

DIGITAL MAPPING TECHNIQUES 2020

**The following was presented at DMT'20
(June 8 - 10, 2020 - A Virtual Event)**

The contents of this document are provisional

**See Presentations and Proceedings
from the DMT Meetings (1997-2020)**

<http://ngmdb.usgs.gov/info/dmt/>

Producing tsunami simulations with ArcGIS Pro and Adobe Creative Suite

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Using time series data produced by numerical models of tsunami inundation we created simulation videos as an informative product for the public. This process used tools in ArcGIS Pro and the Adobe Creative Suite to produce a final product that is informative, visually appealing, and fully accessible to the public. This lightning talk walks through the process and discuss several challenges that were overcome to achieve successful completion of the project. Author notes summarizing the content on each slide is available within the PDF by clicking the note icon in the upper left corner of the screen. The list below also contains the text by slide. Tsunami simulation videos published by the Washington Geological Survey can be found at the link below.

<https://www.dnr.wa.gov/programs-and-services/geology/geologic-hazards/tsunamis#tsunami-simulation-videos>

Slide 1. -- Title Slide

Slide 2. -- The largest threat in the Pacific Northwest is the Cascadia Subduction zone.

The Cascadia Subduction Zone is a large megathrust fault where the oceanic Juan de Fuca Plate meets the continental North American plate.

This fault has produced large tsunami-inducing earthquakes in the past and will again in the future.

These earthquakes are known to go back at least 10,000 years, with the average interval between earthquakes is 240 years, and the average interval between large earthquakes, magnitude 8.5 or greater, is between 500 and 600 years.

The last large Cascadia earthquake was on January 26, 1700, and we know the precise date because there are written records in Japan of the resulting tsunami that traveled across the Pacific.

Slide 3. -- An now to zoomed in views showing details on the Westport Peninsula.

The map on the left shows binned inundation, with yellow showing inundation of zero to 2 and a half feet, light orange showing 2 and a half to 6 feet and dark orange showing inundation of 6 feet and above, which is most of the map.

The map in the center shows a more detailed continuous inundation raster, with spot values in certain areas. You can see a shocking modeled water depth of 53 feet near the middle of the image.

The map on the right shows current speeds with the purple areas being the fastest at 9 knots and above.

Slide 4. -- Another challenge is our long and complicated coastline. Washington has over twice as much coastline as our neighbor to the south, Oregon, does. The narrow waterways of the Salish Sea and Puget Sound complicates data results where model resolution exceeds channel width. It also can make map layout tricky, depending on the study area.

Slide 5. -- And finally to our most recent map product, tsunami simulation videos.

These simulations provide an understanding of tsunami physics, mechanics, and movement that static maps and data do not.

The main takeaway from these is that tsunami waves can continue for hours after an earthquake and that it is not just a single wave event. These videos are also meant to be viewed more than once.

We have produced 9 simulations so far at various locations and scales showing wave amplitude and current velocity. They are on Washington Department of Natural Resources YouTube page as well as our website, where you can download the videos directly.

NetCDF files were produced using modeling software. They were animated in ArcGIS Pro, and imported into Adobe After Effects where contextual data and maps were added for the final video.

We have more on the way in the next month. The statewide amplitude video received more than 140,000 views in the first week after release.

Slide 6. -- Follow link to WGS Youtube page where tsunami simulations are posted.
https://youtu.be/e5PJQW_6k6M

Slide 7. -- Example of the time function in ArcGIS Pro. Can also be a range if not working with time dependent data a works on both raster datasets and feature classes.

Slide 8. -- ArcGIS Pro has the standard tools for setting up the scene like any GIS session, however the time series data can be tied to Dynamic Text, set to a moving path to track features, and have overlays turn on an off at various time steps for labeling or other enhancements.

Slide 9. -- Thumbnail image of each time step can be viewed on the Animation Timeline window. Various animation properties and controls can be found on the ribbon bar and right window.

