



Adapting Landsat 9 Launch Preparations to COVID Restrictions

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Agenda



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- Mission Status
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- Summary

System enhancements are required to continue launch preparations



Landsat 9 Mission Summary

Mission Objectives

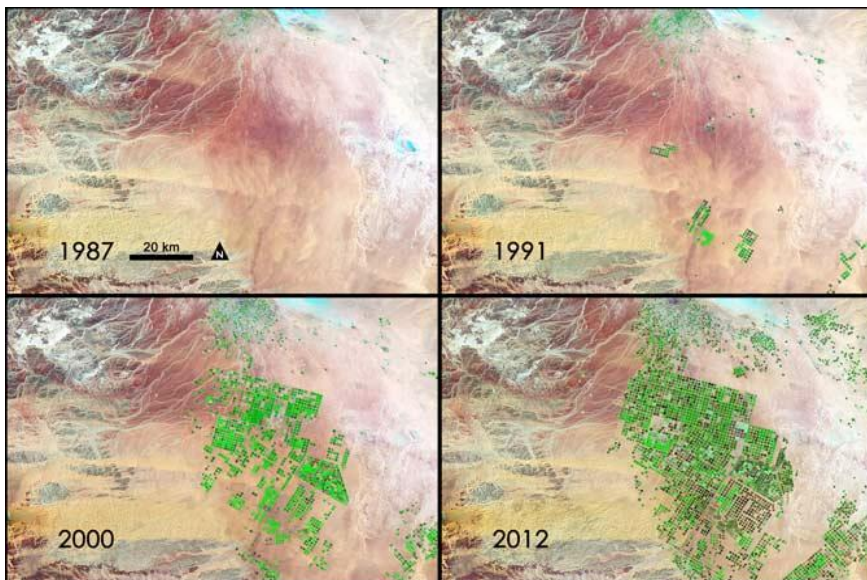
- Provide continuity in multi-decadal Landsat land surface observations to study, predict, and understand the consequences of land surface dynamics
- Core Component of Sustainable Land Imaging program

Mission Team

- NASA Goddard Space Flight Center (GSFC)
- USGS Earth Resources Observation & Science (EROS) Center
- NASA Kennedy Space Center (KSC)

Mission Parameters

- **Single Satellite, Mission Category 1, Risk Class B**
 - 5-year design life after on-orbit checkout
 - At least 10 years of consumables
- **Sun-synchronous orbit, 705 km at equator, 98° inclination**
 - Expected to replace Landsat 7's location in the constellation
- **16-day global land revisit**
- **Partnership: NASA & USGS**
 - NASA: Flight segment & checkout
 - USGS: Ground system and operations
- **Category 3 Launch Vehicle**
- **Launch Readiness Date: 9/16/2021**



Increase in pivot irrigation in Saudi Arabia from 1987 to 2012 as recorded by Landsat. The increase in irrigated land correlates with declining groundwater levels measured from GRACE (courtesy M. Rodell, GSFC)

Instruments

- **Operational Land Imager 2 (OLI-2; Ball Aerospace)**
 - Reflective-band push-broom imager (15-30m res)
 - 9 spectral bands at 15 - 30m resolution
 - Retrieves data on surface properties, land cover, and vegetation condition
- **Thermal Infrared Sensor 2 (TIRS-2; NASA GSFC)**
 - Thermal infrared (TIR) push-broom imager
 - 2 TIR bands at 100m resolution
 - Retrieves surface temperature, supporting agricultural and climate applications, including monitoring evapotranspiration

Spacecraft (S/C) & Observatory Integration & Test (I&T)

- Northrop Grumman Innovation Systems (NGIS), formerly Orbital ATK (OA)

Launch Services

- United Launch Alliance (ULA) Atlas V 401

Mission Operations Center (MOC) and Mission Operations

- General Dynamics Mission Systems (GDMS)

Landsat 9 Current Project Status

- Operational Land Imager-2 (OLI-2) and Thermal Infrared Sensor-2 (TIRS-2) are fully integrated
- Completed the Pre-Environmental Review 10/13-10/15
- Observatory EMI testing is complete; vibe testing underway
- Four of 6 Mission Readiness Tests (MRTs) completed
 - *End to End system level tests*
 - *Two MRTs have been executed remotely during COVID-19*
- Ground Readiness Tests (GRTs) 1-4 completed
 - *Functionality needed for launch*
 - *Two GRTs have been executed remotely*
- Mission Simulation 1 complete
- Spacecraft/Observatory Simulator (SOS) has been delivered and multiple updates delivered
- TVAC planned to begin in Feb 2021
- Ship to Launch site summer of 2021



