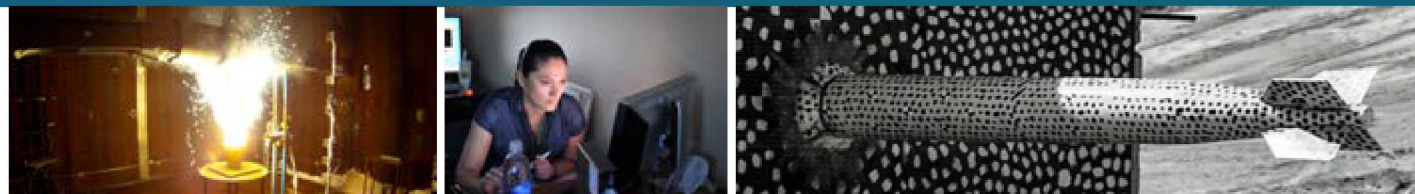


In-stream Hydrokinetic Testing in an Irrigation Canal



Center 8800 - Energy & Earth Systems Symposium

PRESENTED BY

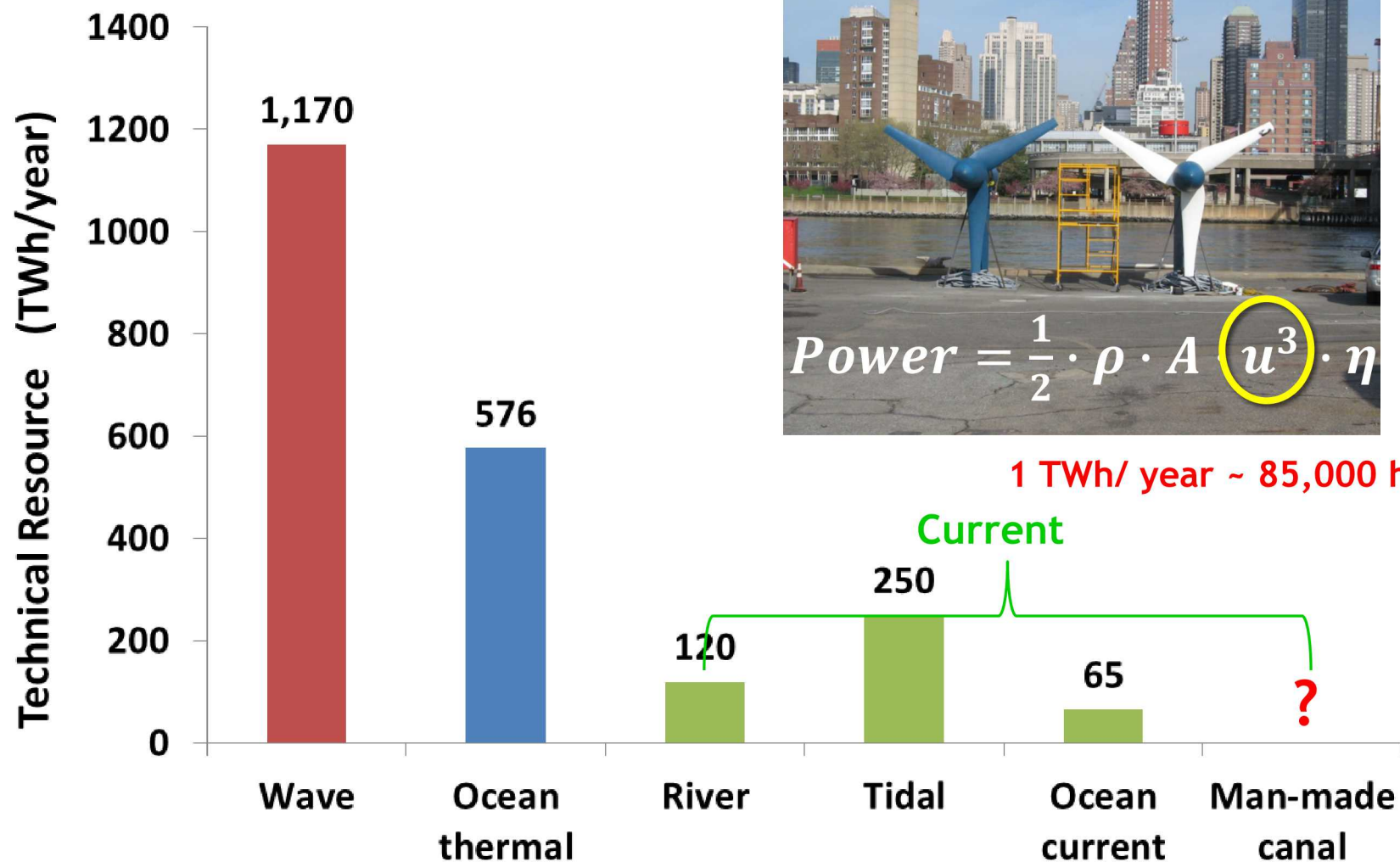
Budi Gunawan

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Hydrokinetic (HK) Intro: Resource



