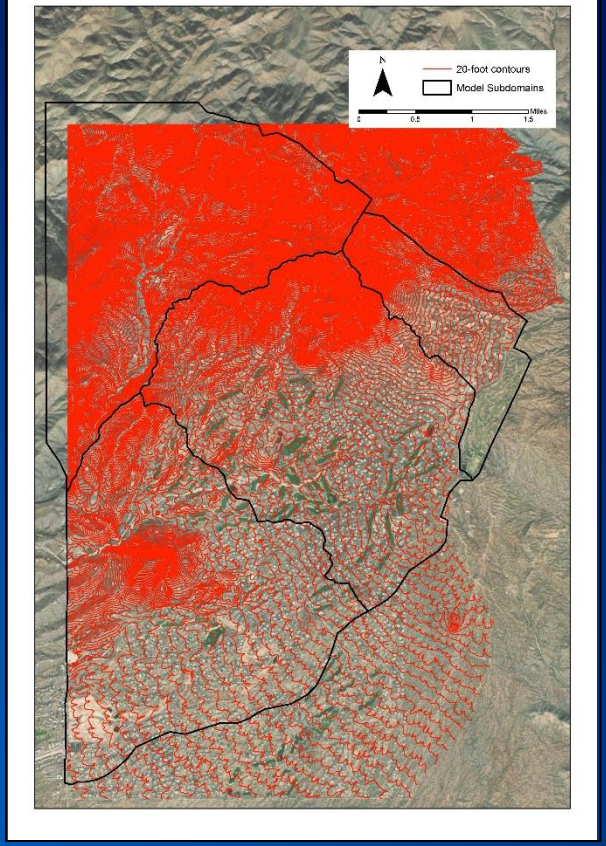
Flood Control District of Maricopa County

General Background

- Desert Mountain is a low-density master-planned community north of Scottsdale
  - Approx. 18 square miles
- Home to almost 14,000 residents
- Terrain is steep, rocky foothills and includes shale slopes
- WEST working with City of Scottsdale and Flood Control District of Maricopa County
  - Area Drainage Master Study

Location and Topographic Map





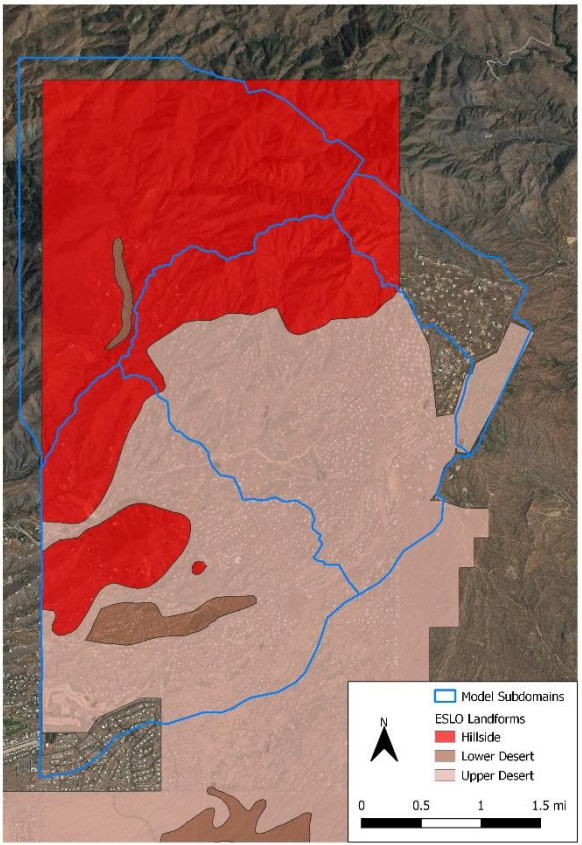
Purpose

- Purpose of project
  - Quantify hazards
    - Erosion and degradation
    - Deposition
    - Vehicle/pedestrian safety and structural safety
  - Create mitigation strategies in order to stabilize watercourses and road crossings
    - NAOS compliant

NAOS and its Requirements

- What is NAOS?
  - Natural Area Open Space
  - Easement that restricts land development
- What does NAOS require?
  - Designated land must be preserved in its natural desert state, remain free of obstruction
  - No grading, filling, clearing or excavation of any kind

NAOS Map



NATURAL AREA OPEN SPACE (NAOS)

The amount of NAOS required to be set aside with each development is based upon two factors -- the landform area and land slopes.

