# GEOLOGICAL CONSIDERATIONS FOR CONSTRUCTING A RAFTING AND KAYAKING COURSE ON THE CHATTAHOOCHEE RIVER, COLUMBUS, GEORGIA

We have added links to Columbus Ledger-Enquirer articles and photos about the E&P dam and the construction project as well as post-breach photos from above the dam.

Thomas Hanley, Department of Earth and Space Science, Columbus State University

Edward Kinner, Uptown Columbus, Inc.

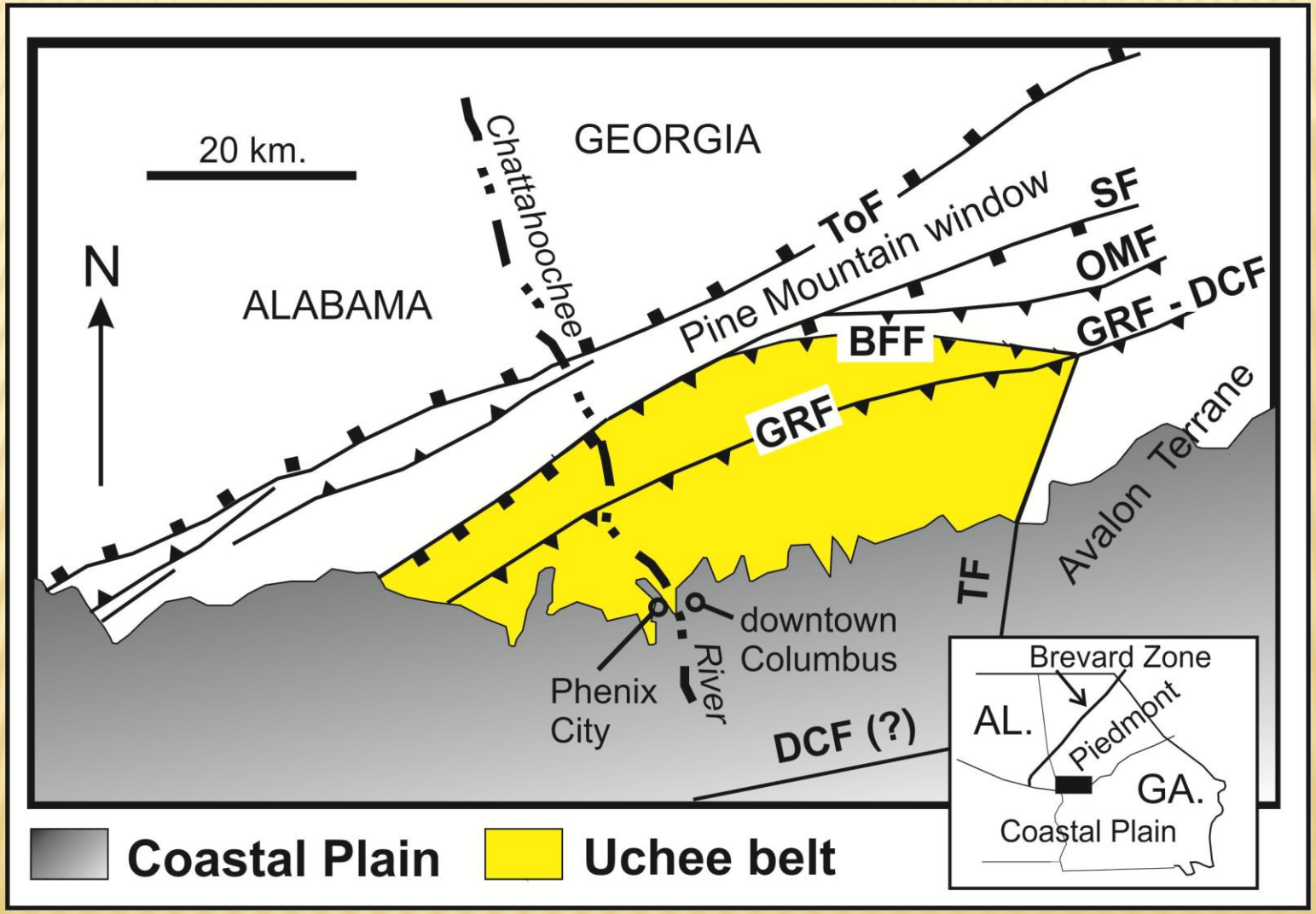
SEGSA, Asheville, NC
April 1, 2012

We have also added mineral identification changes thanks to Julian Gray of Tellus Museum in Cartersville. This information is included in a supplemental powerpoint found on this searchable GSA site.

Uptown COLUMBUS

CSU COLUMBUS STATE UNIVERSITY

# Location and Regional Geology

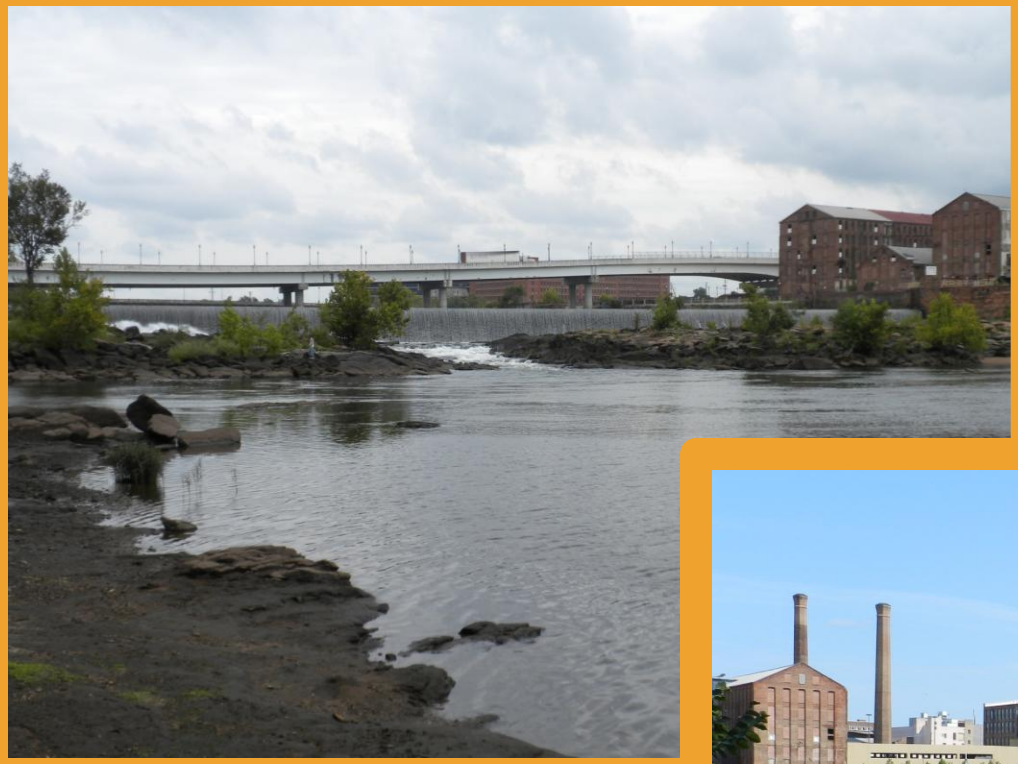



The Chattahoochee River separates Georgia and Alabama in the vicinity of Columbus GA and Phenix City AB. There are six dams along the Chattahoochee in this area. Bartletts Ferry, Goat Rock, Oliver and North Highland are currently generating; City Mills and Eagle and Phenix no longer generate.


The plan, which has been bouncing around Columbus for at least a decade, is to remove the City Mills and Eagle and Phenix dams and to construct a rafting and kayaking course from North Highlands dam to below the Eagle & Phenix dam. This amounts to about 2.5 miles for the course.

The pool below Eagle and Phenix dam (controlled by the Walter F. George dam) varies from 188’ to 190’ at low flow. The pool upstream of E&P is 215 at low flow; the pool upstream of City Mills is 225 ft’. The riverbed drops about 35’ from below North Highlands to below Eagle & Phenix.

The normal hydroelectric release from North Highlands varies from 800cfs to 13,300 cfs.



