Gazebo renders the moon

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RP Driving ConOps Simulator

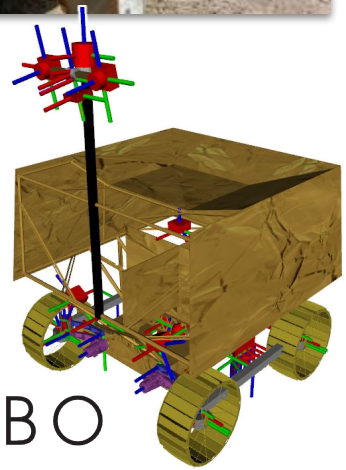
Resource Prospector

Goal: send a rover to the moon to mine volatiles such as hydrogen, oxygen and water

Simulation

End-to-end lunar rover driving simulation to assist in the development of the RP Driving Concept of Operations

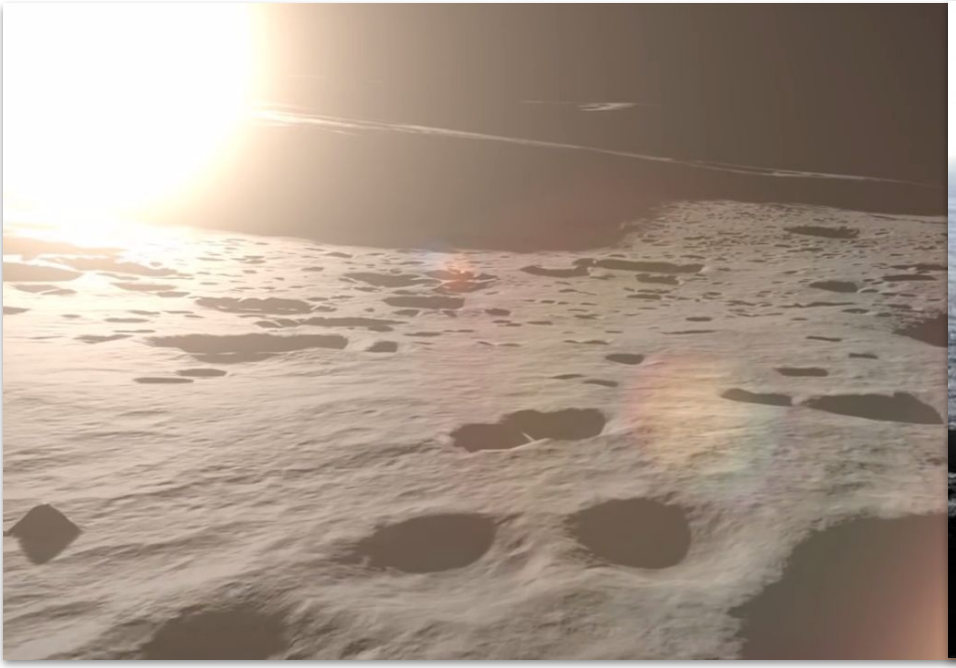
- ROS used to emulate flight software and ground software functionality
- Simulated rover is 4 wheel steer platform scaled to RP rover dimensions with RP chassis and mast



