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Department of the Interior
U.S. Geological Survey

Landsat Collection 2
U.S. Analysis Ready Data
Data Format Control Book

Version 4.0

August 2023

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Executive Summary

Landsat Collection 2 marks the second major reprocessing effort on the Landsat archive by the USGS that provides several data product improvements that harness recent advancements in data processing, algorithm development, and data access and distribution capabilities.

This Data Format Control Book (DFCB) presents detailed data formats for the Landsat Collection 2 (C2) U.S. Analysis Ready Data (ARD). The C2 ARD is consistently processed to the highest scientific standard and level of processing required for direct use in remote sensing applications. The Landsat C2 Level-2 Science Products (L2SP) and Level-2 Surface Reflectance (L2SR) products serve as the input for generating C2 ARD.

A key goal for ARD is to significantly reduce the burden of processing on remote sensing scientists, who would need to download and prepare large amounts of data for time series analysis (such as performing additional radiometric and/or geometric corrections and geographic subsetting). In doing so, users create their own archives and unique ARD for their specific applications. A successful ARD implementation significantly simplifies this process so data are ready for applications with a minimal amount of independent preparation.

This document is under Data Processing and Archive System (DPAS) Configuration Control Board (CCB) control. Please submit changes to this document, as well as supportive material justifying the proposed changes, via Change Request (CR) to the Process and Change Management Tool.

Document History

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Section 1 Introduction

1.1 Background

Landsat satellite data have been produced, archived, and distributed by the U.S. Geological Survey (USGS) since 1972. Users rely upon these data for conducting historical studies of land surface change but have shouldered the burden of post-production processing to create application-ready datasets. To alleviate this burden, the USGS initiated an effort to produce a collection of Landsat Science Products that are suitable for monitoring, assessing, and predicting the land surface change over time. These products include terrestrial variables such as Surface Reflectance (SR), Surface Temperature (ST), Top of Atmosphere (TOA) reflectance, TOA Brightness Temperature (BT), Burned Area (BA), Fractional Snow Covered Area (fSCA), and Dynamic Surface Water Extent (DSWE).

The Landsat Collection 2 (C2) U.S. Analysis Ready Data (ARD) was released in September 2021 and provides several improvements in the Landsat Science Products. A primary characteristic of Collection 2 is the substantial improvement in the absolute geolocation accuracy of the global ground reference dataset – which improves the interoperability of the Landsat archive through time. Collection 2 also includes updated global digital elevation modeling sources and calibration and validation updates.

1.2 Purpose and Scope

The primary purpose of this Data Format Control Book (DFCB) is to provide detailed information on the Landsat C2 U.S. ARD specifications and product packaging.

The scope of this DFCB is the formats and data contents of the Landsat C2 U.S. ARD.

1.3 Document Organization

This document contains the following sections:

- Section 1 provides an introduction
- Section 2 provides an overview of the Landsat U.S. ARD
- Section 3 provides information about data format definition
- Appendix A and Appendix B provide sample metadata
- Appendix C provides ARD metadata definition
- Appendix D lists the World Reference System 2 (WRS-2) scenes used in ARD
- The References section contains a list of reference documents

1.4 Terminology

Level-1 – Level-1 processing refers to the generation of radiometrically calibrated and orthorectified data products as a collection. This includes the quantized and calibrated scaled Digital Numbers (DN) as well as the derived physical quantities such as Top of Atmosphere (TOA) spectral radiance, TOA Reflectance, and TOA Brightness Temperature (BT) products.

Level-2 – Level-2 processing refers to the generation of atmospherically corrected geophysical retrievals of the Earth's surface such as Surface Reflectance (SR) and Surface Temperature (ST) products as inputs to ARD.

Level-3 – Level-3 processing refers to retrieval of Burned Area (BA), Dynamic Surface Water Extent (DSWE), and Fractional Snow Covered Area (fSCA) terrestrial land surface conditions via data products from Level 2 to inform land change science.

Tier 1 – Landsat scenes with the highest available data quality are placed into Tier 1 and are considered suitable for time-series analysis. This includes Landsat Level 1 Thematic Mapper (TM), Enhanced Thematic Mapper Plus (ETM+), and Operational Land Imager (OLI) / Thermal Infrared Sensor (TIRS) data processed to Level 1 Terrain Precision (Corrected) (L1TP) with a post model fit to the Global Land Survey (GLS) control of ≤12- meter (m) Root Mean Square Error (RMSE) (ideal for time series "stacking").

Tier 2 – Landsat scenes not meeting Tier 1 criteria during processing are assigned to Tier 2. This includes Landsat Level 1 TM and ETM+ data processed to Level 1 Geometric Systematic (Corrected) (L1GS) products, and ETM+ and OLI/TIRS data processed to Level 1 Systematic Terrain (Corrected) (L1GT) products and to L1TP, for which the post model fit to the GLS control is >12-m RMSE. Tier 2 scenes adhere to the same radiometric standard as Tier 1 scenes but do not meet the Tier 1 geometry specification due to less accurate orbital information (specific to older Landsat sensors), significant cloud cover, insufficient ground control, or other factors.

ARD – The ARD refers to tiled, georegistered, TOA and atmospherically corrected geophysical products defined in a common equal area projection, accompanied by spatially explicit Quality Assessment (QA) information, and appropriate metadata to enable further processing while retaining traceability of data provenance.

Tile – ARD is packaged in tiles, which are units of uniform dimension bounded by static corner points in a defined grid system (see Figure 1-1, Figure 1-2, and Figure 1-3 for Conterminous U.S. (CONUS), Alaska, and Hawaii examples, respectively). An ARD tile is defined as 5,000 x 5,000 30-m pixels. For a given acquisition date, an ARD tile can be created from 1 to 3 scenes acquired over the same WRS-2 path.

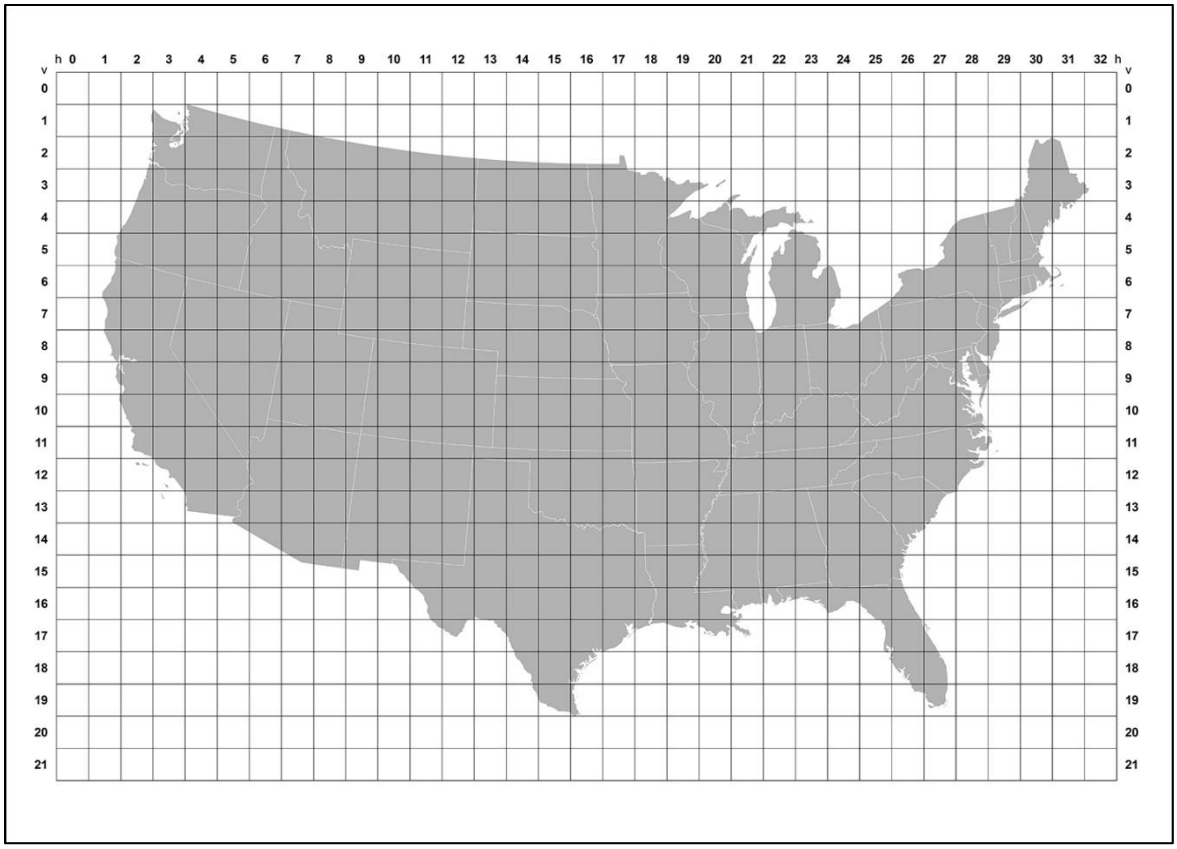

Figure 1-1. Landsat C2 ARD Tile Grid for the Conterminous U.S.

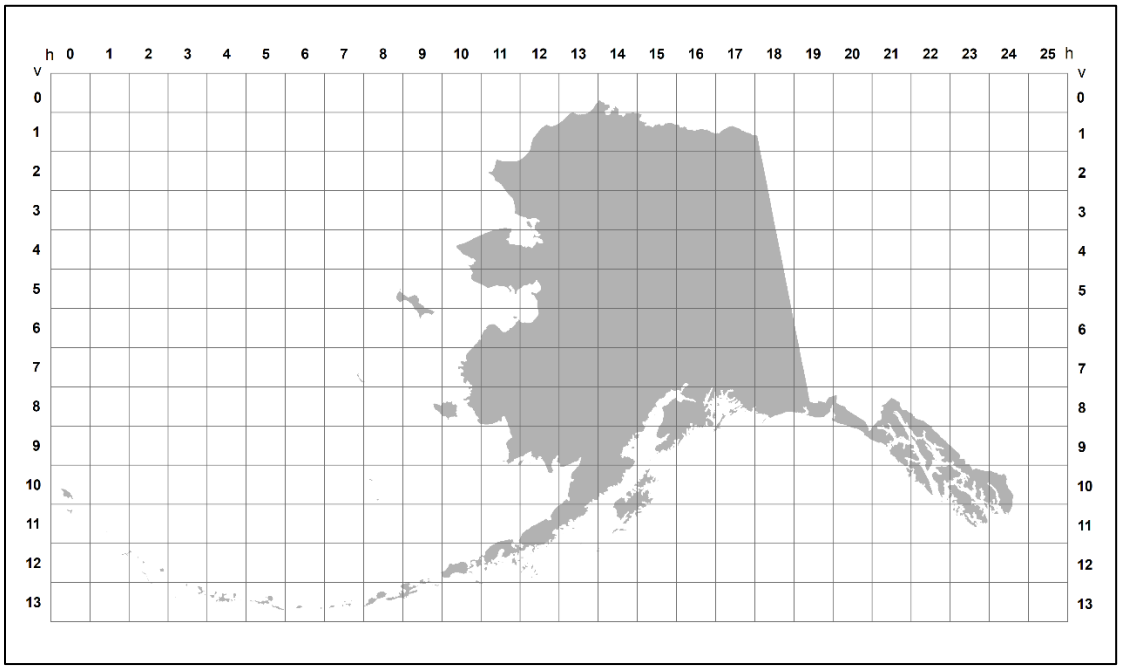

Figure 1-2. Landsat C2 ARD Tile Grid for Alaska

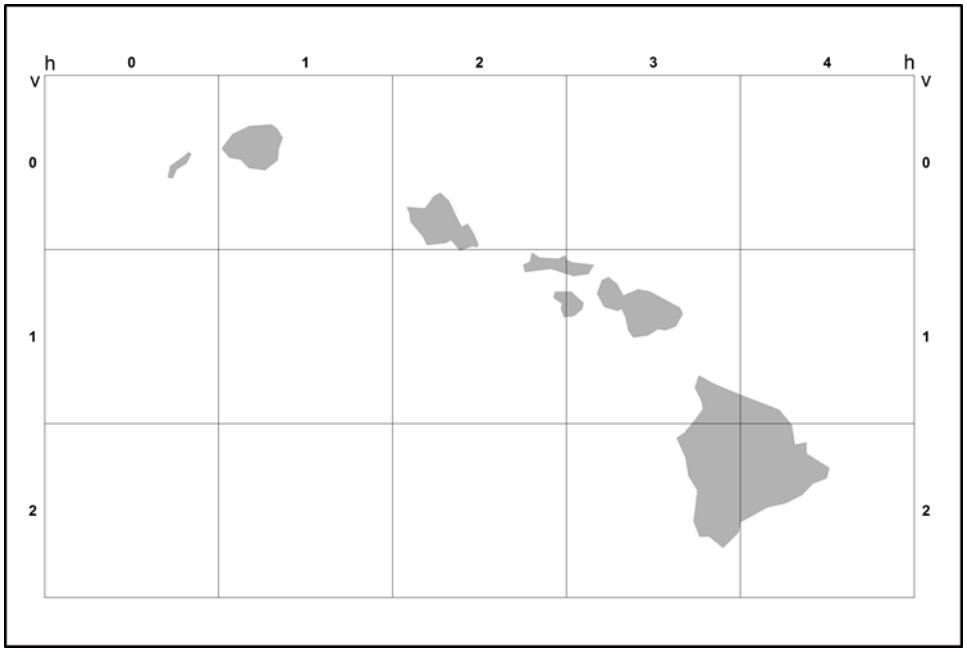

Figure 1-3. Landsat C2 ARD Tile Grid for Hawaii

Section 2 Overview of Landsat U.S. ARD

The Landsat Collection 2 U.S. ARD consists of Level-1 Top of Atmosphere (TOA) Reflectance and TOA Brightness Temperature (BT), the Level-2 Surface Reflectance (SR) and Surface Temperature (ST), and the associated Quality Assessment (QA) data gridded to a common cartographic projection and accompanied by appropriate metadata to enable further processing while retaining traceability of data provenance. Subsequently, numerous products can be derived from ARD that are used as direct inputs to monitoring and assessment activities, which include, but are not limited to maps of land cover and land cover change, spectral indices, temporal composites, and Level-3 Science Products such as Burned Area (BA), Dynamic Surface Water Extent (DSWE), and Fractional Snow Covered Area (fSCA).

The Landsat Collection 2 U.S. ARD is available for the Conterminous United States (CONUS), Alaska and Hawaii, using the following Landsat Collection 2 products:

- Landsat 8-9 OLI/TIRS Tier 1, Tier 2
- Landsat 7 ETM+ Tier 1
- Landsat 4-5 TM Tier 1

Landsat C2 ARD is available for CONUS from 1982-present, and from 1984-present for Alaska. For Hawaii, ARD is available from 1989-1993, and 1999-present.

Landsat 1-5 Multispectral Scanner (MSS) data will be considered for processing into the U.S. ARD inventory, once these data have been sufficiently analyzed for their suitability.

The current definition of Landsat Collection 2 U.S. ARD includes the products output by the USGS Landsat Ecosystem Disturbance Adaptive Processing System (LEDAPS) Surface Reflectance algorithm version 3.4.0 (derived from the February 2011 version of NASA LEDAPS code), the USGS Land Surface Reflectance Code (LaSRC) version 1.5.0 (derived from NASA LaSRC version 3.5.5), and the Landsat Level-2 Surface Temperature algorithm version 1.3.0 (derived from June 2017 version of RIT ST code). The C2 Level-2 Science Products (L2SP) and Level-2 Surface Reflectance (L2SR) products are generated using Landsat Product Generation System (LPGS) versions 15.4.0c to 15.6.0. The LPGS software includes a new Quality Assessment (QA) Application that provides consistent per-pixel QA in Level-1 and Level-2 product packages. The QA Application uses the outputs of C version of Function of Mask (CFMask) version 3.3.1 (derived from Fmask version 3.3.1) to detect cloud, water, and snow.

The Landsat Level-2 SR science product is generated by applying atmospheric correction routines to Landsat TOA Reflectance data, using auxiliary input data such as water vapor, ozone, and Aerosol Optical Thickness (AOT). The Level-2 ST science product is generated from the Landsat Level-1 thermal infrared band radiance and auxiliary input data such as Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER) Global Emissivity Database (GED) data, ASTER Normalized

Difference Vegetation Index (NDVI) data, and atmospheric profiles of geopotential height, specific humidity, and air temperature obtained from Goddard Earth Observing System, Version 5 (GEOS-5) Forward Processing for Instrument Teams (FP-IT) or NASA's Modern-Era Retrospective analysis for Research and Application, Version 2 (MERRA-2) reanalysis data. The GEOS-5 FP-IT data are used in the surface temperature processing of Landsat data acquired between January 1, 2000, to present and the MERRA-2 provides atmospheric data for Landsat acquisitions between 1982 to December 31, 1999. Additional information about C2 L2SP and L2SR can be found in LSDS-1618 and LSDS-1619 in the References section.

2.1 Landsat U.S. ARD Product Band Specifications

2.1.1 Landsat 4-7 TM/ETM+ U.S. ARD Product Specifications

The Landsat 4-7 TM/ETM+ C2 ARD product options include the TOA Reflectance, TOA Brightness Temperature (BT), Surface Reflectance, and Surface Temperature science products. The TOA Reflectance and TOA BT are generated using the calibration parameters from the metadata. Atmospheric correction routines are applied to the TOA reflectance using LEDAPS algorithm to generate Surface Reflectance. The Surface Temperature product is generated from the thermal infrared bands using the Single Channel algorithm. The detailed description of the C2 Level-2 atmospheric compensation algorithms can be found in LSDS-1747 and LSDS-1983 in the References section. The Surface Temperature product is available from the L2SP scenes only and will not be generated for the L2SR scenes. The per-pixel Quality Assessment bands derived from Landsat 4-5 TM and Landsat 7 ETM+ inputs are also available in the Landsat 4-7 TM/ETM+ ARD product. Table 2-1 through Table 2-5 list the specifications for all associated bands in Landsat 4-7 TM/ETM+ C2 ARD.

For Landsat 7 products, the Band 6 ST and TOA BT products are generated from ETM+ Band 6H and Band 6L merged together. Pixels that are not saturated in Band 6H contain the output of the 6H band. Pixels with brightness temperature outside of the 6H dynamic range (from 240K to 322K) will contain the output of the 6L band. Pixels that are saturated in Band 6L remain saturated in the merged Band 6 product. The merged thermal radiance is then used in the creation of the ST and TOA BT products.

The Landsat 7 panchromatic band (ETM+ Band 8) is not processed to TOA or surface reflectance.

Level-1 / Level-2 Band Designation	ARD Band Designation	Band Name	Data Type	Units	Range	Valid Range	Fill Value	Saturate Value	Multiplicative Scale Factor	Additive Offset
TOA_B1	TOA_B1	Band 1 TOA Reflectance	UINT16	Refl	1 – 65535	7273 – 43636	0	65535	0.0000275	-0.2
TOA_B2	TOA_B2	Band 2 TOA Reflectance	UINT16	Refl	1 – 65535	7273 – 43636	0	65535	0.0000275	-0.2
TOA_B3	TOA_B3	Band 3 TOA Reflectance	UINT16	Refl	1 – 65535	7273 – 43636	0	65535	0.0000275	-0.2
TOA_B4	TOA_B4	Band 4 TOA Reflectance	UINT16	Refl	1 – 65535	7273 – 43636	0	65535	0.0000275	-0.2
TOA_B5	TOA_B5	Band 5 TOA Reflectance	UINT16	Refl	1 – 65535	7273 – 43636	0	65535	0.0000275	-0.2
TOA_B7	TOA_B7	Band 7 TOA Reflectance	UINT16	Refl	1 – 65535	7273 – 43636	0	65535	0.0000275	-0.2
SAA	SAA	Solar Azimuth Angles Band 4	INT16	Degrees	-32767 – 32767	-18000 – 18000	-32768	NA	0.01	NA
SZA	SZA	Solar Zenith Angles Band 4	INT16	Degrees	-32767 – 32767	-9000 – 9000	-32768	NA	0.01	NA
VAA	VAA	Viewing Azimuth Angles Band 4	INT16	Degrees	-32767 – 32767	-18000 – 18000	-32768	NA	0.01	NA
VZA	VZA	Viewing Zenith Angles Band 4	INT16	Degrees	-32767 – 32767	-9000 – 9000	-32768	NA	0.01	NA

TOA=top of atmosphere, TOA_B=top of atmosphere reflectance band, UINT16 = 16-bit unsigned integer, INT16=16-bit signed integer, Refl=reflectance

Table 2-1. Landsat 4-7 Top of Atmosphere Reflectance Band Specifications

Level-2 Band Designation	ARD Band Designation	Band Name	Data Type	Units	Range	Valid Range	Fill Value	Saturate Value	Multiplicative Scale Factor	Additive Offset
BT_B6	BT_B6	Band 6 Brightness Temp	UINT16	Top of Atmosphere Brightness Temp (K)	1 - 65535	292 - 61440	0	65535	0.00341802	149.0

BT=top of atmosphere brightness temperature, BT_B= top of atmosphere brightness temperature band, INT16=16-bit signed integer, Temp=temperature, K=Kelvin

Table 2-2. Landsat 4-7 Top of Atmosphere Brightness Temperature Band Specifications

Level-2 Band Designation	ARD Band Designation	Band Name	Data Type	Units	Range	Valid Range	Fill Value	Saturate Value	Multiplicative Scale Factor	Additive Offset
SR_B1	SR_B1	Band 1	UINT16	Refl	1 – 65535	7273 – 43636	0	65535	0.0000275	-0.2
SR_B2	SR_B2	Band 2	UINT16	Refl	1 – 65535	7273 – 43636	0	65535	0.0000275	-0.2
SR_B3	SR_B3	Band 3	UINT16	Refl	1 – 65535	7273 – 43636	0	65535	0.0000275	-0.2
SR_B4	SR_B4	Band 4	UINT16	Refl	1 – 65535	7273 – 43636	0	65535	0.0000275	-0.2
SR_B5	SR_B5	Band 5	UINT16	Refl	1 – 65535	7273 – 43636	0	65535	0.0000275	-0.2
SR_B7	SR_B7	Band 7	UINT16	Refl	1 – 65535	7273 – 43636	0	65535	0.0000275	-0.2
SR=surface reflectance, SR_B=surface reflectance band, UINT16 = 16-bit unsigned integer, Refl=reflectance										