Land Slope	Lower Desert	Upper Desert	Hillside
0 to 2 %	20%	25%	50%
2 to 5%	25%	25%	50%
5 to 10%	30%	35%	50%
10 to 15%	30%	45%	50%
15 to 25%	30%	45%	65%
Over 25%	30%	45%	80%

Watershed Description

- Steep, rocky foothills of the New River Mountains
  - Shale slopes weather and produce sediment
- Drained by 4 major washes:
  - Grapevine Wash
  - Galloway Wash North Tributary
  - Galloway Wash Middle Branch and South Branch
- Bed material
  - Lower reaches: coarse sand/gravel
  - Upper, steeper reaches: cobbles and exposed bedrock
- Partially urbanized, which has altered the natural sediment balance

Issues to be addressed

- Flooding
  - High-intensity storms
- Erosion and degradation of washes
  - Steep terrain and intense storms exacerbate issues
- Deposition of sediment
  - Culverts and steep terrain

Stormwater flooding

- Caused by high-intensity rainfall
- Magnified by steep terrain
- Poses serious hazards during and after storm
  - Towards pedestrians, vehicles and structures
- Flooding itself can be quite devastating…

Stormwater flooding

Pictures are good, but videos are better…

Erosion and Degradation

- Degradation
  - Lowering of stream bed through erosional processes
- Occurs naturally during storms
- But high-intensity rainfall, steep slopes and development cause excessive issues
- Can pose hazards both during and after storm event
- Natural erosion okay, excessive erosion causes problems…


03/04/2014

Deposition

- Why is deposition occurring?
  - Culverts and their lack of capacity
  - Roadway designers not caring
  - Radical expansion and contraction
- Can cause indirect hazards to pedestrians, vehicles and structures
- Degree of deposition can vary dramatically…

Deposition in a wash?

Not exactly

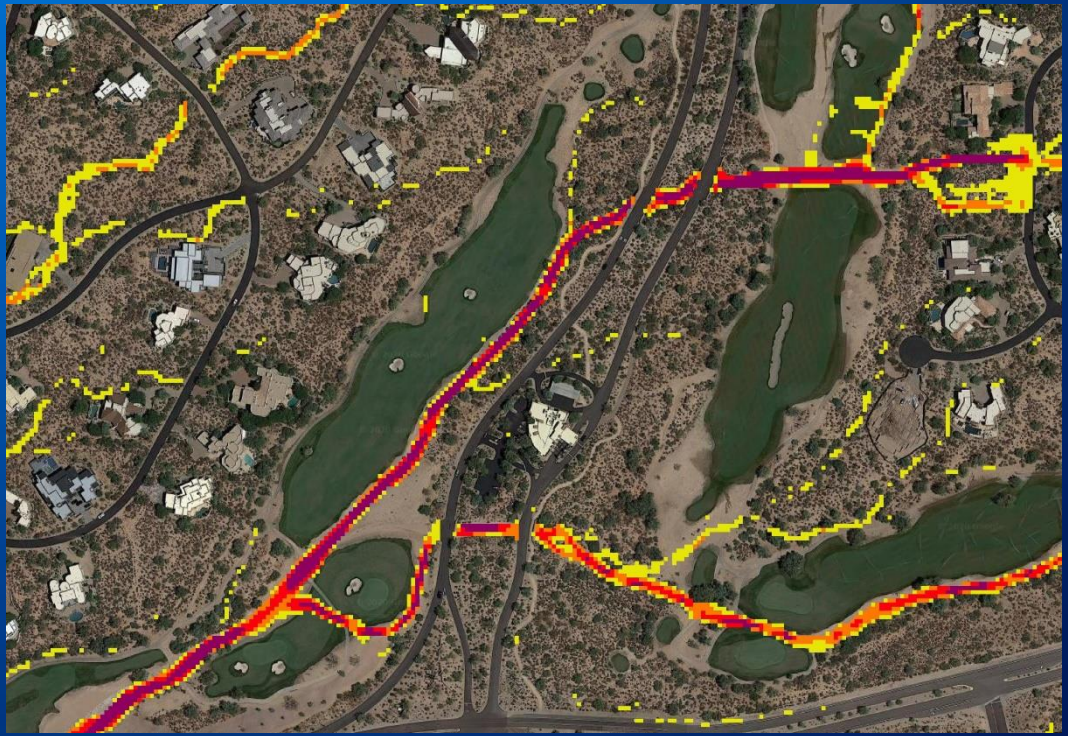
Before

After

What has been done so far?

- WEST has created Hydrology and Hydraulic models
  - Characterize existing conditions
- Correlation between model and field visits
- Developed flood hazard maps
  - We'll look at erosion and deposition

Erosion Hazard Map



Legend

Parcel

Low Erosion Potential

- 10% annual risk of some erosion of desert landscaping (scour of sandy surfaces, some risk of damage to small plants).
- Minor scour downstream of culverts likely.
- Low risk of scour in washes.
- Low risk to roadways.
- Sand and fine gravel likely washed away during major storm events.