ROS

GAZEBO

Visual Simulation



Lunar scene from Gazebo

Lunar scene from Apollo 12 mission

Large Scale, High Fidelity Terrain Simulation

Synthetic Terrain Generation

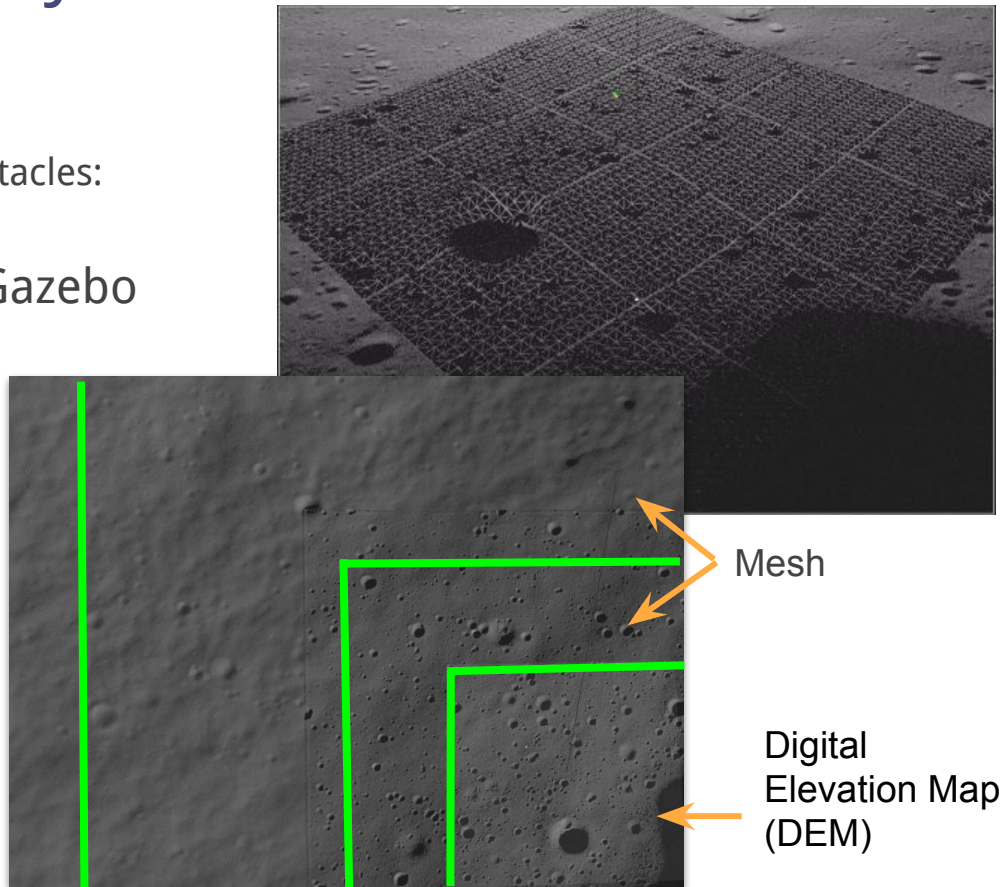
- High resolution (~4cm) to simulate obstacles: positive (rocks), negative (craters)

Large DEMs rendered too slow in Gazebo

- 8K resolution, 213MB
- load time ~5min

Improvements

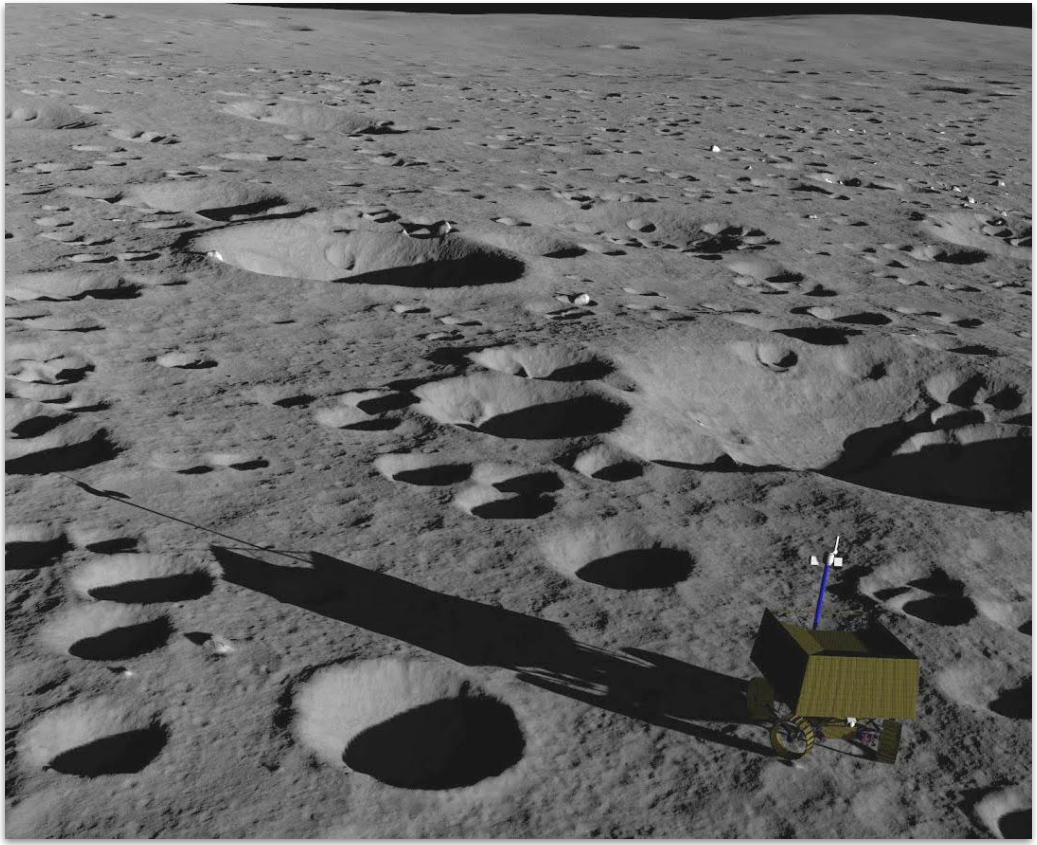
- Enabled caching of terrain data
- Added Level-Of-Details
- Background tiles - coarse meshes
  - 6 layers