Table 2-3. Landsat 4-7 Surface Reflectance Band Specifications

Level-2 Band Designation	ARD Band Description	Band Name	Data Type	Units	Range	Valid Range	Fill Value	Saturate Value	Multiplicative Scale Factor	Additive Offset
ST_B6	ST_B6	Surface Temperature	UINT16	Kelvin	1 - 65535	292 - 61440	0	NA	0.00341802	149.0
ST_ATRAN	ST_ATRAN	Atmospheric Transmittance	INT16	Unitless	0 – 10000	0 – 10000	-9999	NA	0.0001	NA
ST_DRAD	ST_DRAD	Downwelling Radiance	INT16	W/(m^2.sr.µm)/DN	0 – 28000	0 – 28000	-9999	NA	0.001	NA
ST_URAD	ST_URAD	Upwelling Radiance	INT16	W/(m^2.sr.µm)/DN	0 – 28000	0 – 28000	-9999	NA	0.001	NA
ST_TRAD	ST_TRAD	Thermal band converted to radiance	INT16	W/(m^2.sr.µm)/DN	0 – 22000	0 – 22000	-9999	NA	0.001	NA
ST_EMIS	ST_EMIS	Landsat Emissivity estimated from ASTER GED data	INT16	Emissivity coefficient	0 – 10000	0 – 10000	-9999	NA	0.0001	NA
ST_EMSD	ST_EMSD	Landsat Emissivity Standard Deviation	INT16	Emissivity coefficient	0 – 32767	0 – 10000	-9999	NA	0.0001	NA
ST_CDIST	ST_CDIST	Pixel distance to cloud	INT16	Kilometers	0 – 24000	0 – 24000	-9999	NA	0.01	NA
ST=surface temperature, ST_B=surface temperature band, UINT16 = 16-bit unsigned integer, INT16=16-bit signed integer										

Table 2-4. Landsat 4-7 Surface Temperature Band Specifications

Level-2 Band Designation	ARD Band Designation	Band Name	Data Type	Units	Range	Valid Range	Fill Value	Saturate Value	Scale Factor
QA_PIXEL	QA_PIXEL	Pixel Quality Assessment	UINT16	Bit Index	1 – 65535	5440 – 16382	1 (bit 0)	NA	NA
QA_RADSAT	QA_RADSAT	Radiometric Saturation QA	UINT16	Bit Index	0 – 65535	0 – 3829	NA	NA	NA
NA	QA_LINEAGE	Lineage QA	UINT8	NA	0 – 255	0 – 3	0	NA	NA
SR_ATMOS_OPACITY	SR_ATMOS OPACITY	Internal SR Atmospheric Opacity	INT16	NA	0 – 32767	0 – 1000	-9999	20000	0.001
SR_CLOUD_QA	SR_CLOUD_QA	Internal SR QA	UINT8	Bit Index	0 – 255	0 – 63	NA	NA	NA
ST_QA	ST_QA	ST Uncertainty	INT16	Kelvin	0 – 32767	0 – 32767	-9999	NA	0.01
QA=quality assessment, UINT16=16-bit unsigned integer, INT16=16-bit signed integer, UINT8=8-bit unsigned integer, NA=not applicable, SR=surface reflectance, ST=surface temperature									

Table 2-5. Landsat 4-7 U.S. ARD Quality Assessment Band Specifications

2.1.2 Landsat 4-7 TM/ETM+ Landsat U.S. ARD Quality Assessment Band Specifications

The quality bands delivered with Level-2 products are the Level-1 QA bands and the additional quality bands derived from Level-2 processing. The Level-1 QA bands include the QA_PIXEL that describes the general state of each pixel and the QA_RADSAT that characterizes radiometric saturation. In the Landsat 4-7 C2 U.S. ARD, the Level-1 QA bands are accompanied with Level-2 processing QA bands that describe parameters specific to Surface Reflectance atmospheric correction (SR_ATMOS_OPACITY and SR_CLOUD_QA) and the Surface Temperature uncertainty (ST_QA). The Surface Temperature Uncertainty (ST_QA) will include valid data if at least one of the ARD input scenes is L2SP. The Lineage index (QA_LINEAGE) information is also included in the Landsat C2 U.S. ARD QA package. Sections 2.1.2.1 through 2.1.2.6 provide additional information on the Landsat C2 U.S. ARD QA bands for Landsat 4-7 TM/ETM+. Table 2-6 through Table 2-12 list all bit-packed QA bands and their associated contents.

2.1.2.1 Landsat 4-7 Pixel Quality Assessment Band

The Landsat 4-7 pixel quality assessment (QA_PIXEL) band includes the information from the Level-1 Quality Assessment (QA_PIXEL) band which is carried through unchanged into Level-2 processing and is provided in the ARD product package. QA_PIXEL includes information about Cloud, Cloud Confidence, Cloud Shadow, Cloud Shadow Confidence, and Snow/Ice flags derived from the CFMask algorithm version 3.3.1. Table 2-6 shows the bit assignments and their description in QA_PIXEL. Cloud Shadow and Snow/Ice Confidence flags in bits 10-13 each have a reserved value for future improvements. They match the respective flags in bits 4 and 5 and may be used interchangeably.

Bit	Flag Description	Values
0	Fill	0 for image data 1 for fill data
1	Dilated Cloud	0 for cloud is not dilated or no cloud 1 for cloud dilation
2	Unused	Unused
3	Cloud	0 for cloud confidence is not high 1 for high confidence cloud
4	Cloud Shadow	0 for Cloud Shadow Confidence is not high 1 for high confidence cloud shadow
5	Snow	0 for Snow/Ice Confidence is not high 1 for high confidence snow cover
6	Clear	0 if Cloud or Dilated Cloud bits are set 1 if Cloud and Dilated Cloud bits are not set
7	Water	0 for land or cloud 1 for water
8-9	Cloud Confidence	00 for no confidence level set 01 Low confidence 10 Medium confidence 11 High confidence
10-11	Cloud Shadow Confidence	00 for no confidence level set 01 Low confidence 10 Reserved 11 High confidence
12-13	Snow/Ice Confidence	00 for no confidence level set 01 Low confidence 10 Reserved 11 High confidence
14-15	Unused	NA

Table 2-6. Landsat 4-7 Pixel Quality Assessment Bit Index

The bit combinations that define certain quality conditions appear as integer values in the QA_PIXEL band. Unpacking the bits represented by the pixel values deconstructs them into comprehensible condition descriptions. Table 2-7 displays the interpretation of example pixel values expected in the QA_PIXEL band after its bits are unpacked. For example, a pixel value of 5440 represents the bit combination indicating a clear pixel condition.

Pixel Value	Fill	Dilated Cloud	Cirrus	Cloud	Cloud Shadow	Snow	Clear	Water	Cloud Conf.	Cloud Shadow Conf.	Snow/ Ice Conf.	Cirrus Conf.	Pixel Description
1	Yes	No	N/A	No	No	No	No	No	None	None	None	None	Fill
5440	No	No	N/A	No	No	No	Yes	No	Low	Low	Low	None	Clear with lows set
5442	No	Yes	N/A	No	No	No	Yes	No	Low	Low	Low	None	Dilated cloud over land
5504	No	No	N/A	No	No	No	No	Yes	Low	Low	Low	None	Water with lows set
5506	No	Yes	N/A	No	No	No	No	Yes	Low	Low	Low	None	Dilated cloud over water
5696	No	No	N/A	No	No	No	Yes	No	Mid	Low	Low	None	Mid conf cloud
5760	No	No	N/A	No	No	No	No	Yes	Mid	Low	Low	None	Mid conf cloud over water
5896	No	No	N/A	Yes	No	No	No	No	High	Low	Low	None	High conf Cloud
7440	No	No	N/A	No	Yes	No	No	No	Low	High	Low	None	High conf cloud shadow
7568	No	No	N/A	No	Yes	No	No	Yes	Low	High	Low	None	Water with cloud shadow
7696	No	No	N/A	No	Yes	No	No	No	Mid	High	Low	None	Mid conf cloud with shadow
7824	No	No	N/A	No	Yes	No	No	Yes	Mid	High	Low	None	Mid conf cloud with shadow over water
7960	No	No	N/A	Yes	Yes	No	No	No	High	High	Low	None	High conf cloud with shadow
8088	No	No	N/A	Yes	Yes	No	No	Yes	High	High	Low	None	High conf cloud with shadow over water
13664	No	No	N/A	No	No	Yes	Yes	No	Low	Low	High	None	High conf snow/ice

Table 2-7. Landsat 4-7 Pixel Quality Assessment Bit Values

2.1.2.2 Landsat 4-7 Radiometric Saturation Quality Band

The radiometric saturation quality band (QA_RADSAT) is a bit-packed representation of which sensor bands were saturated during data capture, yielding unusable data. Table 2-8 displays the bit assignments in the QA_RADSAT band. For example, a pixel value of 32 indicates that Band 6 is saturated.

Bit	Flag Description		Value
	Landsat 4-5	Landsat 7	
0	Band 1 Data Saturation	Band 1 Data Saturation	0 no saturation 1 saturated data
1	Band 2 Data Saturation	Band 2 Data Saturation	0 no saturation 1 saturated data
2	Band 3 Data Saturation	Band 3 Data Saturation	0 no saturation 1 saturated data
3	Band 4 Data Saturation	Band 4 Data Saturation	0 no saturation 1 saturated data
4	Band 5 Data Saturation	Band 5 Data Saturation	0 no saturation 1 saturated data
5	Band 6 Data Saturation	Band 6L Data Saturation	0 no saturation 1 saturated data
6	Band 7 Data Saturation	Band 7 Data Saturation	0 no saturation 1 saturated data
7	Unused	Unused	0 not checked
8	Unused	Band 6H Data Saturation	0 no saturation 1 saturated data
9	Dropped Pixel	Dropped Pixel	0 Pixel present 1 detector doesn't have a value – no data
10	Unused	Unused	0
11	Unused	Unused	0
12	Unused	Unused	0
13	Unused	Unused	0
14	Unused	Unused	0
15	Unused	Unused	0

Table 2-8. Landsat 4-7 Radiometric Saturation Quality Assessment Bit Index

2.1.2.3 Landsat 4-7 Lineage Index Band

Each Landsat U.S. ARD tile contains only one date of acquisition and may contain information from one, two, or three Level-2 scenes. Each ARD tile package contains a band indicating which Level-2 scene was the source for each pixel. If areas of a scene overlap on a single path, the northern-most scene takes precedence. An exception may be noted for Landsat 7 ETM+ scenes, in which it is possible, due to scan line pixel gaps, that a particular pixel could derive from the southern scene. The pixel values are used in conjunction with the metadata file to retrieve scene-specific information. The lineage index (QA_LINEAGE) band is included in all packages related to a particular ARD tile. Table 2-9 displays the pixel values and descriptions for the Lineage Index Band.

Pixel Value	Fill	Pixel Description
0	Yes	Fill pixel
1, 2, 3	No	Indicates which Level-2 scene was the source for a pixel. Corresponds with an entry in the metadata file.

Table 2-9. Landsat 4-7 Lineage Index Band

Figure 2-1 displays a lineage index band example of color composite tile (left) and tiling logic used to indicate source data (right).

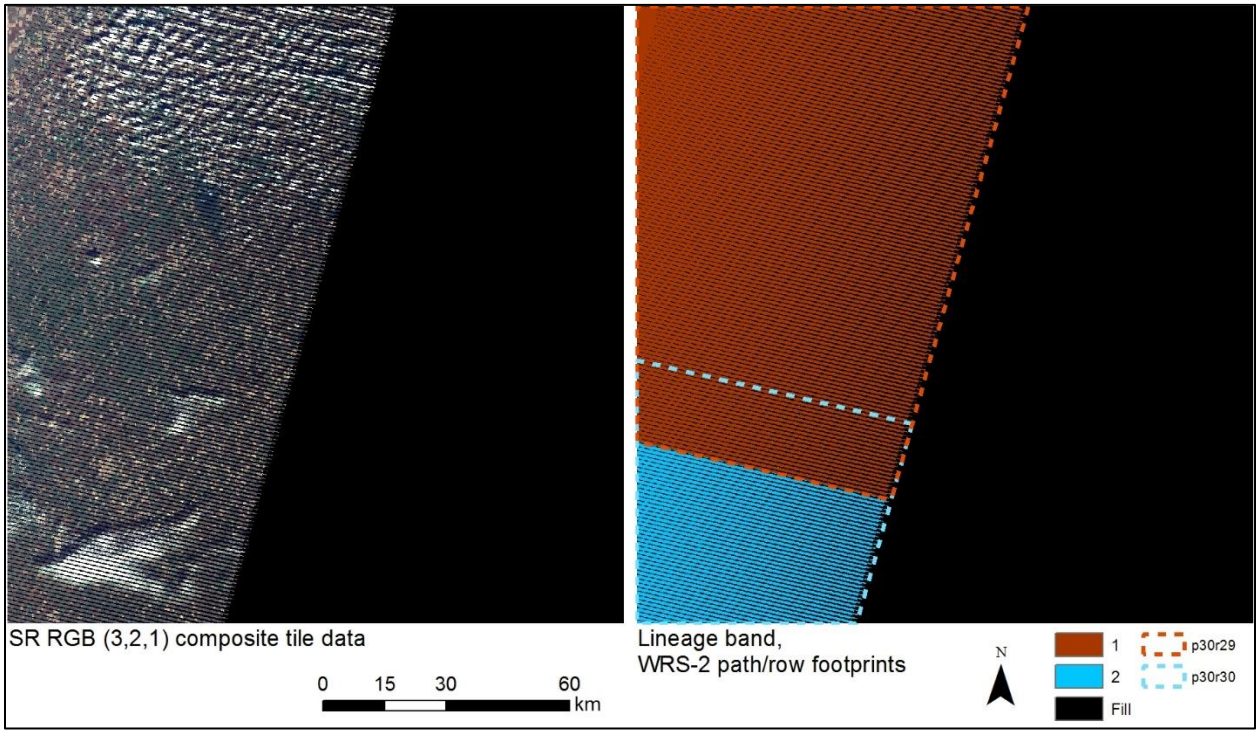

Figure 2-1. Lineage Index Band Example

2.1.2.4 Landsat 4-7 Internal Surface Reflectance Atmospheric Opacity Band

An estimate of atmospheric opacity is derived from the LEDAPS atmospheric correction calculations used in generating Level-2 surface reflectance for Landsat 4-7. The internal surface reflectance atmospheric opacity band output with the surface reflectance product describes that parameter to provide additional detail about the factors that may have influenced the final product result. Atmospheric opacity may be considered a proxy for aerosol optical thickness (i.e., the greater the atmospheric opacity, the greater the aerosol optical thickness).

Level-2 Band Designation	ARD Band Designation	Band Name	Data Type	Units	Range	Valid Range	Fill Value	Saturate Value	Scale Factor
SR_ATMOS_OPACITY	SR_ATMOS_OPACITY	Internal SR Atmospheric Opacity	INT16	NA	-2000 – 16000	0 – 1000	-9999	NA	0.001
SR=surface reflectance, INT=signed integer, NA=not applicable									

Table 2-10. Landsat 4-7 Internal Surface Reflectance Atmospheric Opacity Band Specifications

2.1.2.5 Landsat 4-7 Internal Surface Reflectance Quality Assessment Band

The algorithm used to generate Level-2 surface reflectance for Landsat 4-7 requires specialized data input to perform the atmospheric correction. Although some of the needed parameters are included in Level-1 products, the algorithm executes its own calculations to meet the specific requirements of the atmospheric correction routines and outputs a bit-packed internal surface reflectance quality assessment band (SR_CLOUD_QA).

Bit	Value	Cumulative Sum	Description
Bits are numbered from right to left (bit 0 = LSB, bit 7 = MSB)			
0	1	1	Dense Dark Vegetation (DDV)
1	2	3	Cloud
2	4	7	Cloud Shadow
3	8	15	Adjacent Cloud
4	16	31	Snow
5	32	63	Water
6	64	127	Unused
7	128	255	Unused
LSB=least significant bit, MSB=most significant bit			

Table 2-11. Landsat 4-7 Internal Surface Reflectance Quality Assessment Bit Index

The bit combinations that define the quality conditions influencing atmospheric correction appear as integer values in the internal SR_CLOUD_QA band. Unpacking the bits represented by the pixel values deconstructs them into comprehensible condition descriptions.

Table 2-12 displays the interpretation of possible pixel values expected in the SR_CLOUD_QA band after its bits are unpacked. For example, a pixel value of 32 represents the bit combination indicating the pixel is covered with water.

Pixel Value	DDV	Cloud	Cloud shadow	Adjacent to cloud	Snow	Water	Pixel Description
1	Yes	No	No	No	No	No	DDV
2	No	Yes	No	No	No	No	Cloud
4	No	No	Yes	No	No	No	Cloud shadow
8	No	No	No	Yes	No	No	Adjacent to cloud
9	Yes	No	No	Yes	No	No	DDV, adjacent to cloud
12	No	No	Yes	Yes	No	No	Adjacent to cloud, cloud shadow
16	No	No	No	No	Yes	No	Snow
20	No	No	Yes	No	Yes	No	Cloud shadow, snow
24	No	No	No	Yes	Yes	No	Adjacent to cloud, snow
32	No	No	No	No	No	Yes	Water
34	No	Yes	No	No	No	Yes	Cloud, water
36	No	No	Yes	No	No	Yes	Cloud shadow, water
40	No	No	No	Yes	No	Yes	Adjacent to cloud, water
48	No	No	No	No	Yes	Yes	Snow, water
52	No	No	Yes	No	Yes	Yes	Cloud shadow, snow, water
56	No	No	No	Yes	Yes	Yes	Adjacent to cloud, snow, water

DDV = dense dark vegetation

Table 2-12. Landsat 4-7 Internal Surface Reflectance Quality Assessment Bit Values

2.1.2.6 Landsat 4-7 Surface Temperature Quality Assessment Band

The Landsat 4-7 surface temperature quality assessment (ST_QA) band provides the surface temperature product uncertainty (in units of Kelvin) using a combination of uncertainty values and distance to cloud values.

2.1.3 Landsat 8-9 OLI-TIRS ARD Product Specifications

Similar to Landsat 4-7, the Landsat 8-9 OLI-TIRS ARD product options include the TOA Reflectance, TOA Brightness Temperature, Surface Reflectance, and Surface Temperature Science Products. The TOA Reflectance and TOA Brightness Temperature (BT) are generated using the calibration parameters from the metadata. The Landsat 8-9 Surface Reflectance is generated using LaSRC algorithm, which

applies the atmospheric correction routines on the TOA Reflectance. The auxiliary atmospheric characterization datasets for LaSRC are sourced from MODIS C6 prior to 2/17/2022, after which Landsat 8-9 Surface Reflectance processing switched to using auxiliary data from MODIS C6.1. The Surface Temperature is calculated by applying the Single Channel algorithm on TIRS Band 10. Detailed description of the C2 Landsat 8-9 science product algorithms is provided in LSDS-1747 in the References section. The Surface Temperature product is available from the L2SP products only. The ARD package also contains the Quality Assessment (QA) bands, which are derived from the Landsat 8-9 OLI-TIRS inputs. Table 2-13 through Table 2-17 list the specification for all associated bands in the Landsat 8-9 OLI-TIRS Landsat U.S. ARD product.

Level-1 / Level-2 Band Designation	ARD Band Designation	Band Name	Data Type	Units	Range	Valid Range	Fill Value	Saturate Value	Multiplicative Scale Factor	Additive Offset
TOA_B1	TOA_B1	Band 1 TOA Reflectance	UINT 16	Refl	1 – 65455	7273 – 43636	0	65455	0.0000275	-0.2
TOA_B2	TOA_B2	Band 2 TOA Reflectance	UINT 16	Refl	1 – 65455	7273 – 43636	0	65455	0.0000275	-0.2
TOA_B3	TOA_B3	Band 3 TOA Reflectance	UINT 16	Refl	1 – 65455	7273 – 43636	0	65455	0.0000275	-0.2
TOA_B4	TOA_B4	Band 4 TOA Reflectance	UINT 16	Refl	1 – 65455	7273 – 43636	0	65455	0.0000275	-0.2
TOA_B5	TOA_B5	Band 5 TOA Reflectance	UINT 16	Refl	1 – 65455	7273 – 43636	0	65455	0.0000275	-0.2
TOA_B6	TOA_B6	Band 6 TOA Reflectance	UINT 16	Refl	1 – 65455	7273 – 43636	0	65455	0.0000275	-0.2
TOA_B7	TOA_B7	Band 7 TOA Reflectance	UINT 16	Refl	1 – 65455	7273 – 43636	0	65455	0.0000275	-0.2
TOA_B9	TOA_B9	Band 9 TOA Reflectance	UINT 16	Refl	1 – 65455	7273 – 43636	0	65455	0.0000275	-0.2
SAA	SAA	Solar Azimuth Angles Band 4	INT16	Degrees	-32767 – 32767	-18000 – 18000	0	NA	0.01	NA
SZA	SZA	Solar Zenith Angles Band 4	INT16	Degrees	-32767 – 32767	-9000 – 9000	0	NA	0.01	NA
VAA	VAA	Sensor Azimuth Angles Band 4	INT16	Degrees	-32767 – 32767	-18000 – 18000	0	NA	0.01	NA
VZA	VZA	Sensor Zenith Angles Band 4	INT16	Degrees	-32767 – 32767	-9000 – 9000	0	NA	0.01	NA

TOA=top of atmosphere reflectance, TOA_B=top of atmosphere reflectance band, SAA=solar azimuth angle, SZA=solar zenith angle, VAA=sensor viewing azimuth angle, VZA=sensor viewing zenith angle, UINT16=16-bit unsigned integer, INT16=16-bit signed integer, Refl=reflectance, NA=not applicable

Table 2-13. Landsat 8-9 Top of Atmosphere Reflectance Band Specifications

Level-2 Band Designation	ARD Band Designation	Band Name	Data Type	Units	Range	Valid Range	Fill Value	Saturate Value	Multiplica-tive Scale Factor	Additive Offset
BT_B10	BT_B10	Band 10 Brightness Temperature	UINT16	top of atmosphere Brightness Temp (K)	1 - 65535	292 - 61440	0	65535	0.00341802	149.0

Level-2 Band Designation	ARD Band Designation	Band Name	Data Type	Units	Range	Valid Range	Fill Value	Saturate Value	Multiplica-tive Scale Factor	Additive Offset
BT_B11	BT_B11	Band 11 Brightness Temperature	UINT16	top of atmosphere Brightness Temp (K)	1 - 65535	292 - 61440	0	65535	0.00341802	149.0
BT=top of atmosphere brightness temperature, BT_B=brightness temperature band, UINT16=16-bit unsigned integer, Temp= temperature, K=Kelvin										

Table 2-14. Landsat 8-9 Top of Atmosphere Brightness Temperature Band Specifications

Level-2 Band Designation	ARD Band Designation	Band Name	Data Type	Units	Range	Valid Range	Fill Value	Saturate Value	Multiplicative Scale Factor	Additive Offset
SR_B1	SR_B1	Band 1 Surface Reflectance	UINT16	Refl	1 – 65455	7273 – 43636	0	65455	0.0000275	-0.2
SR_B2	SR_B2	Band 2 Surface Reflectance	UINT16	Refl	1 – 65455	7273 – 43636	0	65455	0.0000275	-0.2
SR_B3	SR_B3	Band 3 Surface Reflectance	UINT16	Refl	1 – 65455	7273 – 43636	0	65455	0.0000275	-0.2
SR_B4	SR_B4	Band 4 Surface Reflectance	UINT16	Refl	1 – 65455	7273 – 43636	0	65455	0.0000275	-0.2
SR_B5	SR_B5	Band 5 Surface Reflectance	UINT16	Refl	1 – 65455	7273 – 43636	0	65455	0.0000275	-0.2
SR_B6	SR_B6	Band 6 Surface Reflectance	UINT16	Refl	1 – 65455	7273 – 43636	0	65455	0.0000275	-0.2
SR_B7	SR_B7	Band 7 Surface Reflectance	UINT16	Refl	1 – 65455	7273 – 43636	0	65455	0.0000275	-0.2
SR=surface reflectance, SR_B=surface reflectance band, UINT16=16-bit unsigned integer, Refl=reflectance										