Electricity use in the US = 4,000 TWh/year

Potential Effects of HK Deployment



Questions:

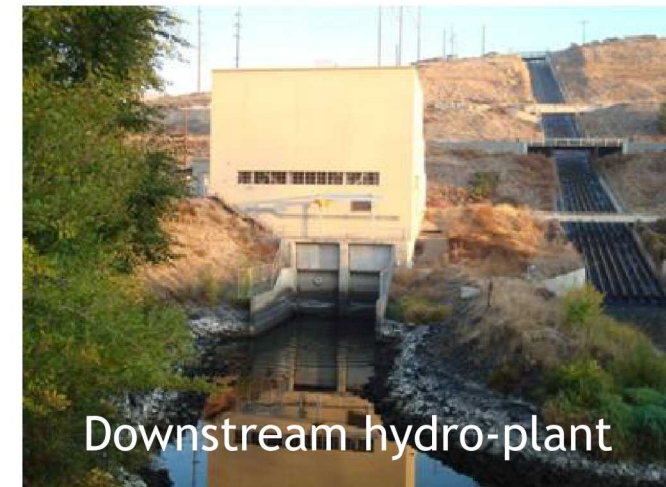
- Increase of water level?
- Downstream effect?
- Aquatic organisms?
- Pumping cost?



Objectives:

Use USBR's Roza Main Canal as an "outdoor laboratory" for HK testing:

- Determine hydrodynamic effects of HK operation – field measurements (water level, velocity, energy grade line)
- Use field measurements for numerical model validation (SNL-Delft3D) (hydrodynamic effects, turbine performance, array optimization)



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Instream Energy Systems, Corp. (**Shane Grovue**): turbine performance characterization and demonstration testing



Reclamation (**Josh Mortensen, Bryan Heiner**): hydraulic impacts to canal system and HEC-RAS numerical modeling