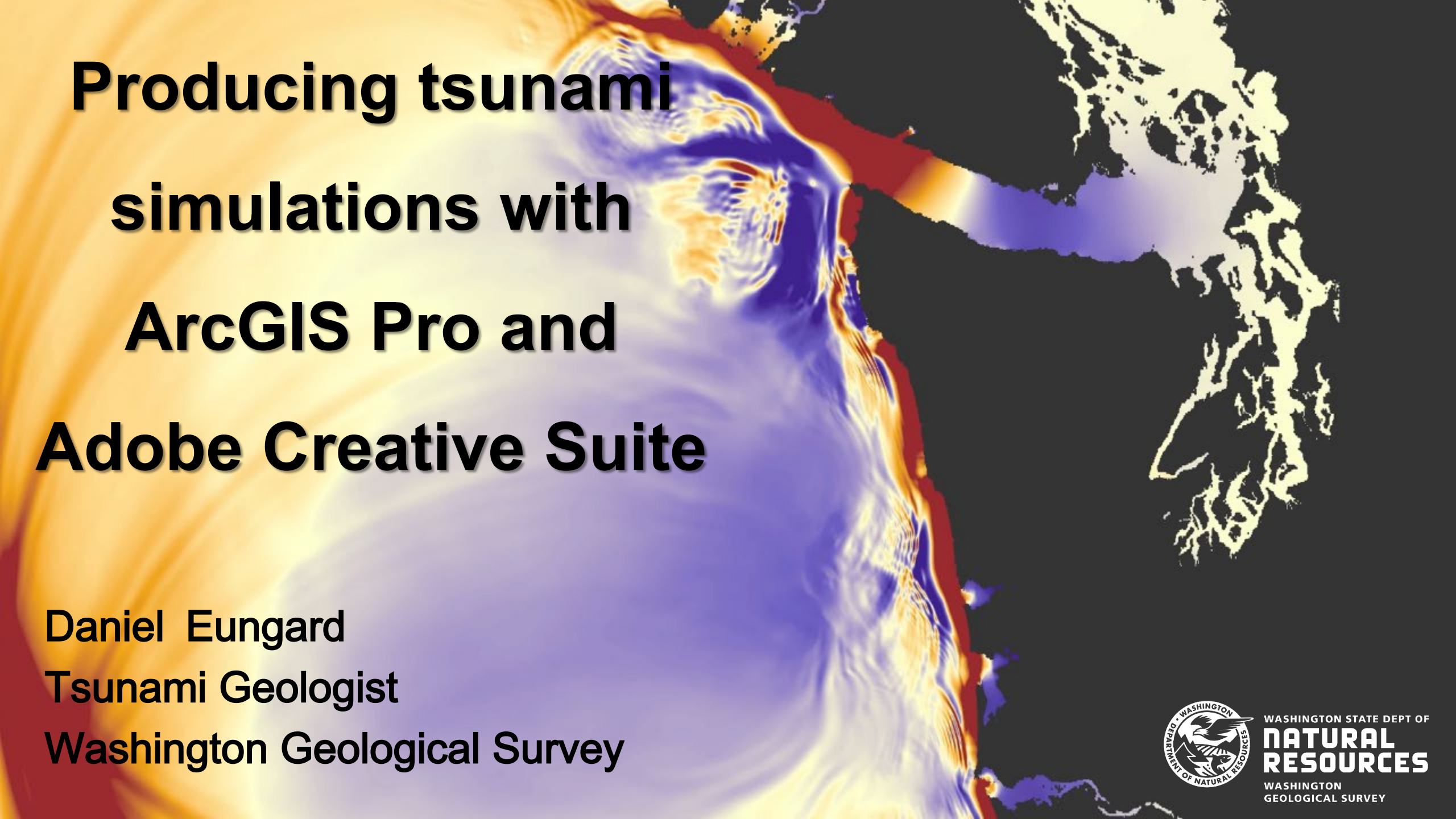
Slide 10. -- Numerous export options are available directly to social media accounts or to local disk with a wide range of resolution options to choose from. Careful attention should be paid to the Frames Per Second option. If you chose too low of an FPS option compared to the frequency of your time steps the animation will produce a jerky or stuttering effect that is visually unappealing. On the other side of things too high a FPS for your input time series will not produce any visual enhancements to the video and drastically increase the file size.

Slide 11. -- At this point you could be done having done all the necessary work in GIS to produce a visually appealing animated map product. However, further enhancements are possible using a post GIS editing software. For this the WGS used Adobe After Effects.

Slide 12. -- After Effects in conjunction with other Adobe products (Photoshop/Illustrator) provide a more robust method of building overlays, labels, and transitions than ArcGIS could alone. Together they can be integrated into a visually stunning product that helps communicate the data to the user.

Slide 13. -- To summarize: Geologic processes often take time or occur in a sequence. These processes are either short term or long term but either can be expressed with a time/sequence driven data series. This extra dimensionality of the geology is often lost or poorly conveyed in static map products. Consider your institution and the data that you routinely work with. What could you do to visualize it better and drive a deeper understanding of the science to the end user?

Slide 14. -- Contact of authors and lead developers of WA State tsunami simulation product.