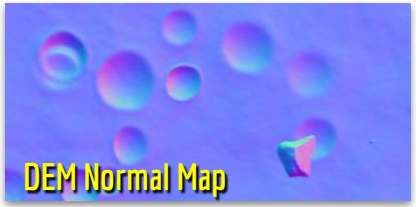
Lunar Appearance

Default shading model - inadequate to model the unique reflective properties of lunar surface

Added support for applying custom shaders to heightmaps



Terrain Material Shader Components



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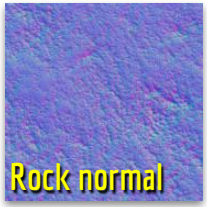
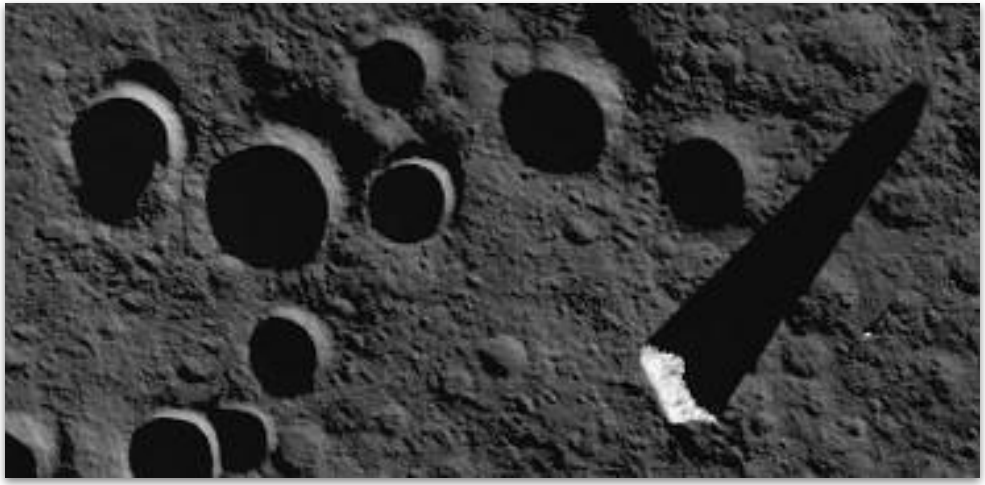


