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Landsat Data Continuity Mission (LDCM)
Implementation Phase

Level 1G-ortho Data Option

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CONSULT THE LDCM CM OFFICE
301-286-6772
TO VERIFY THAT THIS IS THE CORRECT VERSION PRIOR TO USE.

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DOCUMENT REVISION HISTORY

Document Title: Landsat Data Continuity Mission (LDCM) Implementation Phase Level 1G-ortho Data Option			
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CONTRACT CHANGE HISTORY

Mod. #	Mod Date	CCR #	CCR Effective Date	Section(s)

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J.1 LDCM Level 1G-ortho Data Option Statement of Work

The activities defined below are intended to maximize the value of the LDCM mission by providing consistent and continuous access to LDCM data that have been orthorectified to a standard map projection using knowledge of the LDCM satellite and instrument imaging geometry and digital elevation data. Such data are defined below as LDCM Level 1G–ortho Data.

During the routine (post-IOC) delivery of LDCM Level 1G-ortho Data the Contractor shall, within 48 hours of acquiring LDCM Sensor Data, transfer the data to the USGS/EDC Active Archive. The Contractor will generate LDCM Level 1G-ortho Data from the 250 (on average) LDCM scenes acquired daily, with the actual number of LDCM Level 1G-ortho Data scenes determined by cloud cover. In addition, all of the data acquired for the LDCM will be delivered as NSLRSDA Data Packages. The Contractor shall, therefore, ensure that the LDCM planning and scheduling baseline supports the generation and delivery of the LDCM Level 1G-ortho Data specified in this attachment.

Receipt of the LDCM Level 1G-ortho Data enables the USGS/EDC Active Archive to offer this imagery to the public on request. The LDCM Level 1G-ortho Data must be consistent with the requirements of the Land Remote Sensing Policy Act of 1992 for "unenhanced, preprocessed" data where preprocessing is defined as "rectification of system and sensor distortions" and "registration of such data with respect to features of the Earth."

J.1.1 Introduction

This attachment defines the requirements to generate and deliver the LDCM Level 1G-ortho Data to the Government.

J.1.2 Scope

The Contractor shall have the end-to-end responsibility to provide all personnel, services and equipment required for the post-IOC delivery of the LDCM Level 1G-ortho Data to the USGS/EDC Active Archive. The LDCM Level 1G-ortho Data shall be compliant with the LDCM Level 1G-ortho Data Option Requirements contained in Section J.2.

The supporting digital elevation data used in the generation of the LDCM Level 1G-ortho Data will be furnished by the Government. The Government will also provide data identifying the allocation of WRS-2 scenes to UTM zones used in generating the LDCM Level 1G-ortho Data.

Delivery of the Active Archive Data Packages is not a requirement under this option.

J.1.3 Work To Be Performed

J.1.3.1 Update CDRLs

The Contractor shall deliver updates to the CDRLs listed in Attachment F of the Implementation Phase Contract as necessary to define implementation and delivery details of the LDCM Level 1G-ortho Data, including but not limited to enhancements to, or new versions of, data format control documents (DFCDs), interface control documents (ICDs) and operations documents.

J.1.3.2 Report Progress

The Contractor shall implement and report on the progress of this option throughout the remainder of the reviews for the LDCM Implementation Phase Contract per the CDRLs.

J.1.3.3 Exceptions to the Baseline SOW

The Contractor shall comply with all of the requirements defined in the LDCM Implementation Phase Statement of Work (SOW), with the exceptions as noted below.

J.1.3.3.a Section 1.2, paragraph 1 shall read as follows:

The Contractor shall perform and maintain a comprehensive risk management and mitigation program. Risks and mitigation analyses shall include risks to the Contractor's business, system performance, LDCM requirements, interfaces with any Government systems, and other risks that may impact the Government's ability to receive LDCM Data Packages, VDPs, and Level 1G-ortho Data. The risk management plan shall be documented as part of the Program Execution Plan in accordance with the CDRL. The Contractor's risk list shall be presented and reviewed at all MPSRs.

J.1.3.3.b Section 1.4, paragraph 1 shall read as follows:

The Contractor shall perform analyses, studies, or other task orders (including, but not limited to, the generation, characterization, and delivery of customized VDPs) relating to topics that may affect the acquisition, generation, characterization, quality, and/or delivery of LDCM Sensor Data, Data Packages, Level 1G-ortho Data, or VDPs, as authorized by the Government and in accordance with contract clause C.2. Customized VDPs may include non-standard imagery, imagery that uses manipulated calibration coefficients, or products from new or altered data processing algorithms.