Table 2-15. Landsat 8-9 Surface Reflectance Band Specifications

Level-2 Band Designation	ARD Band Description	Band Name	Data Type	Units	Range	Valid Range	Fill Value	Saturate Value	Multiplicative Scale Factor	Additive Offset
ST_B10	ST_B10	Surface Temperature	UINT16	Kelvin	1 - 65535	292 - 61440	0	NA	0.00341802	149.0
ST_ATRAN	ST_ATRAN	Atmospheric Transmittance	INT16	Unitless	0 – 10000	0 – 10000	-9999	NA	0.0001	NA
ST_DRAD	ST_DRAD	Downwelling Radiance	INT16	W/(m^2 sr µm)/DN	0 – 28000	0 – 28000	-9999	NA	0.001	NA
ST_URAD	ST_URAD	Upwelling Radiance	INT16	W/(m^2 sr µm)/DN	0 – 28000	0 – 28000	-9999	NA	0.001	NA
ST_TRAD	ST_TRAD	Thermal band converted to radiance	INT16	W/(m^2 sr µm)/DN	0 – 22000	0 – 22000	-9999	NA	0.001	NA
ST_EMIS	ST_EMIS	Landsat Emissivity estimated from ASTER GED data	INT16	Emissivity coefficient	0 – 10000	0 – 10000	-9999	NA	0.0001	NA
ST_EMSD	ST_EMSD	Landsat Emissivity Standard Deviation	INT16	Emissivity coefficient	0 – 32767	0 – 10000	-9999	NA	0.0001	NA
ST_CDIST	ST_CDIST	Pixel distance to cloud	INT16	Kilometers	0 – 24000	0 – 24000	-9999	NA	0.01	NA
ST=surface temperature, ST_B=surface temperature band, UINT16=16-bit unsigned integer, INT16=16-bit signed integer										

Table 2-16. Landsat 8-9 Surface Temperature Band Specifications

Level-2 Band Designation	ARD Band Designation	Band Name	Data Type	Units	Range	Valid Range	Fill Value	Scale Factor
QA_PIXEL	QA_PIXEL	Pixel Quality Assessment	UINT16	Bit Index	1 – 65535	21824 - 65534	1 (bit 0)	NA
QA_RADSAT	QA_RADSAT	Radiometric Saturation QA	UINT16	Bit Index	0 – 65535	0 – 3829	NA	NA
NA	QA_LINEAGE	Lineage QA	UINT8	NA	0 – 255	1 – 3	0	NA
SR_QA_AEROSOL	SR_QA_AEROSOL	Aerosol QA	UINT8	Bit Index	0 – 255	1 – 254	1	NA
ST_QA	ST_QA	ST Uncertainty	INT16	Kelvin	0 – 32767	0 – 32767	-9999	0.01
QA=quality assessment, NA=not applicable, SR=surface reflectance, ST=surface temperature, UINT16=16-bit unsigned integer, INT16=16-bit signed integer								

Table 2-17. Landsat 8-9 ARD Quality Assessment Band Specifications

2.1.4 Landsat 8-9 OLI-TIRS ARD Quality Assessment Band Specifications

Landsat 8-9 ARD quality bands are similar to those delivered for Landsat 4-7. The Level-1 QA_PIXEL and QA_RADSAT bands are carried over to the Level-2 product package and are accompanied with additional calculations derived from higher-level processing, including a band describing parameters specific to SR atmospheric correction (SR_QA_AEROSOL), a band describing the ST uncertainty (ST_QA), and a band describing the scene index (QA_LINEAGE). For the ARD tiles created form the L2SP scenes the ST_QA band will include valid data. Sections 2.1.4.1 through 2.1.4.5

provide detailed information on the Landsat 8-9 U.S. ARD QA bands. Table 2-18 through Table 2-23 list all bit-packed QA bands and their associated contents.

2.1.4.1 Landsat 8-9 Pixel Quality Assessment Band

The Landsat 8-9 QA_PIXEL band includes information from the Level-1 Quality Assessment (QA_PIXEL) band which is carried through unchanged into Level-2 processing and is provided in ARD product package. The QA_PIXEL include information about Cloud, Cloud Confidence, Cloud Shadow, and Snow/Ice flags derived from the CFMask algorithm version 3.3.1. Table 2-18 describes the bit assignment of the QA_PIXEL. Cloud Shadow, Snow/Ice, and Cirrus Confidence flags in bits 10-15 each have a reserved value for future improvements. They match the respective flags in bits 2, 4, and 5 and may be used interchangeably.

Bit	Flag Description	Values
0	Fill	0 for image data 1 for fill data
1	Dilated Cloud	0 for cloud is not dilated or no cloud 1 for cloud dilation
2	Cirrus	0 for Cirrus Confidence: no confidence level set or Low Confidence 1 for high confidence cirrus
3	Cloud	0 for cloud confidence is not high 1 for high confidence cloud
4	Cloud Shadow	0 for Cloud Shadow Confidence is not high 1 for high confidence cloud shadow
5	Snow	0 for Snow/Ice Confidence is not high 1 for high confidence snow cover
6	Clear	0 if Cloud or Dilated Cloud bits are set 1 if Cloud and Dilated Cloud bits are not set
7	Water	0 for land or cloud 1 for water
8-9	Cloud Confidence	00 for no confidence level set 01 Low confidence 10 Medium confidence 11 High confidence
10-11	Cloud Shadow Confidence	00 for no confidence level set 01 Low confidence 10 Reserved 11 High confidence
12-13	Snow/Ice Confidence	00 for no confidence level set 01 Low confidence 10 Reserved 11 High confidence
14-15	Cirrus Confidence	00 for no confidence level set 01 Low confidence 10 Reserved 11 High confidence

Table 2-18. Landsat 8-9 Pixel Quality Assessment Bit Index

The bit combinations that define certain quality conditions appear as integer values in the QA_PIXEL band. Unpacking the bits represented by the pixel values deconstructs them into comprehensible condition descriptions. Table 2-19 displays the interpretation of common pixel values expected in the QA_PIXEL band after its bits are unpacked. For example, a pixel value of 22280 represents the bit combination indicating a high chance that the pixel is covered with cloud.

Pixel Value	Fill	Dilated Cloud	Cirrus	Cloud	Cloud Shadow	Snow	Clear	Water	Cloud Conf.	Cloud Shadow Conf.	Snow/ Ice Conf.	Cirrus Conf.	Pixel Description
1	Yes	No	No	No	No	No	No	No	None	None	None	None	Fill
21824	No	No	No	No	No	No	Yes	No	Low	Low	Low	Low	Clear with lows set
21826	No	Yes	No	No	No	No	Yes	No	Low	Low	Low	Low	Dilated cloud over land
21888	No	No	No	No	No	No	No	Yes	Low	Low	Low	Low	Water with lows set
21890	No	Yes	No	No	No	No	No	Yes	Low	Low	Low	Low	Dilated cloud over water
22080	No	No	No	No	No	No	Yes	No	Mid	Low	Low	Low	Mid conf cloud
22144	No	No	No	No	No	No	No	Yes	Mid	Low	Low	Low	Mid conf cloud over water
22280	No	No	No	Yes	No	No	No	No	High	Low	Low	Low	High conf Cloud
23888	No	No	No	No	Yes	No	Yes	No	Low	High	Low	Low	High conf cloud shadow
23952	No	No	No	No	Yes	No	No	Yes	Low	High	Low	Low	Water with cloud shadow
24088	No	No	No	Yes	Yes	No	No	No	Mid	High	Low	Low	Mid conf cloud with shadow
24216	No	No	No	Yes	Yes	No	No	Yes	Mid	High	Low	Low	Mid conf cloud with shadow over water
24344	No	No	No	Yes	Yes	No	No	No	High	High	Low	Low	High conf cloud with shadow
24472	No	No	No	Yes	Yes	No	No	Yes	High	High	Low	Low	High conf cloud with shadow over water
30048	No	No	No	No	No	Yes	Yes	No	Low	Low	High	Low	High conf snow/ice
54596	No	No	Yes	No	No	No	Yes	No	Low	Low	Low	High	High conf Cirrus
54852	No	No	Yes	No	No	No	Yes	No	Mid	Low	Low	High	Cirrus, mid cloud
55052	No	No	Yes	Yes	No	No	No	No	High	Low	Low	High	Cirrus, high cloud

Table 2-19. Landsat 8-9 Pixel Quality Assessment Bit Values

2.1.4.2 Landsat 8-9 Radiometric Saturation Quality Assessment Band

The QA_RADSAT band is a bit-packed representation of which sensor bands were saturated during data capture, yielding unusable data. Table 2-20 displays the

description of bit values in the QA_RADSAT band. For example, a pixel value of 8 indicates that OLI Band 4 is saturated.

Saturation in Landsat 8-9 is not common. When saturation does occur, it usually happens over volcanoes and wildland fires in the Shortwave Infrared (SWIR) wavelengths.

Saturation does not occur with the TIRS thermal bands. The Landsat 8-9 QA_RADSAT band flags the saturation cases for OLI bands as well as the terrain occlusion.

Bit	Flag Description	Values
0	Band 1 Data Saturation	0 no saturation 1 saturated data
1	Band 2 Data Saturation	0 no saturation 1 saturated data
2	Band 3 Data Saturation	0 no saturation 1 saturated data
3	Band 4 Data Saturation	0 no saturation 1 saturated data
4	Band 5 Data Saturation	0 no saturation 1 saturated data
5	Band 6 Data Saturation	0 no saturation 1 saturated data
6	Band 7 Data Saturation	0 no saturation 1 saturated data
7	Unused	0 not checked
8	Band 9 Data Saturation	0 no saturation 1 saturated data
9	Unused	0
10	Unused	0
11	Terrain occlusion	0 no terrain occlusion 1 terrain occlusion
12	Unused	0
13	Unused	0
14	Unused	0
15	Unused	0

Table 2-20. Landsat 8-9 Radiometric Saturation Quality Assessment Bit Index

2.1.4.3 Landsat 8-9 Lineage Index Band

Each ARD tile contains only one date of acquisition and may contain information from one, two, or three Level-2 scenes. Each ARD tile package contains a QA_LINEAGE band, which indicates which Level-2 scene was the source for each pixel. In areas of scene overlap on a single path, the northern-most scene takes precedence. The QA_LINEAGE band is included in all packages related to a particular ARD tile.

The lineage index pixel values are used in conjunction with the metadata file to retrieve scene-specific information. Figure 2-1 illustrates an example of the lineage index band and tile compositing logic.

Pixel Value	Fill	Pixel Description
0	Yes	Fill pixel
1, 2, 3	No	Indicates which Level-2 scene was the source for a pixel. Corresponds with an entry in the metadata file.

Table 2-21. Landsat 8-9 Lineage Index Band Values

2.1.4.4 Landsat 8-9 Internal Surface Reflectance Aerosol Quality Assessment Band

Aerosol retrieval is a critical component in the atmospheric correction calculations used in generating Level-2 surface reflectance for Landsat 8-9. The internal surface reflectance aerosol quality assessment (SR_QA_AEROSOL) band output with the surface reflectance product provides additional detail about the factors that may have influenced the final product result.

Bit	Flag Description	Values
0	Fill	0 Pixel is not fill 1 Pixel is fill
1	Valid aerosol retrieval	0 Pixel retrieval is not valid 1 Pixel retrieval is valid
2	Water	0 Pixel is not water 1 Pixel is water
3	Unused	0
4	Unused	0
5	Interpolated Aerosol	0 Pixel is not aerosol interpolated 1 Pixel is aerosol interpolated
6	Aerosol Level	00 Climatology 01 Low 10 Medium 11 High
7		
0 is Least Significant Bit, 7 is Most Significant Bit		

Table 2-22. Landsat 8-9 Internal Surface Reflectance Aerosol Quality Assessment Bit Index

The bit combinations that define the quality conditions influencing atmospheric correction appear as integer values in the internal SR_QA_AEROSOL band. Unpacking the bits represented by the pixel values deconstructs them into comprehensible condition descriptions. Table 2-23 displays the interpretation of possible pixel values expected in the SR_QA_AEROSOL band after its bits are unpacked. For example, a pixel value of 96 represents the bit combination indicating the pixel value may be unreliable because aerosol retrieval was not possible, and the value had to be interpolated.

Pixel Value	Fill	Aerosol Retrieval – Valid (center of 3x3 window)	Water	Aerosol Retrieval – Interpolated (non-center of 3x3 window)	Aerosol	Pixel Description
1	Yes	No	No	No	NA	Fill
2	No	Yes	No	No	Climatology	Valid aerosol retrieval
4	No	No	Yes	No	Climatology	Water

Pixel Value	Fill	Aerosol Retrieval – Valid (center of 3x3 window)	Water	Aerosol Retrieval – Interpolated (non-center of 3x3 window)	Aerosol	Pixel Description
32	No	No	No	Yes	Climatology	Aerosol interpolated
66	No	Yes	No	No	Low	Valid aerosol ret., low aerosol
68	No	No	Yes	No	Low	Water, low aerosol
96	No	No	No	Yes	Low	Aerosol interpolated, low aerosol
100	No	No	Yes	Yes	Low	Water pixel used in interpolation, aerosol interpolated, low aerosol
130	No	Yes	No	No	Medium	Valid aerosol retrieval, medium aerosol
132	No	No	Yes	No	Medium	Water, medium aerosol
160	No	No	No	Yes	Medium	Aerosol interpolated, medium aerosol
164	No	No	Yes	Yes	Medium	Water pixel used in interpolation, aerosol interpolated, medium aerosol
192	No	No	No	No	High	High aerosol
194	No	Yes	No	No	High	Valid aerosol retrieval, high aerosol
196	No	No	Yes	No	High	Water, high aerosol
224	No	No	No	Yes	High	Aerosol interpolated, high aerosol
228	No	No	Yes	Yes	High	Water pixel used in interpolation, aerosol interpolated, high aerosol

Table 2-23. Landsat 8-9 Internal Surface Reflectance Aerosol Quality Assessment Bit Values

2.1.4.5 Landsat 8-9 Surface Temperature Quality Assessment Band

The Landsat 8-9 STQA band provides the surface temperature product uncertainty (in units of Kelvin) using a combination of uncertainty values and distance to cloud values.

2.2 Landsat U.S. ARD Naming Conventions

2.2.1 Landsat U.S. ARD Product Identifier Conventions

The Landsat C2 U.S. ARD product identifier (Product ID) follows the naming convention of its collection-based source data to the extent possible.

Collection 2 Level-1 Product ID
LXSS_LLLL_PPPRRR_YYYYMMDD_yyyymmdd_CC_AX

Table 2-24 decomposes the definition of the Landsat Collection 2 Level-1 Product ID terms.

LXSS_LLLL_PPPRRR_YYYYMMDD_yyyymmdd_CC_AX	
Term	Definition
L	Landsat
X	Sensor (“C” = OLI / TIRS Combined, “O” = OLI-only, “T” = TIRS-only, “E” = ETM+, “T” = TM)
SS	Satellite (“04” = Landsat 4, “05” = Landsat 5, “07” = Landsat 7, “08” = Landsat 8, “09” = Landsat 9)
LLLL	Processing correction level (“L1TP” = terrain precision correction, “L1GT” = systematic terrain correction, “L1GS” = geometric systematic correction)
PPP	WRS-2 path
RRR	WRS-2 row
YYYYMMDD	Acquisition year (YYYY) month (MM) day (DD)
yyyymmdd	Level-1 production year (yyyy) month (mm) day (dd)
CC	Collection number (“02” = Collection 2)
AX	Collection category (“A1” = Albers Equal Area Tier 1, “A2” = Albers Equal Area Tier 2)

Table 2-24. Landsat Collection 2 Level-1 Product Identifier Terms

When Landsat Collection 2 data are processed to Level-2 Surface Reflectance, Surface Temperature, and the Quality Assessment products, the Product ID is updated to reflect the Level-2 processing level and new processing date. The Level-2 Product ID is appended with product and band designations. Sample Level-2 package and product file names are defined as follows:

Collection 2 Level-2 Product ID
The Level-2 product files that are input to ARD tiles follow the Level-1 naming convention but are updated to reflect Level-2 processing level with their Level-2 product band name.

LXSS_LLLL_PPPRRR_YYYYMMDD_yyyymmdd_CC_AX_PRODUCT_BAND

The Level-2 Product ID is deconstructed in Table 2-25.

LXSS_LLLL_PPPRRR_YYYYMMDD_yyyymmdd_CC_AX_PRODUCT_BAND	
Term	Definition
L	Landsat
X	Sensor (“C” = OLI / TIRS Combined, “O” = OLI-only, “T” = TIRS-only, “E” = ETM+, “T” = TM)
SS	Satellite (“04” = Landsat 4, “05” = Landsat 5, “07” = Landsat 7, “08” = Landsat 8, “09” = Landsat 9)
LLLL	Processing correction level (“L2SP” if SR and ST are generated or “L2SR” if ST could not be generated)
PPP	WRS-2 path
RRR	WRS-2 row
YYYYMMDD	Acquisition year (YYYY) month (MM) day (DD)
yyyymmdd	Level-2 production year (yyyy) month (mm) day (dd)
CC	Collection number (“02” = Collection 2)
AX	Collection category (“A1” = Albers Equal Area Tier 1, “A2” = Albers Equal Area Tier 2)
PRODUCT	Data product (“TOA” = top of atmosphere reflectance, “BT” = top of atmosphere brightness temperature, “SR” = surface reflectance, “ST” = surface temperature, “SAA” = solar azimuth angle, “SZA” = solar zenith angle, “VAA” = sensor azimuth angle, “VZA” = sensor zenith angle, “ST_ATRAN” = atmospheric transmittance, “ST_DRAD” = downwelling radiance, “ST_URAD” = upwelling radiance, “ST_TRAD” = thermal band converted to radiance, “ST_EMIS” = Landsat emissivity estimated from ASTER GED data, “ST_EMSD” = Landsat emissivity standard deviation, “ST_CDIST” = pixel distance to cloud, “QA_PIXEL” = pixel quality assessment, “SR_ATMOS_OPACITY” = internal Landsat 4-7 surface reflectance atmospheric opacity, “SR_CLOUD_QA” = internal Landsat 4-7 surface reflectance quality assessment, “SR_QA_AEROSOL” = internal Landsat 8-9 surface reflectance aerosol parameters, “ST_QA” = surface temperature uncertainty)
BAND	Band (such as “B1” for reflectance products)

Table 2-25. Landsat Level-2 Product Identifier Terms

Collection 2 ARD Product ID

An ARD Product ID replaces path/row designations with tile identifiers (HHH horizontal; VVV vertical), as an ARD tile may include data from overlapping rows. Processing level (LLLL) and collection category (AX) are removed from the ARD Product ID as a redundancy; ARD is created only from Landsat 4-7 Tier 1, Landsat 8-9 Tier 1, or Tier 2 data. The Level-2 production date is also removed from the file name.

The regional grid of the U.S. used in the production of the tile is designated after the sensor term.

LXSS_US_HHHVVV_YYYYMMDD_yyyymmdd_CC_PRODUCT_BAND

Table 2-26 decomposes the definition of Landsat U.S. ARD Product ID terms.

LXSS_US_HHHVVV_YYYYMMDD_yyyymmdd_CC_PRODUCT_BAND	
Term	Definition
L	Landsat
X	Sensor (“C” = OLI/TIRS Combined, “O” = OLI-only, “T” = TIRS-only, “E” = ETM+, “T” = TM)
SS	Satellite (“04” = Landsat 4, “05” = Landsat 5, “07” = Landsat 7, “08” = Landsat 8, “09” = Landsat 9)
US	Regional grid of the U.S. (“CU” = CONUS, “AK” = Alaska, “HI” = Hawaii)
HHH	Horizontal tile number
VVV	Vertical tile number
YYYYMMDD	Acquisition year (YYYY) month (MM) day (DD)
yyyymmdd	ARD production year (yyyy) month (mm) day (dd)
CC	Collection number (“02” = Collection 2)
PRODUCT	Data product (“TOA” = top of atmosphere reflectance, “BT” = top of atmosphere brightness temperature, “SR” = surface reflectance, “ST” = surface temperature, “SAA” = solar azimuth angle, “SZA” = solar zenith angle, “VAA” = sensor azimuth angle, “VZA” = sensor zenith angle, “ST_ATRAN” = atmospheric transmittance, “ST_DRAD” = downwelling radiance, “ST_URAD” = upwelling radiance, “ST_TRAD” = thermal band converted to radiance, “ST_EMIS” = Landsat emissivity estimated from ASTER GED data, “ST_EMSD” = Landsat emissivity standard deviation, “ST_CDIST” = pixel distance to cloud, “QA_PIXEL” = pixel quality assessment, “QA_RADSAT” = radiometric saturation, “QA_LINEAGE” = lineage index, “SR_ATMOS_OPACITY” = internal Landsat 4-7 surface reflectance atmospheric opacity, “SR_CLOUD_QA” = internal Landsat 4-7 surface reflectance quality assessment, “SR_QA_AEROSOL” = internal Landsat 8-9 surface reflectance aerosol parameters, “ST_QA” = surface temperature quality assessment)
BAND	Band (such as “B1” for reflectance products)

Table 2-26. Landsat U.S. ARD Product Identifier Terms

2.2.2 Landsat U.S. ARD Product Identifier Examples

Example ARD Product IDs follow the convention specified and are listed based on the following sample Level-1 Product IDs:

LE07_L1TP_034031_20180211_20200610_02_A1
LC08_L1TP_013028_20181014_20200621_02_A1
LC09_L2SP_027031_20220221_20220224_02_A1

2.2.2.1 Image Product Identifier

Image files in the Landsat 4-7 TM/ETM+ derived TOA Reflectance product would be output for ARD as:

LE07_CU_011007_20180211_20200615_02_TOA_B<1-5, 7>
i.e., LE07_CU_011007_20180211_20200615_02_TOA_B4

Image files in the Landsat 4-7 TM/ETM+ derived TOA Brightness Temperature product would be output for ARD as:

LE07_CU_011007_20180211_20200615_02_BT_B<6>
i.e., LE07_CU_011007_20180211_20200615_02_BT_B6

Image files in the Landsat 4-7 TM/ETM+ derived surface reflectance product would be output for ARD as:

LE07_CU_011007_20180211_20200615_02_SR_B<1-5, 7 >.
i.e., LE07_CU_011007_20180211_20200615_02_SR_B3

Image files in the Landsat 4-7 TM/ETM+ derived surface temperature product would be output for ARD as:

LE07_CU_011007_20180211_20200615_02_ST_B6
LE07_CU_011007_20180211_20200615_02_ST_ATRAN
LE07_CU_011007_20180211_20200615_02_ST_DRAD
LE07_CU_011007_20180211_20200615_02_ST_URAD
LE07_CU_011007_20180211_20200615_02_ST_TRAD
LE07_CU_011007_20180211_20200615_02_ST_EMIS
LE07_CU_011007_20180211_20200615_02_ST_EMSD
LE07_CU_011007_20180211_20200615_02_ST_CDIST

Image files in the Landsat 4-7 TM/ETM+ angle bands product would be output for ARD as:

LE07_CU_011007_20180211_20200615_02_SAA
LE07_CU_011007_20180211_20200615_02_SZA
LE07_CU_011007_20180211_20200615_02_VAA
LE07_CU_011007_20180211_20200615_02_VZA

2.2.2.2 Quality Assessment Product Identifier

The ARD quality assessment products for Landsat 4-7 TM/ETM+ would be output as:

LE07_CU_011007_20180211_20200615_02_QA_PIXEL
LE07_CU_011007_20180211_20200615_02_QA_RADSAT
LE07_CU_011007_20180211_20200615_02_QA_LINEAGE
LE07_CU_011007_20180211_20200615_02_SR_ATMOS_OPACITY
LE07_CU_011007_20180211_20200615_02_SR_CLOUD_QA
LE07_CU_011007_20180211_20200615_02_ST_QA

For comparison, the ARD quality products for Landsat 8 OLI/TIRS would be output as:

LC08_CU_029004_20181014_20200614_02_QA_PIXEL
LC08_CU_029004_20181014_20200614_02_QA_RADSAT
LC08_CU_029004_20181014_20200614_02_QA_LINEAGE
LC08_CU_029004_20181014_20200614_02_SR_QA_AEROSOL
LC08_CU_029004_20181014_20200614_02_ST_QA

2.2.2.3 Metadata Product Identifier

The tile-based ARD metadata file for Landsat 4-7 TM/ETM+ would be output as:

LE07_CU_011007_20180211_20200615_02.xml
LE07_CU_011007_20180211_20200615_02.json

2.3 Landsat U.S. ARD Spatial Attributes

2.3.1 Map Projection

Landsat U.S. ARD is generated in the Albers Equal Area (AEA) Conic map projection and processed directly from Level-1 AEA scenes through Level-2 products using the World Geodetic System 1984 (WGS84) datum. The ARD products cover the Conterminous U.S., Alaska, and Hawaii. Table 2-27 lists the projection parameters for the final product.