Below Eagle and Phenix dam

Above  Eagle and Phenix dam

# In this talk we will:

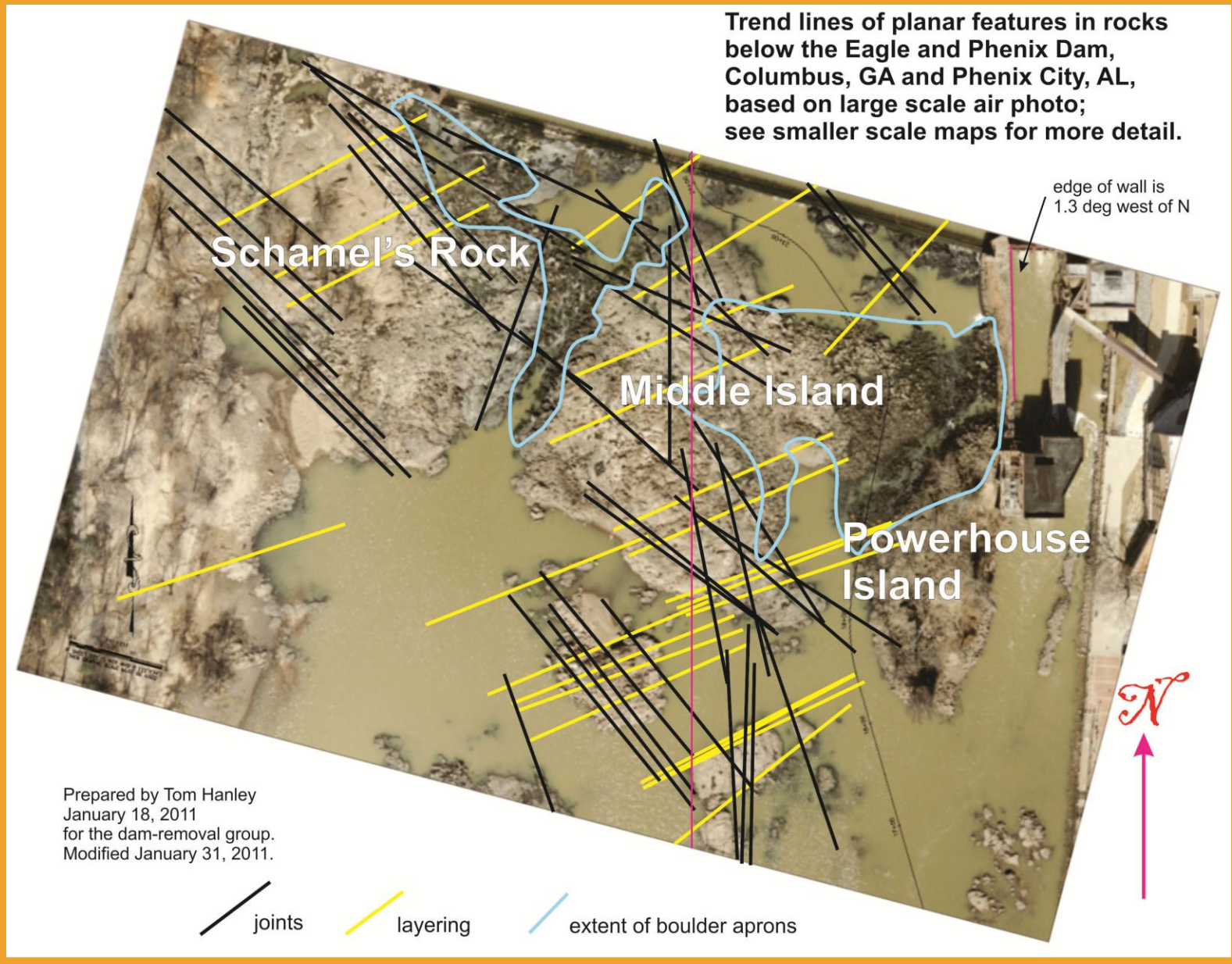
- List geological issues associated with building the course
- Present the results of geological studies that bear on these issues
- Describe the construction to date
- Describe to what extent the conclusions of the studies have played out during construction
- If time permits, show the first two breaching events.

# GEOLOGY RELATED ISSUES

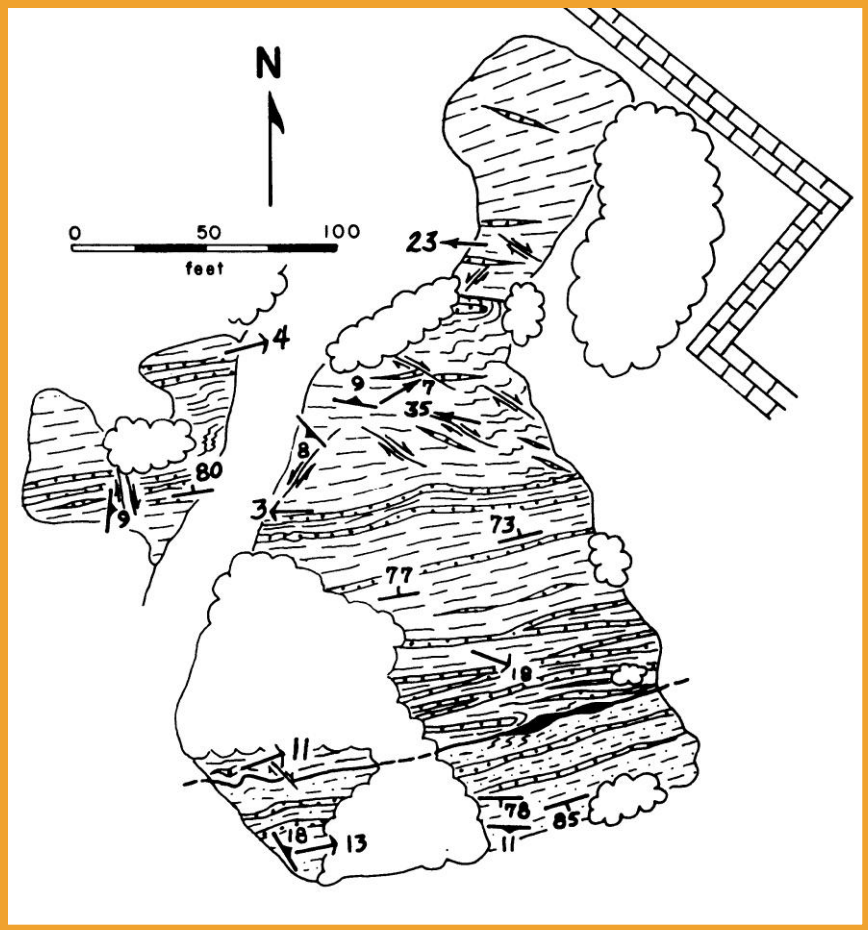
My co-author, Ed Kinner, a civil engineer who is advising sponsors of the project, asked if I would, as a local geologist, provide information bearing on the following:

- nature of the bedrock
- permeability of bedrock to seepage flow
- availability of large slabs of rock for shaping the channels
- the effect of blasting on existing structures.

# Aerial Photograph of the Eagle and Phenix dam site



# Schamel's Rock – Legacy data

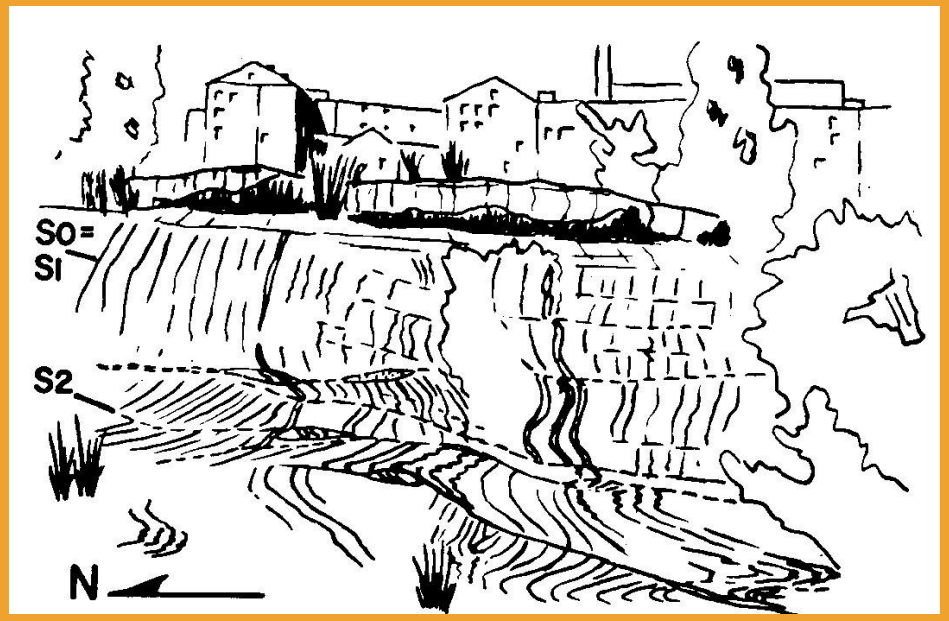



Geologic map of Schamel's Rock showing various structural features described in the following slides. This map is from the 1986 SEGSA DNAG field guide after earlier work published in a 1980 SEGSA field guide whose main authors were Steve Schamel, myself and Jim Sears. Schamel was responsible for this map.