J.1.3.3.c Section 2.0, paragraph 1 shall read as follows:

The Contractor shall perform all systems engineering activities needed to ensure that the LDCM Data Packages, Level 1G-ortho Data, and VDPs meet or exceed all requirements and specifications. The systems engineering effort shall encompass all phases of the LDCM program. The prime Contractor shall perform,

and ensure all its major subcontractors perform, systems engineering functions to execute the following tasks, as applicable to their specific responsibilities.

J.1.3.3.d Section 2.1, paragraph 1 shall read as follows:
The Contractor shall provide a concept of operations for the system that produces LDCM Data Packages, Level 1G-ortho Data, and VDPs. The Concept of Operations shall be developed and delivered in accordance with the Contract Schedule.

J.1.3.3.e Section 2.2, paragraph 1 shall read as follows:
The Contractor shall conduct a comprehensive test program, for all system phases, that assures that the LDCM Data Packages, Level 1G-ortho Data, and VDPs will reliably comply with all LDCM specifications. The Contractor shall develop and deliver a Data Specification Compliance Plan and a Data Specification Compliance Report in accordance with the Contract Schedule.

J.1.3.3.f Section 2.2.1, paragraph 2 shall read as follows:
Prior to the System Pre-Ship Review, the Contractor shall conduct one or more successful tests which exercise the entire data flow chain from receipt of sensor data at the focal plane of the instrument used to acquire LDCM data to delivery of Level 1G-ortho Data, NSLRSDA Data Packages, and Validation Data Products to the USGS/EDC Active Archive, to NSLRSDA, and to the Government Calibration/Validation System, respectively. Success shall be measured against the test goals defined in the Contractor's Data Flow Test Plan. The Contractor shall conduct pre-test reviews of the procedures, scripts, test support, and coordination for each test. The Contractor shall conduct TIMs to disclose the results of the test(s).

J.1.3.3.g Section 2.2.1, paragraph 4 shall read as follows:
As a condition of and prior to IOC, the Contractor shall successfully conduct a test that demonstrates delivery of specification-compliant Level 1G-ortho Data and NSLRSDA Data Packages to the USGS/EDC Active Archive and NSLRSDA, respectively, as well as delivery of Government-requested specification-compliant Validation Data Products. At a minimum the test shall include planning, data collection, and delivery of Active Archive and NSLRSDA Data Packages containing an average of 250 WRS-2 scenes per day throughout one uninterrupted 16-day WRS-2 cycle, and a specification-compliant amount of daily Level 1G-ortho Data for that period. During this test, the contractor shall demonstrate receipt and implementation of a seasonality file, receipt and fulfillment of Special Requests, collection of calibration data from all on-board calibration sources, and a spacecraft propulsive maneuver. The contractor shall define this test in the Data Flow Test Plan/Procedures and provide results in a Data Flow Test Report in accordance with the CDRL.

J.1.3.3.h Section 2.4, paragraph 1 shall read as follows:
The Contractor shall provide for all personnel, services and equipment required for system maintenance and sustaining engineering in support of all LDCM data deliveries together with a documentation process for addressing changes, upgrades, and anomalies, including reporting, tracking, and anomaly resolution, to ensure that all Contractor delivered LDCM Data Packages and VDPs meet all LDCM specifications throughout the contract period of performance, and to ensure that all Contractor delivered LDCM Level 1G-ortho Data meet all LDCM specifications throughout the option period of performance.

J.1.3.3.i Section 3.0, paragraph 1 shall read as follows:
The Contractor shall acquire LDCM Data Packages from a Contractor developed, owned and operated system and deliver Level 1G-ortho Data to the USGS/EDC Active Archive and NSLRSDA Data Packages to NSLRSDA in accordance with the LDCM Level 1G-ortho Data Specification (Section J.2) and the LDCM Data Specification.

J.1.3.3.j Section 3.2, paragraph 1 shall read as follows:
The Contractor shall store all LDCM Sensor Data and Ancillary Data until delivery of the associated LDCM NSLRSDA Data Packages and Level 1G-ortho Data to the USGS/EDC Active Archive and NSLRSDA is verified and accepted in accordance with the applicable ICD.

J.1.3.3.k Section 3.3, paragraph 1 shall read as follows:
The Contractor shall deliver LDCM NSLRSDA Data Packages to NSLRSDA and the LDCM Level 1G-ortho Data to the USGS/EDC Active Archive in accordance with the LDCM Data Specification and the LDCM Level 1G-ortho Data Specification (Section J.2), respectively, and the applicable ICD. The Contractor shall prepare and deliver a Daily Data Delivery Report in accordance with the Contract Schedule.