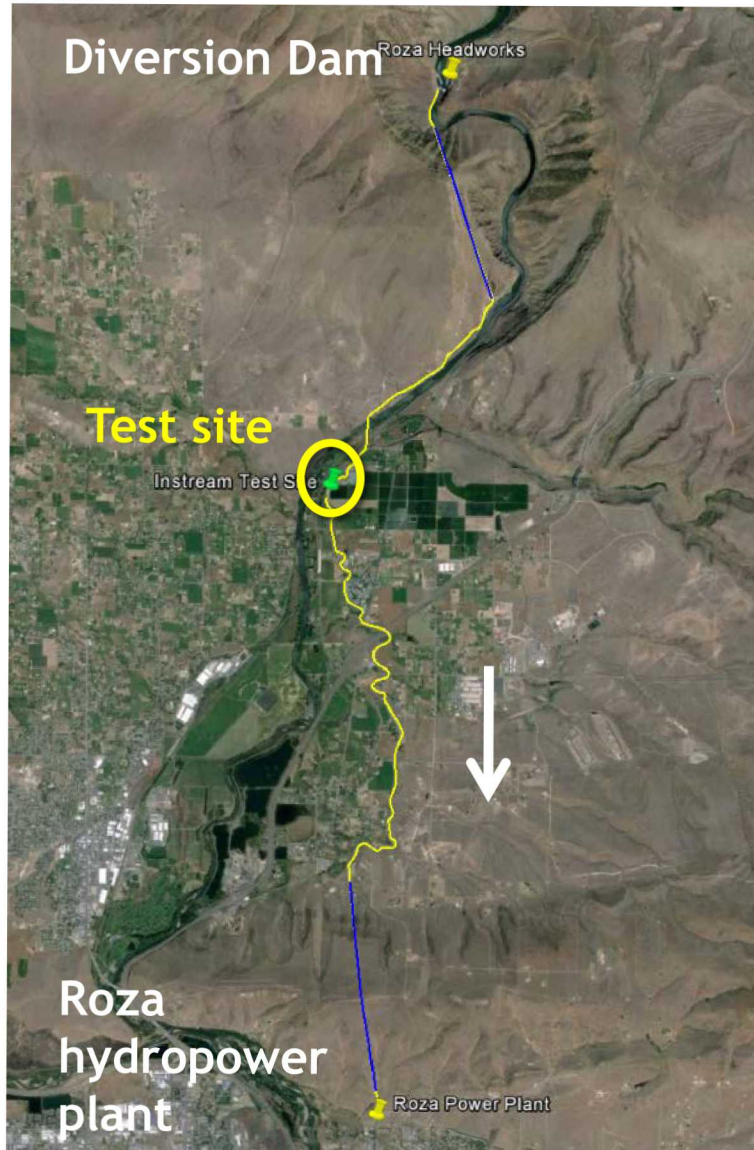


Sandia National Laboratories (**Budi Gunawan, Jesse Roberts, Vincent Neary**): near field hydrodynamics, Delft3D numerical modeling, turbine performance characterization

Case Study: Instream hydrokinetic (HK) turbine at Roza Canal, Yakima, WA



Study site





Hobo logger (Water level)



ADCP (Velocity & flow discharge)



ADV (Turbulence)



Remote control boat with RTK GPS



Tethered ADCP boat

Disclaimer:

The use of trade, product, or firm names in this paper is for descriptive purposes only and does not imply endorsement by the U.S. Government