Moderate Erosion Potential

- 10% annual risk of moderate erosion of desert landscaping (scour of gravel, potential removal of small plants).
- Some scour downstream of culverts likely.
- Potential for scour in major washes.
- Larger gravel and short grass at risk of erosion during major storm events.
- Potential risk to gravel roadways and / or roads with unpaved shoulders during a major storm event. Proceed with caution.

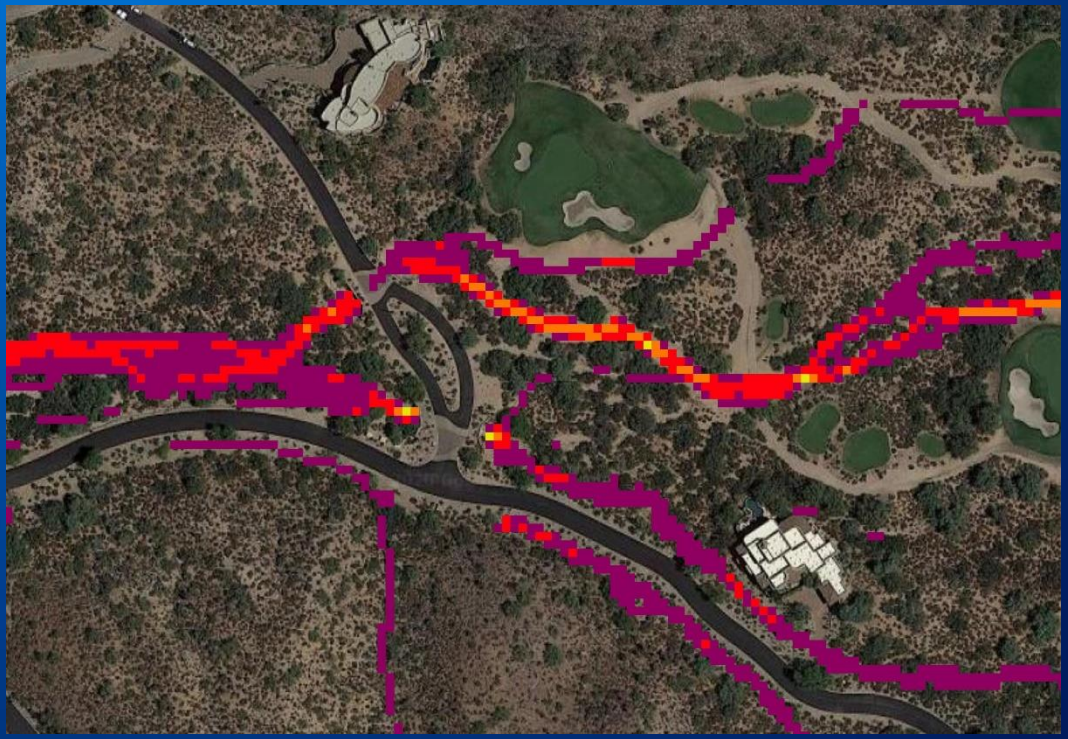
High Erosion Potential

- 10% annual risk of significant erosion of desert landscaping (gravel surfaces likely scoured, small plants likely damaged or removed, larger plants at risk).
- 10% annual risk of significant scour downstream of culverts.
- High potential for ongoing scour and avulsions in major washes.
- Small cobbles and long grass at risk of erosion during major storm events.
- High risk to gravel roadways and / or roads with unpaved shoulders during major storm events. Proceed with caution.

Extreme Erosion Potential

- 90% annual risk of significant erosion of desert landscaping (all plants in danger of removal, surface treatments likely scoured away).
- 90% annual risk of significant scour downstream of culverts.
- High potential for culvert installation failure during major storm events.
- Wash instability likely due to significant scour and avulsion potential.
- All grass types likely scoured during major storm events.
- Gravel roadway surface likely to fail and should be avoided during major storm events.

Deposition Hazard Map



Legend

Parcel

Low Deposition Potential

- Low potential of significant deposition of silty sand.
- Some deposition upstream of culverts may occur.
- Low risk to roadways.

Moderate Deposition Potential

- Moderate potential of significant deposition of sands, silts, and gravel.
- Some deposition upstream of culverts likely. Smaller culverts may clog.
- Proceed with caution at roadways.

High Deposition Potential

- High potential for sand and gravel deposition; moderate risk of cobble deposition.
- Significant deposition of culverts likely. High clogging potential at all culverts.
- Proceed with caution at roadways.