Observatory level testing has begun

COVID 19 Impacts to Landsat 9



- Project baseline envisioned all operations from Goddard Spaceflight Center for Mission Readiness and Launch campaigns
 - *LMOC houses Flight OPS Team and Flight Dynamics support*
 - *Launch Support Room hosts FOT Subsystem Engineers, NASA, and other contractors*
- Landsat 9 is in the pre-launch development phase and did not meet the criteria for on-going onsite access for Mission Critical Activities
 - *COVID Restrictions were implemented that vastly curtailed onsite personnel*
 - *Some special access was granted where no viable workaround existed (simulator operator)*
- Baseline plans assumed observatory vendor contractors would travel onsite to support testing and launch activities
- The Project needed to adapt rapidly to continue supporting Observatory Integration and Test activities
- COVID 19 Working Group was stood up to adapt critical systems and operations to remote operations

System enhancements are required to continue launch preparations

COVID 19 Restriction Details



- Onsite restrictions imposed by GSFC are in line with CDC Guidelines and limit facility usage
 - *Occupancy and social distancing restrictions reduce engineer support from existing facilities*
 - *Movement and people flow further restrict movement patterns onsite*
 - *Eating at workstations is restricted and has required additional consideration*
- All onsite work requests must be submitted and approved through the COVID Task Force at GSFC
 - *Includes detailed lists of personnel and scheduled activities*
 - *Must also include detailed room layouts and seating arrangements*
- Travel has been significantly curtailed to align with each respective State's guidelines. Pre- and post-travel quarantining, although not required, is encouraged where practical
- Occupied areas must be supplied with additional PPE and sanitation supplies
- Exposure events require review by GSFC medical officer
 - *Investigations are performed and affected personnel are notified*
 - *If risks of exposure are identified, remedial actions are recommended*
 - *Affected (mission essential) personnel may require quarantining*

Restrictions and operational guidelines generally follow CDC recommendations

COVID 19 Response



- Remote capabilities were rapidly deployed allowing work to continue
 - USGS and NASA teams deployed remote access software solution for command and telemetry monitoring
 - Additional laptops have been deployed to allow additional remote users access
 - Travel restrictions have inhibited credentialing activities for those without existing access
- LSR and LMOC are being reconfigured to support social distancing for onsite operations
- L9 solicited input from other missions that have launched or are operational during COVID to develop a best practices approach
 - NRO-L-129 at Wallops, Planet, NASA ESMO and SSMO missions, JWST
- Baseline voice communications system accommodated onsite support only. Upgraded real time voice communications are being implemented (Internet Voice Distribution System VoIP solution)
 - Currently used at other NASA Centers
 - Rapid deployment is underway and nearly complete
- Remote control access to high fidelity Spacecraft Observatory Simulator (SOS) is in work
- SC commanding activities will continue to occur from the LMOC with support from remote participants
 - Command Controllers will operate from LMOC
 - Other critical positions will support as required
 - Testing w/ simulators can now be executed entirely remotely (exception is simulator operator)
- Smaller Mission Simulation activities are being planned to exercise selected COVID response adaptations
 - Revised voice communications
 - Anomaly investigation and collaboration
- Loss of remote communications response plan is being developed
- Video capture device allows one way broadcast of critical information to the team

L9 is planning for remote execution of tests, simulations, and if required launch operations

Ongoing COVID 19 Challenges



- Landsat 9 high fidelity Spacecraft/Observatory Simulator (SOS) located in an equipment room with little workspace
 - *Onsite simulator access is required for some activities*
 - *Effectively restricts access to 1 person at the simulator if observing social distancing protocols*
 - *Simulator updates and checkout often require more than one party; room shared with another project*
 - *Remote control from an alternate site is now in place with some reduced functionality*
- Team training activities allow for limited collaboration
 - *Collaboration tools are being utilized for training opportunities*
 - *Informal learning opportunities are limited as almost all interactions are now via scheduled events*
 - *Some operator functions cannot be fully replicated w/ remote operations*
- Unclear return to work schedule requires a worst-case preparedness posture
 - *Must be prepared to operate in a highly restricted environment*
 - *Requires a tiered response plan to allow for operational flexibility – ability to return to baseline*
 - Facility plans allow for 40%, 60%, 100% on-site staffing solutions
 - Remote access provides flexibility for hybrid solutions in each configuration