View from above the rotor



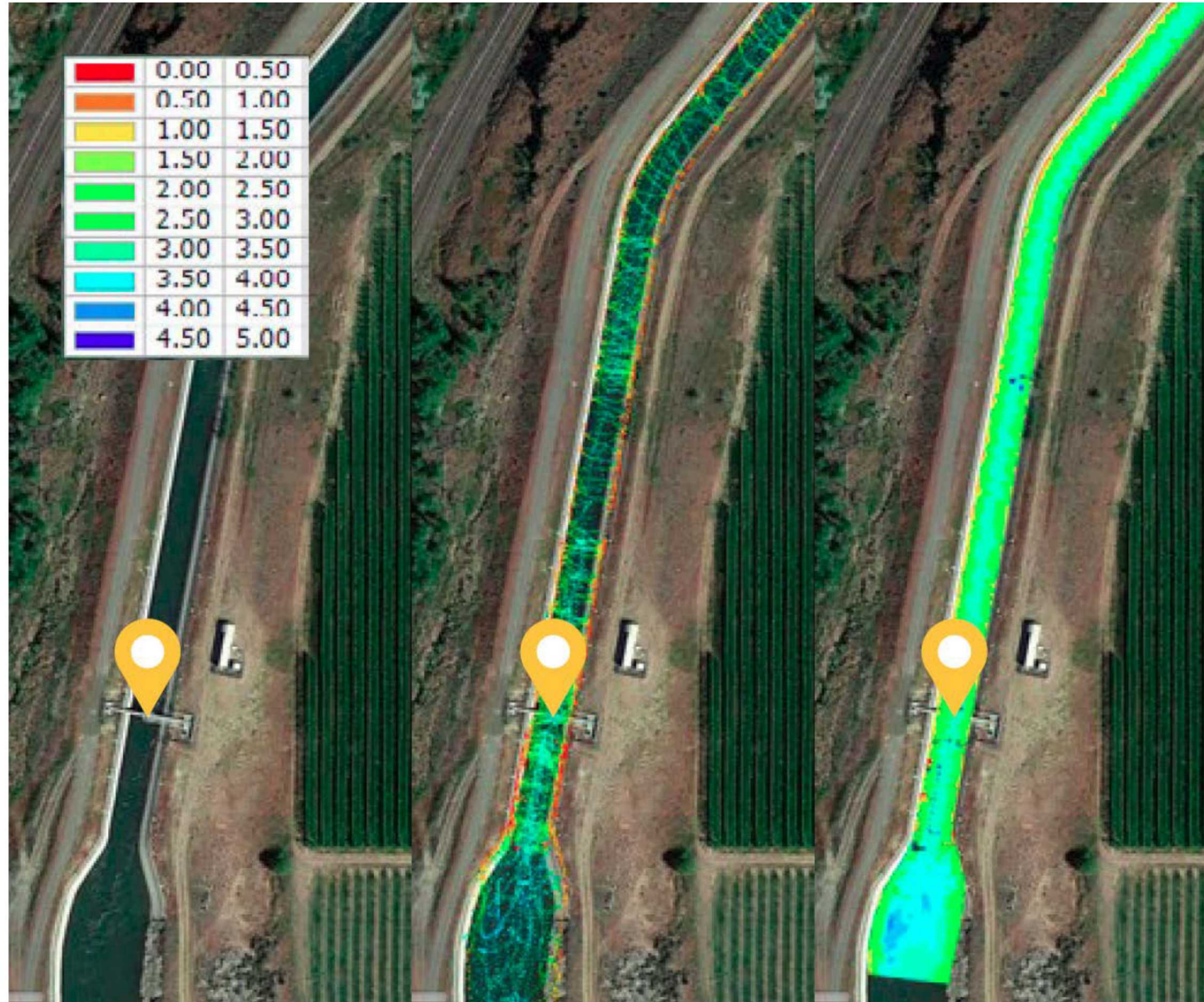
Velocity and bathymetry survey



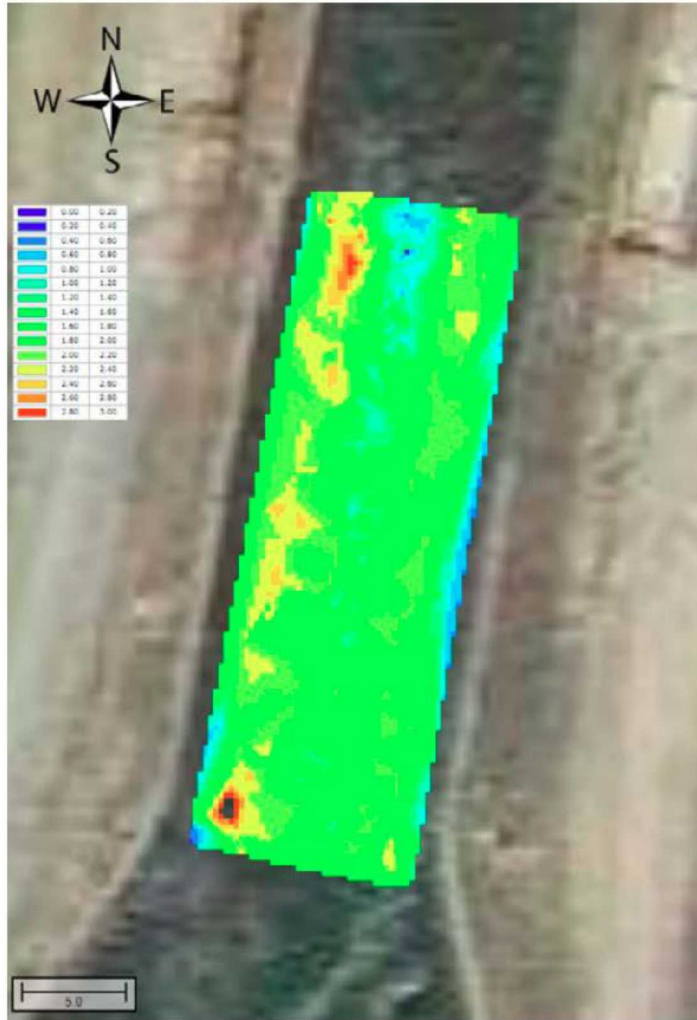
Velocity and bathymetry survey