This site has been visited repeatedly and studied by students from Columbus State, Auburn, University of Alabama, University of Georgia, Georgia State, Fort Valley State, University of Florida, Florida State and probably many others I don't know about.

Discussions with Aditya Kar of Fort Valley State and Pam Burnley of Georgia State and UNLV through the ACRES program have been useful and enjoyable.

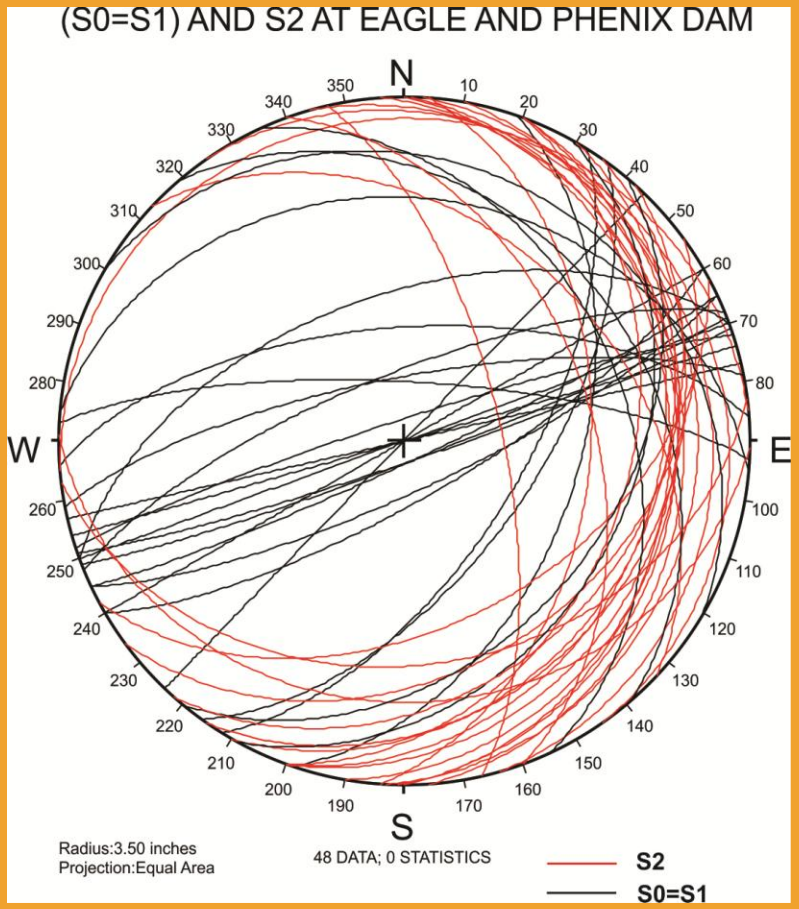
# STRUCTURES IN THE ROCKS




West side of Schamel's Island, looking east.

Subhorizontal to shallow dipping S2. This may have been enhanced by sheeting and weakened by weathering, thus is more likely to split.
Stereonet plotted using Netprog v.5 by David Allison

Steeply-dipping early foliation: S0=S1. This is a fairly tight structure in the rock; i.e., less likely to split.



# Structures west side of Schamel's Rock.

West-facing ledge west ofSchamel's Rock channel. Hornblende gneiss has vertical layering enhanced by thin, light-colored granitoid layers that are nearly concordant to foliation in the gneiss. The gneiss is cut by irregular shallow-dipping slip surfaces (S2) shown by red. layers are offset near and within these slip zones. Folding in the middle of the photo seems related to S2. Axis of fold is nearly horizontal, but the axial surface is steep.

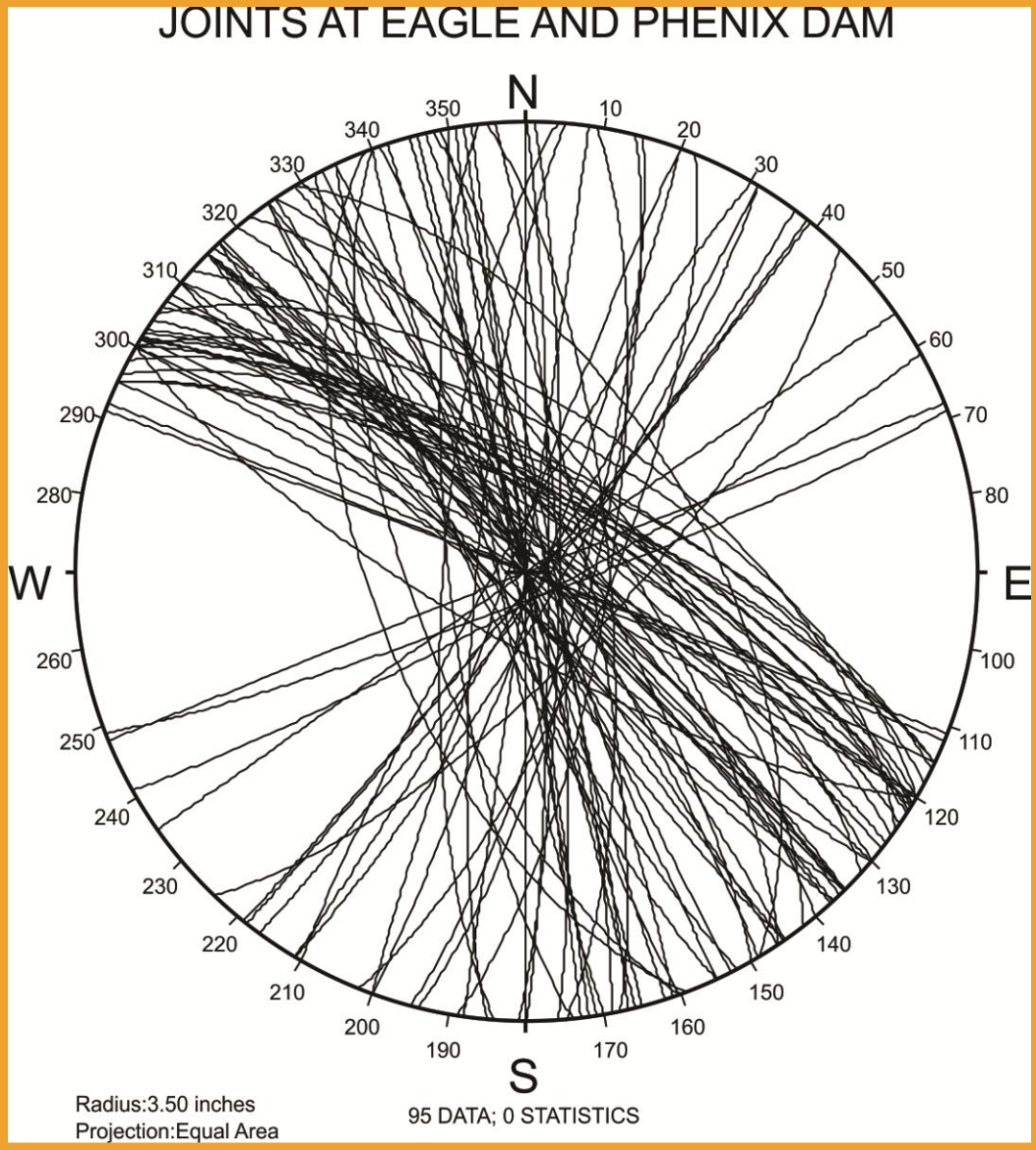
# Middle Island beach looking northeast

Near vertical layering are actually, in many cases, limbs of isoclinal folds.

Last known location of Brunton.