Producing tsunami simulations with ArcGIS Pro and Adobe Creative Suite

Daniel Eungard

Tsunami Geologist

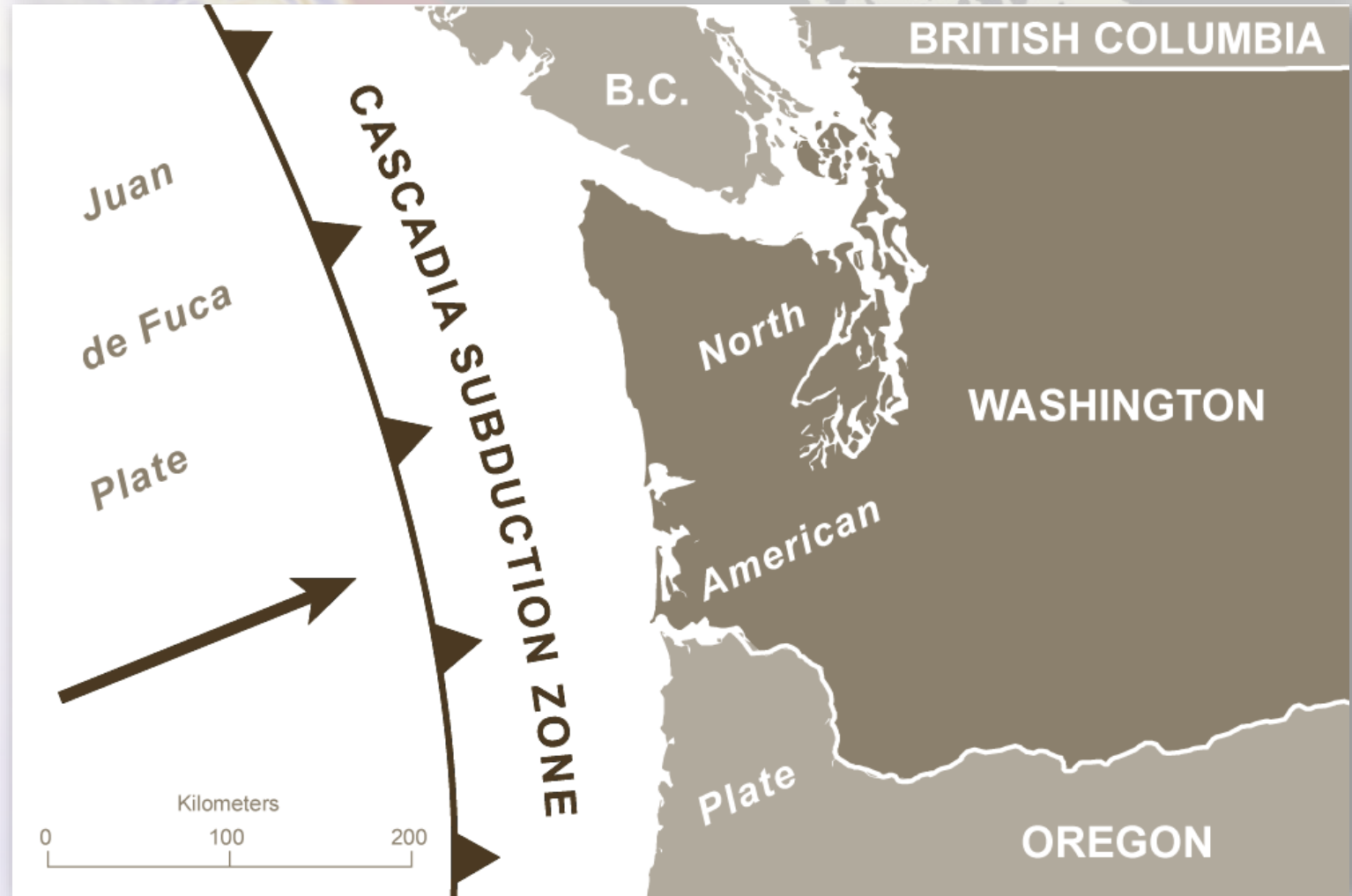
Washington Geological Survey

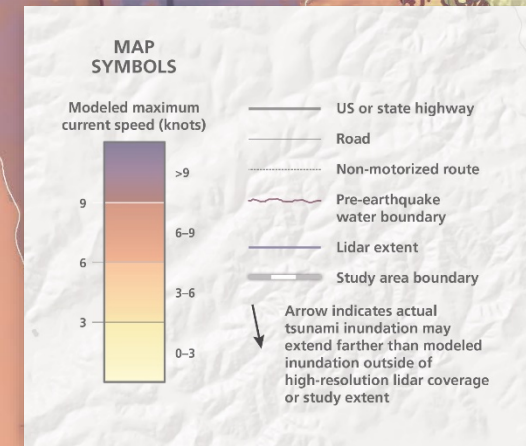
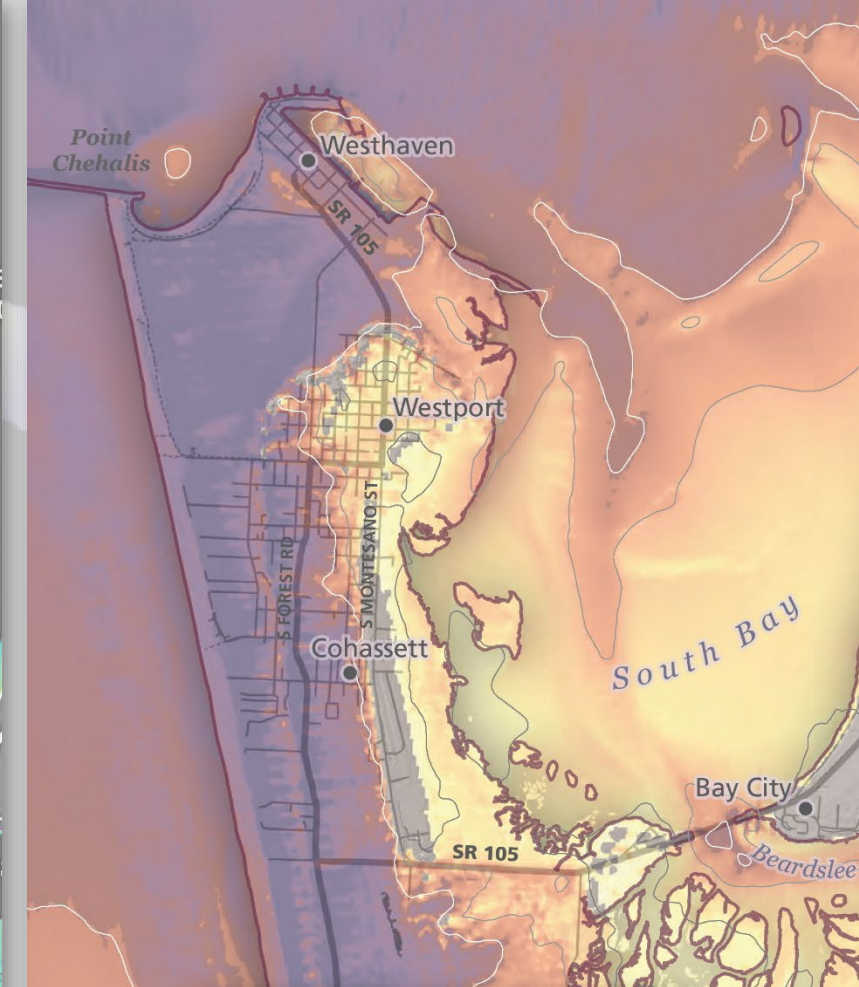
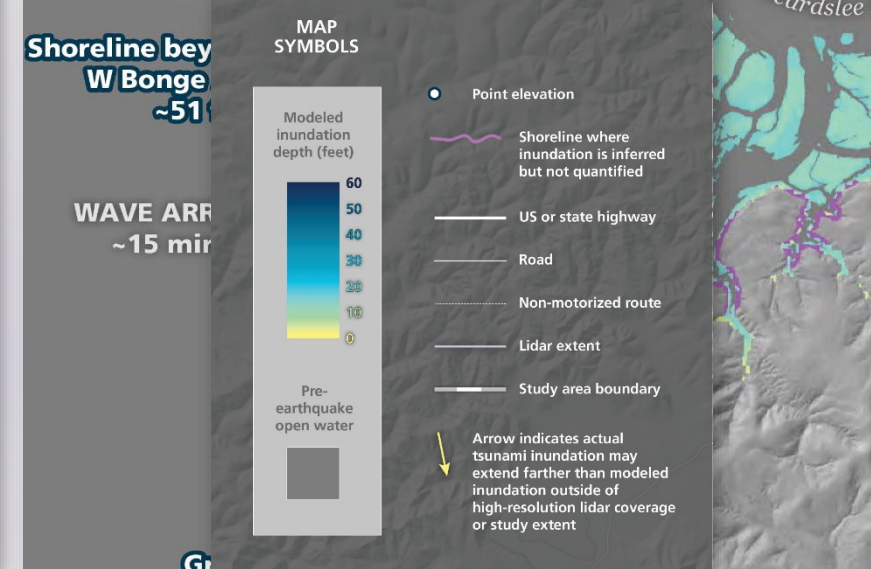
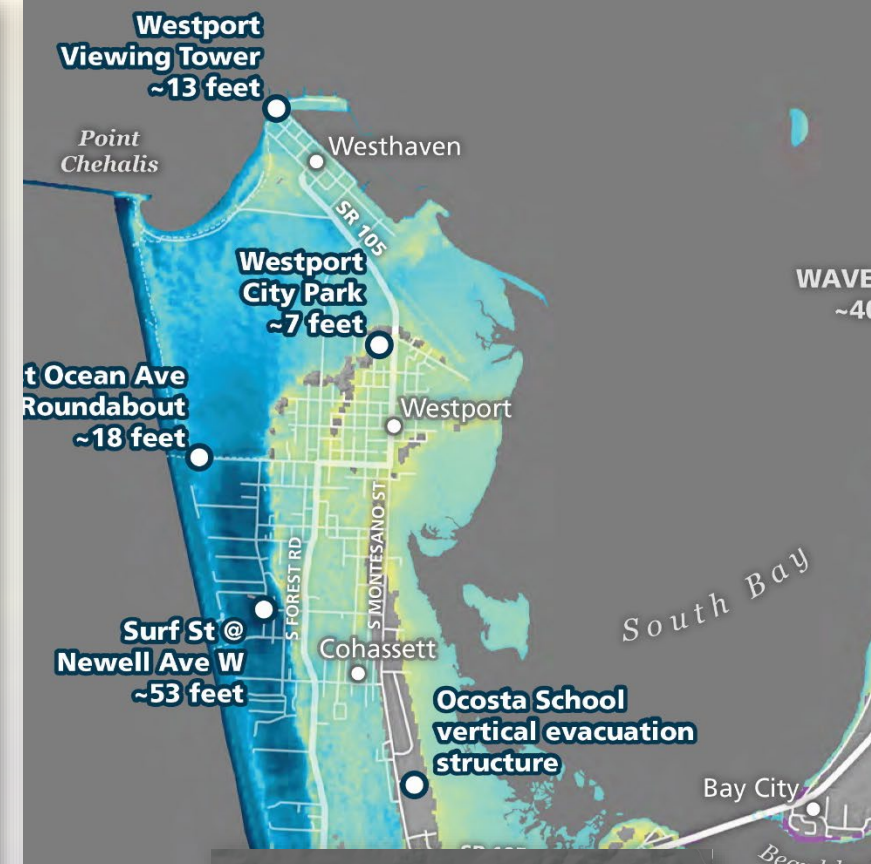
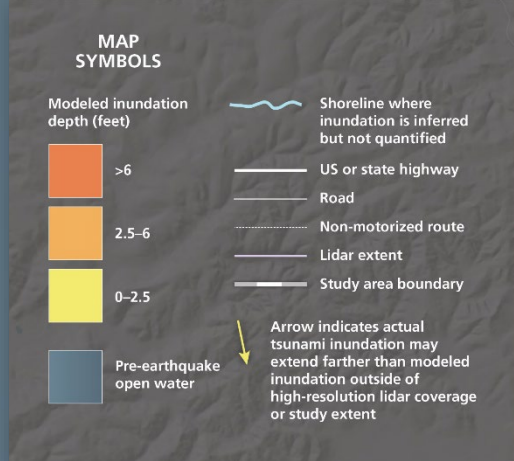


WASHINGTON STATE DEPT OF
**NATURAL
RESOURCES**
WASHINGTON
GEOLOGICAL SURVEY

Cascadia Subduction Zone (CSZ)

- Average interval between earthquakes: 240 years
- Average interval between large (>8.5 M_w) earthquakes: 500–600 years
- Last large CSZ earthquake: January 26, 1700