L9 is planning for remote execution of tests and simulations

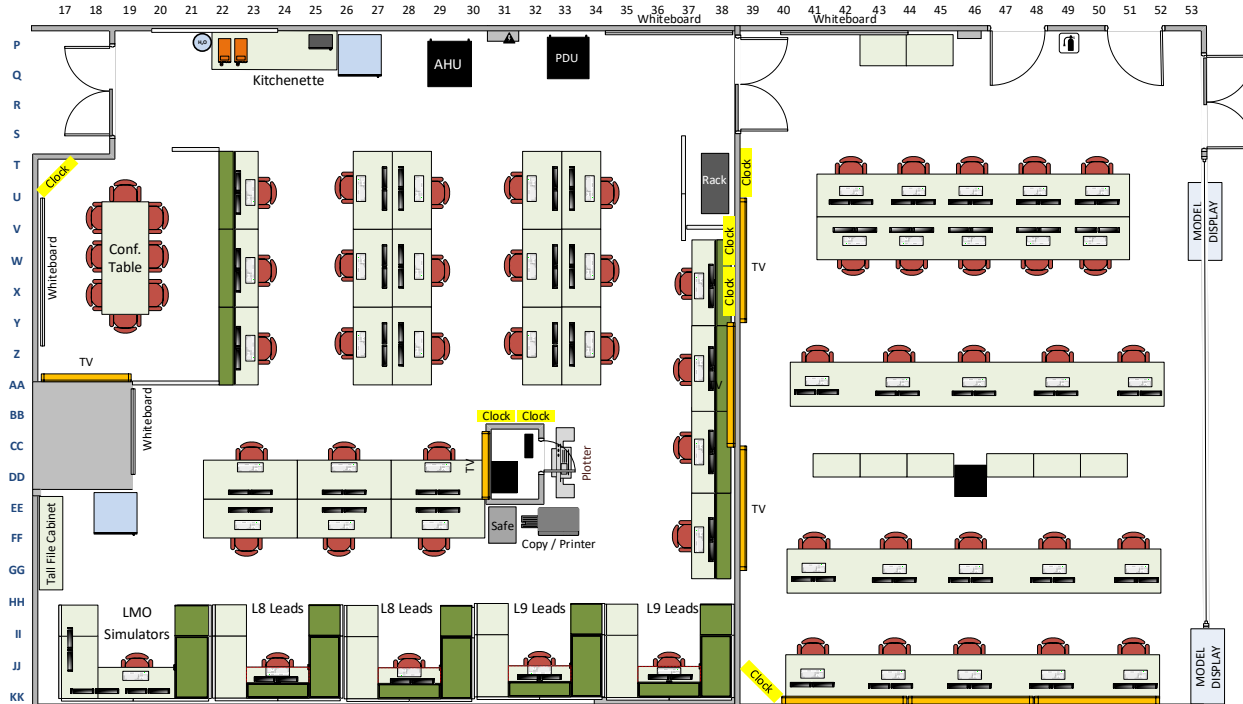
Facility Adaptations



- Social distancing facility restrictions greatly limit the personnel density allowed in spaces
 - *Density is in some cases less than half of pre-COVID planned usage*
 - *Requires additional outfitting of facilities to reduce potential exposures*
- Modifications of personnel foot traffic helps limit cross-project interactions
 - *Building entrances, stairwells, public spaces*
 - *Eating areas*
- Addition of plexiglass barriers helps reduce potential onsite exposures
 - *Supports most conservative social distancing design*
 - *Can be modified to include barriers at 100% staffing levels*
- Additional PPE and sanitation supplies provide for reduced transmission pathways
 - *Masks provided for onsite personnel*
 - *Keyboard covers and individually assigned headsets*
- Usage of additional conference space to accommodate personnel displaced by lower density workspaces
- Together these allow a safe onsite contingent to support critical operations if required