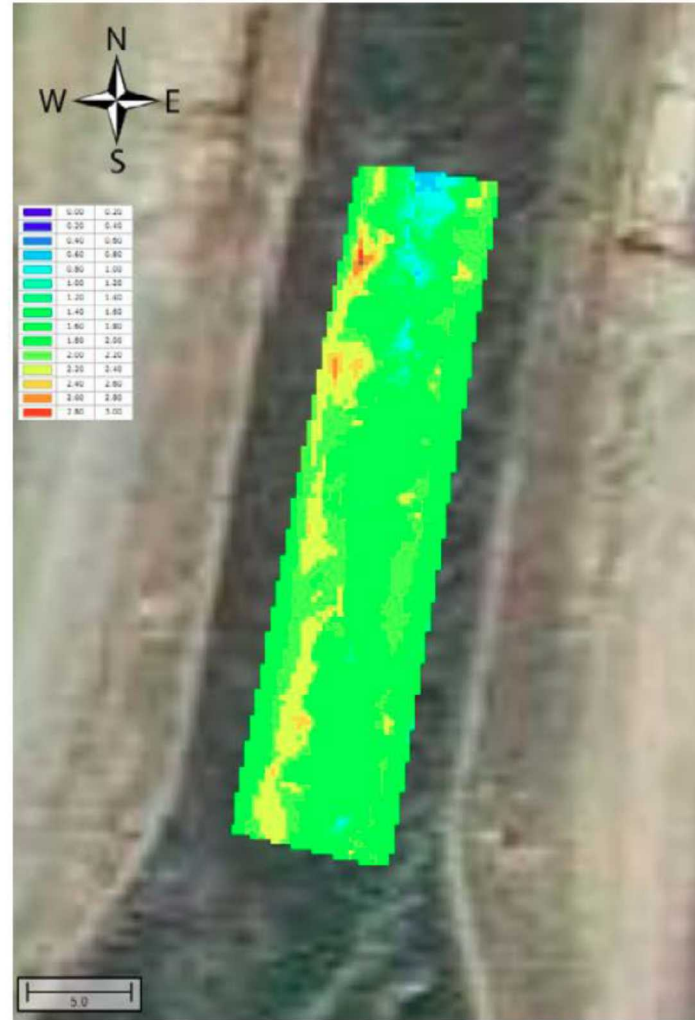
Bathymetry measurements



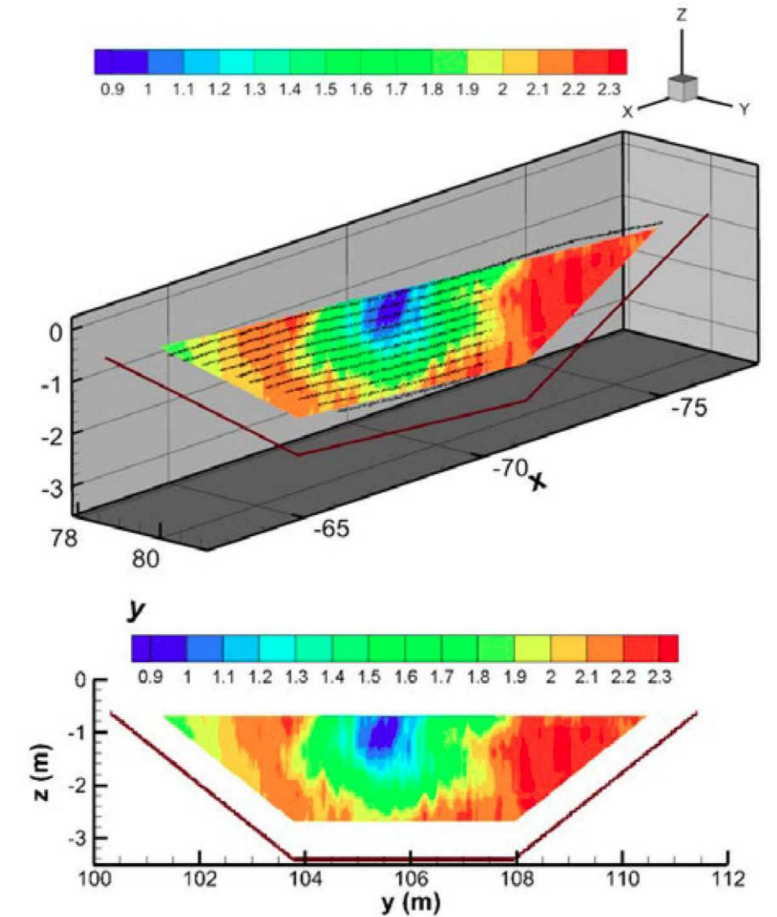
Velocity measurements



Water surface