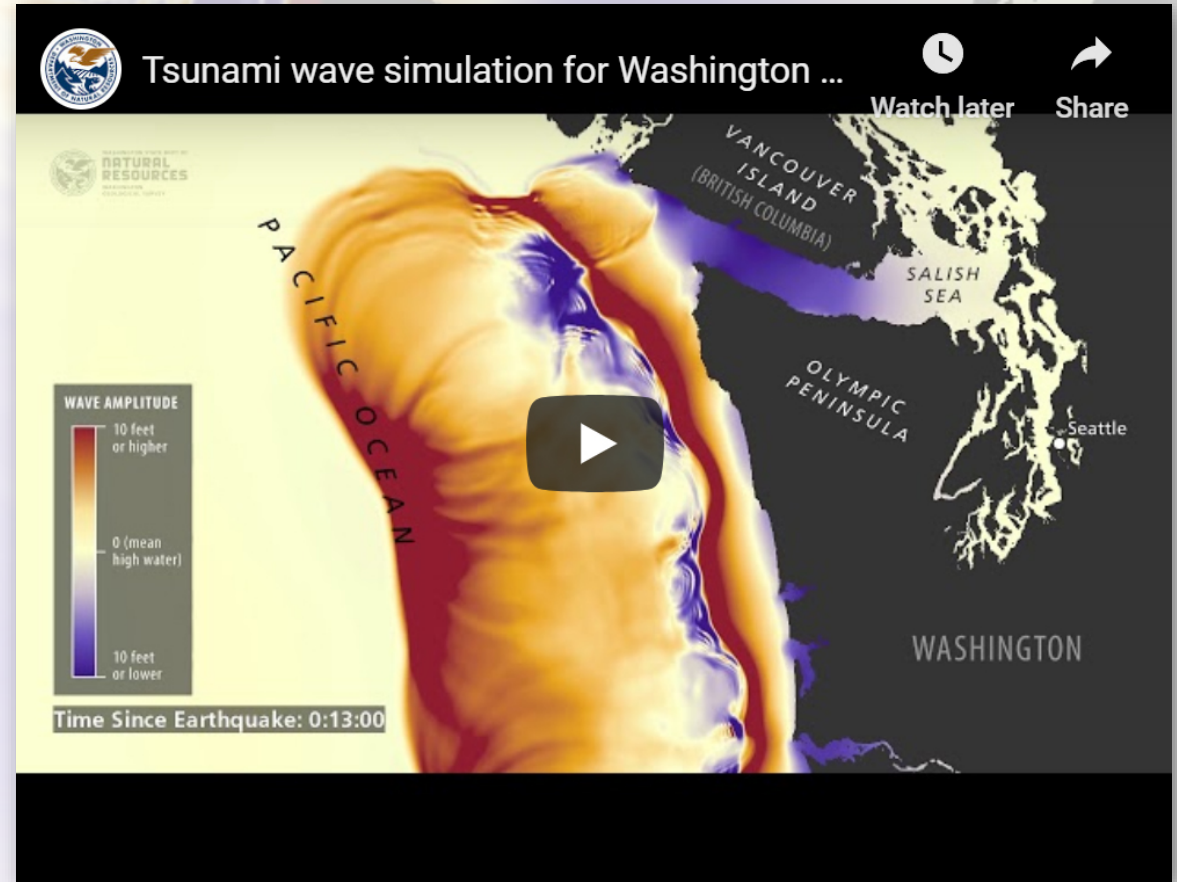


Tsunami Communication Challenges

- To date all products are based on maximum values independent of time
- The public has very little understanding of tsunamis over time
 - Duration of event
 - Complex wave behavior

Amplitude and Velocity Simulations

- Wave amplitude (peaks and troughs)
- Current velocity (speed)
- YouTube and direct MP4 download
- Modeling Software (MOST)—
NetCDF files, ArcGIS Pro,
Adobe After Effects and
Illustrator





Tsunami wave simulation

for Washington State
from a hypothetical
magnitude 9.0
earthquake
(L1) scenario
on the Cascadia
subduction zone



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National
Tsunami
Hazard
Mitigation
Program



Link to
tsunami simulations:

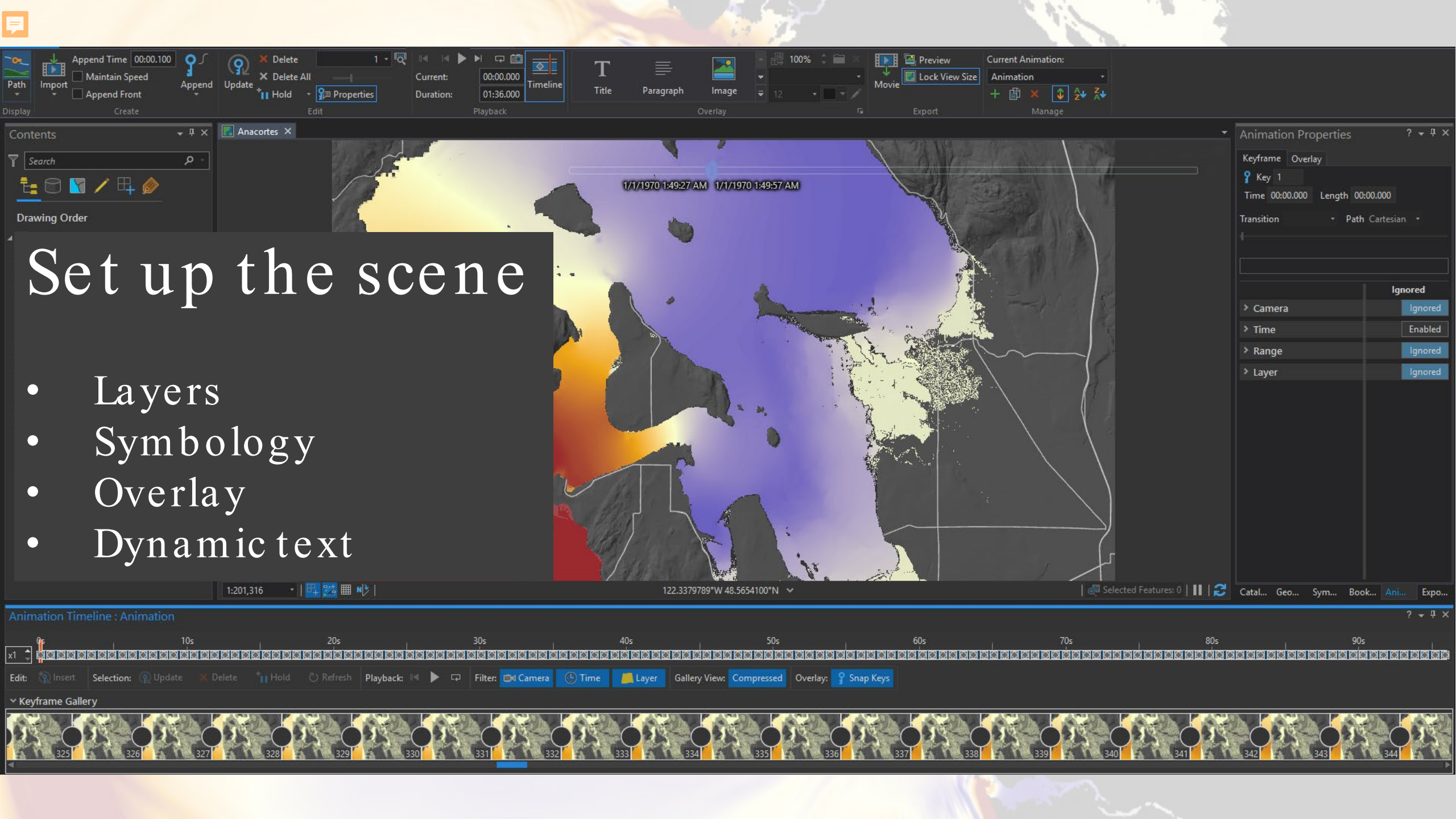
https://youtu.be/e5PJQW_6k6M

How to produce a video in ArcGIS Pro

- Enable time on rasters
 - Also works with features
 - Also works with range or time as a proxy

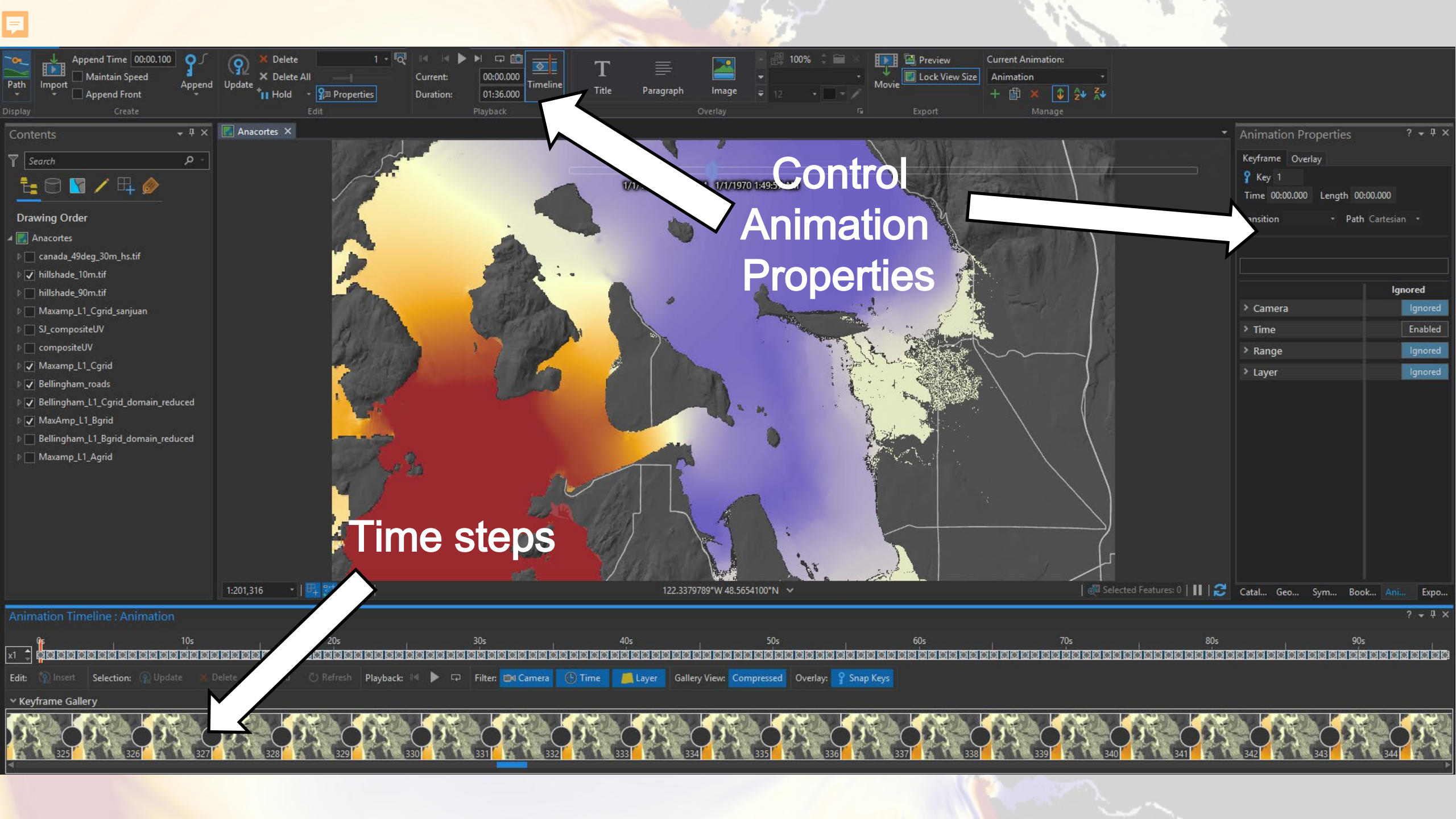
time	arcgis_time
30	1/1/1970 12:00:30 AM
300	1/1/1970 12:05:00 AM
3000	1/1/1970 12:50:00 AM
3030	1/1/1970 12:50:30 AM
3060	1/1/1970 12:51:00 AM
3090	1/1/1970 12:51:30 AM
3120	1/1/1970 12:52:00 AM
3150	1/1/1970 12:52:30 AM
3180	1/1/1970 12:53:00 AM

The screenshot shows the 'Time' properties pane in ArcGIS Pro. The 'Time' tab is selected in the left-hand menu. The 'Layer Time' is set to 'Each feature has a single time field'. The 'Time Field' is 'arcgis_time'. The 'Time Extent' is set to '1/1/1970 12:00:30 AM' to '1/1/1970 8:00:00 AM'. There is a 'Calculate' button and a checkbox for 'Data is a live feed'. The 'Rate' is set to '1' and the unit is 'Seconds'. The 'Time Zone' is '<None>'. There is a checkbox for 'Adjust For Daylight Saving'. The 'Time Offset' is set to '0'. A link 'Learn more about time properties' is visible at the bottom.