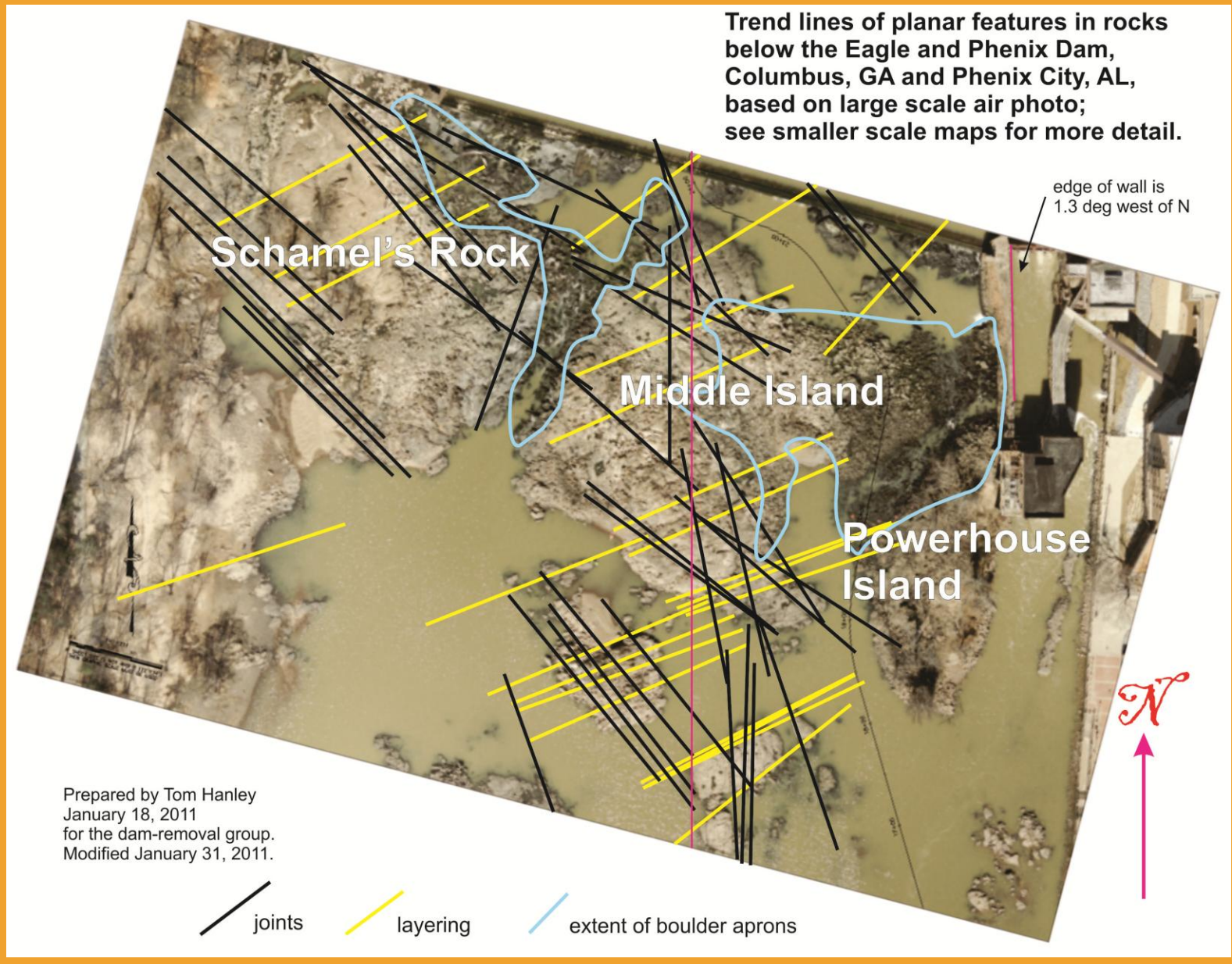
Intersecting joints and layering below the E&P Dam

Joints controlling pot holes.

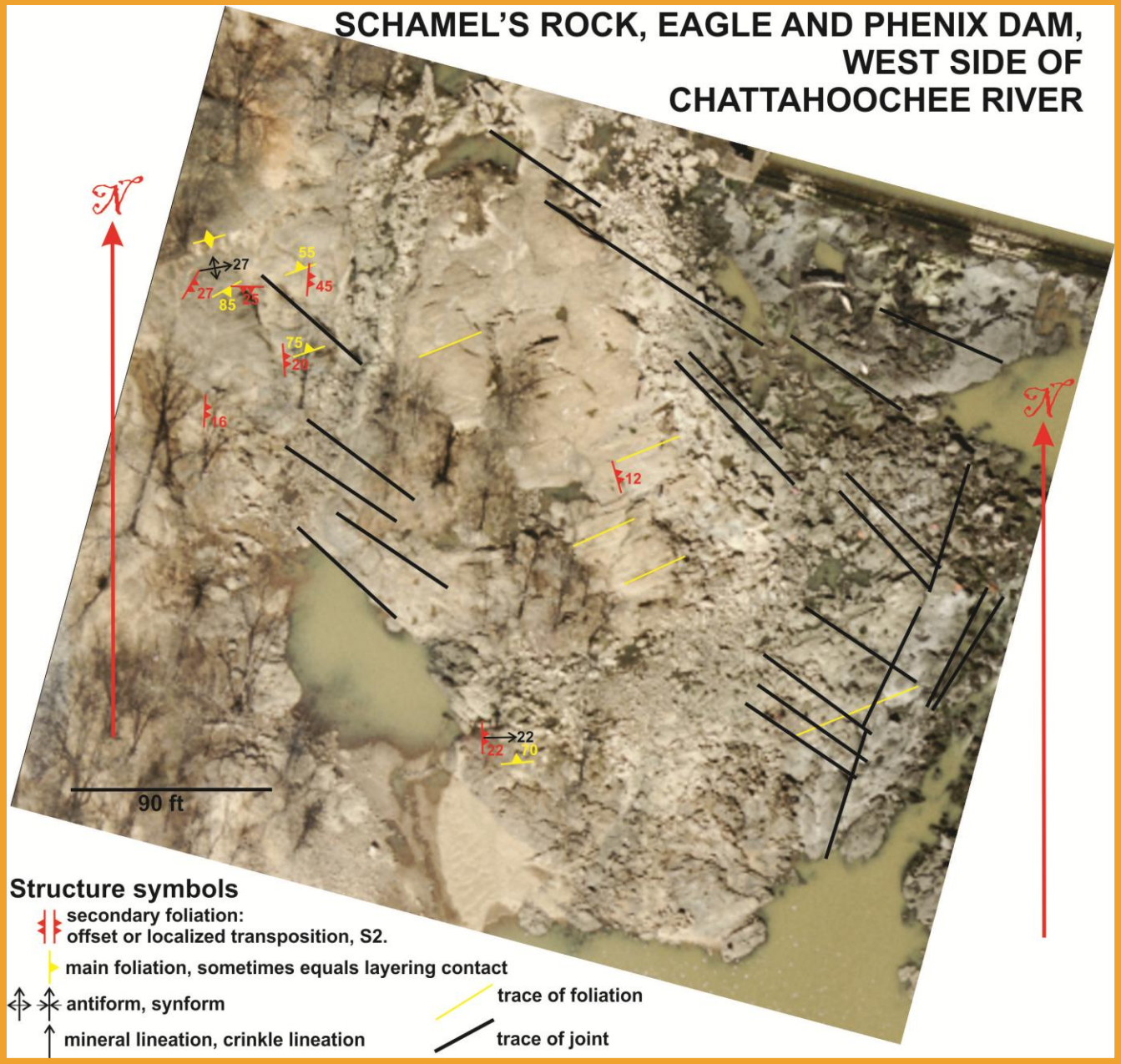



Stereonet plotted using Netprog v.5 by David Allison

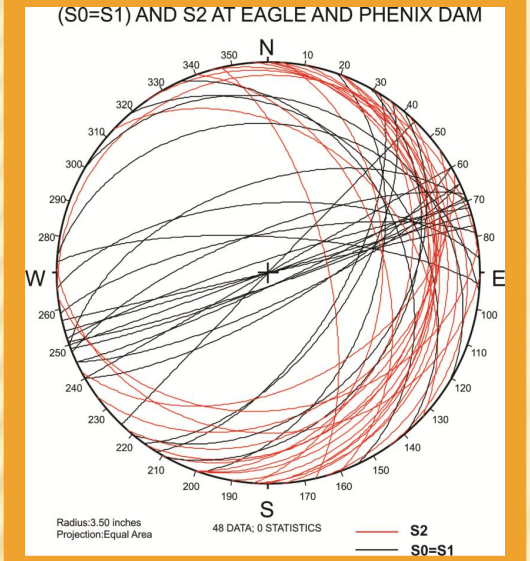
# Aerial Photograph of the Eagle and Phenix dam site