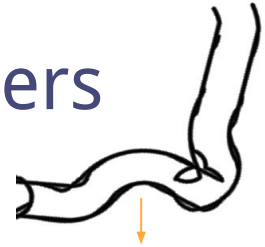
+ Real time shadows set up by Gazebo

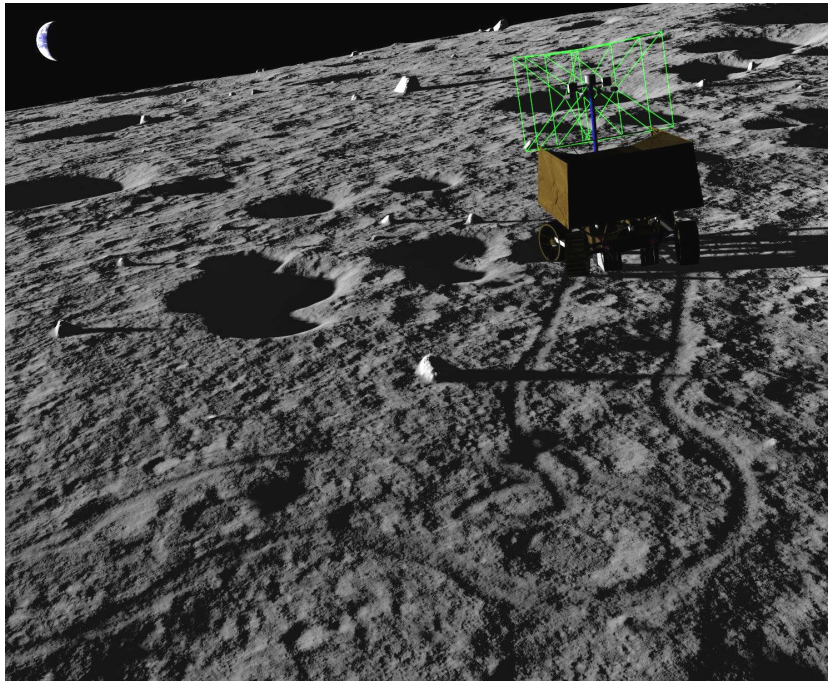
+ Hapke Lunar regolith reflectance model