USGS Analysis Ready Data (ARD) Projection Parameters			
Projection: Albers Equal Area Conic (AEA)			
Datum: World Geodetic System 1984 (WGS84)			
	Conterminous U.S.	Alaska	Hawaii
First standard parallel	29.5˚	55.0˚	8.0˚
Second standard parallel	45.5˚	65.0˚	18.0˚
Longitude of central meridian	-96.0˚	-154.0˚	-157.0˚
Latitude of projection origin	23.0˚	50.0˚	3.0˚
False Easting (meters)	0.0	0.0	0.0
False Northing (meters)	0.0	0.0	0.0

Table 2-27. Landsat ARD Map Projection Parameters

2.3.2 Tile Grid System

All AEA-projected ARD products are processed to a common tiling scheme, which is modified from the Web-Enabled Landsat Data (WELD) system developed at South Dakota State University (SDSU) (Roy and others, 2010). The WELD-defined grid is similar to the National Land Cover Dataset (NLCD), except that WELD is based on WGS84 and NLCD uses the North American Datum of 1983 (NAD83), causing an approximately 0.5 pixel offset in the X and Y directions between the two grids.

The Landsat U.S. ARD grid is an adaptation of the WELD grid that aligns with NLCD. The ARD is gridded into tiles of 5,000 x 5,000 30m pixels and is anchored to the coordinates listed in Table 2-28. These grid origins are defined in relation to the WGS84 datum used by WELD but are adjusted to align with the origin used by NLCD datasets.

	Upper Left Tile (UL Corner)				**Lower Right Tile (LR Corner)**			
	(h)	**(v)**	**ulX (m)**	**ulY (m)**	**(h)**	**(v)**	**lrX (m)**	**lrY (m)**
CONUS	0	0	-2565585	3314805	32	21	2384415	14805
Alaska	0	0	-2201715	2474325	25	13	1698285	374325
Hawaii	0	0	-444345	2168895	4	2	305655	1718895
CONUS=conterminous United States, UL=upper left, LR=lower right, h=horizontal tile, v=vertical tile, m=meters, ulX=upper-left X coordinate, ulY=upper-left Y coordinate, lrX=lower-right X coordinate, lrY=lower-right Y coordinate								

Table 2-28. Landsat U.S. ARD Tile Grid Extents

Each Landsat U.S. ARD tile contains all the pixels acquired in a given day within its extent. In the event a tile intersects more than one scene, the data and metadata from the northern row populate the tile. Future changes may implement a more sophisticated compositing scheme to handle the intersect.

2.4 Landsat U.S. ARD Known Caveats and Artifacts

During Landsat C2 U.S. ARD product analysis and user feedback, some caveats and artifacts have been identified. For a list of the current known caveats and artifacts please visit the Landsat C2 U.S. ARD webpage (https://www.usgs.gov/landsat-missions/us-landsat-analysis-ready-data-ard-artifacts). Please note that these issues do not significantly impact the scientific integrity of the ARD product.

Section 3 Data Format Definition

3.1 Landsat U.S. ARD Distribution Product Packaging

The EarthExplorer (EE) will be used to search, preview, and download Landsat C2 U.S. ARD data. The collection is located under the Landsat category, Landsat C2 U.S. Analysis Ready Data (ARD) sub-category, and listed as Landsat 4-9 U.S. ARD.

Users will be able to download compressed .tar files containing all related data for each product (TOA Reflectance, TOA Brightness Temperature, Surface Reflectance, Surface Temperature, or QA - see Section 3.1.2), or select and download individual files separately..

The package identifier (Package ID) of the distributed files is derived from the ARD Product ID (see Section 2.2), using the production date from the QA_LINEAGE index band.

LXSS_US_HHHVVV_YYYYMMDD_yyyymmdd_CC_PRODUCT.tar

LXSS_US_HHHVVV_YYYYMMDD_yyyymmdd_CC_PRODUCT.tar	
Term	Definition
L	Landsat
X	Sensor (“C” = OLI/TIRS Combined, “O” = OLI-only, “T” = TIRS-only, “E” = ETM+, “T” = TM)
SS	Satellite (“04” = Landsat 4, “05” = Landsat 5, “07” = Landsat 7, “08” = Landsat 8, “09” = Landsat 9)
US	Regional grid of the U.S. (“CU” = CONUS, “AK” = Alaska, “HI” = Hawaii)
HHH	Horizontal tile number
VVV	Vertical tile number
YYYYMMDD	Acquisition year (YYYY) month (MM) day (DD)
yyyymmdd	ARD production year (yyyy) month (mm) day (dd)
CC	Collection number (“02”)
PRODUCT	Data product (“TA” = top of atmosphere reflectance, “BT” = top of atmosphere brightness temperature, “SR” = surface reflectance, “ST” = surface temperature, “QA” = quality assessment)

Table 3-1. Landsat U.S. ARD Package ID Terms

3.1.1 Metadata Files

The tiling process can include multiple scenes containing pixels acquired from the same WRS-2 path on a given day, each of which is associated with specific metadata. To maintain the provenance of the source data used to create a tile, the Level-1, Level-2, and tile-based metadata are appended into comprehensive Extensible Markup Language (XML) and JavaScript Object Notation (JSON) files. Scene-based metadata groups that are redundant or not applicable to the characteristics of the tile are removed (e.g., Level-2 PROJECTION_ATTRIBUTES, Level-1 MIN_MAX_RADIANCE), and new tile-based groups are added (e.g., PRODUCT_CONTENTS and IMAGE_ATTRIBUTES).

The general contents of the tile-based XML/JSON metadata are listed as follows:

- ARD Product Contents Metadata
- ARD Image Attributes Metadata
- ARD Projection Attributes Metadata
- ARD Processing Record Metadata
- ARD Surface Reflectance Parameters Metadata
- ARD Surface Temperature Parameters Metadata
- ARD TOA Reflectance Parameters Metadata
- ARD TOA Brightness Temperature Parameters Metadata
- ARD Quality Assessment Parameters Metadata
- Level-2 and Level-1 Scene Metadata

Sample XML and JSON metadata contents are presented in Appendix A and Appendix B. Excerpts from a sample tile-based XML metadata can be viewed as follows:

Example of Landsat U.S. ARD Tile Product Contents Metadata

```
<PRODUCT_CONTENTS>
    <ORIGIN>Image courtesy of the U.S. Geological Survey</ORIGIN>
<DIGITAL_OBJECT_IDENTIFIER>https://doi.org/10.5066/P960F8OC</DIGITAL_OBJECT_IDENTIFIER>
    <ARD_PRODUCT_ID>LC08_CU_015003_20200704_20200918_02</ARD_PRODUCT_ID>
    <COLLECTION_NUMBER>02</COLLECTION_NUMBER>
    <OUTPUT_FORMAT>GEOTIFF</OUTPUT_FORMAT>
<FILE_NAME_SR_BAND_1>LC08_CU_015003_20200704_20200918_02_SR_B1.TIF</FILE_NAME_SR_BAND_1>
<FILE_NAME_SR_BAND_2>LC08_CU_015003_20200704_20200918_02_SR_B2.TIF</FILE_NAME_SR_BAND_2>
<FILE_NAME_SR_BAND_3>LC08_CU_015003_20200704_20200918_02_SR_B3.TIF</FILE_NAME_SR_BAND_3>
<FILE_NAME_SR_BAND_4>LC08_CU_015003_20200704_20200918_02_SR_B4.TIF</FILE_NAME_SR_BAND_4>
<FILE_NAME_SR_BAND_5>LC08_CU_015003_20200704_20200918_02_SR_B5.TIF</FILE_NAME_SR_BAND_5>
<FILE_NAME_SR_BAND_6>LC08_CU_015003_20200704_20200918_02_SR_B6.TIF</FILE_NAME_SR_BAND_6>
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<FILE_NAME_ST_BAND_10>LC08_CU_015003_20200704_20200918_02_ST_B10.TIF</FILE_NAME_ST_BAND_10>
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<FILE_NAME_TOA_BAND_3>LC08_CU_015003_20200704_20200918_02_TOA_B3.TIF</FILE_NAME_TOA_BAND_3>
<FILE_NAME_TOA_BAND_4>LC08_CU_015003_20200704_20200918_02_TOA_B4.TIF</FILE_NAME_TOA_BAND_4>
<FILE_NAME_TOA_BAND_5>LC08_CU_015003_20200704_20200918_02_TOA_B5.TIF</FILE_NAME_TOA_BAND_5>
<FILE_NAME_TOA_BAND_6>LC08_CU_015003_20200704_20200918_02_TOA_B6.TIF</FILE_NAME_TOA_BAND_6>
<FILE_NAME_TOA_BAND_7>LC08_CU_015003_20200704_20200918_02_TOA_B7.TIF</FILE_NAME_TOA_BAND_7>
<FILE_NAME_TOA_BAND_9>LC08_CU_015003_20200704_20200918_02_TOA_B9.TIF</FILE_NAME_TOA_BAND_9>

<FILE_NAME_ANGLE_SOLAR_ZENITH_BAND_4>LC08_CU_015003_20200704_20200918_02_SZA.TIF</FILE_NAME_ANGLE
_SOLAR_ZENITH_BAND_4>
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LE_SENSOR_AZIMUTH_BAND_4>
<FILE_NAME_BT_BAND_10>LC08_CU_015003_20200704_20200918_02_BT_B10.TIF</FILE_NAME_BT_BAND_10>
<FILE_NAME_BT_BAND_11>LC08_CU_015003_20200704_20200918_02_BT_B11.TIF</FILE_NAME_BT_BAND_11>
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DIANCE>
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G_RADIANCE>
<FILE_NAME_DOWNWELLING_RADIANCE>LC08_CU_015003_20200704_20200918_02_ST_DRAD.TIF</FILE_NAME_DOWNWE
LLING_RADIANCE>
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NCE>
<FILE_NAME_QUALITY_AEROSOL>LC08_CU_015003_20200704_20200918_02_SR_QA_AEROSOL.TIF</FILE_NAME_QUALI
TY_AEROSOL>
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UALITY_SURFACE_TEMPERATURE>
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L>
<FILE_NAME_QUALITY_RADIOMETRIC_SATURATION>LC08_CU_015003_20200704_20200918_02_QA_RADSAT.TIF</FILE
_NAME_QUALITY_RADIOMETRIC_SATURATION>
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LINEAGE>
<FILE_NAME_METADATA_XML>LC08_CU_015003_20200704_20200918_02.xml</FILE_NAME_METADATA_XML>
    <DATA_TYPE_SR_BAND_1>UINT16</DATA_TYPE_SR_BAND_1>
    <DATA_TYPE_SR_BAND_2>UINT16</DATA_TYPE_SR_BAND_2>
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    <DATA_TYPE_SR_BAND_4>UINT16</DATA_TYPE_SR_BAND_4>
    <DATA_TYPE_SR_BAND_5>UINT16</DATA_TYPE_SR_BAND_5>
    <DATA_TYPE_SR_BAND_6>UINT16</DATA_TYPE_SR_BAND_6>
    <DATA_TYPE_SR_BAND_7>UINT16</DATA_TYPE_SR_BAND_7>
    <DATA_TYPE_ST_BAND_10>UINT16</DATA_TYPE_ST_BAND_10>
    <DATA_TYPE_TOA_BAND_1>UINT16</DATA_TYPE_TOA_BAND_1>
    <DATA_TYPE_TOA_BAND_2>UINT16</DATA_TYPE_TOA_BAND_2>
    <DATA_TYPE_TOA_BAND_3>UINT16</DATA_TYPE_TOA_BAND_3>
    <DATA_TYPE_TOA_BAND_4>UINT16</DATA_TYPE_TOA_BAND_4>
    <DATA_TYPE_TOA_BAND_5>UINT16</DATA_TYPE_TOA_BAND_5>
    <DATA_TYPE_TOA_BAND_6>UINT16</DATA_TYPE_TOA_BAND_6>
    <DATA_TYPE_TOA_BAND_7>UINT16</DATA_TYPE_TOA_BAND_7>
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    <DATA_TYPE_ANGLE_SOLAR_ZENITH_BAND_4>INT16</DATA_TYPE_ANGLE_SOLAR_ZENITH_BAND_4>
    <DATA_TYPE_ANGLE_SOLAR_AZIMUTH_BAND_4>INT16</DATA_TYPE_ANGLE_SOLAR_AZIMUTH_BAND_4>
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    <DATA_TYPE_BT_BAND_11>UINT16</DATA_TYPE_BT_BAND_11>
    <DATA_TYPE_THERMAL_RADIANCE>INT16</DATA_TYPE_THERMAL_RADIANCE>
    <DATA_TYPE_UPWELLING_RADIANCE>INT16</DATA_TYPE_UPWELLING_RADIANCE>
    <DATA_TYPE_DOWNWELLING_RADIANCE>INT16</DATA_TYPE_DOWNWELLING_RADIANCE>
    <DATA_TYPE_ATMOSPHERIC_TRANSMITTANCE>INT16</DATA_TYPE_ATMOSPHERIC_TRANSMITTANCE>
    <DATA_TYPE_EMISSIVITY>INT16</DATA_TYPE_EMISSIVITY>
    <DATA_TYPE_EMISSIVITY_STDEV>INT16</DATA_TYPE_EMISSIVITY_STDEV>
    <DATA_TYPE_CLOUD_DISTANCE>INT16</DATA_TYPE_CLOUD_DISTANCE>
    <DATA_TYPE_QUALITY_AEROSOL>UINT8</DATA_TYPE_QUALITY_AEROSOL>
<DATA_TYPE_QUALITY_SURFACE_TEMPERATURE>INT16</DATA_TYPE_QUALITY_SURFACE_TEMPERATURE>
    <DATA_TYPE_QUALITY_PIXEL>UINT16</DATA_TYPE_QUALITY_PIXEL>
<DATA_TYPE_QUALITY_RADIOMETRIC_SATURATION>UINT16</DATA_TYPE_QUALITY_RADIOMETRIC_SATURATION>
    <DATA_TYPE_QUALITY_LINEAGE>UINT8</DATA_TYPE_QUALITY_LINEAGE>
</PRODUCT_CONTENTS>
```

Example of ARD Image Attributes Metadata

```
<IMAGE_ATTRIBUTES>
    <SPACECRAFT_ID>LANDSAT_8</SPACECRAFT_ID>
    <SENSOR_ID>OLI_TIRS</SENSOR_ID>
    <REGION>CU</REGION>
    <TILE_GRID_H>15</TILE_GRID_H>
    <TILE_GRID_V>3</TILE_GRID_V>
    <DATE_ACQUIRED>2020-07-04</DATE_ACQUIRED>
    <SCENE_COUNT>2</SCENE_COUNT>
    <CLOUD_COVER>22.9329</CLOUD_COVER>
    <CLOUD_SHADOW_COVER>7.3129</CLOUD_SHADOW_COVER>
    <SNOW_ICE_COVER>0.0019</SNOW_ICE_COVER>
    <FILL>21.9750</FILL>
</IMAGE_ATTRIBUTES>
```

Example of ARD Projection Attributes Metadata

```
<PROJECTION_ATTRIBUTES>
    <MAP_PROJECTION>AEA</MAP_PROJECTION>
    <DATUM>WGS84</DATUM>
    <ORIGIN_LAT>23.000000</ORIGIN_LAT>
    <CENTRAL_MERIDIAN_LON>-96.000000</CENTRAL_MERIDIAN_LON>
    <STANDARD_PARALLEL_1_LAT>29.500000</STANDARD_PARALLEL_1_LAT>
    <STANDARD_PARALLEL_2_LAT>45.500000</STANDARD_PARALLEL_2_LAT>
    <FALSE_EASTING>0.000000</FALSE_EASTING>
    <FALSE_NORTHING>0.000000</FALSE_NORTHING>
    <GRID_CELL_SIZE_REFLECTIVE>30.00</GRID_CELL_SIZE_REFLECTIVE>
    <GRID_CELL_SIZE_THERMAL>30.00</GRID_CELL_SIZE_THERMAL>
    <GRID_CELL_SIZE_UNITS>METERS</GRID_CELL_SIZE_UNITS>
    <REFLECTIVE_LINES>5000</REFLECTIVE_LINES>
    <REFLECTIVE_SAMPLES>5000</REFLECTIVE_SAMPLES>
    <THERMAL_LINES>5000</THERMAL_LINES>
    <THERMAL_SAMPLES>5000</THERMAL_SAMPLES>
    <GRID_ORIGIN>UL</GRID_ORIGIN>
    <ORIENTATION>NORTH_UP</ORIENTATION>
    <CORNER_UL_LAT_PRODUCT>48.76925</CORNER_UL_LAT_PRODUCT>
    <CORNER_UL_LON_PRODUCT>-100.24272</CORNER_UL_LON_PRODUCT>
    <CORNER_LR_LAT_PRODUCT>47.36363</CORNER_LR_LAT_PRODUCT>
    <CORNER_LR_LON_PRODUCT>-98.18090</CORNER_LR_LON_PRODUCT>
    <CORNER_UL_PROJECTION_X_PRODUCT>-315585.000</CORNER_UL_PROJECTION_X_PRODUCT>
    <CORNER_UL_PROJECTION_Y_PRODUCT>2864805.000</CORNER_UL_PROJECTION_Y_PRODUCT>
    <CORNER_LR_PROJECTION_X_PRODUCT>-165585.000</CORNER_LR_PROJECTION_X_PRODUCT>
    <CORNER_LR_PROJECTION_Y_PRODUCT>2714805.000</CORNER_LR_PROJECTION_Y_PRODUCT>
</PROJECTION_ATTRIBUTES>
```

Example of ARD Processing Record Metadata

```
<ARD_PROCESSING_RECORD>
    <ORIGIN>Image courtesy of the U.S. Geological Survey</ORIGIN>
<DIGITAL_OBJECT_IDENTIFIER>https://doi.org/10.5066/P960F8OC</DIGITAL_OBJECT_IDENTIFIER>
    <ARD_PRODUCT_ID>LC08_CU_015003_20200704_20200918_02</ARD_PRODUCT_ID>
    <OUTPUT_FORMAT>GEOTIFF</OUTPUT_FORMAT>
    <DATE_PRODUCT_GENERATED>2020-10-06T13:17:33Z</DATE_PRODUCT_GENERATED>
    <PROCESSING_SOFTWARE_VERSION>ARD TILING CODE VERSION 2.0.0</PROCESSING_SOFTWARE_VERSION>
</ARD_PROCESSING_RECORD>
```