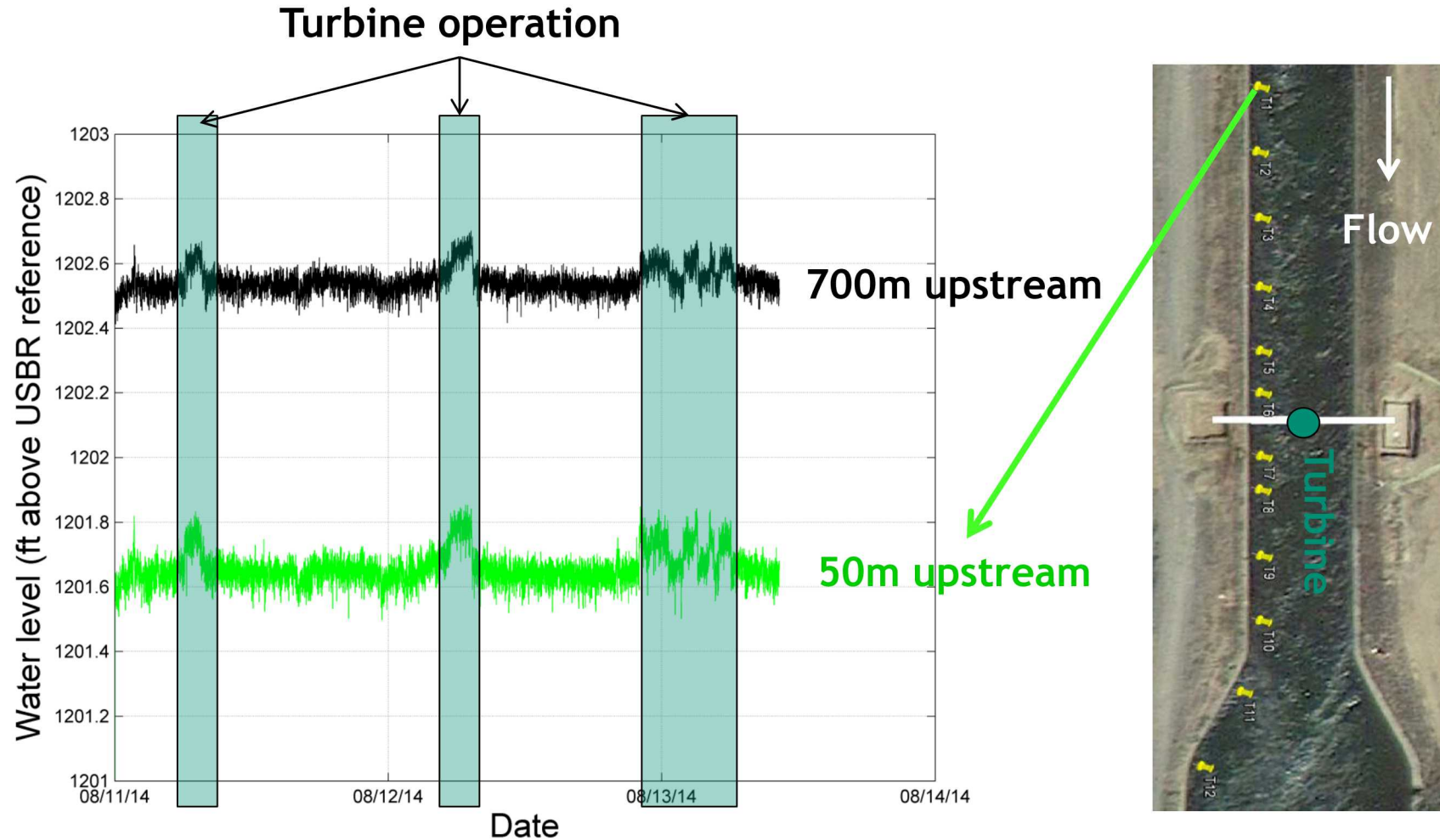


Rotor mid-span



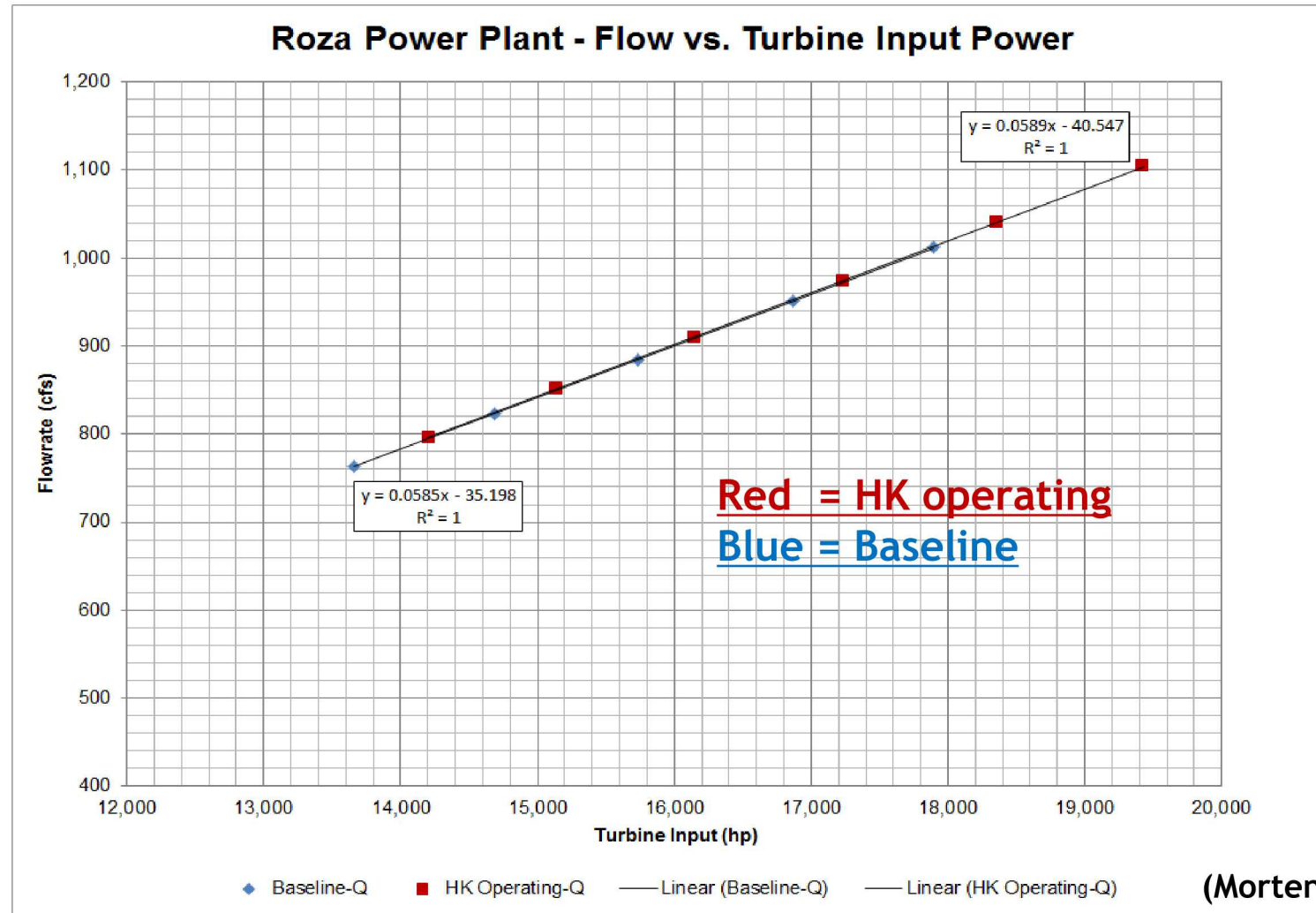
Near-wake velocity

Impact on water level



Small water level increase upstream of the turbine