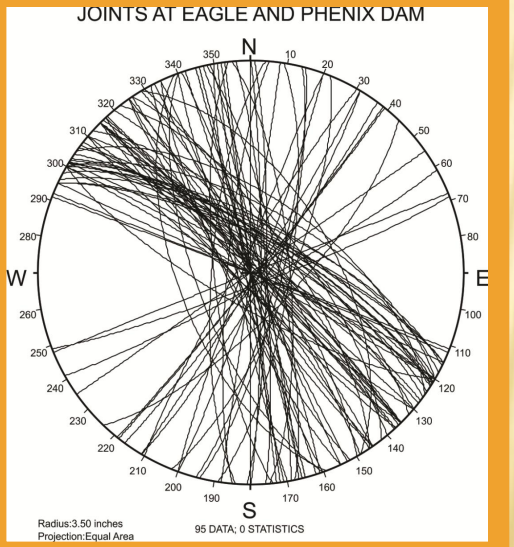
# Schamel's Rock



# Foliations and joints, Eagle and Phenix dam




S0=S1 and S2




joints

Structural summary:

- Foliations and joints intersect each other producing blocks
- The bedrock is solid and has a low permeability
- Joints and foliation are probably  tight at depth

Stereonets plotted using Netprog v.5 by David Allison

# PREDICTIONS BASED ON STUDY

After studying the outcrops below the Eagle and Phenix Dam, we conclude:

- Intersecting joints and foliation would provide enough slabs and blocks for modifying the channels.
- The low permeability of bedrock, joints and foliation will minimizing seepage during construction.
- Data on structures might prove useful in developing the blasting plan.

**How did these predictions work out?**

# Construction proceeds: Alabama channel  is widened  and deepened


Bottom of dry Alabama channel, looking east. Coffer dam at head of Alabama channel has allowed draining of the Alabama channel.

Excavation of Alabama channel led to discovery of a white mass dominated by quartz.

# Close-up of “angle plated” quartz in fracture zone.


1 inch

# Mineralized fracture sub parallel and adjacent to the Alabama channel

# Gray calcite + ?

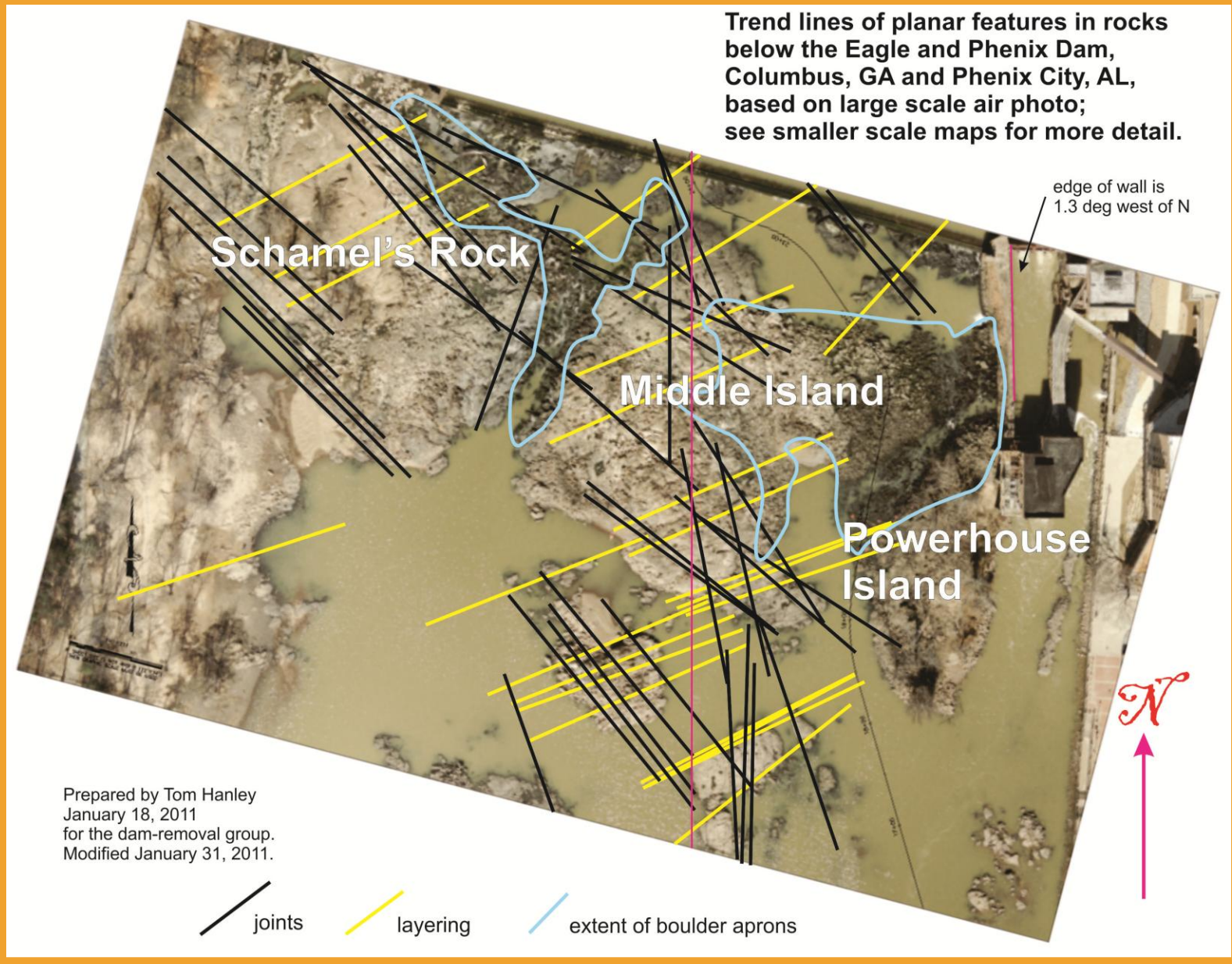

Note foliation in the orange joint-fill material indicating movement; west is towards top of photo.

# Broken gneiss where fracture bifurcates

White mass, oriented N15E, with mineralized N45W joint set.


Preliminary study did not detect the quartz mass, but we were able to put it in context.

# Aerial Photograph of the Eagle and Phenix dam site



Nearly complete entry gate for Alabama Channel; note big stone slab steps

Alabama Channel, upper invert sill.


Intersecting joints and S2 facilitated widening and deepening of channel.

Placing boulders in Alabama Channel for lower invert sill.

Watch your head! Engineer checking bottom topography for lower invert sill.


Upper invert sill in foreground.

Surveying channel bottom, lower invert sill.

Grout mattresses at end of Alabama Channel: the whitewater sill.