Example of ARD Surface Reflectance Parameters Metadata

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<ARD_SURFACE_REFLECTANCE_PARAMETERS>
    <MAXIMUM_SR_BAND_1>1.602213</MAXIMUM_SR_BAND_1>
    <MINIMUM_SR_BAND_1>-0.199972</MINIMUM_SR_BAND_1>
    <MAXIMUM_SR_BAND_2>1.602213</MAXIMUM_SR_BAND_2>
    <MINIMUM_SR_BAND_2>-0.199972</MINIMUM_SR_BAND_2>
    <MAXIMUM_SR_BAND_3>1.602213</MAXIMUM_SR_BAND_3>
    <MINIMUM_SR_BAND_3>-0.199972</MINIMUM_SR_BAND_3>
    <MAXIMUM_SR_BAND_4>1.602213</MAXIMUM_SR_BAND_4>
    <MINIMUM_SR_BAND_4>-0.199972</MINIMUM_SR_BAND_4>
    <MAXIMUM_SR_BAND_5>1.602213</MAXIMUM_SR_BAND_5>
    <MINIMUM_SR_BAND_5>-0.199972</MINIMUM_SR_BAND_5>
    <MAXIMUM_SR_BAND_6>1.602213</MAXIMUM_SR_BAND_6>
    <MINIMUM_SR_BAND_6>-0.199972</MINIMUM_SR_BAND_6>
    <MAXIMUM_SR_BAND_7>1.602213</MAXIMUM_SR_BAND_7>
    <MINIMUM_SR_BAND_7>-0.199972</MINIMUM_SR_BAND_7>
    <QUANTIZE_CAL_MAX_SR_BAND_1>65535</QUANTIZE_CAL_MAX_SR_BAND_1>
    <QUANTIZE_CAL_MIN_SR_BAND_1>1</QUANTIZE_CAL_MIN_SR_BAND_1>
    <QUANTIZE_CAL_MAX_SR_BAND_2>65535</QUANTIZE_CAL_MAX_SR_BAND_2>
    <QUANTIZE_CAL_MIN_SR_BAND_2>1</QUANTIZE_CAL_MIN_SR_BAND_2>
    <QUANTIZE_CAL_MAX_SR_BAND_3>65535</QUANTIZE_CAL_MAX_SR_BAND_3>
    <QUANTIZE_CAL_MIN_SR_BAND_3>1</QUANTIZE_CAL_MIN_SR_BAND_3>
```

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Example of ARD Surface Temperature Parameters Metadata

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Example of ARD TOA Reflectance Parameters Metadata

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Example of ARD TOA Brightness Temperature Parameters Metadata

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    <QUANTIZE_CAL_MAX_QUALITY_LINEAGE>255</QUANTIZE_CAL_MAX_QUALITY_LINEAGE>
    <QUANTIZE_CAL_MIN_QUALITY_LINEAGE>0</QUANTIZE_CAL_MIN_QUALITY_LINEAGE>
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    <ADD_BT_BAND_10>149.0</ADD_BT_BAND_10>
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    <FILL_BT_BAND_11>0</FILL_BT_BAND_11>
    <FILL_QUALITY_PIXEL>1</FILL_QUALITY_PIXEL>
    <FILL_QUALITY_LINEAGE>0</FILL_QUALITY_LINEAGE>
    <DATA_UNITS_BT_BAND_10>Kelvin</DATA_UNITS_BT_BAND_10>
    <DATA_UNITS_BT_BAND_11>Kelvin</DATA_UNITS_BT_BAND_11>
    <DATA_UNITS_QUALITY_LINEAGE>Index</DATA_UNITS_QUALITY_LINEAGE>
</ARD_BRIGHTNESS_TEMPERATURE_PARAMETERS>
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Example of ARD Quality Assessment Parameters Metadata

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    <MAXIMUM_QUALITY_SURFACE_TEMPERATURE>327.67</MAXIMUM_QUALITY_SURFACE_TEMPERATURE>
    <MINIMUM_QUALITY_SURFACE_TEMPERATURE>0</MINIMUM_QUALITY_SURFACE_TEMPERATURE>
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    <QUANTIZE_CAL_MIN_QUALITY_AEROSOL>1</QUANTIZE_CAL_MIN_QUALITY_AEROSOL>
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RATION>
<QUANTIZE_CAL_MIN_QUALITY_RADIOMETRIC_SATURATION>0</QUANTIZE_CAL_MIN_QUALITY_RADIOMETRIC_SATURATI
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    <QUANTIZE_CAL_MAX_QUALITY_LINEAGE>255</QUANTIZE_CAL_MAX_QUALITY_LINEAGE>
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    <FILL_QUALITY_SURFACE_TEMPERATURE>-9999</FILL_QUALITY_SURFACE_TEMPERATURE>
    <FILL_QUALITY_PIXEL>1</FILL_QUALITY_PIXEL>
    <FILL_QUALITY_AEROSOL>1</FILL_QUALITY_AEROSOL>
    <FILL_QUALITY_LINEAGE>0</FILL_QUALITY_LINEAGE>
<DATA_UNITS_QUALITY_SURFACE_TEMPERATURE>Kelvin</DATA_UNITS_QUALITY_SURFACE_TEMPERATURE>
    <DATA_UNITS_QUALITY_LINEAGE>Index</DATA_UNITS_QUALITY_LINEAGE>
</ARD_QUALITY_ASSESSMENT_PARAMETERS>
```

Example of Level-2 Scene Metadata Image Attributes Group

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<SCENE_INDEX>1</SCENE_INDEX>
<IMAGE_ATTRIBUTES>
    <SPACECRAFT_ID>LANDSAT_8</SPACECRAFT_ID>
    <SENSOR_ID>OLI_TIRS</SENSOR_ID>
    <WRS_TYPE>2</WRS_TYPE>
    <WRS_PATH>32</WRS_PATH>
    <WRS_ROW>26</WRS_ROW>
    <NADIR_OFFNADIR>NADIR</NADIR_OFFNADIR>
    <TARGET_WRS_PATH>32</TARGET_WRS_PATH>
    <TARGET_WRS_ROW>26</TARGET_WRS_ROW>
    <DATE_ACQUIRED>2020-07-04</DATE_ACQUIRED>
    <SCENE_CENTER_TIME>17:28:32.1845560Z</SCENE_CENTER_TIME>
    <STATION_ID>LGN</STATION_ID>
    <CLOUD_COVER>20.64</CLOUD_COVER>
    <CLOUD_COVER_LAND>20.64</CLOUD_COVER_LAND>
    <IMAGE_QUALITY_OLI>9</IMAGE_QUALITY_OLI>
    <IMAGE_QUALITY_TIRS>9</IMAGE_QUALITY_TIRS>
    <SATURATION_BAND_1>N</SATURATION_BAND_1>
    <SATURATION_BAND_2>N</SATURATION_BAND_2>
    <SATURATION_BAND_3>N</SATURATION_BAND_3>
    <SATURATION_BAND_4>N</SATURATION_BAND_4>
    <SATURATION_BAND_5>Y</SATURATION_BAND_5>
    <SATURATION_BAND_6>Y</SATURATION_BAND_6>
    <SATURATION_BAND_7>Y</SATURATION_BAND_7>
    <SATURATION_BAND_8>N</SATURATION_BAND_8>
    <SATURATION_BAND_9>N</SATURATION_BAND_9>
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```

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    <SUN_AZIMUTH>143.86197853</SUN_AZIMUTH>
    <SUN_ELEVATION>60.04052861</SUN_ELEVATION>
    <EARTH_SUN_DISTANCE>1.0166942</EARTH_SUN_DISTANCE>
    <TRUNCATION_OLI>UPPER</TRUNCATION_OLI>
    <TIRS_SSM_MODEL>FINAL</TIRS_SSM_MODEL>
    <TIRS_SSM_POSITION_STATUS>ESTIMATED</TIRS_SSM_POSITION_STATUS>
</IMAGE_ATTRIBUTES>
```

3.1.2 Landsat U.S. ARD Package Contents

The available contents for Landsat 4, 5, and 7 C2 ARD products are listed below. Landsat 8-9 ARD is similar, differing only in the reflectance and thermal band numbers and its specific QA band (SR_QA_AEROSOL for Landsat 8-9 instead of SR_CLOUD_QA and SR_ATMOS_OPACITY for Landsat 4-7).

Top of Atmosphere Reflectance Product

LXSS_US_HHHVVV_YYYYMMDD_yyyymmdd_CC_TOA.tar
- LXSS_US_HHHVVV_YYYYMMDD_yyyymmdd_CC.xml
- LXSS_US_HHHVVV_YYYYMMDD_yyyymmdd_CC.json
- LXSS_US_HHHVVV_YYYYMMDD_yyyymmdd_CC_TOA_B1.TIF
- LXSS_US_HHHVVV_YYYYMMDD_yyyymmdd_CC_TOA_B2.TIF
- LXSS_US_HHHVVV_YYYYMMDD_yyyymmdd_CC_TOA_B3.TIF
- LXSS_US_HHHVVV_YYYYMMDD_yyyymmdd_CC_TOA_B4.TIF
- LXSS_US_HHHVVV_YYYYMMDD_yyyymmdd_CC_TOA_B5.TIF
- LXSS_US_HHHVVV_YYYYMMDD_yyyymmdd_CC_TOA_B7.TIF
- LXSS_US_HHHVVV_YYYYMMDD_yyyymmdd_CC_SAA.TIF
- LXSS_US_HHHVVV_YYYYMMDD_yyyymmdd_CC_SZA.TIF
- LXSS_US_HHHVVV_YYYYMMDD_yyyymmdd_CC_VAA.TIF
- LXSS_US_HHHVVV_YYYYMMDD_yyyymmdd_CC_VZA.TIF
- LXSS_US_HHHVVV_YYYYMMDD_yyyymmdd_CC_QA_PIXEL.TIF
- LXSS_US_HHHVVV_YYYYMMDD_yyyymmdd_CC_QA_RADSAT.TIF
- LXSS_US_HHHVVV_YYYYMMDD_yyyymmdd_CC_QA_LINEAGE.TIF

Top of Atmosphere Brightness Temperature Product

LXSS_US_HHHVVV_YYYYMMDD_yyyymmdd_CC_BT.tar
- LXSS_US_HHHVVV_YYYYMMDD_yyyymmdd_CC.xml
- LXSS_US_HHHVVV_YYYYMMDD_yyyymmdd_CC.json
- LXSS_US_HHHVVV_YYYYMMDD_yyyymmdd_CC_BT_B6.TIF
- LXSS_US_HHHVVV_YYYYMMDD_yyyymmdd_CC_QA_PIXEL.TIF
- LXSS_US_HHHVVV_YYYYMMDD_yyyymmdd_CC_QA_RADSAT.TIF
- LXSS_US_HHHVVV_YYYYMMDD_yyyymmdd_CC_QA_LINEAGE.TIF

Surface Reflectance Product

LXSS_US_HHHVVV_YYYYMMDD_yyyymmdd_CC_SR.tar
- LXSS_US_HHHVVV_YYYYMMDD_yyyymmdd_CC.xml
- LXSS_US_HHHVVV_YYYYMMDD_yyyymmdd_CC.json
- LXSS_US_HHHVVV_YYYYMMDD_yyyymmdd_CC_SR_B1.TIF

LXSS_US_HHHVVV_YYYYMMDD_yyyymmdd_CC_SR_B2.TIF
LXSS_US_HHHVVV_YYYYMMDD_yyyymmdd_CC_SR_B3.TIF
LXSS_US_HHHVVV_YYYYMMDD_yyyymmdd_CC_SR_B4.TIF
LXSS_US_HHHVVV_YYYYMMDD_yyyymmdd_CC_SR_B5.TIF
LXSS_US_HHHVVV_YYYYMMDD_yyyymmdd_CC_SR_B6.TIF
LXSS_US_HHHVVV_YYYYMMDD_yyyymmdd_CC_QA_PIXEL.TIF
LXSS_US_HHHVVV_YYYYMMDD_yyyymmdd_CC_QA_RADSAT.TIF
LXSS_US_HHHVVV_YYYYMMDD_yyyymmdd_CC_QA_LINEAGE.TIF
LXSS_US_HHHVVV_YYYYMMDD_yyyymmdd_CC_SR_CLOUD_QA.TIF
LXSS_US_HHHVVV_YYYYMMDD_yyyymmdd_CC_SR_ATMOS_OPACITY.TIF

Surface Temperature Product

LXSS_US_HHHVVV_YYYYMMDD_yyyymmdd_CC_ST.tar
LXSS_US_HHHVVV_YYYYMMDD_yyyymmdd_CC.xml
LXSS_US_HHHVVV_YYYYMMDD_yyyymmdd_CC.json
LXSS_US_HHHVVV_YYYYMMDD_yyyymmdd_CC_ST_B6.TIF
LXSS_US_HHHVVV_YYYYMMDD_yyyymmdd_CC_ST_ATRAN.TIF
LXSS_US_HHHVVV_YYYYMMDD_yyyymmdd_CC_ST_DRAD.TIF
LXSS_US_HHHVVV_YYYYMMDD_yyyymmdd_CC_ST_URAD.TIF
LXSS_US_HHHVVV_YYYYMMDD_yyyymmdd_CC_ST_TRAD.TIF
LXSS_US_HHHVVV_YYYYMMDD_yyyymmdd_CC_ST_EMIS.TIF
LXSS_US_HHHVVV_YYYYMMDD_yyyymmdd_CC_ST_EMSD.TIF
LXSS_US_HHHVVV_YYYYMMDD_yyyymmdd_CC_ST_CDIST.TIF
LXSS_US_HHHVVV_YYYYMMDD_yyyymmdd_CC_QA_PIXEL.TIF
LXSS_US_HHHVVV_YYYYMMDD_yyyymmdd_CC_QA_RADSAT.TIF
LXSS_US_HHHVVV_YYYYMMDD_yyyymmdd_CC_QA_LINEAGE.TIF
LXSS_US_HHHVVV_YYYYMMDD_yyyymmdd_CC_ST_QA.TIF

Quality Assessment Product

LXSS_US_HHHVVV_YYYYMMDD_yyyymmdd_CC_QA.tar
LXSS_US_HHHVVV_YYYYMMDD_yyyymmdd_CC.xml
LXSS_US_HHHVVV_YYYYMMDD_yyyymmdd_CC.json
LXSS_US_HHHVVV_YYYYMMDD_yyyymmdd_CC_QA_PIXEL.TIF
LXSS_US_HHHVVV_YYYYMMDD_yyyymmdd_CC_QA_RADSAT.TIF
LXSS_US_HHHVVV_YYYYMMDD_yyyymmdd_CC_QA_LINEAGE.TIF
LXSS_US_HHHVVV_YYYYMMDD_yyyymmdd_CC_SR_CLOUD_QA.TIF
LXSS_US_HHHVVV_YYYYMMDD_yyyymmdd_CC_SR_ATMOS_OPACITY.TIF
LXSS_US_HHHVVV_YYYYMMDD_yyyymmdd_CC_ST_QA.TIF

For comparison, the QA product for Landsat 8 ARD would have the following contents available:

LXSS_US_HHHVVV_YYYYMMDD_yyyymmdd_CC_QA.tar
LXSS_US_HHHVVV_YYYYMMDD_yyyymmdd_CC.xml

LXSS_US_HHHVVV_YYYYMMDD_yyyymmdd_CC.json
LXSS_US_HHHVVV_YYYYMMDD_yyyymmdd_CC_QA_PIXEL.TIF
LXSS_US_HHHVVV_YYYYMMDD_yyyymmdd_CC_QA_RADSAT.TIF
LXSS_US_HHHVVV_YYYYMMDD_yyyymmdd_CC_QA_LINEAGE.TIF
LXSS_US_HHHVVV_YYYYMMDD_yyyymmdd_CC_SR_QA_AEROSOL.TIF
LXSS_US_HHHVVV_YYYYMMDD_yyyymmdd_CC_ST_QA.TIF

Metadata Bundle

LXSS_US_HHHVVV_YYYYMMDD_yyyymmdd_CC_MTL.tar
LXSS_US_HHHVVV_YYYYMMDD_yyyymmdd_CC.xml
LXSS_US_HHHVVV_YYYYMMDD_yyyymmdd_CC.json

3.2 COG Specifications

3.2.1 COG Image Preparation

Landsat U.S. ARD is stored in Cloud Optimized Georeferenced Tagged Image File Format (GeoTIFF) (COG). The COG file format is an extension of the GeoTIFF file format which enables more flexible access to Geospatial data. For additional information about the COG format please refer to LSDS-1388 Landsat Cloud Optimized GeoTIFF Data Format Control Book.

3.2.2 Files Headers and Tags

COG tags are inherited from the GeoTIFF format. GeoTIFF tags convey information about the image. The tags describe the image using information a GeoTIFF reader needs to control the appearance of the image on the user's screen. The Tagged Image File Format (TIFF) tags are embedded in the same file as the TIFF image. The GeoTIFF tags provide information on the image projection and corner points, which define the geographic location and extent of the image.

A complete description of the raster data requires the data to be georeferenced, which is accomplished using tags. The Level-2 production system uses the transformation raster, model space tiepoints, and scaling parameters. ModelTiepointTag and ModelPixelScaleTag are used for this purpose.

3.2.2.1 GeoTIFF ModelTiepointTag

The GeoTIFF ModelTiepointTag stores the raster-to-model tiepoint pairs.

The raster-to-model tiepoint pairs are stored in the following order: ModelTiepointTag = (..., I, J, K, X, Y, Z...), where (I, J, K) is the point at location (I, J) in raster space with pixel-value K, and (X, Y, Z) is a vector in model space. The ModelTiepointTag requires that K and Z are set to zero. See the GeoTIFF Specification document (see References) for more information.

The raster image is geo-referenced by specifying its location, size, and orientation in the model coordinate space. Because the relationship between the raster space and the

model space is often exact, the affine transformation relationship can be defined using one set of tiepoints and the ModelPixelScaleTag (see Section 3.2.2.2), which gives the vertical and horizontal raster grid cell size. The ModelTiepointTag parameters are as follows:

Tag = 33922
Type = DOUBLE
N = 6*K, K = number of tiepoints

3.2.2.2 GeoTIFF ModelPixelScaleTag Tag

The GeoTIFF ModelPixelScaleTag tag specifies the size of the raster pixel spacing in the model space units when the raster space is embedded in the model space coordinate system without rotation.
The size of raster pixel spacing in the model space units consists of three values. These values are ModelPixelScaleTag = (ScaleX, ScaleY, ScaleZ), where ScaleX and ScaleY give the horizontal and vertical spacing of raster pixels, and ScaleZ maps the pixel value of a Digital Elevation Model (DEM) into the correct Z-scale.

A single tiepoint in the ModelTiepointTag, together with the ModelPixelScaleTag, determines the relationship between raster and model space. The ModelPixelScaleTag parameters are listed as follows:

Tag = 33550
Type = DOUBLE
N = 3

3.2.3 GeoTIFF Keys

The spatial description of an image in GeoTIFF requires keys stored within the image files and accessible by GeoTIFF readers. Table 3-2 defines the keys necessary to support the AEA map projection used for ARD.

Valid Keys	Possible Values	Meaning
GTModelTypeGeoKey	ModelTypeProjected	Projection Coordinate System
GTRasterTypeGeoKey	RasterPixelIsPoint	The coordinate is at the upper left corner of the pixel. This matches the Level-2 source scenes.
GTCitationGeoKey	AEA WGS84	American Standard Code for Information Interchange (ASCII) reference to public documentation; Albers, Stereographic South Pole, and Universal Transverse Mercator (UTM) are accounted for.
GeographicTypeGeoKey	GCS_WGS_84	Geographic coordinate system used to map lat-long to a specific ellipsoid over the Earth
GeogCitationGeoKey	WGS 84	General citation and reference for all Geographic CS parameters; WGS 84
GeogAngularUnitsGeoKey	Angular_Degree	Geocentric CS Linear units
GeogSemiMajorAxisGeoKey	6378137.0	Ellipsoid Semi-Major Axis
GeogInvFlatteningGeoKey	298.257223563	Inverse of Ellipsoid's flattening parameter

Valid Keys	Possible Values	Meaning
ProjectedCSTypeGeoKey	20000–32760	User-Defined projected coordinate system; European Petroleum Survey Group (EPSG) Projection Codes
ProjectionGeoKey	10000-19999	User-Defined; EPSG / Petrotechnical Open Software Corporation (POSC) Projection Codes (see the EPSG Geodetic Parameter Registry for values)
ProjCoordTransGeoKey	CT_AlbersEqualArea	Coordinate transformation method
ProjLinearUnitsGeoKey	Linear_Meter	Linear units used by this projection
ProjStdParallel1GeoKey	45.5	Latitude of primary Standard Parallel; Value in units of GeogAngularUnits
ProjStdParallel2GeoKey	29.5	Latitude of second Standard Parallel; Value in units of GeogAngularUnits
ProjNatOriginLongGeoKey	-96.0	Longitude of map-projection Natural origin; Value in units of GeogAngluarUnits
ProjNatOriginLatGeoKey	23.0	Latitude of map-projection Natural origin; Value in units of GeogAngularUnits
ProjFalseEastingGeoKey	0.0000000	Easting coordinate of the map projection Natural origin; Value entered in units of ProjLinearUnits
ProjFalseNorthingGeoKey	0.0000000	Northing coordinate of the map projection Natural origin; Value entered in units of ProjLinearUnits

Table 3-2. Albers GeoTIFF Key Description

Appendix A Landsat U.S. ARD Tile XML Metadata Sample

```
<?xml version="1.0" encoding="UTF-8"?>
<LANDSAT_ARD_METADATA_FILE>
    <TILE_METADATA>
        <PRODUCT_CONTENTS>
            <ORIGIN>Image courtesy of the U.S. Geological Survey</ORIGIN>
<DIGITAL_OBJECT_IDENTIFIER>https://doi.org/10.5066/P960F8OC</DIGITAL_OBJECT_IDENTIFIER>
            <ARD_PRODUCT_ID>LC08_CU_014002_20200704_20200918_02</ARD_PRODUCT_ID>
            <COLLECTION_NUMBER>02</COLLECTION_NUMBER>
            <OUTPUT_FORMAT>GEOTIFF</OUTPUT_FORMAT>
<FILE_NAME_SR_BAND_1>LC08_CU_014002_20200704_20200918_02_SR_B1.TIF</FILE_NAME_SR_BAND_1>
<FILE_NAME_SR_BAND_2>LC08_CU_014002_20200704_20200918_02_SR_B2.TIF</FILE_NAME_SR_BAND_2>
<FILE_NAME_SR_BAND_3>LC08_CU_014002_20200704_20200918_02_SR_B3.TIF</FILE_NAME_SR_BAND_3>
<FILE_NAME_SR_BAND_4>LC08_CU_014002_20200704_20200918_02_SR_B4.TIF</FILE_NAME_SR_BAND_4>
<FILE_NAME_SR_BAND_5>LC08_CU_014002_20200704_20200918_02_SR_B5.TIF</FILE_NAME_SR_BAND_5>
<FILE_NAME_SR_BAND_6>LC08_CU_014002_20200704_20200918_02_SR_B6.TIF</FILE_NAME_SR_BAND_6>
<FILE_NAME_SR_BAND_7>LC08_CU_014002_20200704_20200918_02_SR_B7.TIF</FILE_NAME_SR_BAND_7>
<FILE_NAME_ST_BAND_10>LC08_CU_014002_20200704_20200918_02_ST_B10.TIF</FILE_NAME_ST_BAND_10>
<FILE_NAME_TOA_BAND_1>LC08_CU_014002_20200704_20200918_02_TOA_B1.TIF</FILE_NAME_TOA_BAND_1>
<FILE_NAME_TOA_BAND_2>LC08_CU_014002_20200704_20200918_02_TOA_B2.TIF</FILE_NAME_TOA_BAND_2>
<FILE_NAME_TOA_BAND_3>LC08_CU_014002_20200704_20200918_02_TOA_B3.TIF</FILE_NAME_TOA_BAND_3>
<FILE_NAME_TOA_BAND_4>LC08_CU_014002_20200704_20200918_02_TOA_B4.TIF</FILE_NAME_TOA_BAND_4>
<FILE_NAME_TOA_BAND_5>LC08_CU_014002_20200704_20200918_02_TOA_B5.TIF</FILE_NAME_TOA_BAND_5>
<FILE_NAME_TOA_BAND_6>LC08_CU_014002_20200704_20200918_02_TOA_B6.TIF</FILE_NAME_TOA_BAND_6>
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<FILE_NAME_TOA_BAND_9>LC08_CU_014002_20200704_20200918_02_TOA_B9.TIF</FILE_NAME_TOA_BAND_9>
<FILE_NAME_ANGLE_SOLAR_ZENITH_BAND_4>LC08_CU_014002_20200704_20200918_02_SZA.TIF</FILE_NAME_ANGLE_SOLAR_ZENITH_
BAND_4>
<FILE_NAME_ANGLE_SOLAR_AZIMUTH_BAND_4>LC08_CU_014002_20200704_20200918_02_SAA.TIF</FILE_NAME_ANGLE_SOLAR_AZIMUT
H_BAND_4>
<FILE_NAME_ANGLE_SENSOR_ZENITH_BAND_4>LC08_CU_014002_20200704_20200918_02_VZA.TIF</FILE_NAME_ANGLE_SENSOR_ZENIT
H_BAND_4>
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UTH_BAND_4>
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<FILE_NAME_BT_BAND_11>LC08_CU_014002_20200704_20200918_02_BT_B11.TIF</FILE_NAME_BT_BAND_11>
<FILE_NAME_THERMAL_RADIANCE>LC08_CU_014002_20200704_20200918_02_ST_TRAD.TIF</FILE_NAME_THERMAL_RADIANCE>
<FILE_NAME_UPWELLING_RADIANCE>LC08_CU_014002_20200704_20200918_02_ST_URAD.TIF</FILE_NAME_UPWELLING_RADIANCE>
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>
<FILE_NAME_ATMOSPHERIC_TRANSMITTANCE>LC08_CU_014002_20200704_20200918_02_ST_ATRAN.TIF</FILE_NAME_ATMOSPHERIC_TR
ANSMITTANCE>
<FILE_NAME_EMISSIVITY>LC08_CU_014002_20200704_20200918_02_ST_EMIS.TIF</FILE_NAME_EMISSIVITY>
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<FILE_NAME_CLOUD_DISTANCE>LC08_CU_014002_20200704_20200918_02_ST_CDIST.TIF</FILE_NAME_CLOUD_DISTANCE>
<FILE_NAME_QUALITY_AEROSOL>LC08_CU_014002_20200704_20200918_02_SR_QA_AEROSOL.TIF</FILE_NAME_QUALITY_AEROSOL>
<FILE_NAME_QUALITY_SURFACE_TEMPERATURE>LC08_CU_014002_20200704_20200918_02_ST_QA.TIF</FILE_NAME_QUALITY_SURFACE
_TEMPERATURE>
<FILE_NAME_QUALITY_PIXEL>LC08_CU_014002_20200704_20200918_02_QA_PIXEL.TIF</FILE_NAME_QUALITY_PIXEL>
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Appendix C Landsat U.S. ARD Tile Metadata Definitions

