



75 cm DTM Verification Matrix — DRM Rev C

Requirement	SPC	SPC+OLA	OLA
For > 80% of the asteroid surface, produce a set of DTMs at < 0.75 m in ground sample distance (sample resolution).	X		
For > 80% of the asteroid surface, produce a set of DTMs with post-fit residual RMS < 0.38 m (1-sigma) for each maplet	X(2)(3)		
For > 80% of the asteroid surface, produce a set of DTMs with a 3D RMS accuracy < 1m (1-sigma).	X(1)(2)(3)		
Provide the global 75cm DTM product to FDS within 14 days of downlink of all Preliminary Survey OCAMS and OLA data.	X(4)		



35 cm DTM Verification Matrix — DRM Rev C

Requirement	SPC	SPC+OLA	OLA
For > 80% of the asteroid surface, produce a set of DTMs at < 0.35 m in ground sample distance (sample resolution).	X		X (7)
For > 80% of the asteroid surface, produce a set of DTMs with post-fit residual RMS < 0.18 m (1-sigma) for each maplet	X(2)(3)		X (7)
For > 80% of the asteroid surface, produce a set of DTMs with a 3D RMS accuracy < 0.75 m (1-sigma).	X(2)		X (7)
Provide the global 35cm DTM product to FDS within 14 days of downlink of all Detailed Survey "Baseball Diamond" OCAMS and OLA data.	(5)(6)		X (7)



Footnotes to 75cm and 35cm

- (1) This requirement needs analysis by flight dynamics
- (2) There is a tool gap to evaluate the 80 percent performance
- (3) Needs decision on how we evaluate performance during and at the asteroid (Discussion with FD and ALTWG, Eric will work with Coralie to develop some evaluation products, ALTWG and FD will agree on decision products for ground and in-flight verification. ~10 business days? Once this is addressed, the path to addressing item (2) get more clear.)
- (4) Need an real-time end-2-end test with no test data issues and realistic errors, and new shape. Initial and intermediate deliveries to FD may mitigate impact of late delivery of final data. (Eric suggests a draft preliminary survey delivery...)
- (5) Have not exercised using a full data set.
- (6) May not be the right requirement - earliest needed would be 6-7 weeks after baseball diamond. FDS should revisit impact of extending this date. Needed to support science obs during Orb B. SPC is concerned about this delivery. FDS can't deliver a COF-COM tweak until in Orb B. The conops for a iteration would need to be worked out. Perhaps even 1 week after insertion begin?
- (7) Data could be obtained in Orb A, but at present, no clear need. Should not be pursued unless further analysis shows that schedule is in jeopardy
- Overall footnote. A desire to update COM-COF offset may create some concerns for schedule. Conops need to be worked out.



NFT Verification Matrix — DRM Rev C

Requirement	SPC	SPC+OLA	OLA*
The Ground System shall , for each in a set of pre-defined NFT features, produce a DTM which results in a normalized-cross-correlation score of 0.6 or greater when rendered and correlated against a “truth” image.	(1)		X (5)
The Ground System shall , for each in a set of pre-defined NFT Features, produce a DTM that results in a 0.99 probability of no false positive feature matches within a search region that is 140 NavCam pixels larger than the NFT Feature on each border.	(1)		X (5)
The Ground System shall , for each in a set of pre-defined NFT features, produce a DTM that generates a search solution where the highest normalized cross-correlation location is within 2 NavCam pixels (1-sigma) of the actual feature represented in a “truth image”.	(1)		X (5)
The Ground System shall, for each of a set of pre-defined NFT features, produce a DTM with a 3D RMS accuracy < 0.75 m (1-sigma).	X		X (6)
The Ground System shall, for a 3-sigma TAG delivery error ellipse around each of up to 2 (1 primary and 1 backup) sampling sites, produce a DTM with vertical RMS error < 0.14 m (1-sigma).	X (2)		X (6) (2)
The Ground System shall, for a 3-sigma TAG delivery error ellipse around each of up to 2 (1 primary and 1 backup) sampling sites, produce a DTM with vertical RMS error < 0.14 m when compared to each of the NFT features (1-sigma).	X (3)		X (6)
The Ground System shall provide up to 300 NFT Feature DTM products to MSA within 30 days of downlink of required Orbital B OCAMS and OLA data.	X (4)		X (5)