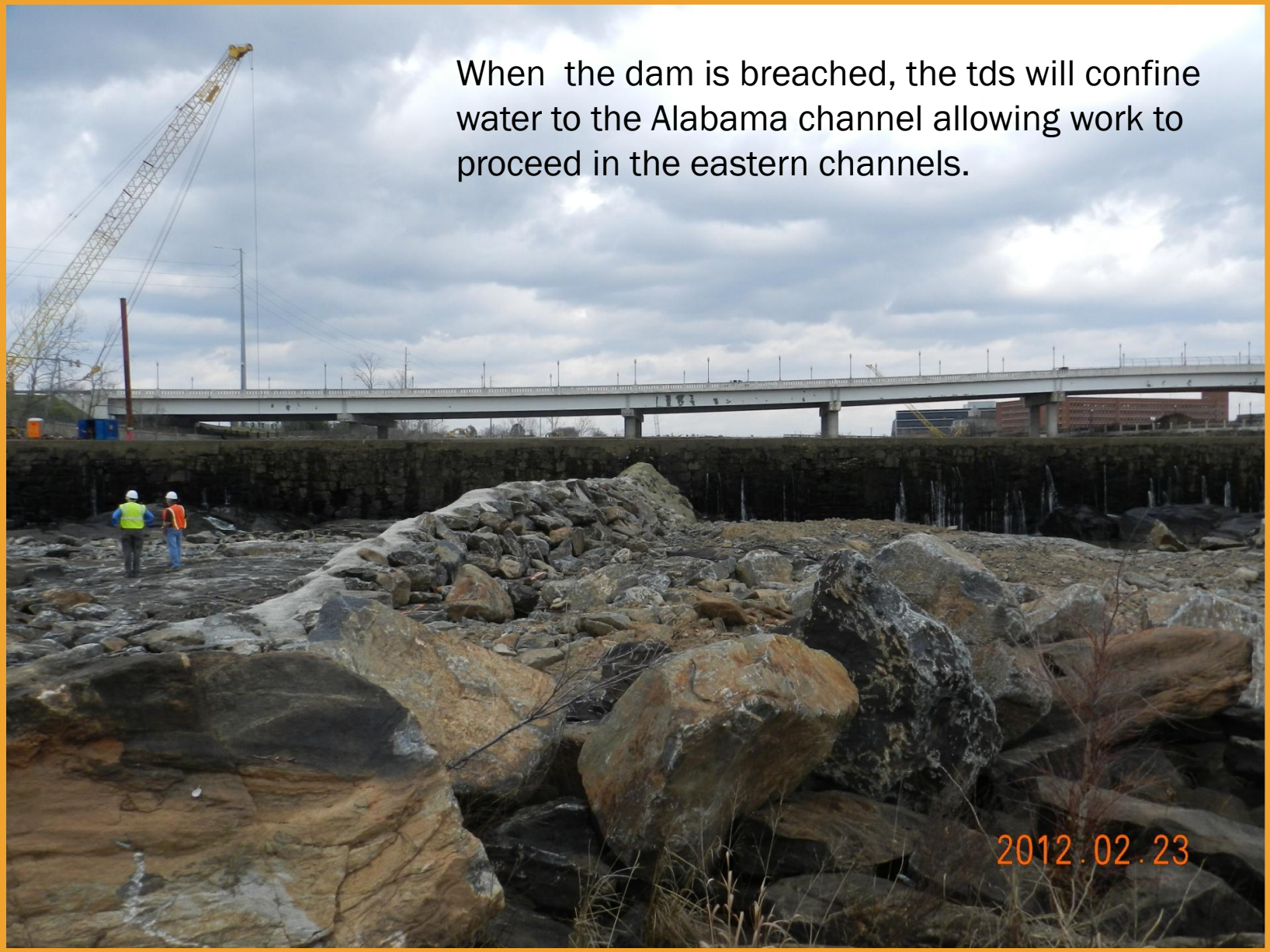
# EVALUATION OF PREDICTIONS

As the project proceeds, we have been able to see how our predictions worked out. The legacy of geologic studies has proved useful.

- Rock has broken as predicted providing blocks the right size and shape for channel shaping.
- The amount of local rock has been sufficient for most construction purposes
- Seepage has not been a problem
- Though the angle-plated quartz rock was not predicted, geological studies allowed us to put it in context.
- We should expect to see the angle-plated quartz joint set playing a role above the dam.

If you want to keep up with the project at Eagle and Phenix, look for the Whitewater project security camera: http://vsasecuritysystems.com/whitewater-project/

# Continued development: temporary diversion structure.



Dam is being drilled for placing charges.

Chain link drapes to control blast on west side of the TDS; Metal pipes are drill hole locations for charges.

Photo by Mike Haskey, Columbus Ledger-Enquirer
mhaskey@ledger-enquirer.com, March 20, 2012

Looking over the eastern channels towards the blast site from the powerhouse

From Ready 2 Raft website just before first breach, March 21, 2012

# First blast from downstream side of dam

Columbus Ledger-Enquirer website, March 21
Robin Trimarchi, rtrimarchi@Ledger-Enquirer.com

# First blast from upstream side of dam


Columbus Ledger-Enquirer website, March 21
Joe Paull, jpaull@Ledger-Enquirer.com

Post-blast; western wall broken, one more to go.

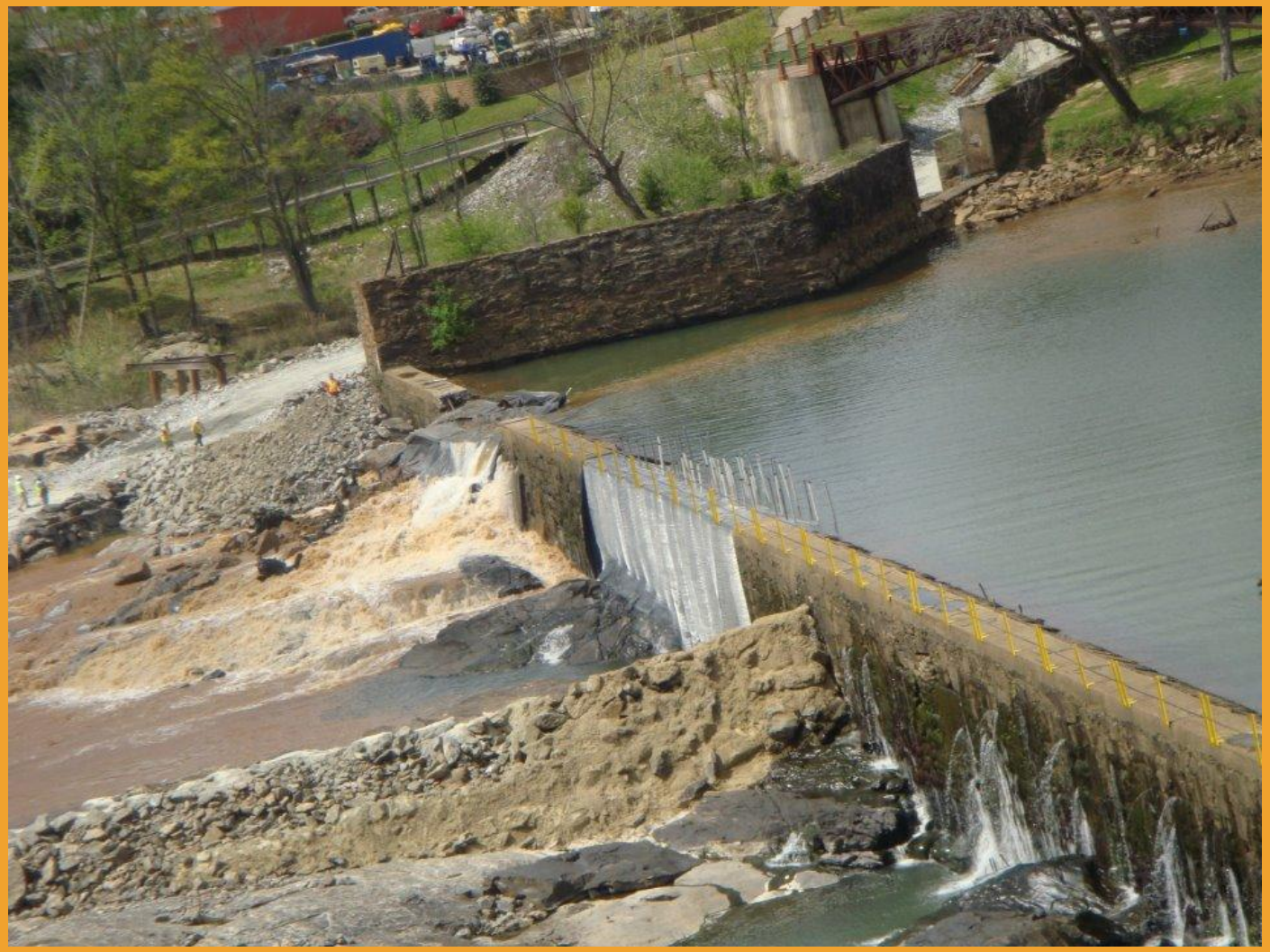


Photo from Eagle Phenix Facebook page, March 22, 2012.