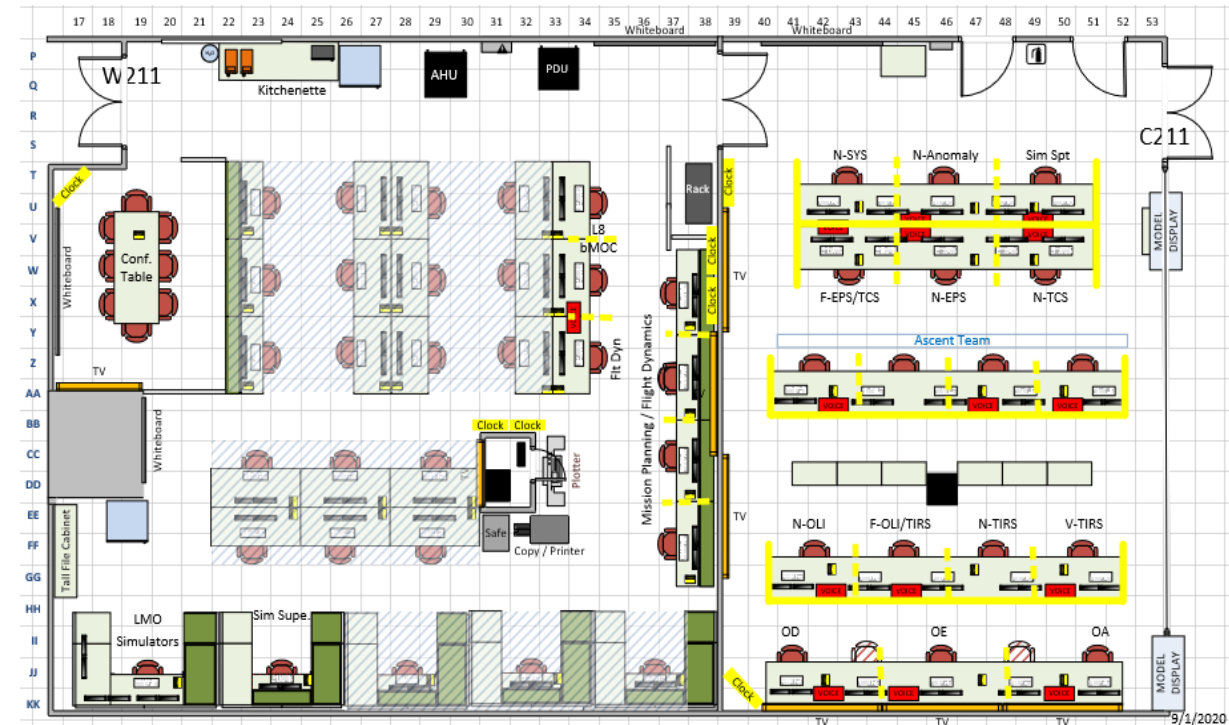
Onsite modifications allow for critical onsite participation

LMOC Design Modifications



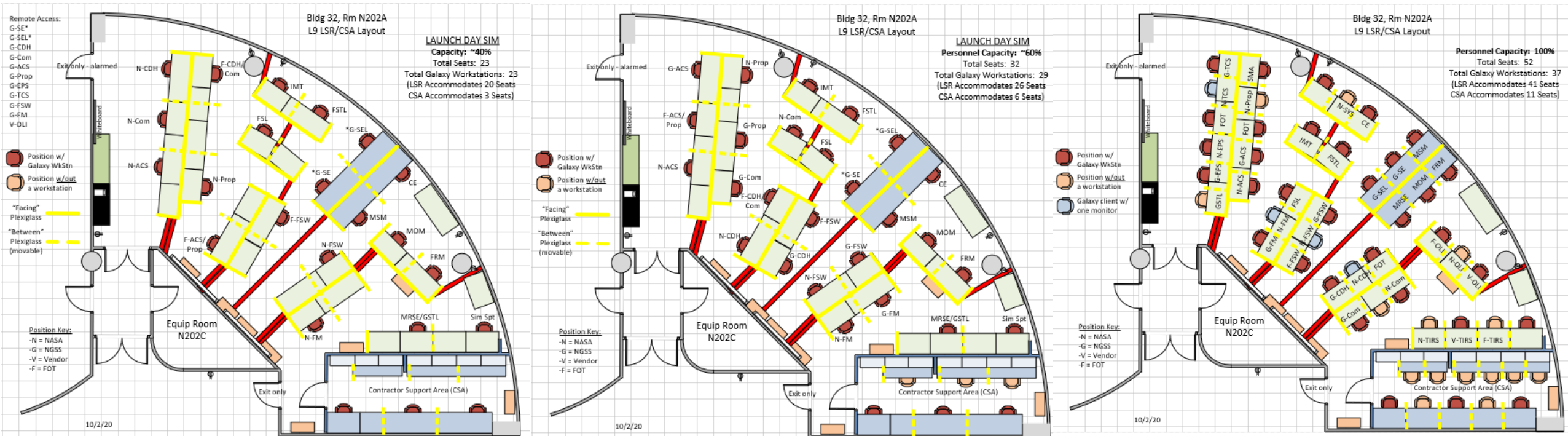
Baseline Seating Plan

COVID 19 Reduced Density Seating Plan



LMOC reduced seating; office space is restricted

LSR Design Modifications



40% Capacity

60% Capacity

100% Capacity

Onsite seating density has been reduced to roughly 40% of pre-COVID plans; allows return to full staffing w/ plexiglass separators