Set up the scene

- Layers
- Symbology
- Overlay
- Dynamic text



Control
Animation
Properties

Time steps

Path Import Append
Append Time 00:00.100
Maintain Speed
Append Front

Delete Delete All
Hold Properties

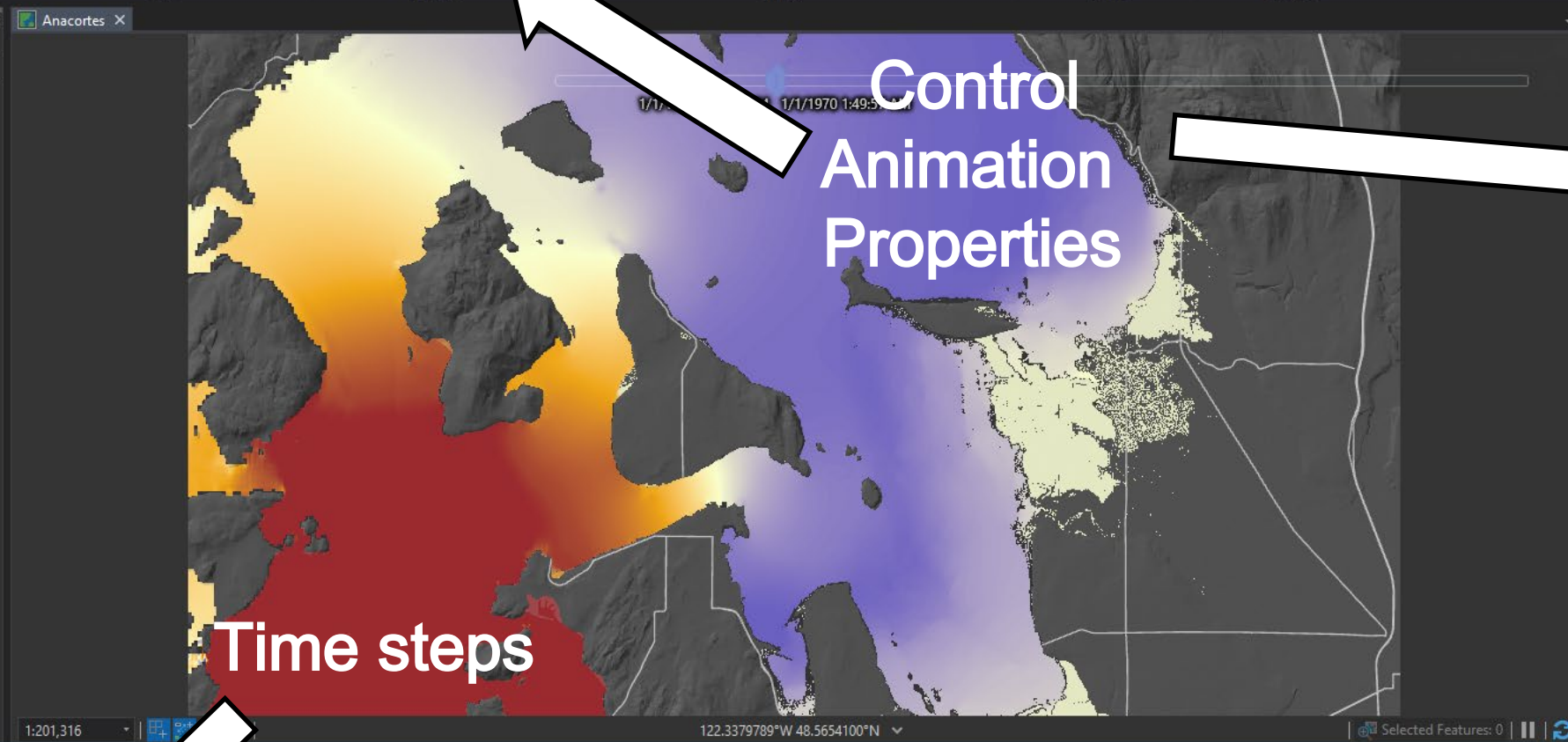
Current: 00:00.000
Duration: 01:36.000
Timeline

Title Paragraph Image

100%
12

Preview Lock View Size
Current Animation: Animation
Manage

Contents
Search
Drawing Order
Anacortes
canada_49deg_30m_hs.tif
hillshade_10m.tif
hillshade_90m.tif
Maxamp_L1_Cgrid_sanjuan
SJ_compositeUV
compositeUV
Maxamp_L1_Cgrid
Bellingham_roads
Bellingham_L1_Cgrid_domain_reduced
MaxAmp_L1_Bgrid
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Maxamp_L1_Agrid