J.1.3.3.l Section 4, paragraph 1 shall read as follows:
The Contractor shall establish a calibration and data validation program that characterizes system performance, meets the Calibration/Validation (Cal/Val) requirements in Contract Attachment I, and maintains a well-characterized, highly calibrated system throughout the contract performance period. The Contractor shall be responsible for pre- and post-IOC measurements and tests to ensure that the LDCM NSLRSDA Data Packages, Level 1G-ortho Data, and VDPs meet or exceed LDCM Data Specification requirements and the LDCM Level 1G-ortho Data Specification requirements (Section J.2).

J.1.3.3.m Section 4.3, paragraph 1 shall read as follows:
The Contractor shall implement the commissioning phase Cal/Val activities detailed in the Calibration/Validation Plan leading to LDCM NSLRSDA Data Packages, Level 1G-ortho Data, and VDPs that meet the LDCM Data Specification and the LDCM Level 1G-ortho Data Specification requirements

(Section J.2). The Contractor shall provide results in a Calibration/Validation Report in accordance with the CDRL.

J.1.3.3.n Section 5.0, paragraph 1 shall read as follows:
The Contractor shall develop and document all algorithms used to create and process LDCM Sensor Data and Ancillary Data and produce the LDCM NSLRSDA Data Packages and VDPs. The Contractor shall deliver to the Government all algorithms used to create and process LDCM Sensor Data and to produce the LDCM NSLRSDA Data Packages, LDCM Level 1G-ortho Data, and VDPs. The delivered algorithms are for public release to the extent allowable by U.S. export laws and regulations. These algorithms shall include but are not limited to:

J.1.3.3.o Section 5.0, paragraph 2 shall read as follows:
Algorithms delivered to the Government shall be the identical algorithms used in the production of LDCM Sensor Data, LDCM NSLRSDA Data Packages, LDCM Level 1G-ortho Data, and VDPs. Changes to these algorithms shall be delivered to the Government at least five business days before they are used to generate LDCM Sensor Data, LDCM NSLRSDA Data Packages, LDCM Level 1G-ortho Data, and VDPs, along with sufficient documentation that describes the changes and why they were required.

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J.2 LDCM Level 1G-ortho Data Option Specification

The contractor shall comply with the requirements in the LDCM Implementation Phase Data Specification with the exception(s) as noted below.

a. Requirements for the Active Archive Data Packages contained in Section 2.4 of the LDCM Implementation Phase Data Specification do not apply under Option 2, Option 3 and Option 4.

In addition, the following sections specify the requirements to generate and deliver the LDCM Level 1G-ortho Data to the Government.

J.2.1 Global Coverage
The Contractor shall produce LDCM Level 1G-ortho Data from all of the daylight, land WRS-2 scenes acquired for LDCM that meet the specified cloud cover restrictions.

J.2.2 LDCM Level 1G-ortho Data Cloud Cover
LDCM Level 1G-ortho Data shall be generated from all acquired LDCM data which have a cloud cover estimate of less than or equal to 50 percent.

J.2.3 Timeliness of Delivery
The Contractor shall provide the USGS/EDC Active Archive with all LDCM Level 1G-ortho LDCM Data such that the Data are delivered within 48 hours of acquisition.

J.2.4 Store LDCM Level 1G-ortho Data
The Contractor shall retain LDCM Level 1G-ortho Data until receipt of an acknowledgement that the products were delivered to the USGS/EDC Active Archive and verified.

J.2.5 WRS-2 Scenes
LDCM Level 1G-ortho Data shall conform to the spatial coverage of the heritage Worldwide Reference System-2 (WRS-2) path/row scenes (185 x 180 km).

J.2.6 Data Format
LDCM Level 1G-ortho LDCM Data shall be provided in the FAST Data Format.

J.2.7 LDCM Level 1G-ortho Radiometric and Geometric Reference

LDCM Level 1G-ortho Data shall provide radiometrically corrected digital image data consisting of digital values linearly scaled to at-aperture spectral radiance.

J.2.8 Radiometric Scale

LDCM Level 1G-ortho Data shall have a constant linear radiometric scale for all the data from a particular spectral band.

J.2.9 Universal Transverse Mercator Map Projection

LDCM Level 1G-ortho Data shall be registered to the Universal Transverse Mercator map projection.

J.2.10 Scene Orientation

The LDCM Level 1G-ortho Data output image grid shall be aligned to map projection grid North-up.

J.2.11 Resampling Method

LDCM Level 1G-ortho Data image resampling shall be performed using the cubic convolution interpolation resampling method.

J.2.12 Resampled Grid Cell Size Characteristics

LDCM Level 1G-ortho Data grid cell sizes shall be resampled into the cartographic projection system using grid cell (i.e., resampled output pixel) sizes as specified in Table J.2.12-1, or grid cell sizes equal to the GSD for the corresponding LDCM Level 1R VDP data if the LDCM Level 1R VDP GSD is smaller than the values in Table J.2.12-1.