Parameter Name	Value, Format, and Range	Parameter Description/Remarks
GROUP	= LANDSAT_ARD_METADATA_FILE	The beginning of the first-level ODL group. It indicates the start of the Landsat ARD metadata file group.
GROUP	= TILE_METADATA	The beginning of the tile metadata group.
GROUP	= PRODUCT_CONTENTS	The beginning of the product contents group.
ORIGIN	= “Image courtesy of the U.S. Geological Survey”	Origin of the product.
DIGITAL_OBJECT_IDENTIFIER	= “https://doi.org/10.5066/P960F8OC”	Digital Object Identifier for Landsat C2 ARD. For more information on Digital Object Identifiers, visit https://www.doi.org.
ARD_PRODUCT_ID	= “LXSS_US_HHHVVV_YYYYMMDD_yyyymmdd_CC”	Landsat ARD uses the “LXSS_US_HHHVVV_YYYYMMDD_yyyymmdd_CC” format, where: L = Landsat X = Sensor SS = Satellite US = Regional grid of the U.S. HHH = Horizontal tile number VVV = Vertical tile number YYYYMMDD = Acquisition year (YYYY) month (MM) day (DD) Yyyymmdd = ARD production year (yyyy) month (mm) day (dd) CC = Collection number
COLLECTION_NUMBER	= NN	The product collection number.
OUTPUT_FORMAT	= “GEOTIFF”	Output file format for image files.
FILE_NAME_SR_BAND_<1-7>	= “LXSS_US_HHHVVV_YYYYMMDD_yyyymmdd_CC_SR_B<1-7>.TIF”	The file name for Surface Reflectance from bands 1 to 7.
FILE_NAME_TOA_BAND_<1-7>	= “LXSS_US_HHHVVV_YYYYMMDD_yyyymmdd_CC_TOA_B<1-9>.TIF”	The file name for TOA Reflectance from bands 1 to 9.
FILE_NAME_ST_BAND<6,10>	= “LXSS_US_HHHVVV_YYYYMMDD_yyyymmdd_CC_ST_B<6,10>.TIF”	The file name for Surface Temperature from band 6 or 10.
FILE_NAME_BT_BAND<6,10,11>	= “LXSS_US_HHHVVV_YYYYMMDD_yyyymmdd_CC_BT_B<6,10,11>.TIF”	The file name for TOA Brightness Temperature from band 6, 10-11.
FILE_NAME_ANGLE_SOLAR_ZENITH_BAND_4	= “LXSS_US_HHHVVV_YYYYMMDD_yyyymmdd_CC_SZA.TIF”	The file name for Solar Zenith Angle band.
FILE_NAME_ANGLE_SOLAR_AZIMUTH_BAND_4	= “LXSS_US_HHHVVV_YYYYMMDD_yyyymmdd_CC_SAA.TIF”	The file name for Solar Azimuth Angle band.
FILE_NAME_ANGLE_SENSOR_ZENITH_BAND_4	= “LXSS_US_HHHVVV_YYYYMMDD_yyyymmdd_CC_VZA.TIF”	The file name for Sensor Zenith Angle band.
FILE_NAME_ANGLE_SENSOR_AZIMUTH_BAND_4	= “LXSS_US_HHHVVV_YYYYMMDD_yyyymmdd_CC_VAA.TIF”	The file name for Sensor Azimuth Angle band.
FILE_NAME_THERMAL_RADIANCE	= “LXSS_US_HHHVVV_YYYYMMDD_yyyymmdd_CC_ST_TRAD.TIF”	The file name for the thermal band converted to radiance.

Parameter Name	Value, Format, and Range	Parameter Description/Remarks
FILE_NAME_UPWELLING_RADIANCE	= “LXSS_US_HHHVVV_YYYYMMDD_yyyymmdd_CC_ST_URAD.TIF”	The file name for the upwelling radiance.
FILE_NAME_DOWNWELLING_RADIANCE	= “LXSS_US_HHHVVV_YYYYMMDD_yyyymmdd_CC_ST_DRAD.TIF”	The file name for the downwelling radiance.
FILE_NAME_ATMOSPHERIC_TRANSMITTANCE	= “LXSS_US_HHHVVV_YYYYMMDD_yyyymmdd_CC_ST_ATRAN.TIF”	The file name for the atmospheric transmittance.
FILE_NAME_EMISSIVITY	= “LXSS_US_HHHVVV_YYYYMMDD_yyyymmdd_CC_ST_EMIS.TIF”	The file name for the emissivity estimated from ASTER GED for band 10.
FILE_NAME_EMISSIVITY_STDEV	= “LXSS_US_HHHVVV_YYYYMMDD_yyyymmdd_CC_ST_EMSD.TIF”	The file name for standard deviation of the emissivity estimated from ASTER GED.
FILE_NAME_CLOUD_DISTANCE	= “LXSS_US_HHHVVV_YYYYMMDD_yyyymmdd_CC_ST_CDIST.TIF”	The file name for Surface Temperature cloud distance band which gives the pixel distance to the cloud in Kilometers.
FILE_NAME_QUALITY_AEROSOL	= “LXSS_US_HHHVVV_YYYYMMDD_yyyymmdd_CC_SR_QA_AEROSOL.TIF”	The file name for the Surface Reflectance Aerosol QA Band.
FILE_NAME_QUALITY_SURFACE_TEMPERATURE	= “LXSS_US_HHHVVV_YYYYMMDD_yyyymmdd_CC_ST_QA.TIF”	The file name for the Surface Temperature QA Band.
FILE_NAME_QUALITY_PIXEL	= “LXSS_US_HHHVVV_YYYYMMDD_yyyymmdd_CC_QA_PIXEL.TIF”	The file name for the Quality Assessment (QA) Band.
FILE_NAME_QUALITY_RADIOMETRIC_SATURATION	= “LXSS_US_HHHVVV_YYYYMMDD_yyyymmdd_CC_QA_RADSAT.TIF”	The file name for the Radiometric Saturation Quality Assessment (QA) Band.
FILE_NAME_QUALITY_LINEAGE	= “LXSS_US_HHHVVV_YYYYMMDD_yyyymmdd_CC_QA_LINEAGE.TIF”	The file name for the lineage Quality Assessment (QA) scene index file.
FILE_NAME_METADATA_XML	= “LXSS_US_HHHVVV_YYYYMMDD_yyyymmdd_CC.xml”	The file name for ARD XML metadata.
DATA_TYPE_SR_BAND_<1-7>	= “UINT16”	The GeoTIFF file for SR bands 1 to 7 uses unsigned 16-bit integers.
DATA_TYPE_TOA_BAND_<1-9>	= “UINT16”	The GeoTIFF file for TOA Reflectance bands 1-9 uses unsigned 16-bit integers.
DATA_TYPE_ST_BAND_<6,10>	= “UINT16”	The GeoTIFF file for ST bands 6, 10 uses unsigned 16-bit integers.
DATA_TYPE_BT_BAND_<6,10,11>	= “UINT16”	The GeoTIFF file for TOA BT bands 6, 10-11 uses unsigned 16-bit integers.
DATA_TYPE_ANGLE_SOLAR_ZENITH_BAND_4	= “INT16”	The GeoTIFF file for Solar Zenith Angle band uses unsigned 16-bit integers.
DATA_TYPE_ANGLE_SOLAR_AZIMUTH_BAND_4	= “INT16”	The GeoTIFF file for Solar Azimuth Angle band uses unsigned 16-bit integers.
DATA_TYPE_ANGLE_SENSOR_ZENITH_BAND_4	= “INT16”	The GeoTIFF file for Sensor Zenith Angle band uses unsigned 16-bit integers.
DATA_TYPE_ANGLE_SENSOR_AZIMUTH_BAND_4	= “INT16”	The GeoTIFF file for Sensor Azimuth Angle band uses unsigned 16-bit integers.
DATA_TYPE_THERMAL_RADIANCE	= “INT16”	The thermal band converted to radiance uses signed 16-bit integers.
DATA_TYPE_UPWELLING_RADIANCE	= “INT16”	The upwelling radiance band uses signed 16-bit integers.
DATA_TYPE_DOWNWELLING_RADIANCE	= “INT16”	The downwelling radiance band uses signed 16-bit integers.

Parameter Name	Value, Format, and Range	Parameter Description/Remarks
DATA_TYPE_ATMOSPHERIC_TRANSMITTANCE	= “INT16”	The atmospheric transmittance band uses signed 16-bit integers.
DATA_TYPE_EMISSIVITY	= “INT16”	The emissivity estimated from ASTER GED uses signed 16-bit integers.
DATA_TYPE_EMISSIVITY_STDEV	= “INT16”	The emissivity standard deviation uses signed 16-bit integers.
DATA_TYPE_CLOUD_DISTANCE	= “INT16”	The Surface Temperature cloud distance band uses signed 16-bit integers.
DATA_TYPE_QUALITY_AEROSOL	= “UINT8”	The Surface Reflectance aerosol QA file uses unsigned 8-bit integers.
DATA_TYPE_QUALITY_SURFACE_TEMPERATURE	= “INT16”	The Surface Temperature QA file uses signed 16-bit integers.
DATA_TYPE_QUALITY_PIXEL	= “UINT16”	The Pixel Quality Assessment Band uses unsigned 16-bit integers.
DATA_TYPE_QUALITY_RADIOMETRIC_SATURATION	= “UINT16”	The radiometric saturation band uses unsigned 16-bit integers.
END_GROUP	= PRODUCT_CONTENTS	
GROUP	= IMAGE_ATTRIBUTES	
SPACECRAFT_ID	= “LANDSAT_8” = “LANDSAT_7” = “LANDSAT_5” = “LANDSAT_4”	Spacecraft from which the data were captured.
SENSOR_ID	= “OLI_TIRS” = “ETM+” = “TM”	Sensor used to capture this scene.
REGION	= “CU” = “AK” = “HI”	Landsat U.S. ARD region.
TILE_GRID_H	= 1-32	Horizontal tile number.
TILE_GRID_V	= 1-21	Vertical tile number.
DATE_ACQUIRED	= YYYY-MM-DD	The date the input scene(s) acquired.
SCENE_COUNT	= 1-3	Number of scenes used in ARD
CLOUD_COVER	= 0.00–100.00	The cloud coverage (percent) withing non-fill area of the ARD tile.
CLOUD_SHADOW_COVER	= 0.00–100.00	The cloud shadow coverage (percent) withing non-fill area of the ARD tile.
SNOW_ICE_COVER	= 0.00–100.00	The snow/ice coverage (percent) withing non-fill area of the ARD tile.
FILL	= 0.00–100.00	The percentage of fill pixels in the ARD tile.
END_GROUP	= IMAGE_ATTRIBUTES	
GROUP	= PROJECTION_ATTRIBUTES	
MAP_PROJECTION	= “AEA”	The map projection used in creating the ARD which is Albers Equal Area.
DATUM	= “WGS84”	The datum used in creating the image.
ORIGIN_LAT	= -90.00000 – 90.00000	Latitude of the origin in AEA projection.
CENTRAL_MERIDIAN_LON	= -180.00000 – 180.00000	Longitude of the central meridian in AEA projection
STANDARD_PARALLEL_1_LAT	= -90.00000 – 90.00000	Latitude of standard parallel 1
STANDARD_PARALLEL_2_LAT	= -90.00000 – 90.00000	Latitude of standard parallel 2
FALSE_EASTING	= 0	Value added to all "x" values in the rectangular coordinates for a map projection.

Parameter Name	Value, Format, and Range	Parameter Description/Remarks
FALSE_NORTHING	= 0	Value added to all "y" values in the rectangular coordinates for a map projection.
GRID_CELL_SIZE_REFLECTIVE	= 30.00	The grid cell size in meters used in creating the SR and TOA Reflectance science product at Visible and Near Infrared (VNIR) and Short-Wave Infrared (SWIR) bands.
GRID_CELL_SIZE_THERMAL	= 30.00	The grid cell size in meters used in creating the ST and TOA BT science products from the thermal bands.
REFLECTIVE_LINES	= 5000	The number of ARD product lines for the reflective bands (SR bands 1–7 and TOA Reflectance bands 1-7, 9).
REFLECTIVE_SAMPLES	= 5000	The number of ARD product samples for the reflective bands (SR bands 1–7 and TOA Reflectance bands 1-7, 9).
THERMAL_LINES	= 5000	The number of ARD product lines for the thermal bands (TOA BT bands 6, 10–11 and ST bands 6 and 10).
THERMAL_SAMPLES	= 5000	The number of ARD product samples for the thermal bands (TOA BT bands 6, 10–11 and ST bands 6 and 10).
GRID_ORIGIN	= UL	The origin of pixel (usually upper left)
ORIENTATION	= NOMINAL, NORTH_UP, TRUE_NORTH, USER	The Orientation angle used in creating the image.
CORNER_UL_LAT_PRODUCT	= -90.00000 through +90.00000	The latitude value for the upper-left corner of the geographic bounding-box that contains the ARD product. A positive (+) value indicates north latitude; a negative (-) value indicates south latitude. Units are in degrees.
CORNER_UL_LON_PRODUCT	= -180.00000 through +180.00000	The longitude value for the upper-left corner of the geographic bounding-box that contains the ARD product. Positive (+) value indicates east longitude; negative (-) value indicates west longitude. Units are in degrees.
CORNER_LR_LAT_PRODUCT	= -90.00000 through +90.00000	The latitude value for the lower-right corner of the geographic bounding-box that contains the ARD product. Units are in degrees.
CORNER_LR_LON_PRODUCT	= -180.00000 through +180.00000	The longitude value for the lower-right corner of the geographic bounding box that contains the ARD product. Units are in degrees.
CORNER_UL_PROJECTION_X_PRODUCT	= -132000000.000 through 132000000.000	The map projection X coordinate of the upper-left corner of the ARD tile. Units are in meters.
CORNER_UL_PROJECTION_Y_PRODUCT	= -132000000.000 through 132000000.000	The map projection Y coordinate of the upper-left corner of the ARD tile. Units are in meters.
CORNER_LR_PROJECTION_X_PRODUCT	= -132000000.000 through 132000000.000	The map projection X coordinate of the lower-right corner of the ARD tile. Units are in meters.
CORNER_LR_PROJECTION_Y_PRODUCT	= -132000000.000 through 132000000.000	The map projection Y coordinate of the lower-right corner of the ARD tile. Units are in meters.
END_GROUP	= PROJECTION_ATTRIBUTES	
GROUP	= ARD_PROCESSING_RECORD	

Parameter Name	Value, Format, and Range	Parameter Description/Remarks
ORIGIN	= “Image courtesy of the U.S. Geological Survey”	Origin of the product.
DIGITAL_OBJECT_IDENTIFIER	= “https://doi.org/10.5066/P960F8OC”	Digital Object Identifier for Level-2 OLI-TIRS. For more information on Digital Object Identifiers, visit https://www.doi.org.
ARD_PRODUCT_ID	= “LXSS_US_HHHVVV_YYYYMMDD_yyyymmdd_CC”	Landsat ARD uses the “LXSS_US_HHHVVV_YYYYMMDD_yyyymmdd_CC” format, where: L = Landsat X = Sensor SS = Satellite US = Regional grid of the U.S. HHH = Horizontal tile number VVV = Vertical tile number YYYYMMDD = Acquisition year (YYYY) month (MM) day (DD) Yyyymmdd = ARD production year (yyyy) month (mm) day (dd) CC = Collection number
OUTPUT_FORMAT	= “GEOTIFF”	Output file format for image files.
DATE_PRODUCT_GENERATED	= YYYY-MM-DDTHH:MI:SSZ	The date when the ARD product was created: YYYY-MM-DDTHH:MI:SSZ Where: YYYY = Four-digit Julian year MM = Month of the Julian year (01-12) DD = Day of the Julian month (01-31) T = Start of time information in ODL American Standard Code for Information Interchange (ASCII) time code format HH = Hours (00-23) MI = Minutes (00-59) SS = Seconds (00-59) Z = Zulu time (same as Greenwich Mean Time (GMT))
PROCESSING_SOFTWARE_VERSION	= “ARD_TILING_CODE_VERSION_1.1”	The processing software version that tiled the scenes.
END_GROUP	= ARD_PROCESSING_RECORD	
GROUP	= ARD_SURFACE_REFLECTANCE_PARAMETERS	
MAXIMUM_SR_BAND_<1-7>	= N.NNNNNN	Maximum achievable value for SR bands 1 to 7.
MINIMUM_SR_BAND_<1-7>	= N.NNNNNN	Minimum achievable value for SR bands 1 to 7.
QUANTIZE_CAL_MAX_SR_BAND_<1-7>	= 65535	Maximum possible pixel value for SR bands 1 to 7.
QUANTIZE_CAL_MIN_SR_BAND_<1-7>	= 1	Minimum possible pixel value for SR bands 1 to 7.
QUANTIZE_CAL_MAX_QUALITY_PIXEL	= 65535	Maximum possible pixel value for QA_PIXEL.
QUANTIZE_CAL_MIN_QUALITY_PIXEL	= 1	Minimum possible pixel value for QA_PIXEL.
QUANTIZE_CAL_MAX_QUALITY_AEROSOL	= 255	Maximum possible pixel value for SR Aerosol QA.
QUANTIZE_CAL_MIN_QUALITY_AEROSOL	= 1	Minimum possible pixel value for SR Aerosol QA.

Parameter Name	Value, Format, and Range	Parameter Description/Remarks
QUANTIZE_CAL_MAX_QUALITY_RADIOMETRIC_SATURATION	= 65535	Maximum possible pixel value for RADSAT QA.
QUANTIZE_CAL_MIN_QUALITY_RADIOMETRIC_SATURATION	= 0	Minimum possible pixel value for RADSAT QA.
QUANTIZE_CAL_MAX_QUALITY_LINEAGE	= 255	Maximum possible pixel value for LINEAGE index.
QUANTIZE_CAL_MIN_QUALITY_LINEAGE	= 0	Minimum possible pixel value for LINEAGE index.
MULT_SR_BAND_<1-7>	= 2.75e-05	Multiplicative rescaling factor applied to SR bands 1 to 7.
ADD_SR_BAND_<1-7>	= -0.2	Additive rescaling factor applied to the SR bands 1 to 7.
FILL_SR_BAND_<1-7>	= 0	Fill value for the SR bands 1 to 7.
FILL_QUALITY_PIXEL	= 1	Fill value for the QA_PIXEL.
FILL_QUALITY_AEROSOL	= 1	Fill value for the SR Aerosol QA.
FILL_QUALITY_LINEAGE	= 0	Fill value for the LINEAGE index.
DATA_UNITS_SR_BAND_<1-7>	= Unitless	Data units for the SR bands 1 to 7.
DATA_UNITS_QUALITY_LINEAGE	= Index	Data units for the LINEAGE index.
END_GROUP	= ARD_SURFACE_REFLECTANCE_PARAMETERS	
GROUP	= ARD_SURFACE_TEMPERATURE_PARAMETERS	
MAXIMUM_ST_BAND_<6, 10>	= NNN.NNNNNN	Maximum achievable value for ST bands 6, 10.
MINIMUM_ST_BAND_<6, 10>	= NNN.NNNNNN	Minimum achievable value for ST bands 6, 10.
MAXIMUM_QUALITY_SURFACE_TEMPERATURE	= NNN.NN	Maximum achievable ST uncertainty.
MINIMUM_QUALITY_SURFACE_TEMPERATURE	= NNN.NN	Minimum achievable ST uncertainty.
MAXIMUM_THERMAL_RADIANCE	= NNN.NNN	Maximum achievable thermal radiance.
MINIMUM_THERMAL_RADIANCE	= NNN.NNN	Minimum achievable thermal radiance.
MAXIMUM_UPWELLING_RADIANCE	= NNN.NNN	Maximum achievable upwelling radiance.
MINIMUM_UPWELLING_RADIANCE	= NNN.NNN	Minimum achievable upwelling radiance.
MAXIMUM_DOWNWELLING_RADIANCE	= NNN.NNN	Maximum achievable downwelling radiance.
MINIMUM_DOWNWELLING_RADIANCE	= NNN.NNN	Minimum achievable downwelling radiance.
MAXIMUM_ATMOSPHERIC_TRANSMITTANCE	= NNN.NNNN	Maximum achievable atmospheric transmittance.
MINIMUM_ATMOSPHERIC_TRANSMITTANCE	= NNN.NNNN	Minimum achievable atmospheric transmittance.
MAXIMUM_EMISSIVITY	= NNN.NNNN	Maximum achievable emissivity.
MINIMUM_EMISSIVITY	= NNN.NNNN	Minimum achievable emissivity.
MAXIMUM_EMISSIVITY_STDEV	= NNN.NNNN	Maximum achievable emissivity standard deviation.