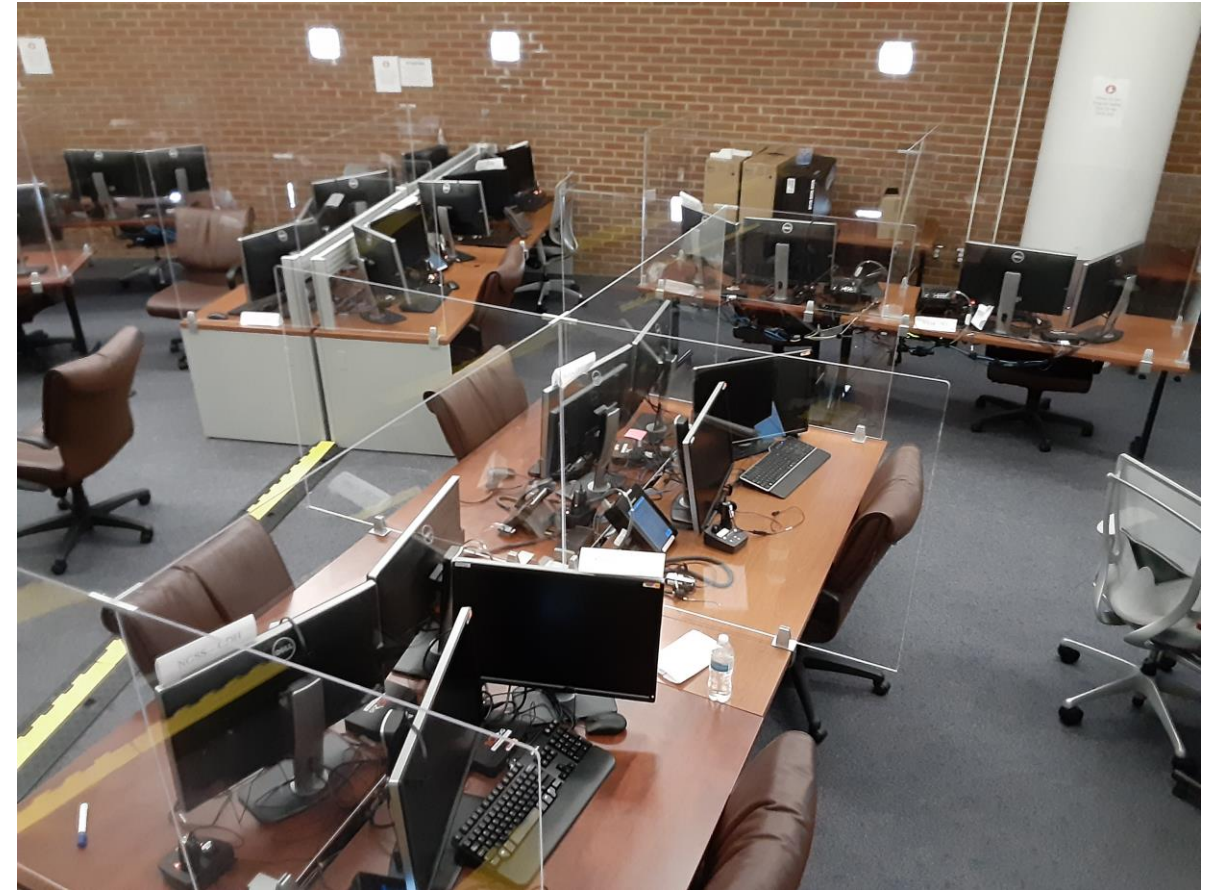
Plexiglass Shielding Implementation



Pre-COVID Seating



COVID Adapted Seating



Plexiglass has been designed to allow for increased seating density if COVID restrictions are lifted

Summary



- Landsat 9's Mission Readiness test activities required significant adaptation for operations in a COVID-19 restricted environment
 - *Additional Software, hardware, and facility modifications were required*
 - *Implementation of remote software solutions was necessary to keep progressing to launch readiness*
 - *New collaboration tools required for information sharing*
- USGS and NASA have closely coordinated the response and support
- Remote operations require process modifications
 - *Must deal with loss of efficiency*
 - *Loss of key individuals at critical times*
- Facilities plan allows for multiple configurations to maximize flexibility in staffing posture