Whitewater project security camera: http://vsasecuritysystems.com/whitewater-project/

Second breach, Sunday, March 25, 2012

This photo and following:Joe Paull, jpaull@Ledger-Enquirer.com

Joe Paull, jpaull@Ledger-Enquirer.com

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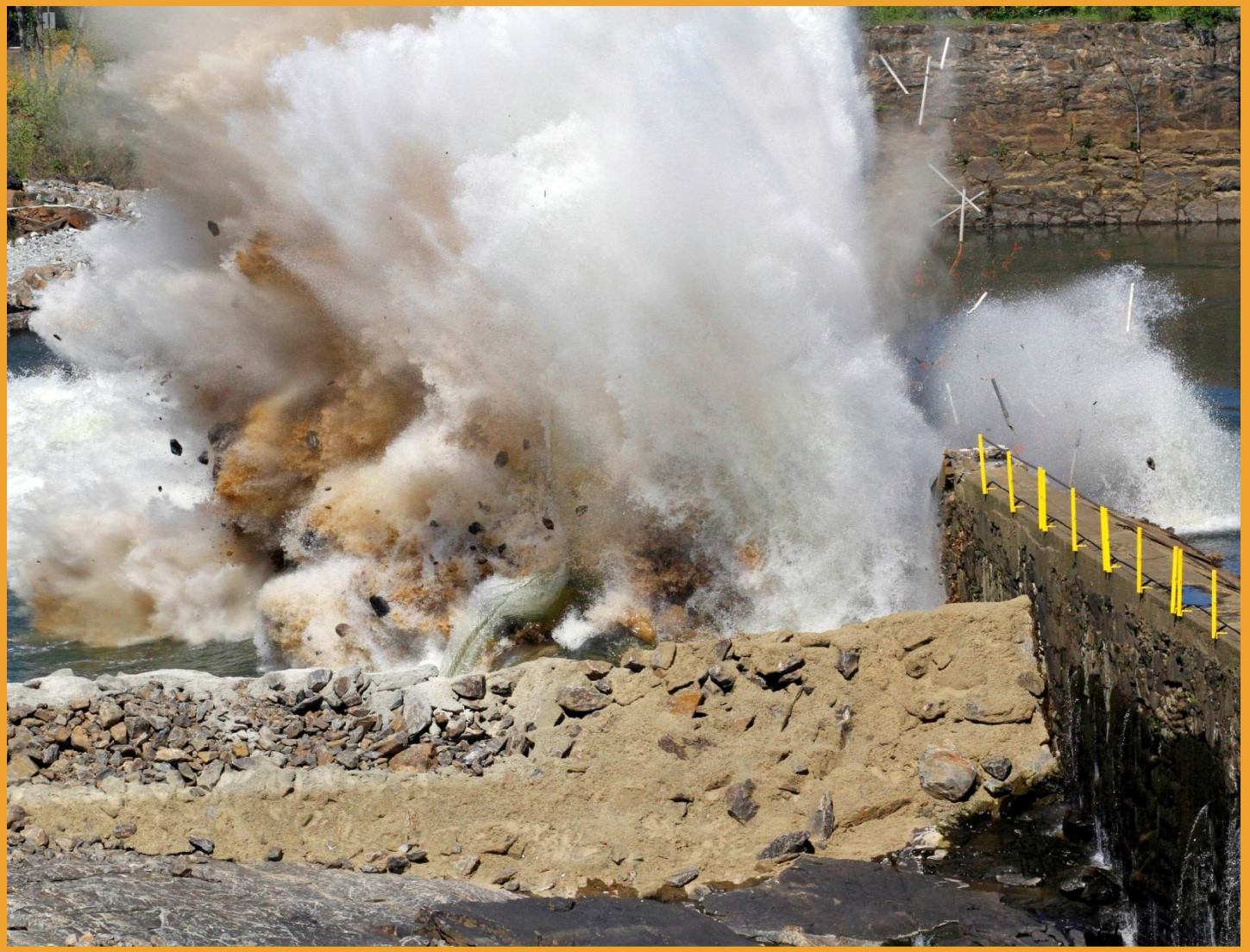

Joe Paull, jpaull@Ledger-Enquirer.com

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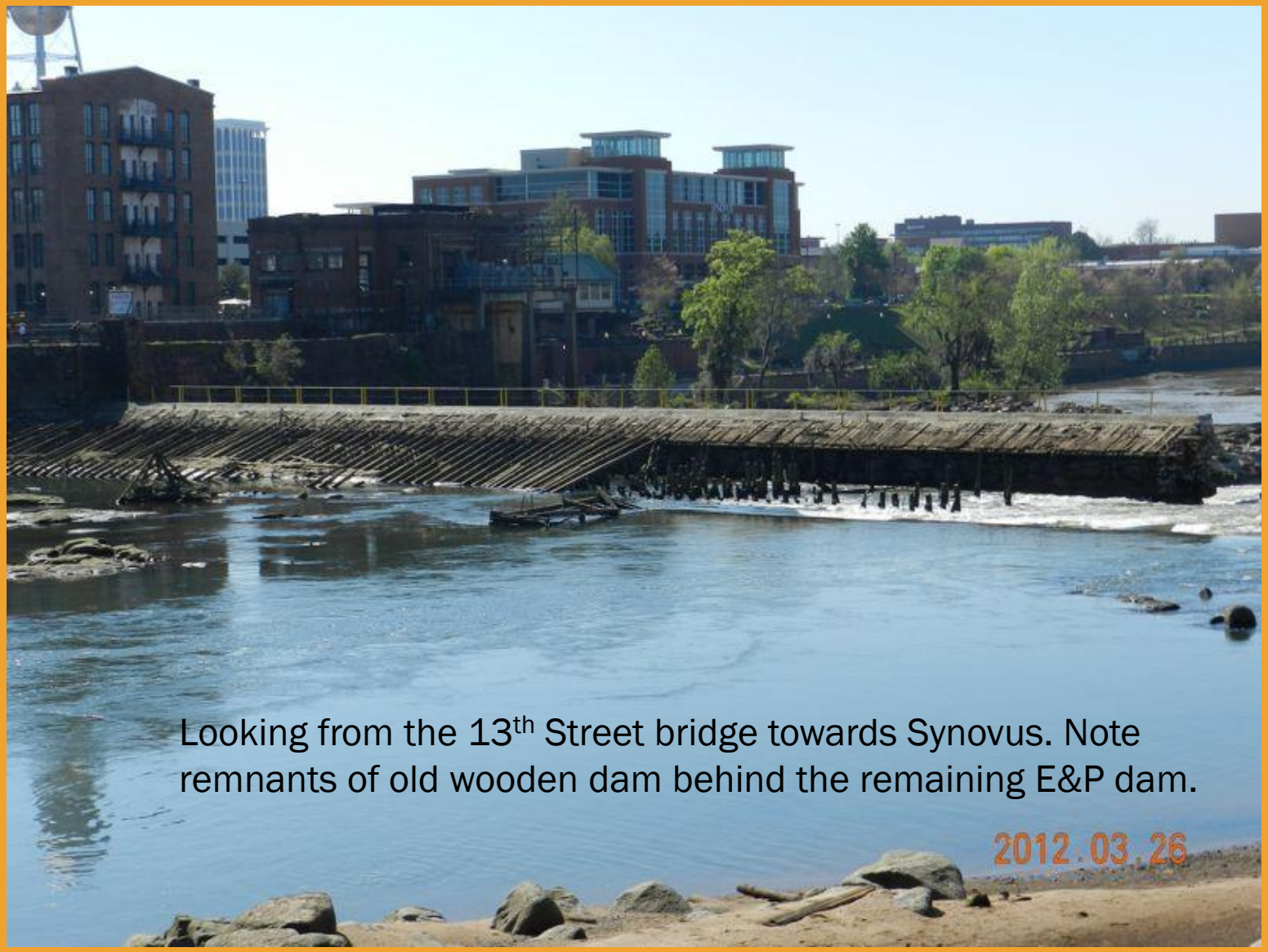
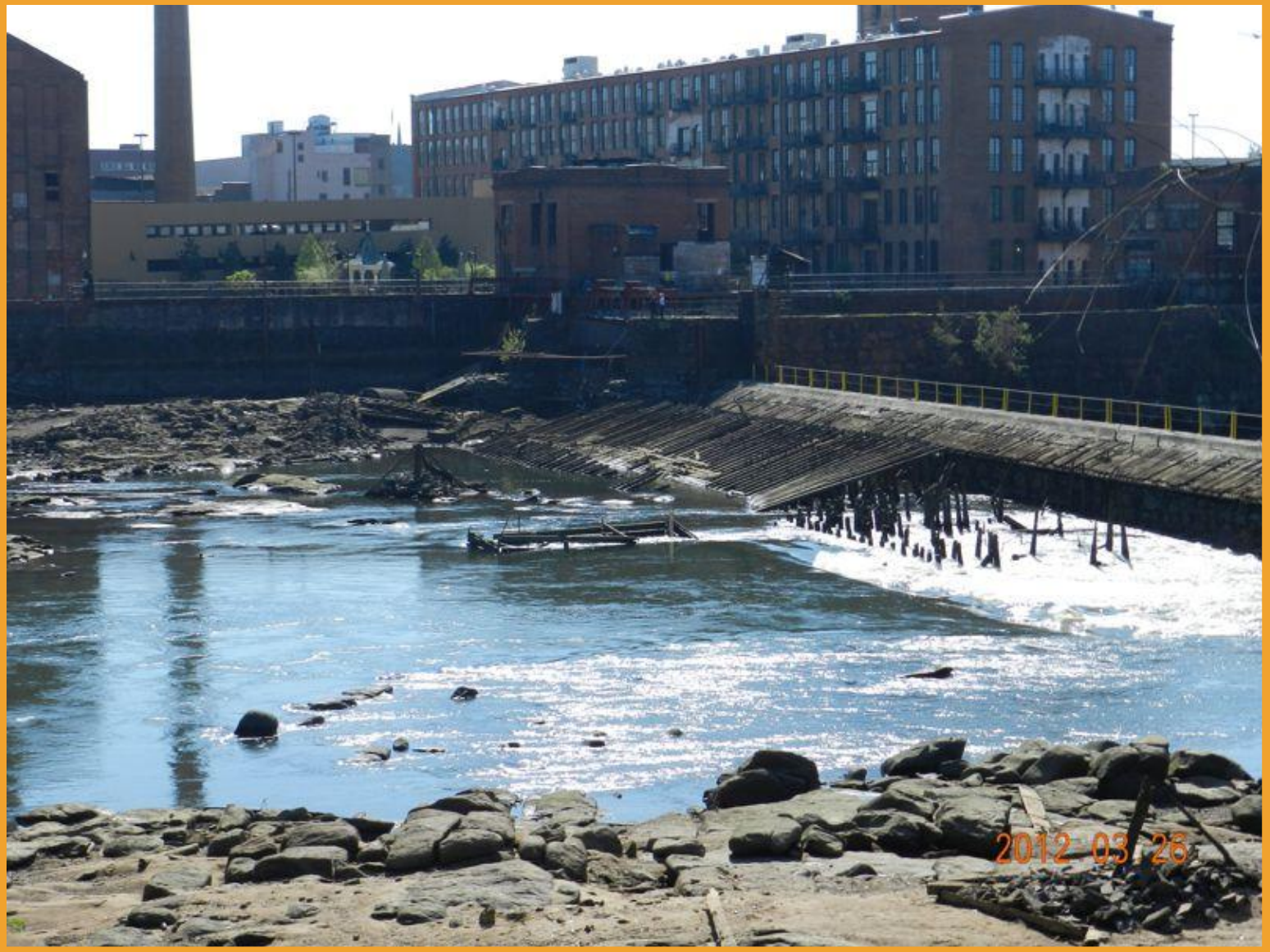
Joe Paull, jpaull@Ledger-Enquirer.com