Extreme Deposition Potential

- Extreme potential for significant deposition of sands, silts, gravels, and cobbles.
- Culvert installations in danger due to likelihood of clogging.
- Proceed with extreme caution at roadways.

What still needs to be done?

- Develop mitigation measures
  - NAOS compliant
  - Permanent structures, sediment basins?
    - NAOS complications
  - Release of Easement?
- Coordinate with City of Scottsdale, HOA's and homeowners
  - Develop possible solutions to address problems

Possible Mitigation Measures

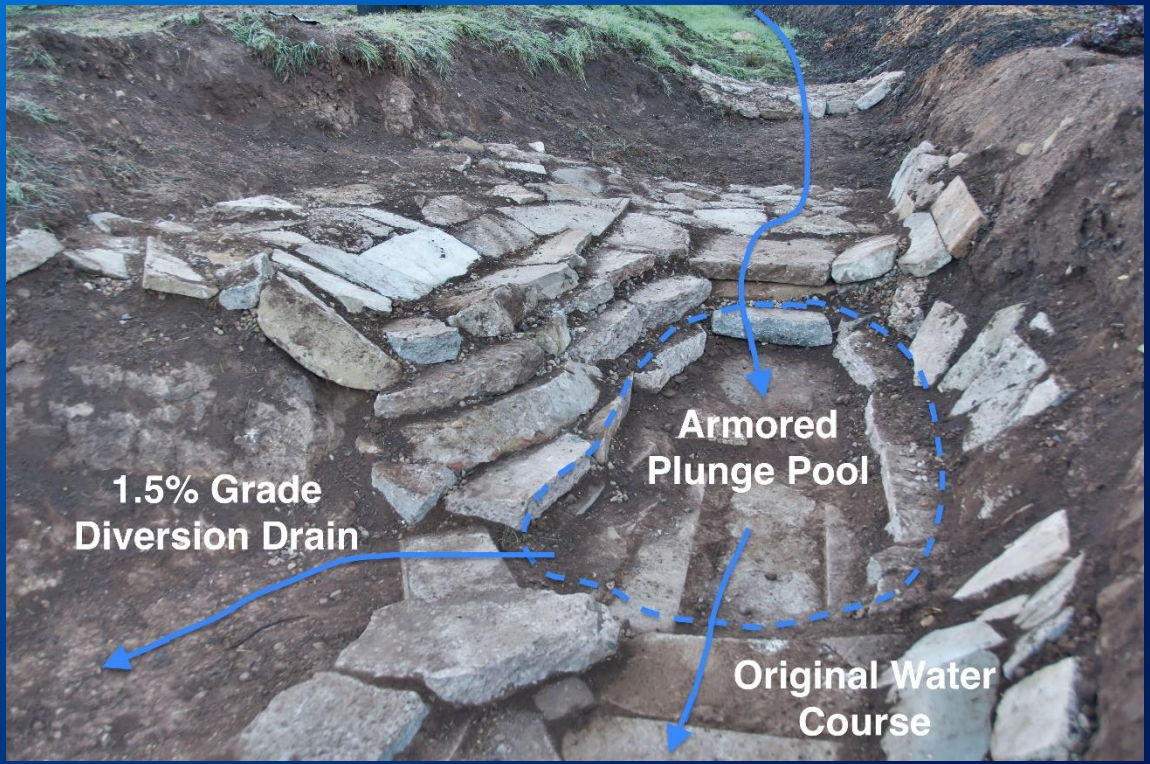


Photo credit: https://i2.wp.com/www.7thgenerationdesign.com/wp-content/uploads/2018/10/Zuni-Bowl-CVF-Annotated.jpg?ssl=1

Possible Mitigation Measures

Photo credit: https://naranjocivil.com/portfolio-items/sculpted-structures/#iLightbox[innovative-solutions]/5

Possible Mitigation Measures

Photo credit: https://naranjocivil.com/development/wp-content/uploads/2015/11/Bridge-Edit_0002_Layer-9.jpg

Possible Mitigation Measures

Photo credit: https://www.natinaproducts.com/project-item/revere-golf-club-rock-henderson-nv/

Moving forward

- Purpose
  - Quantify hazards and create mitigation strategies
- Issues
  - Flooding, Erosion/degradation, Deposition
- What's been done?
  - Modeling, field visits, hazard analysis
- What we need to do?
  - Develop appropriate mitigation strategies

Photo credit: https://www.natinaproducts.com/project-item/revere-golf-club-rock-henderson-nv/

Questions?

Thank you for your time!

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