Impact on Roza hydro-plant power generation

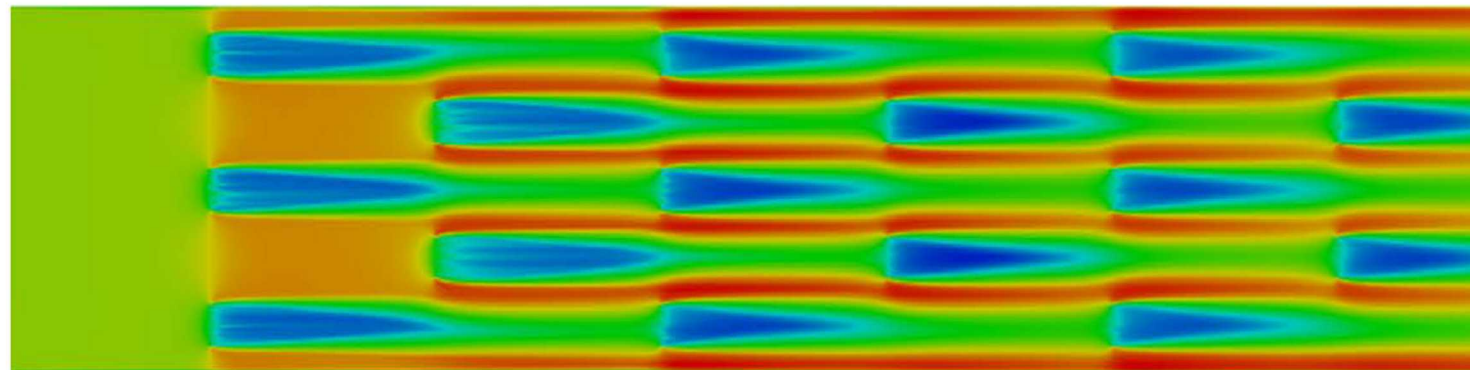
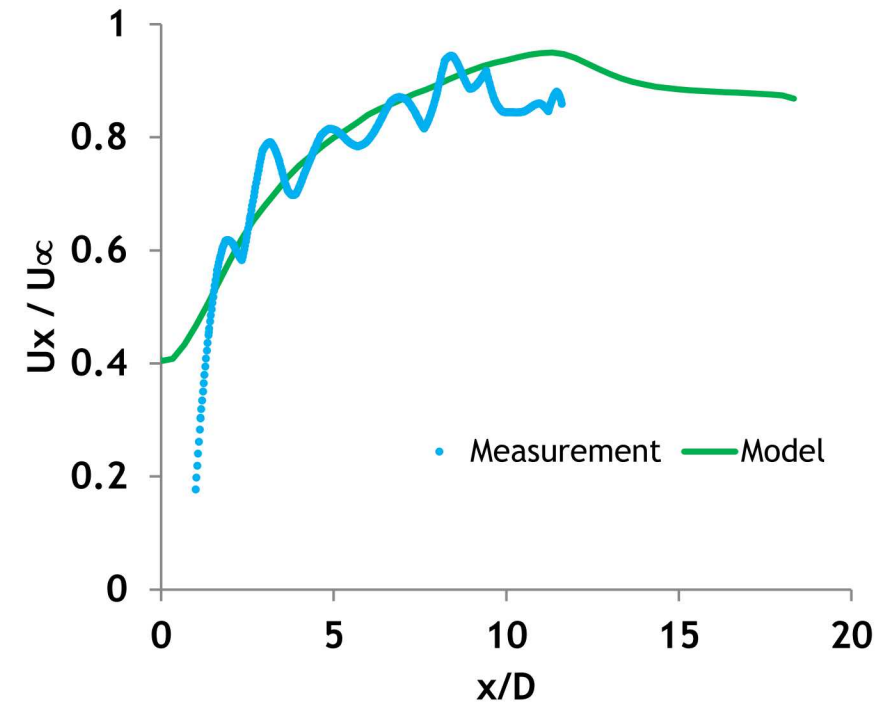
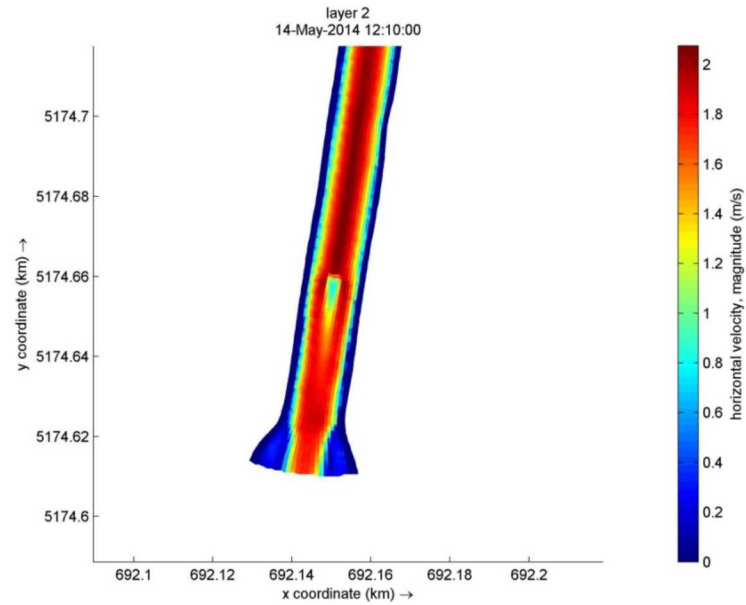