This and the following four photos are post-breach.




Looking from the 13th Street bridge towards Synovus. Note remnants of old wooden dam behind the remaining E&P dam.




Eagle Phenix Condos beyond the dam

Water coursing through the Alabama channel


Entry gate is seen as the low fall in left side of photo.

Looking down the main channel to the breach and the Alabama channel beyond.

East edge of steep-walled channel at the N12W reading.


Joints in rock just east of the main channel: readings eyeballed from 13th bridge.

# Joints in outcrop above dam: eyeballed from 13th Street bridge.


N55W
N20W
2012.04.03

# Joints eyeballed from 13th Street bridge.


Powerhouse on left seems to have a boat ramp; linear structure may have directed water towards powerhouse.

# Looking northwest towards 14th Street bridge from 13th Street bridge

View upstream from 13th Street bridge


Bedrock above 13th Street bridge; old wall apparently directed water to E&P powerhouse. 14th Street bridge is being repaired for use by pedestrians. Railroad bridge and City Mills dam lies beyond. TSYS campus with first Columbus library building is upper right.

Jointed bedrock on north side of 13th Street bridge.


Strikes of joints eyeballed from 13th Street bridge.

# Ready to raft!!!

Angle-plated quartz with dog-tooth spar calcite  filling voids: photo and id by Julian Gray, Tellus Science Museum, Cartersville, GA.

Photo by Julian Gray at Tellus Science Museum; magnification is 6.5X , field of view is 24mm.

Hi Tom

Well after tormenting myself that this putative zeolite would be an optical mineralogy research project, I finally decided to buckle down and do the work. Quick macroscopic observation told me this wasn't a zeolite. It is calcite!

The crystals are elongated, acicular and tapered to a sharp point; a common habit of calcite, but not zeolite. It effervesces in dilute HCl, has high birefringence, and rhombic cleavage. To nail it, I did a cursory check of lowest $n_D$ and found it is close to 1.480. Easy! Most of the calcite was dirty with inclusions, but I found a large, clean piece for the optical work.

Photos forthcoming, but I made an interesting observation of what I'm calling the angle plate quartz.

So this was my original hypothesis of paragenesis:

1. Host rock is brittley fractured.
2. Quartz deposited hydrothermally(?) in fractures
3. Host rock weathered to leave geometric arrangement of tabular quartz, and in this case
4. Calcite deposited in open space.

So what I observed is a later stage growth of drusy quartz on tabular hydrothermal quartz; quartz crystal terminations growing into the open space, away from the hydrothermal quartz. Furthermore, in at least one instance one tablet ended in an open space and drusy quartz completely surrounded the plate. This is probably easily to explain in this paragenesis:

1. Host rock is brittley fractured.
2. Quartz deposited hydrothermally(?) in the fractures
3. Host rock weathered to leave geometric arrangement of tabular quartz (some ending in open space)
4. Tabular quartz overgrown by drusy quartz
5. Calcite deposited in the open space.

What great fun. I will document the above in photos and send them along.

Cheers

Julian Gray

Julian Gray's thoughts on the origin of the angle-plated quartz and calcite crystals in the voids, i.e., paragenesis. April 17, 2012.

Julian used a special technique for producing these striking photos. As I understand it, he photographed the samples focusing at different levels, then combined the images digitally to produce the great depth of field.

Angle-plated quartz covered by drusy quartz; dog-tooth spar calcite fills voids: photo and id by Julian Gray, Tellus Science Museum, Cartersville, GA.

Photo by Julian Gray of Tellus Science Museum; magnification is 12.5X, field of view is 12 mm.

Dog tooth spar calcite in voids between angle-plated quartz ; photo and id by Julian Gray, Tellus Science Museum, Cartersville, GA.

Photo by Julian Gray of Tellus Science Museum; magnification is 20x, field of view is 7.5 mm.

## References cited in the presentation:


Schamel, S, Hanley, T.B., Sears, J.W., 1980, *Geology of the Pine Mountain Window and Adjacent Terranes in the Piedmont Province of Alabama and Georgia*: Geological Society of America, Guidebook, 29th Annual Meeting, 69 pp.

Hanley, Thomas B., 1986, Petrology and structural geology of Uchee Belt Rocks in Columbus, Georgia: Geological Society of America Centennial Field Guide – Southeastern Section, p. 297-300.

Huebner, Michael T., and Hatcher, Robert D., 2011. Evidence for sinistral Mesozoic inversion of the dextral Alleghanian Towaliga fault, Central Georgia, in Georgia Geological Society Guidebook, v. 34, pp. 55-72


## Photos and articles from the Columbus Ledger-Enquirer site:

Mike Haskey, April 7, 2012 - http://www.ledger-enquirer.com/2012/04/07/2003570/whitewater-update-a-look-upstream.html#storylink=misearch

Tim Chitwood article - http://www.ledger-enquirer.com/2012/03/30/1994268/whitewater-project-outfitter-praises.html#storylink=misearch

Dennis M. Jones historic post card collection - http://www.ledger-enquirer.com/2012/04/07/2003595/chattahoochee-river-postcards.html#storylink=misearch

Tim Chitwood article - http://www.ledger-enquirer.com/2012/04/07/2004019/drained-riverbed-reveals-relics.html#storylink=misearch