Table J.2.12-1: LDCM Level 1G-ortho Resampled Grid Cell Sizes

Band Group	Standard Reflective Bands	Sharpening Band	Cirrus Band
Size Range	30 m	15 m	120 m

J.2.13 Pixel Alignment

LDCM Level 1G-ortho Digital Image Data shall have a pixel center, pixel alignment for purposes of aligning bands with different grid cell sizes.

J.2.14 Metadata

LDCM Level 1G-ortho Metadata shall describe the respective LDCM Level 1G-ortho Data.

J.2.14.1 LDCM Level 1G-ortho Metadata shall adhere to the Federal Geographic Data Committee (FGDC) content standards for geospatial metadata.

J.2.14.2 LDCM Level 1G-ortho Metadata shall include, but not be limited to:

a. all of the items listed in Section 2.5.1.3.c of the LDCM Implementation Phase Data Specification,
b. The version of the calibration coefficients used to generate the LDCM Level 1G-ortho Data,
c. The radiometric scaling factors required to convert the digital values of the LDCM Level 1G-ortho Data to units of spectral radiance with the accuracy specified in Attachment B Section 6.1,
d. The cartographic projection,
e. The cartographic projection parameters,
f. The current Geodetic Reference System (WGS84, G873, or current version),
g. Identification of any supplementary data used to generate the LDCM Level 1G-ortho Data,
h. Product corner points with the accuracy specified in Table J.2.17-1.
i. The resampling method,
j. The output resampled pixel size for each of the spectral band groups identified in Section J.2.12.
k. Information on the digital elevation model data used in generating the product including source, version, accuracy, version date.
l. Processing history containing data source type, product creation date and time, coefficient file version used for processing, coefficient file creation date, and production software version/release number.

J.2.15 LDCM Level 1G-ortho Band-to-Band Registration

Corresponding pixels from the digital images of the spectral bands in LDCM Level 1G-ortho Data shall be co-registered with an uncertainty as specified in Table J.2.15-1 or less in the line and sample directions at the 90% confidence level.

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Table J.2.15-1: Maximum Band Registration Linear Error (LE90) of LDCM Level 1G-ortho Products Given GFE DEMs

	DEM vertical accuracy (LE90)		
	≤12m	12-50m	50-500m
Standard Bands (1 through 8)	4.5m	5.0m	7.0m
Cirrus Band (9)	18m	18m	20m

J.2.16 LDCM Level 1G-ortho Radiometric and Geometric Reference

LDCM Level 1G-ortho Data shall be registered and orthorectified to a cartographic projection, referenced to the World Geodetic System 1984 (WGS84, G873 or current version).

J.2.17 LDCM Level 1G-ortho Geodetic Accuracy

The pixels for the LDCM Level 1G-ortho Data shall be orthorectified to the Earth's topographic surface using the resampling methods defined in Section J.2.11 and Section J.2.12 and shall be located relative to the WGS84 geodetic reference system, G873 or current version. Table J.2.17-1 lists the 90% maximum circular error limits, including compensation for terrain effects, for the LDCM Level 1G-ortho Data. Subsequent sections describe the product characteristics and the support data to be used to create the LDCM Level 1G-ortho Data.

Table J.2.17-1: Maximum Circular Error (CE90) of LDCM Level 1G-ortho Products Given GFE DEMs

	DEM vertical accuracy (LE90)		
	≤12m	12-50m	50-500m
Maximum CE90	75m	75m	150m

Note: The DEM vertical accuracy specifies the accuracy with which the elevation for an arbitrary point within the WRS-2 scene area can be retrieved from the digital elevation data, not the accuracy of the individual elevation samples within the digital elevation data set and, thus, includes the effects of sample spacing and horizontal error.

J.2.18 LDCM Level 1G-ortho Data Elevation Data

LDCM Level 1G-ortho Data shall be created using Government furnished digital elevation data.

J.2.19 LDCM Level 1G-ortho Data Browse

The Contractor shall generate browse images for each Level 1G-ortho WRS-2 scene.

a. Browse images shall be geographically indexed to a WRS-2 based on a grid of nominal LDCM scene centers,
b. Each browse image shall be a red-green-blue (rgb) color composite of image bands using LDCM bands 6, 5, and 4, respectively,
c. Each browse image shall provide a spatial resolution averaged to no greater than 240 meters,
d. Each browse image shall have linear contrast stretch applied to each band by clipping the upper and lower 2.5% of the data and stretching the resultant truncated range from a byte value of 255 to 0,
e. Each browse image shall be JPEG 2000 (or current technology) compressed file,
f. Browse images shall be delivered with the related LDCM Level 1G-ortho Data.