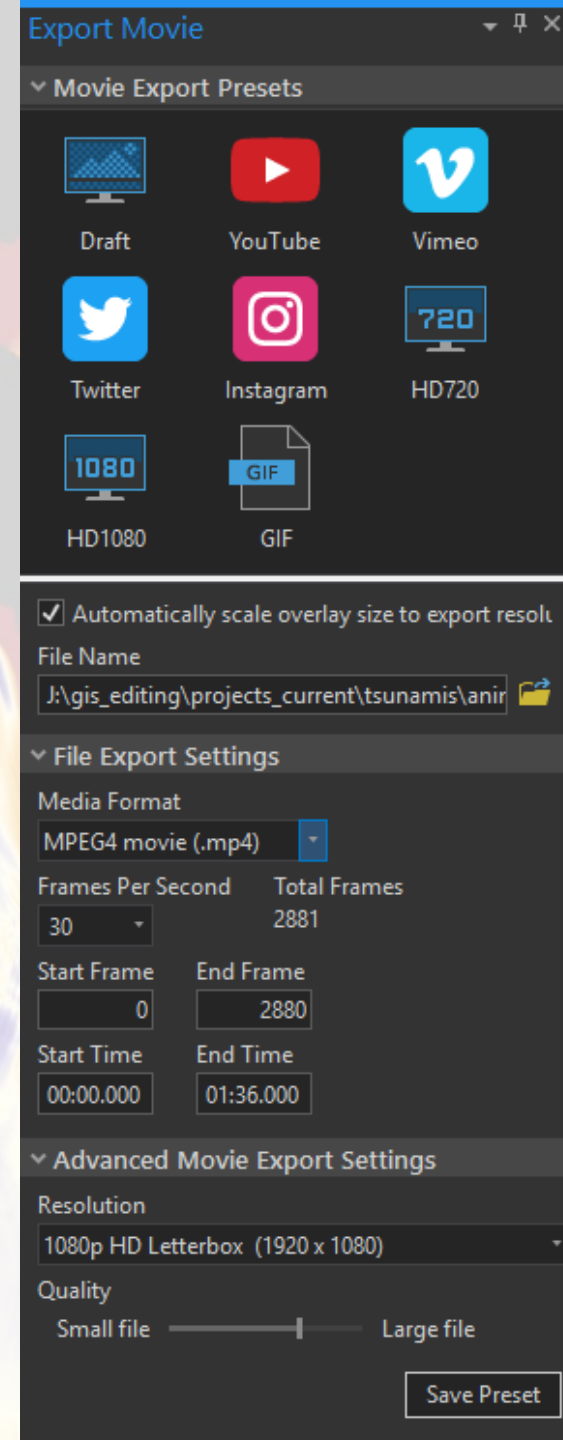


Animation Properties
Keyframe Overlay
Key 1
Time 00:00.000 Length 00:00.000
Transition Path Cartesian
Camera Ignored
Time Enabled
Range Ignored
Layer Ignored

Animation Timeline : Animation
10s 20s 30s 40s 50s 60s 70s 80s 90s
x1
Edit: Insert Selection: Update Delete Refresh Playback: Filter: Camera Time Layer Gallery View: Compressed Overlay: Snap Keys
Keyframe Gallery
325 326 327 328 329 330 331 332 333 334 335 336 337 338 339 340 341 342 343 344

Export your video

- Numerous export options
- Pay attention to time steps vs frames per second (FPS)
 - Too low FPS produces stuttering
 - Too high of FPS increases file size with no benefit





Enhancements in After Effects

- Add intro and outro slides
- Labels
- Transitions
- Export video

tsunami_animation_washington
1920 x 1080 (1.00)
Δ 0:02:18:00, 30.00 fps

Name	Type
San_Juan_Islands_stage1_2.mp4	MP
San_Juan_Islands_stage2.mp4	MP
San_Juan_Islands_stage3.mp4	MP
01_san_juans_animation_intro_frame.png	PNi
01_washington_animation_intro_frame.png	PNi
01_wash_ation_intro_frame_no_model.png	PNi
01_washington_labels.png	PNi
01_wash_on_labels_no_color_gradient.png	PNi
01_washington_logos_slide_5.png	PNi
casadia_subduction_zone.png	PNi
DNR-Geology-White-Stack_aligned.png	PNi
location_map1.png	PNi
location_map2.png	PNi
san_juans_1st_zoom_labels.png	PNi
san_juans_2nd_zoom_labels.png	PNi
san_juans_3rd_zoom_labels.png	PNi
san_juans_amplitude_time_slide_3.png	PNi
san_juans_credits_slide_4.png	PNi
san_juans_full_intro_background.png	PNi
sj_location_map1.png	PNi
sj_location_map2.png	PNi
sj_mask.png	PNi



Info

Audio

Preview

Shortcut

Spacebar

Include: Cache Before Playback

Range

Work Area Extended By Current...

Play From

Current Time

Frame Rate Skip Resolution

(30) 0 Auto

Full Screen

On (Spacebar) Stop:

If caching, play cached frames

Move time to preview time

Effects & Presets

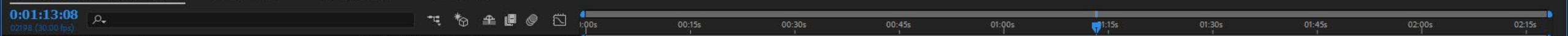
Align

Libraries

Character

Paragraph

Tracker



#	Source Name	Parent
1	san_juans_full_intro_background.png	None
2	washington_amplitude_slide_2.png	None
3	san_juans_amplitude_time_slide_3.png	None
4	Pre-comp 3	None
5	sj_pre_video_w_labels1.png	None
6	washington_mag9_a.png	None
7	Pre-comp 2	None
8	Pre-comp 4	None
9	Pre-comp 2	None
10	Pre-comp 4	None
11	DNR-Geology-White-Stack_aligned.png	None
12	sj_pre_video_w_labels1b.png	None
13	01_san_juans_animation_intro_frame.png	None
14	sj_mask.png	None



Geologic processes take time

Time is often lost in static map products

What data do you have that can be visualized better?



Thanks!

contact: Daniel Eungard and Daniel Coe

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Daniel.Coe@dnr.wa.gov