Footnotes to NFT Requirements

- (1) It has been shown that some features correlate better. The required set of features for the entire descent profile cannot be covered by SPC with the DRM Rev C imaging plan. DRM gets us down to shortly before checkpoint. *Getting the required products may add significantly to the timeline.*
- (2) This requirement may be improperly stated – this may need to be precision. In either case, we may be able to meet this with DRM Rev C, but have only tested with no error.
- (3) MRD-115 provides the 5-cm DTM that can provide the necessary accuracy for the TAG site to make this comparison.
- (4) IF SPC is provided with the needed images, then there should be no impediment to delivering the features.
- (5) To make OLA work for NFT we need to look at how we can extend the 5cm DTM from Orbit B, *combined with albedo from SPC detailed survey observations* (hence the asterisk on OLA*), to obtain required fidelity, otherwise, some low flybys may be needed to obtain higher resolution OLA observations to support full NFT corridor observations, and these could add to the timeline. (About 7-10 days for Olivier to understand these issues, e.g., whether we have to depend on recon passes. Bill will look at potential OLA observing plans for recon passes.)
- (6) OLA produces this from detailed survey observations



NFT — Understanding Requirements

Requirement	SPC	SPC+OLA	OLA
Generate a NFT feature DTM (with albedo) with an accuracy of 2 (TBD) times ground sample distance (Level-3)			
The ground sample distance feature DTM will equal the GSD of NAVCAM (Level-3)			
For a 3-sigma TAG delivery error ellipse around each of up to 2 sampling sites, produce a DTM with vertical RMS error < 0.14 m when compared to each of the NFT features (1-sigma).			
Up to 300 NFT Feature DTM products to MSA within 30 days of downlink of required Orbital B OCAMS and OLA data. (L-3)			
The mission shall collect data to allow the ground system to produce DTMs with sufficient fidelity to perform NFT guided TAG. (L-2) (Verification method should be in rationale...)			
MSA shall provide 300 candidate features to ALTWG (L-3)			
MSA shall test candidate features for robustness, correlation score and position accuracy between the NFT feature DTM and imagery (L-3) (Rationale defines what these three things mean)			
The ground system shall produce for up to 2 TAG sites a DTM with a vertical precision of < 0.14 m (L-3) (Data to meet MRD-115 meets this, OLA can verify)			
The features for the TAG site will be co-registered to the TAG site DTM to better than 0.14m (Needs work?)			
Feature selection process must be complete 45 days prior to the commencement of rehearsal (allows final testing, STL, final test, and uplink) (SWAG)			



Work to go (1/X)

- Aforementioned “requirements” may actually inform rationales of MRD Rev K requirements with (hopefully) few changes to Rev K as stated.
- FD and OLA need to discuss circularization strategies for Orbital B to ensure global observations at < 1km (optional maneuvers exist in current schedule to allow for the needed trim adjustments.)
- OLA should be able to produce DTMs with tilt accuracy to inform downselect to 2 at end of Orb B, which is more consistent with our planned conops.
 - OLA team would need to do testing with errors in NAV
 - Need to analyze the time required to obtain and downlink the data. Might need to push this in front of the radio science campaign or extend Orb B. This would need to be evaluated
 - FD would be able to improve fidelity of even nadir observations if they had some time in Orb B, which may improve the OLA observations.
 - OLA “Safety” observations may simplify site specific OCAMS observations
- To make OLA work for NFT we need to look at how we can extend the 5cm DTM from Orbit B, *combined with albedo from SPC*, to obtain required fidelity, otherwise, some low flybys may be needed to obtain higher resolution OLA observations.
- Need to understand if a recon pass provide the coverage for OLA to get the high resolution DTMs for the final TAG site features.
 - Need to understand the observation strategy for OLA during recon. This requires some simulation and testing by the OLA team.
 - At 225m the OLA scan width is 47 m, at 525 it is ~100m.