Parameter Name	Value, Format, and Range	Parameter Description/Remarks
MINIMUM_EMISSIVITY_STDEV	= NNN.NNNN	Minimum achievable emissivity standard deviation.
MAXIMUM_CLOUD_DISTANCE	= NNN.NN	Maximum achievable distance to cloud [Km].
MINIMUM_CLOUD_DISTANCE	= NNN.NN	Minimum achievable distance to cloud [Km].
QUANTIZE_CAL_MAX_ST_BAND_<6,10>	= 65535	Maximum possible pixel value for ST bands 6, 10.
QUANTIZE_CAL_MINI_ST_BAND_<6,10>	= 1	Minimum possible pixel value for ST bands 6, 10.
QUANTIZE_CAL_MAX_QUALITY_SURFACE_TEMPERATURE	= 32767	Maximum possible pixel value for ST uncertainty.
QUANTIZE_CAL_MIN_QUALITY_SURFACE_TEMPERATURE	= 0	Minimum possible pixel value for ST uncertainty.
QUANTIZE_CAL_MAX_THERMAL_RADIANCE	= 22000	Maximum possible pixel value for thermal radiance.
QUANTIZE_CAL_MIN_THERMAL_RADIANCE	= 0	Minimum possible pixel value for thermal radiance.
QUANTIZE_CAL_MAX_UPWELLING_RADIANCE	= 28000	Maximum possible pixel value for upwelling radiance.
QUANTIZE_CAL_MIN_UPWELLING_RADIANCE	= 0	Minimum possible pixel value for upwelling radiance.
QUANTIZE_CAL_MAX_DOWNWELLING_RADIANCE	= 28000	Maximum possible pixel value for downwelling radiance.
QUANTIZE_CAL_MIN_DOWNWELLING_RADIANCE	= 0	Minimum possible pixel value for downwelling radiance.
QUANTIZE_CAL_MAX_ATMOSPHERIC_TRANSMITTANCE	= 10000	Maximum possible pixel value for atmospheric transmittance.
QUANTIZE_CAL_MIN_ATMOSPHERIC_TRANSMITTANCE	= 0	Minimum possible pixel value for atmospheric transmittance.
QUANTIZE_CAL_MAX_EMISSIVITY	= 10000	Maximum possible pixel value for emissivity.
QUANTIZE_CAL_MIN_EMISSIVITY	= 0	Minimum possible pixel value for emissivity.
QUANTIZE_CAL_MAX_EMISSIVITY_STDEV	= 10000	Maximum possible pixel value for emissivity standard deviation.
QUANTIZE_CAL_MIN_EMISSIVITY_STDEV	= 0	Minimum possible pixel value for emissivity standard deviation.
QUANTIZE_CAL_MAX_CLOUD_DISTANCE	= 24000	Maximum possible pixel value for distance to cloud.
QUANTIZE_CAL_MIN_CLOUD_DISTANCE	= 0	Minimum possible pixel value for distance to cloud.
QUANTIZE_CAL_MAX_QUALITY_PIXEL	= 65535	Maximum possible pixel value for QA_PIXEL.
QUANTIZE_CAL_MIN_QUALITY_PIXEL	= 1	Minimum possible pixel value for QA_PIXEL.
QUANTIZE_CAL_MAX_QUALITY_RADIOMETRIC_SATURATION	= 65535	Maximum possible pixel value for radiometric saturation QA.
QUANTIZE_CAL_MIN_QUALITY_RADIOMETRIC_SATURATION	= 0	Minimum possible pixel value for radiometric saturation QA.
QUANTIZE_CAL_MAX_QUALITY_LINEAGE	= 255	Maximum possible pixel value for LINEAGE index.

Parameter Name	Value, Format, and Range	Parameter Description/Remarks
QUANTIZE_CAL_MIN_QUALITY_LINEAGE	= 0	Minimum possible pixel value for LINEAGE index.
MULT_ST_BAND_<6,10>	= 0.00341802	Multiplicative rescaling factor to convert DN to ST [K].
ADD_ST_BAND_<6,10>	= 149.0	Additive rescaling factor to convert DN to ST [K].
MULT_QUALITY_SURFACE_TEMPERATURE	= 0.01	Multiplicative rescaling factor to convert DN to ST uncertainty [K].
MULT_THERMAL_RADIANCE	= 0.001	Multiplicative rescaling factor applied to thermal radiance.
MULT_UPWELLING_RADIANCE	= 0.001	Multiplicative rescaling factor applied to upwelling radiance.
MULT_DOWNWELLING_RADIANCE	= 0.001	Multiplicative rescaling factor applied to downwelling radiance.
MULT_ATMOSPHERIC_TRANSMITTANCE	= 0.0001	Multiplicative rescaling factor applied to atmospheric transmittance.
MULT_EMISSIVITY	= 0.0001	Multiplicative rescaling factor applied to emissivity.
MULT_EMISSIVITY_STDEV	= 0.0001	Multiplicative rescaling factor applied to emissivity standard deviation.
MULT_CLOUD_DISTANCE	= 0.01	Multiplicative rescaling factor applied to distance to cloud.
FILL_ST_BAND_<6,10>	= 0	Fill value for ST bands 6, 10.
FILL_QUALITY_SURFACE_TEMPERATURE	= -9999	Fill value for ST uncertainty.
FILL_THERMAL_RADIANCE	= -9999	Fill value for thermal radiance
FILL_UPWELLING_RADIANCE	= -9999	Fill value for thermal radiance
FILL_DOWNWELLING_RADIANCE	= -9999	Fill value for thermal radiance
FILL_ATMOSPHERIC_TRANSMITTANCE	= -9999	Fill value for thermal radiance
FILL_EMISSIVITY	= -9999	Fill value for thermal radiance
FILL_EMISSIVITY_STDEV	= -9999	Fill value for thermal radiance
FILL_CLOUD_DISTANCE	= -9999	Fill value for thermal radiance
FILL_QUALITY_PIXEL	= 1	Fill value for the QA_PIXEL.
FILL_QUALITY_LINEAGE	= 0	Fill value for the LINEAGE index.
DATA_UNITS_ST_BAND_<6,10>	= Kelvin	Data units for ST bands 6, 10.
DATA_UNITS_QUALITY_SURFACE_TEMPERATURE	= Kelvin	Data units for ST uncertainty.
DATA_UNITS_THERMAL_RADIANCE	= $W/m^2.sr.\mu m$	Data units for thermal radiance
DATA_UNITS_UPWELLING_RADIANCE	= $W/m^2.sr.\mu m$	Data units for thermal radiance
DATA_UNITS_DOWNWELLING_RADIANCE	= $W/m^2.sr.\mu m$	Data units for thermal radiance
DATA_UNITS_ATMOSPHERIC_TRANSMITTANCE	= Unitless	Data units for thermal radiance
DATA_UNITS_EMISSIVITY	= Emissivity coefficient	Data units for thermal radiance
DATA_UNITS_EMISSIVITY_STDEV	= Emissivity coefficient	Data units for thermal radiance
DATA_UNITS_CLOUD_DISTANCE	= Kilometers	Data units for thermal radiance

Parameter Name	Value, Format, and Range	Parameter Description/Remarks
DATA_UNITS_QUALITY_LINEAGE	= Index	Data units for the LINEAGE index.
END_GROUP	= ARD_SURFACE_TEMPERATURE_PARAMETERS	
GROUP	= ARD_TOA_REFLECTANCE_PARAMETERS	
MAXIMUM_TOA_BAND_<1-9>	= N.NNNNNN	Maximum achievable value for TOA Reflectance bands 1 to 7 and 9.
MINIMUM_TOA_BAND_<1-9>	= N.NNNNNN	Minimum achievable value for TOA Reflectance bands 1 to 7 and 9.
MAXIMUM_ANGLE_SOLAR_ZENITH_BAND_4	= DD.DD	Maximum achievable value for Solar Zenith Angle.
MINIMUM_ANGLE_SOLAR_ZENITH_BAND_4	= DD.DD	Minimum achievable value for Solar Zenith Angle.
MAXIMUM_ANGLE_SOLAR_AZIMUTH_BAND_4	= DDD.DD	Maximum achievable value for Solar Azimuth Angle.
MINIMUM_ANGLE_SOLAR_AZIMUTH_BAND_4	= DDD.DD	Minimum achievable value for Solar Azimuth Angle.
MAXIMUM_ANGLE_SENSOR_ZENITH_BAND_4	= DD.DD	Maximum achievable value for Sensor Zenith Angle.
MINIMUM_ANGLE_SENSOR_ZENITH_BAND_4	= DD.DD	Minimum achievable value for Sensor Zenith Angle.
MAXIMUM_ANGLE_SENSOR_AZIMUTH_BAND_4	= DDD.DD	Maximum achievable value for Sensor Azimuth Angle.
MINIMUM_ANGLE_SENSOR_AZIMUTH_BAND_4	= DDD.DD	Minimum achievable value for Sensor Azimuth Angle.
QUANTIZE_CAL_MAX_TOA_BAND_<1-9>	= 65535	Maximum possible pixel value for TOA Reflectance bands 1 to 7 and 9.
QUANTIZE_CAL_MIN_TOA_BAND_<1-9>	= 1	Minimum possible pixel value for TOA Reflectance bands 1 to 7 and 9.
QUANTIZE_CAL_MAXIMUM_ANGLE_SOLAR_ZENITH_BAND_4	= DD.DD	Maximum achievable value for Solar Zenith Angle.
QUANTIZE_CAL_MINIMUM_ANGLE_SOLAR_ZENITH_BAND_4	= DD.DD	Minimum possible pixel value for Solar Zenith Angle.
QUANTIZE_CAL_MAXIMUM_ANGLE_SOLAR_AZIMUTH_BAND_4	= DDD.DD	Maximum possible pixel value for Solar Azimuth Angle.
QUANTIZE_CAL_MINIMUM_ANGLE_SOLAR_AZIMUTH_BAND_4	= DDD.DD	Minimum possible pixel value for Solar Azimuth Angle.
QUANTIZE_CAL_MAXIMUM_ANGLE_SENSOR_ZENITH_BAND_4	= DD.DD	Maximum possible pixel value for Sensor Zenith Angle.
QUANTIZE_CAL_MINIMUM_ANGLE_SENSOR_ZENITH_BAND_4	= DD.DD	Minimum possible pixel value for Sensor Zenith Angle.
QUANTIZE_CAL_MAXIMUM_ANGLE_SENSOR_AZIMUTH_BAND_4	= DDD.DD	Maximum possible pixel value for Sensor Azimuth Angle.
QUANTIZE_CAL_MINIMUM_ANGLE_SENSOR_AZIMUTH_BAND_4	= DDD.DD	Minimum possible pixel value for Sensor Azimuth Angle.
QUANTIZE_CAL_MAX_QUALITY_PIXEL	= 65535	Maximum possible pixel value for QA_PIXEL.

Parameter Name	Value, Format, and Range	Parameter Description/Remarks
QUANTIZE_CAL_MIN_QUALITY_PIXEL	= 1	Minimum possible pixel value for QA_PIXEL.
QUANTIZE_CAL_MAX_QUALITY_RADIOMETRIC_SATURATION	= 65535	Maximum possible pixel value for radiometric saturation QA.
QUANTIZE_CAL_MIN_QUALITY_RADIOMETRIC_SATURATION	= 0	Minimum possible pixel value for radiometric saturation QA.
QUANTIZE_CAL_MAX_QUALITY_LINEAGE	= 255	Maximum possible pixel value for LINEAGE index.
QUANTIZE_CAL_MIN_QUALITY_LINEAGE	= 0	Minimum possible pixel value for LINEAGE index.
MULT_TOA_BAND_<1-9>	= 2.75e-05	Multiplicative rescaling factor applied to TOA Reflectance bands 1 to 7 and 9.
ADD_TOA_BAND_<1-9>	= -0.2	Additive rescaling factor applied to the TOA Reflectance bands 1 to 7 and 9.
MULT_ANGLE_SOLAR_ZENITH_BAND_4	= 0.01	Multiplicative rescaling factor applied to Solar Zenith Angle band.
MULT_ANGLE_SOLAR_AZIMUTH_BAND_4	= 0.01	Multiplicative rescaling factor applied to Solar Azimuth Angle band.
MULT_ANGLE_SENSOR_ZENITH_BAND_4	= 0.01	Multiplicative rescaling factor applied to Sensor Zenith Angle band.
MULT_ANGLE_SENSOR_AZIMUTH_BAND_4	= 0.01	Multiplicative rescaling factor applied to Sensor Azimuth Angle band.
FILL_TOA_BAND_<1-9>	= 0	Fill value for the TOA Reflectance bands 1 to 7 and 9.
FILL_ANGLE_SOLAR_ZENITH_BAND_4	= 0	Fill value for the Solar Zenith Angle band.
FILL_ANGLE_SOLAR_AZIMUTH_BAND_4	= 0	Fill value for the Solar Azimuth Angle band.
FILL_ANGLE_SOLAR_ZENITH_BAND_4	= 0	Fill value for the Sensor Zenith Angle band.
FILL_ANGLE_SOLAR_AZIMUTH_BAND_4	= 0	Fill value for the Sensor Azimuth Angle band.
FILL_QUALITY_PIXEL	= 1	Fill value for the QA_PIXEL.
FILL_QUALITY_LINEAGE	= 0	Fill value for the LINEAGE index.
DATA_UNITS_TOA_BAND_<1-9>	= Unitless	Data units for the TOA Reflectance bands 1 to 7 and 9.
DATA_UNITS_ANGLE_SOLAR_ZENITH_BAND_4	= Degrees	Data units for the Solar Zenith Angle band.
DATA_UNITS_ANGLE_SOLAR_AZIMUTH_BAND_4	= Degrees	Data units for the Solar Azimuth Angle band.
DATA_UNITS_ANGLE_SOLAR_ZENITH_BAND_4	= Degrees	Data units for the Sensor Zenith Angle band.
DATA_UNITS_ANGLE_SOLAR_AZIMUTH_BAND_4	= Degrees	Data units for the Sensor Azimuth Angle band.
DATA_UNITS_QUALITY_LINEAGE	= Index	Data units for the LINEAGE index.
END_GROUP	= ARD_TOA_REFLECTANCE_PARAMETERS	
GROUP	= ARD_BRIGHTNESS_TEMPERATURE_PARAMETERS	
MAXIMUM_BT_BAND_<6, 10-11>	= NNN.NNNNNN	Maximum achievable value for TOA BT bands 6, 10-11.
MINIMUM_BT_BAND_<6, 10-11>	= NNN.NNNNNN	Minimum achievable value for TOA BT bands 6, 10-11.

Parameter Name	Value, Format, and Range	Parameter Description/Remarks
QUANTIZE_CAL_MAX_BT_BAND_<6,10-11>	= 65535	Maximum possible pixel value for TOA BT bands 6, 10-11.
QUANTIZE_CAL_MIN_BT_BAND_<6,10-11>	= 1	Minimum possible pixel value for TOA BT bands 6, 10-11.
QUANTIZE_CAL_MAX_QUALITY_PIXEL	= 65535	Maximum possible pixel value for QA_PIXEL.
QUANTIZE_CAL_MIN_QUALITY_PIXEL	= 1	Minimum possible pixel value for QA_PIXEL.
QUANTIZE_CAL_MAX_QUALITY_RADIOMETRIC_SATURATION	= 65535	Maximum possible pixel value for radiometric saturation QA.
QUANTIZE_CAL_MIN_QUALITY_RADIOMETRIC_SATURATION	= 0	Minimum possible pixel value for radiometric saturation QA.
QUANTIZE_CAL_MAX_QUALITY_LINEAGE	= 255	Maximum possible pixel value for LINEAGE index.
QUANTIZE_CAL_MIN_QUALITY_LINEAGE	= 0	Minimum possible pixel value for LINEAGE index.
MULT_BT_BAND_<6,10-11>	= 0.00341802	Multiplicative rescaling factor to convert DN to TOA BT [K].
ADD_BT_BAND_<6,10-11>	= 149.0	Additive rescaling factor to convert DN to TOA BT [K].
FILL_BT_BAND_<6,10-11>	= 0	Fill value for TOA BT bands 6, 10-11.
FILL_QUALITY_PIXEL	= 1	Fill value for the QA_PIXEL.
FILL_QUALITY_LINEAGE	= 0	Fill value for the LINEAGE index.
DATA_UNITS_BT_BAND_<6,10-11>	= Kelvin	Data units for TOA BT bands 6, 10-11.
DATA_UNITS_QUALITY_LINEAGE	= Index	Data units for the LINEAGE index.
END_GROUP	= ARD_BRIGHTNESS_TEMPERATURE_PARAMETERS	
GROUP	= ARD_QUALITY_ASSESSMENT_PARAMETERS	
MAXIMUM_QUALITY_SURFACE_TEMPERATURE	= NNN.NN	Maximum achievable ST uncertainty.
MINIMUM_QUALITY_SURFACE_TEMPERATURE	= NNN.NN	Minimum achievable ST uncertainty.
QUANTIZE_CAL_MAX_QUALITY_SURFACE_TEMPERATURE	= 32767	Maximum possible pixel value for ST uncertainty.
QUANTIZE_CAL_MIN_QUALITY_SURFACE_TEMPERATURE	= 0	Minimum possible pixel value for ST uncertainty.
QUANTIZE_CAL_MAX_QUALITY_PIXEL	= 65535	Maximum possible pixel value for QA_PIXEL.
QUANTIZE_CAL_MIN_QUALITY_PIXEL	= 1	Minimum possible pixel value for QA_PIXEL.
QUANTIZE_CAL_MAX_QUALITY_AEROSOL	= 255	Maximum possible pixel value for SR Aerosol QA.
QUANTIZE_CAL_MIN_QUALITY_AEROSOL	= 1	Minimum possible pixel value for SR Aerosol QA.
QUANTIZE_CAL_MAX_QUALITY_RADIOMETRIC_SATURATION	= 65535	Maximum possible pixel value for RADSAT QA.

Parameter Name	Value, Format, and Range	Parameter Description/Remarks
QUANTIZE_CAL_MIN_QUALITY_RADIOMETRIC_SATURATION	= 0	Minimum possible pixel value for RADSAT QA.
QUANTIZE_CAL_MAX_QUALITY_LINEAGE	= 255	Maximum possible pixel value for LINEAGE index.
QUANTIZE_CAL_MIN_QUALITY_LINEAGE	= 0	Minimum possible pixel value for LINEAGE index.
MULT_QUALITY_SURFACE_TEMPERATURE	= 0.01	Multiplicative rescaling factor to convert DN to ST uncertainty [K].
FILL_QUALITY_SURFACE_TEMPERATURE	= -9999	Fill value for ST uncertainty.
FILL_QUALITY_PIXEL	= 1	Fill value for the QA_PIXEL.
FILL_QUALITY_AEROSOL	= 1	Fill value for the SR Aerosol QA.
FILL_QUALITY_LINEAGE	= 0	Fill value for the LINEAGE index.
DATA_UNITS_QUALITY_SURFACE_TEMPERATURE	= Kelvin	Data units for ST uncertainty.
DATA_UNITS_QUALITY_LINEAGE	= Index	Data units for the LINEAGE index.
END_GROUP	= ARD_QUALITY_ASSESSMENT_PARAMETERS	
END_GROUP	= TILE_METADATA	
GROUP	= SCENE_METADATA	
SCENE_INDEX	= 1-3	Scene index for the Landsat Level-2 scene used in creation of ARD
GROUP	= IMAGE_ATTRIBUTES LEVEL2_PROCESSING_RECORD LEVEL2_SURFACE_REFLECTANCE_PARAMETERS LEVEL2_SURFACE_TEMPERATURE_PARAMETERS LEVEL2_BRIGHTNESS_TEMPERATURE_PARAMETERS LEVEL2_TOA_REFLECTANCE_PARAMETERS LEVEL1_PROCESSING_RECORD	The Level-2 scene-based metadata appended at the end of ARD tile metadata
ENG_GROUP	= IMAGE_ATTRIBUTES LEVEL2_PROCESSING_RECORD LEVEL2_SURFACE_REFLECTANCE_PARAMETERS LEVEL2_SURFACE_TEMPERATURE_PARAMETERS LEVEL2_BRIGHTNESS_TEMPERATURE_PARAMETERS LEVEL2_TOA_REFLECTANCE_PARAMETERS LEVEL1_PROCESSING_RECORD	
END_GROUP	= SCENE_METADATA	
END_GROUP	= LANDSAT_METADATA_FILE	

Appendix D WRS-2 Input Scenes

For systematic processing of the Landsat scenes into ARD, a 15-Km buffer of the U.S. ARD regions was created to identify the intersecting WRS-2 scenes. The use of buffer area will provide sufficient coverage over the international borders and coastal waters in the Landsat U.S. ARD. Table D-1 through Table D-3 list the path and row numbers of the WRS-2 scenes used in Landsat U.S. ARD for the CONUS, Alaska, and Hawaii. The contributing tile numbers are determined based on the nominal WRS-2 scene footprints and may slightly vary due to orbital drifting.