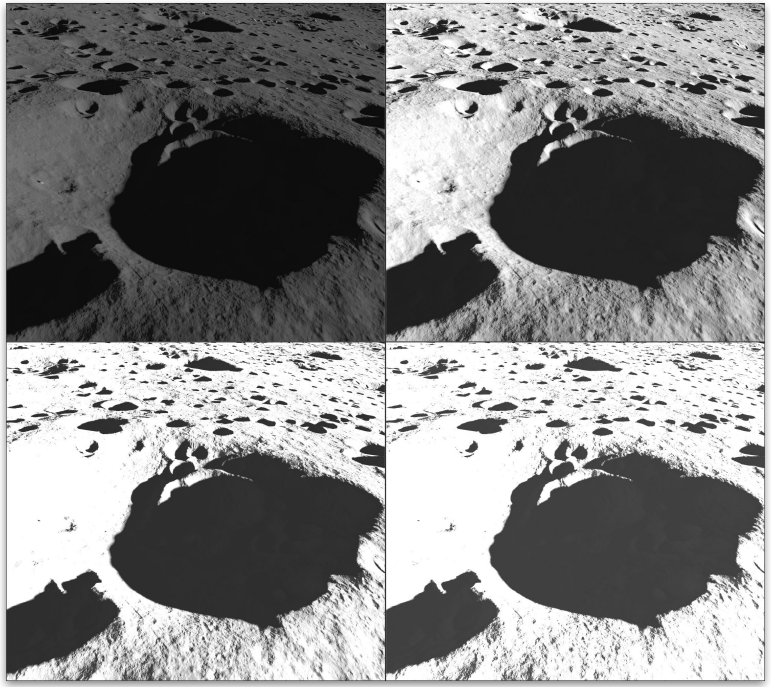
Shader Parameters

Wheel Tracks Plugin





Camera Exposure



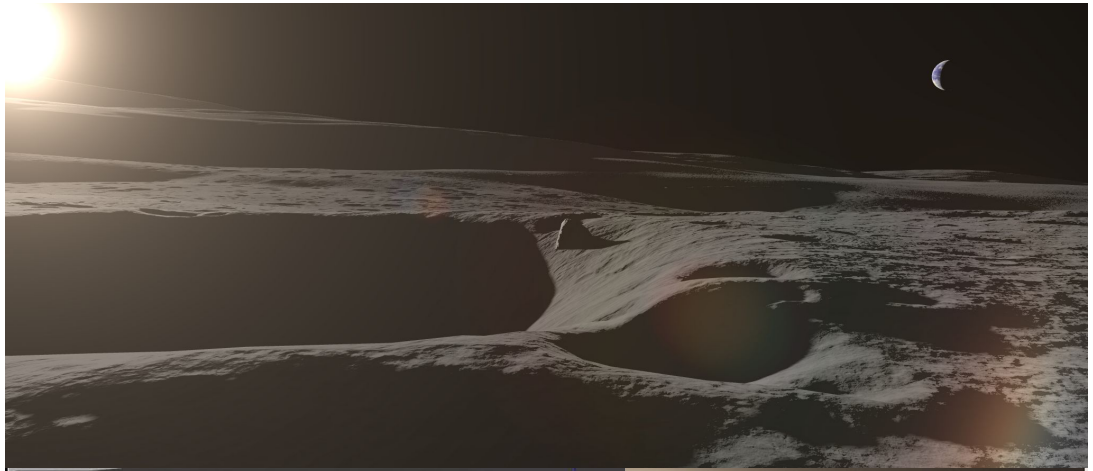
Lens Flares

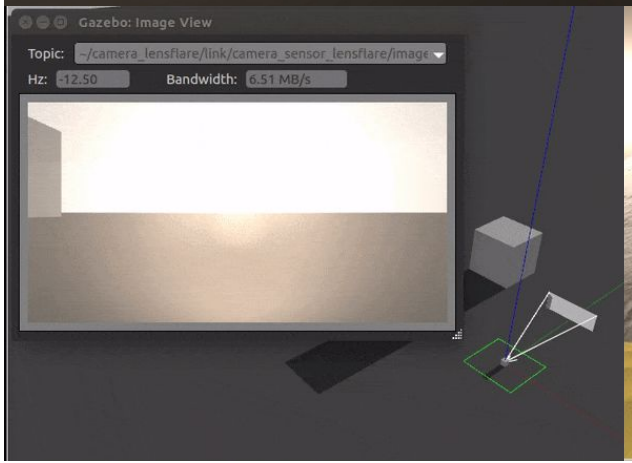
Sun is few degrees above horizon at lunar pole

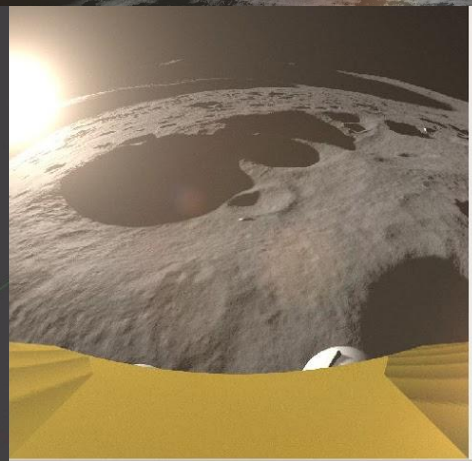
Camera often points at sun or sees long dark shadows

Implementation

- Post processing effect
- Works with wide angle cameras
- Sparse ray based occlusion checking