No impact on Roza Power Plant power generation

Single turbine simulation



SNL-Delft3D model

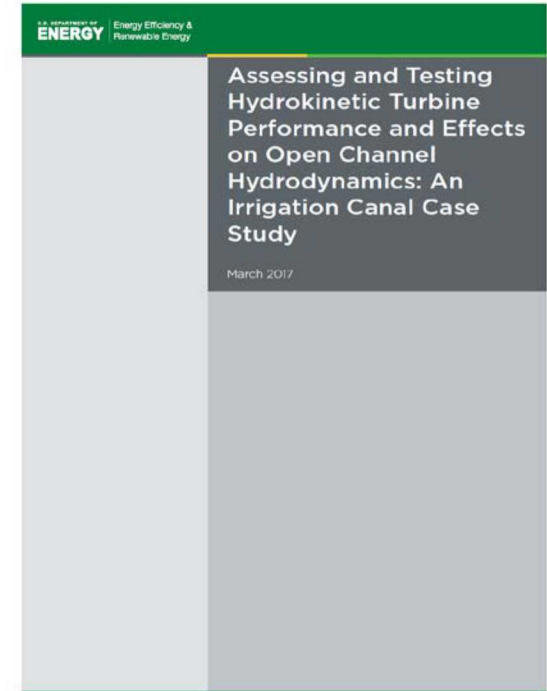


Conclusions

- Exceed free-board limitation? Flooding?
Slight increase in water elevation upstream, not exceeding free-board limitation. No flooding.
- Decrease hydropower production?
No impact to Roza power plant
- Increase pumping cost?
Energy Grade Line analysis - to be done using numerical modeling

Future works

- DOE FOA 2080:
Sandia leads the development of the hydrokinetic call topic & will support FOA awardees (2019 - 2022)
- DOA FOA 1663:
Sandia is a sub-awardee, and will assist Ocean Renewable Power Company on testing their current turbine (2018 - 2020)



Questions ?

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