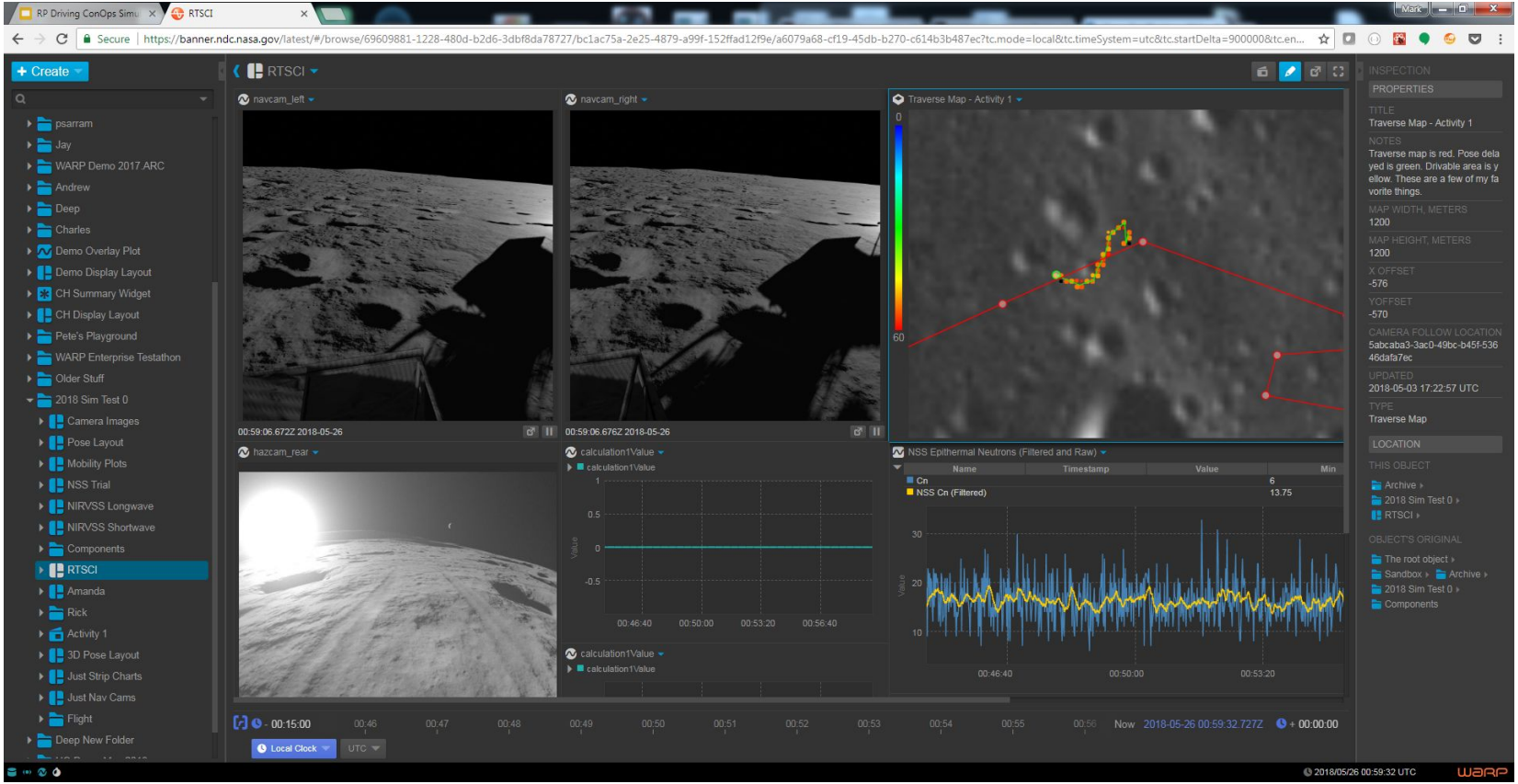
Real Time Shadows

Problem: Poor quality overall esp. when camera view angle is coincident with light direction

Improvements

- Override shadow map generation step
- Increased shadow texture resolution
- Hardware Percentage Closer Filtering + Poisson disk blur filter
- Lowered “built-in ambient” light

WARP


RP Driving ConOps Simu
RTSCI
Secure
https://banner.ndc.nasa.gov/latest/#/browse/69609881-1228-480d-b2d6-3dbf8da78727/bc1ac75a-2e25-4879-a99f-152ffad12f9e/a6079a68-cf19-45db-b270-c614b3b487ec?tc.mode=local&tc.timeSystem=utc&tc.startDelta=900000&tc.en...
Create
RTSCI
psarram
Jay
WARP Demo 2017 ARC
Andrew
Deep
Charles
Demo Overlay Plot
Demo Display Layout
CH Summary Widget
CH Display Layout
Pete's Playground
WARP Enterprise Testathon
Older Stuff
2018 Sim Test 0
Camera Images
Pose Layout
Mobility Plots
NSS Trial
NIRVSS Longwave
NIRVSS Shortwave
Components
RTSCI
Amanda
Rick
Activity 1
3D Pose Layout
Just Strip Charts
Just Nav Cams
Flight
Deep New Folder
navcam_left
navcam_right
Traverse Map - Activity 1
00:59:06.672Z 2018-05-26
00:59:06.676Z 2018-05-26
hazcam_rear
calculation1Value
NSS Epithermal Neutrons (Filtered and Raw)
Name
Timestamp
Value
Min
Cn
NSS Cn (Filtered)
13.75
INSPECTION
PROPERTIES
TITLE
Traverse Map - Activity 1
NOTES
Traverse map is red. Pose delayed is green. Drivable area is yellow. These are a few of my favorite things.
MAP WIDTH, METERS
1200
MAP HEIGHT, METERS
1200
X OFFSET
-576
YOFFSET
-570
CAMERA FOLLOW LOCATION
5abcaba3-3ac0-49bc-b45f-53646dafa7ec
UPDATED
2018-05-03 17:22:57 UTC
TYPE
Traverse Map
LOCATION
THIS OBJECT
Archive
2018 Sim Test 0
RTSCI
OBJECT'S ORIGINAL
The root object
Sandbox
Archive
2018 Sim Test 0
Components
00:15:00
Now
2018-05-26 00:59:32.727Z
+ 00:00:00
Local Clock
UTC
2018/05/26 00:59:32 UTC
WARP

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Questions?