No.	Path	Row	CONUS Tile HV Number
1	9	29	H032V004, H032V003, H032V002
2	10	27	H031V002, H031V001, H032V002, H032V001
3	10	28	H031V003, H031V002, H032V003, H032V002
4	10	29	H031V004, H031V003, H032V004, H032V003
5	10	30	H031V005, H031V004, H032V005, H032V004
6	11	27	H030V002, H030V001, H031V002, H031V001
7	11	28	H030V003, H030V002, H031V003, H031V002
8	11	29	H030V004, H030V003, H031V004, H031V003
9	11	30	H030V005, H030V004, H031V005, H031V004
10	11	31	H030V006, H031V006, H030V005, H031V005
11	11	32	H030V007, H030V006, H031V007, H031V006, H032V007
12	12	27	H029V002, H029V001, H030V002, H030V001, H031V002, H031V001
13	12	28	H029V003, H029V002, H030V003, H030V002, H031V003, H031V002
14	12	29	H029V004, H029V003, H030V004, H030V003, H031V004, H031V003
15	12	30	H029V005, H029V004, H030V005, H030V004, H031V005, H031V004
16	12	31	H029V007, H029V006, H030V007, H030V006, H031V006, H029V005, H030V005, H031V005
17	12	32	H029V008, H029V007, H030V008, H030V007, H030V006, H031V008, H031V007, H031V006
18	13	27	H029V002, H029V001, H030V002, H030V001
19	13	28	H029V003, H029V002, H030V003, H030V002
20	13	29	H029V005, H029V004, H029V003, H030V005, H030V004, H030V003
21	13	30	H029V006, H030V006, H029V005, H029V004, H030V005, H030V004
22	13	31	H029V007, H029V006, H030V007, H030V006
23	13	32	H029V008, H029V007, H030V008, H030V007
24	13	33	H029V009, H029V008, H030V009, H030V008
25	13	34	H029V010, H030V010, H029V009, H030V009
26	13	35	H029V011, H029V010, H030V011, H030V010
27	13	36	H029V012, H030V012, H029V011, H030V011
28	14	28	H028V003, H028V004, H029V004, H029V003, H029V002
29	14	29	H028V004, H028V005, H029V005, H029V004
30	14	30	H028V005, H028V006, H029V006, H029V005

No.	Path	Row	CONUS Tile HV Number
31	14	31	H028V006, H028V007, H029V007, H029V006
32	14	32	H028V007, H028V008, H029V008, H029V007
33	14	33	H028V008, H028V009, H029V009, H029V008
34	14	34	H028V009, H028V010, H029V010, H029V009
35	14	35	H028V010, H028V011, H029V011, H029V010
36	14	36	H028V011, H028V012, H029V012, H029V011
37	14	37	H028V012, H028V013, H028V014, H029V014, H029V013, H029V012
38	15	28	H027V003, H027V004, H028V003, H028V004
39	15	29	H027V004, H027V005, H028V004, H028V005
40	15	30	H027V005, H027V006, H028V005, H028V006
41	15	31	H027V006, H027V007, H028V006, H028V007
42	15	32	H027V007, H027V008, H028V007, H028V008
43	15	33	H027V008, H027V009, H028V008, H028V009
44	15	34	H027V009, H027V010, H028V009, H028V010
45	15	35	H027V010, H027V011, H027V012, H028V010, H028V011, H028V012
46	15	36	H027V011, H027V012, H027V013, H028V011, H028V012, H028V013
47	15	37	H027V013, H027V014, H028V013, H028V014
48	15	40	H027V016, H027V017, H028V016, H028V017
49	15	41	H026V017, H026V018, H027V017, H027V018, H028V017, H028V018
50	15	42	H026V018, H026V019, H027V018, H027V019, H028V018, H028V019
51	15	43	H026V019, H026V020, H027V019, H027V020, H028V019, H028V020
52	16	29	H026V004, H026V005, H027V004, H027V005
53	16	30	H026V005, H026V006, H027V005, H027V006
54	16	31	H026V006, H026V007, H027V006, H027V007
55	16	32	H026V007, H026V008, H027V007, H027V008
56	16	33	H026V008, H026V009, H027V008, H027V009
57	16	34	H026V009, H026V010, H026V011, H027V009, H027V010, H027V011
58	16	35	H026V011, H026V012, H027V011, H027V012
59	16	36	H026V012, H026V013, H027V012, H027V013
60	16	37	H026V013, H026V014, H027V013, H027V014
61	16	38	H026V014, H026V015, H027V014, H027V015
62	16	39	H026V015, H026V016, H027V015, H027V016
63	16	40	H026V016, H026V017, H027V016, H027V017
64	16	41	H025V017, H025V018, H026V017, H026V018, H027V017, H027V018
65	16	42	H025V018, H025V019, H026V018, H026V019, H027V018, H027V019
66	16	43	H025V019, H025V020, H026V019, H026V020, H027V019, H027V020
67	17	29	H025V004, H025V005, H026V004, H026V005, H027V004, H027V005
68	17	30	H025V005, H025V006, H026V005, H026V006, H027V005, H027V006
69	17	31	H025V006, H025V007, H026V006, H026V007, H027V006, H027V007
70	17	32	H025V007, H025V008, H025V009, H026V007, H026V008, H026V009

No.	Path	Row	CONUS Tile HV Number
71	17	33	H025V008, H025V009, H025V010, H026V008, H026V009, H026V010
72	17	34	H025V010, H025V011, H026V010, H026V011
73	17	35	H025V011, H025V012, H026V011, H026V012
74	17	36	H025V012, H025V013, H026V012, H026V013
75	17	37	H025V013, H025V014, H026V013, H026V014
76	17	38	H025V014, H025V015, H026V014, H026V015
77	17	39	H025V015, H025V016, H026V015, H026V016
78	17	40	H025V016, H025V017, H026V016, H026V017
79	17	41	H024V017, H024V018, H025V017, H025V018, H026V017, H026V018
80	17	43	H024V019, H024V020, H025V019, H025V020, H026V019, H026V020, H025V021
81	18	28	H025V003, H025V004, H026V003, H026V004
82	18	29	H025V004, H025V005, H026V004, H026V005
83	18	30	H024V006, H025V005, H025V006, H025V007, H026V005, H026V006, H026V007
84	18	31	H024V006, H024V007, H024V008, H025V006, H025V007, H025V008, H026V006, H026V007, H026V008
85	18	32	H024V008, H024V009, H025V008, H025V009, H026V008, H026V009
86	18	33	H024V009, H024V010, H025V009, H025V010, H026V009
87	18	34	H024V010, H024V011, H025V010, H025V011
88	18	35	H024V011, H024V012, H025V011, H025V012
89	18	36	H024V012, H024V013, H025V012, H025V013
90	18	37	H024V013, H024V014, H025V013, H025V014
91	18	38	H024V014, H024V015, H025V014, H025V015
92	18	39	H024V015, H024V016, H025V015, H025V016
93	18	40	H024V016, H024V017, H025V016, H025V017
94	19	28	H024V003, H024V004, H025V003, H025V004
95	19	29	H024V004, H024V005, H024V006, H025V004, H025V005, H025V006
96	19	30	H024V005, H024V006, H024V007, H025V005, H025V006, H025V007
97	19	31	H024V007, H024V008, H025V007, H025V008
98	19	32	H023V008, H023V009, H024V008, H024V009, H025V008, H025V009
99	19	33	H023V009, H023V010, H024V009, H024V010, H025V009, H025V010
100	19	34	H023V010, H023V011, H024V010, H024V011, H025V010
101	19	35	H023V011, H023V012, H024V011, H024V012
102	19	36	H023V012, H023V013, H024V012, H024V013
103	19	37	H023V013, H023V014, H024V013, H024V014
104	19	38	H023V014, H023V015, H024V014, H024V015
105	19	39	H023V015, H023V016, H024V015, H024V016
106	19	40	H022V017, H023V016, H023V017, H023V018, H024V016, H024V017, H024V018
107	20	28	H023V003, H023V004, H023V005, H024V003, H024V004, H024V005
108	20	29	H023V004, H023V005, H023V006, H024V005, H024V006

No.	Path	Row	CONUS Tile HV Number
109	20	30	H023V006, H023V007, H024V006, H024V007
110	20	31	H023V007, H023V008, H024V007, H024V008
111	20	32	H023V008, H023V009, H024V008, H024V009
112	20	33	H022V009, H022V010, H023V009, H023V010, H024V009, H024V010
113	20	34	H022V010, H022V011, H023V010, H023V011, H024V010, H024V011
114	20	35	H022V011, H022V012, H023V011, H023V012, H024V011
115	20	36	H022V012, H022V013, H023V012, H023V013
116	20	37	H022V013, H022V014, H023V013, H023V014
117	20	38	H022V014, H022V015, H023V014, H023V015
118	20	39	H022V015, H022V016, H022V017, H023V015, H023V016, H023V017
119	21	27	H022V002, H022V003, H022V004, H023V002, H023V003, H023V004, H024V003, H024V004
120	21	28	H022V004, H022V005, H023V004, H023V005, H024V004
121	21	29	H022V005, H022V006, H023V005, H023V006
122	21	30	H022V006, H022V007, H023V006, H023V007
123	21	31	H022V007, H022V008, H023V007, H023V008
124	21	32	H022V008, H022V009, H023V008, H023V009
125	21	33	H022V009, H022V010, H023V009, H023V010
126	21	34	H021V010, H021V011, H022V010, H022V011, H023V010, H023V011
127	21	35	H021V011, H021V012, H022V011, H022V012, H023V011, H023V012
128	21	36	H021V012, H021V013, H022V012, H022V013
129	21	37	H021V013, H021V014, H022V013, H022V014, H022V015
130	21	38	H021V014, H021V015, H021V016, H022V014, H022V015, H022V016
131	21	39	H021V015, H021V016, H021V017, H022V015, H022V016, H022V017
132	21	40	H020V017, H020V018, H021V017, H021V018, H022V017, H022V018
133	22	27	H022V003, H022V004, H023V003, H023V004
134	22	28	H021V004, H021V005, H022V004, H022V005, H023V004, H023V005
135	22	29	H021V005, H021V006, H022V005, H022V006, H023V005, H023V006
136	22	30	H021V006, H021V007, H022V006, H022V007, H023V006
137	22	31	H021V007, H021V008, H022V007, H022V008
138	22	32	H021V008, H021V009, H022V008, H022V009
139	22	33	H021V009, H021V010, H022V009, H022V010
140	22	34	H020V011, H021V010, H021V011, H022V010, H022V011
141	22	35	H020V011, H020V012, H021V011, H021V012, H022V011, H022V012
142	22	36	H020V012, H020V013, H021V012, H021V013, H021V014, H022V012, H022V013
143	22	37	H020V013, H020V014, H020V015, H021V013, H021V014, H021V015
144	22	38	H020V014, H020V015, H020V016, H021V014, H021V015, H021V016
145	22	39	H020V015, H020V016, H020V017, H021V016, H021V017
146	22	40	H019V017, H019V018, H020V017, H020V018, H021V017, H021V018
147	23	26	H021V002, H021V003, H022V002, H022V003

No.	Path	Row	CONUS Tile HV Number
148	23	27	H021V003, H021V004, H022V003, H022V004
149	23	28	H021V004, H021V005, H022V004, H022V005
150	23	29	H020V006, H021V005, H021V006, H022V005, H022V006
151	23	30	H020V006, H020V007, H021V006, H021V007, H022V006, H022V007
152	23	31	H020V007, H020V008, H021V007, H021V008, H022V007
153	23	32	H020V008, H020V009, H021V008, H021V009
154	23	33	H020V009, H020V010, H021V009, H021V010
155	23	34	H020V010, H020V011, H021V010, H021V011
156	23	35	H019V012, H020V011, H020V012, H021V011, H021V012, H021V013
157	23	36	H019V012, H019V013, H020V012, H020V013, H020V014, H021V012, H021V013
158	23	37	H019V013, H019V014, H019V015, H020V013, H020V014, H020V015
159	23	38	H019V014, H019V015, H019V016, H020V015, H020V016
160	23	39	H019V016, H019V017, H020V016, H020V017
161	23	40	H018V017, H018V018, H019V017, H019V018, H020V017, H020V018
162	24	26	H020V002, H020V003, H021V002, H021V003, H022V002
163	24	27	H020V003, H020V004, H021V003, H021V004
164	24	28	H020V004, H020V005, H021V004, H021V005
165	24	29	H020V005, H020V006, H021V005, H021V006
166	24	30	H019V007, H020V006, H020V007, H021V006, H021V007
167	24	31	H019V007, H019V008, H020V007, H020V008, H021V007, H021V008
168	24	32	H019V008, H019V009, H020V008, H020V009
169	24	33	H019V009, H019V010, H020V009, H020V010
170	24	34	H019V010, H019V011, H020V010, H020V011
171	24	35	H018V012, H019V011, H019V012, H019V013, H020V011, H020V012, H020V013
172	24	36	H018V012, H018V013, H018V014, H019V012, H019V013, H019V014, H020V012, H020V013, H020V014
173	24	37	H018V013, H018V014, H018V015, H019V013, H019V014, H019V015
174	24	38	H018V014, H018V015, H018V016, H019V015, H019V016
175	24	39	H018V016, H018V017, H019V016, H019V017
176	24	40	H017V017, H017V018, H018V017, H018V018, H019V017, H019V018
177	25	26	H019V002, H019V003, H020V002, H020V003, H021V002, H021V003
178	25	27	H019V003, H019V004, H020V003, H020V004, H021V003, H021V004
179	25	28	H019V004, H019V005, H020V004, H020V005
180	25	29	H019V005, H019V006, H020V005, H020V006
181	25	30	H019V006, H019V007, H020V006, H020V007
182	25	31	H018V008, H019V007, H019V008, H020V007, H020V008
183	25	32	H018V008, H018V009, H019V008, H019V009, H020V008, H020V009
184	25	33	H018V009, H018V010, H019V009, H019V010
185	25	34	H018V010, H018V011, H019V010, H019V011, H019V012
186	25	35	H018V011, H018V012, H018V013, H019V011, H019V012, H019V013

No.	Path	Row	CONUS Tile HV Number
187	25	36	H017V013, H017V014, H018V012, H018V013, H018V014, H019V013, H019V014
188	25	37	H017V013, H017V014, H017V015, H018V013, H018V014, H018V015, H019V014
189	25	38	H017V015, H017V016, H018V015, H018V016
190	25	39	H017V016, H017V017, H018V016, H018V017
191	25	40	H016V017, H016V018, H017V017, H017V018, H018V017, H018V018
192	25	41	H016V018, H016V019, H017V018, H017V019, H018V018, H018V019
193	26	26	H019V002, H019V003, H020V002, H020V003
194	26	27	H018V004, H019V003, H019V004, H020V003, H020V004
195	26	28	H018V004, H018V005, H019V004, H019V005, H020V004, H020V005
196	26	29	H018V005, H018V006, H019V005, H019V006
197	26	30	H018V006, H018V007, H019V006, H019V007
198	26	31	H018V007, H018V008, H019V007, H019V008
199	26	32	H017V008, H017V009, H018V008, H018V009, H019V008, H019V009
200	26	33	H017V009, H017V010, H018V009, H018V010, H019V009, H019V010
201	26	34	H017V010, H017V011, H018V010, H018V011, H018V012
202	26	35	H017V011, H017V012, H017V013, H018V011, H018V012, H018V013
203	26	36	H016V013, H016V014, H017V012, H017V013, H017V014, H018V013, H018V014
204	26	37	H016V013, H016V014, H016V015, H017V013, H017V014, H017V015, H018V014
205	26	38	H016V015, H016V016, H017V015, H017V016
206	26	39	H016V016, H016V017, H017V016, H017V017
207	26	40	H015V017, H015V018, H016V017, H016V018, H017V017, H017V018
208	26	41	H015V018, H015V019, H016V018, H016V019, H017V018
209	26	42	H015V019, H015V020, H016V019, H016V020
210	27	26	H018V002, H018V003, H019V002, H019V003
211	27	27	H018V003, H018V004, H019V003, H019V004
212	27	28	H017V005, H018V004, H018V005, H019V004, H019V005
213	27	29	H017V005, H017V006, H018V005, H018V006, H019V005, H019V006
214	27	30	H017V006, H017V007, H018V006, H018V007
215	27	31	H017V007, H017V008, H018V007, H018V008
216	27	32	H016V009, H017V008, H017V009, H018V008, H018V009
217	27	33	H016V009, H016V010, H017V009, H017V010, H017V011, H018V009, H018V010
218	27	34	H016V010, H016V011, H017V010, H017V011, H017V012
219	27	35	H016V011, H016V012, H016V013, H017V011, H017V012, H017V013
220	27	36	H015V013, H016V012, H016V013, H016V014, H017V013, H017V014
221	27	37	H015V013, H015V014, H015V015, H016V013, H016V014, H016V015, H017V014
222	27	38	H015V014, H015V015, H015V016, H016V015, H016V016
223	27	39	H015V016, H015V017, H016V016, H016V017

No.	Path	Row	CONUS Tile HV Number
224	27	40	H014V017, H014V018, H015V017, H015V018, H016V017, H016V018
225	27	41	H014V018, H014V019, H015V018, H015V019, H016V018
226	27	42	H014V019, H014V020, H015V019, H015V020
227	28	26	H017V002, H017V003, H018V002, H018V003, H019V002
228	28	27	H017V003, H017V004, H018V003, H018V004
229	28	28	H017V004, H017V005, H018V004, H018V005
230	28	29	H016V005, H016V006, H017V005, H017V006, H018V005, H018V006
231	28	30	H016V006, H016V007, H017V006, H017V007, H018V006
232	28	31	H016V007, H016V008, H017V007, H017V008
233	28	32	H016V008, H016V009, H017V008, H017V009
234	28	33	H015V009, H015V010, H016V009, H016V010, H016V011, H017V009, H017V010, H017V011
235	28	34	H015V010, H015V011, H016V010, H016V011, H016V012, H017V010, H017V011
236	28	35	H015V011, H015V012, H015V013, H016V011, H016V012, H016V013
237	28	36	H014V013, H015V012, H015V013, H015V014, H016V012, H016V013, H016V014
238	28	37	H014V013, H014V014, H014V015, H015V013, H015V014, H015V015, H016V014
239	28	38	H014V014, H014V015, H014V016, H015V015, H015V016
240	28	39	H014V016, H014V017, H015V016, H015V017
241	28	40	H013V017, H013V018, H014V017, H014V018, H015V017, H015V018
242	28	41	H013V018, H013V019, H014V018, H014V019, H015V018
243	29	26	H016V002, H016V003, H017V002, H017V003, H018V002, H018V003
244	29	27	H016V003, H016V004, H017V003, H017V004, H018V003
245	29	28	H016V004, H016V005, H017V004, H017V005
246	29	29	H016V005, H016V006, H017V005, H017V006
247	29	30	H015V006, H015V007, H016V006, H016V007, H017V006, H017V007
248	29	31	H015V007, H015V008, H016V007, H016V008
249	29	32	H015V008, H015V009, H016V008, H016V009
250	29	33	H014V010, H015V009, H015V010, H016V009, H016V010, H016V011
251	29	34	H014V010, H014V011, H015V010, H015V011, H015V012, H016V010, H016V011
252	29	35	H014V011, H014V012, H014V013, H015V011, H015V012, H015V013
253	29	36	H014V012, H014V013, H014V014, H015V012, H015V013, H015V014
254	29	37	H013V014, H013V015, H014V013, H014V014, H014V015, H015V014, H015V015
255	29	38	H013V014, H013V015, H013V016, H014V014, H014V015, H014V016
256	29	39	H013V015, H013V016, H013V017, H014V016, H014V017
257	29	40	H012V017, H012V018, H013V017, H013V018, H014V017, H014V018
258	30	25	H016V001, H016V002, H017V001, H017V002
259	30	26	H016V002, H016V003, H017V002, H017V003
260	30	27	H015V003, H015V004, H016V003, H016V004, H017V003, H017V004

No.	Path	Row	CONUS Tile HV Number
261	30	28	H015V004, H015V005, H016V004, H016V005
262	30	29	H015V005, H015V006, H016V005, H016V006
263	30	30	H014V007, H015V006, H015V007, H016V006, H016V007
264	30	31	H014V007, H014V008, H015V007, H015V008, H016V007, H016V008
265	30	32	H014V008, H014V009, H015V008, H015V009
266	30	33	H014V009, H014V010, H015V009, H015V010
267	30	34	H013V010, H013V011, H014V010, H014V011, H014V012, H015V010, H015V011
268	30	35	H013V011, H013V012, H014V011, H014V012, H014V013
269	30	36	H013V012, H013V013, H013V014, H014V012, H014V013, H014V014
270	30	37	H012V014, H013V013, H013V014, H013V015, H014V014, H014V015
271	30	38	H012V014, H012V015, H012V016, H013V014, H013V015, H013V016, H014V015
272	30	39	H012V015, H012V016, H012V017, H013V016, H013V017
273	30	40	H011V017, H011V018, H012V016, H012V017, H012V018, H013V017, H013V018
274	31	26	H015V002, H015V003, H016V002, H016V003
275	31	27	H014V004, H015V003, H015V004, H016V003, H016V004
276	31	28	H014V004, H014V005, H015V004, H015V005, H016V004, H016V005
277	31	29	H014V005, H014V006, H015V005, H015V006
278	31	30	H014V006, H014V007, H015V006, H015V007
279	31	31	H013V007, H013V008, H014V007, H014V008, H015V007, H015V008
280	31	32	H013V008, H013V009, H014V008, H014V009
281	31	33	H013V009, H013V010, H014V009, H014V010
282	31	34	H012V011, H013V010, H013V011, H014V010, H014V011
283	31	35	H012V011, H012V012, H013V011, H013V012, H013V013, H014V011
284	31	36	H012V012, H012V013, H012V014, H013V012, H013V013, H013V014
285	31	37	H011V014, H012V013, H012V014, H012V015, H013V013, H013V014, H013V015
286	31	38	H011V014, H011V015, H011V016, H012V014, H012V015, H012V016, H013V015
287	31	39	H011V015, H011V016, H011V017, H012V015, H012V016, H012V017
288	31	40	H010V017, H011V016, H011V017, H011V018, H012V017, H012V018
289	32	26	H014V002, H014V003, H015V002, H015V003, H016V002
290	32	27	H014V003, H014V004, H015V003, H015V004
291	32	28	H013V004, H013V005, H014V004, H014V005, H015V004, H015V005
292	32	29	H013V005, H013V006, H014V005, H014V006, H015V005
293	32	30	H013V006, H013V007, H014V006, H014V007
294	32	31	H012V008, H013V007, H013V008, H014V007, H014V008
295	32	32	H012V008, H012V009, H013V008, H013V009, H014V008, H014V009
296	32	33	H012V009, H012V010, H013V009, H013V010
297	32	34	H011V011, H012V010, H012V011, H013V010, H013V011
298	32	35	H011V011, H011V012, H012V011, H012V012, H013V011, H013V012

No.	Path	Row	CONUS Tile HV Number
299	32	36	H011V012, H011V013, H012V012, H012V013, H012V014
300	32	37	H010V014, H011V013, H011V014, H011V015, H012V013, H012V014, H012V015
301	32	38	H010V014, H010V015, H011V014, H011V015, H011V016, H012V014, H012V015
302	32	39	H010V015, H010V016, H010V017, H011V015, H011V016, H011V017
303	33	26	H013V002, H013V003, H014V002, H014V003, H015V002, H015V003
304	33	27	H013V003, H013V004, H014V003, H014V004
305	33	28	H013V004, H013V005, H014V004, H014V005
306	33	29	H012V005, H012V006, H013V005, H013V006, H014V005, H014V006
307	33	30	H012V006, H012V007, H013V006, H013V007
308	33	31	H012V007, H012V008, H013V007, H013V008
309	33	32	H011V008, H011V009, H012V008, H012V009, H013V008, H013V009
310	33	33	H011V009, H011V010, H012V009, H012V010
311	33	34	H011V010, H011V011, H012V010, H012V011
312	33	35	H010V011, H010V012, H011V011, H011V012, H012V011, H012V012
313	33	36	H010V012, H010V013, H011V012, H011V013
314	33	37	H009V014, H010V013, H010V014, H011V013, H011V014
315	33	38	H009V014, H009V015, H010V014, H010V015, H010V016, H011V014, H011V015
316	34	26	H012V003, H013V002, H013V003, H014V002, H014V003
317	34	27	H012V003, H012V004, H013V003, H013V004, H014V003, H014V004
318	34	28	H012V004, H012V005, H013V004, H013V005
319	34	29	H011V006, H012V005, H012V006, H013V005, H013V006
320	34	30	H011V006, H011V007, H012V006, H012V007, H013V006
321	34	31	H011V007, H011V008, H012V007, H012V008
322	34	32	H010V008, H010V009, H011V008, H011V009, H012V008, H012V009
323	34	33	H010V009, H010V010, H011V009, H011V010, H012V009
324	34	34	H010V010, H010V011, H011V010, H011V011
325	34	35	H009V011, H009V012, H010V011, H010V012, H011V011, H011V012
326	34	36	H009V012, H009V013, H010V012, H010V013
327	34	37	H008V014, H009V013, H009V014, H010V013, H010V014
328	34	38	H008V014, H008V015, H009V014, H009V015, H010V014, H010V015
329	34	39	H008V015, H008V016, H009V015, H009V016
330	35	26	H012V002, H012V003, H013V002, H013V003
331	35	27	H011V003, H011V004, H012V003, H012V004, H013V003, H013V004
332	35	28	H011V004, H011V005, H012V004, H012V005, H013V004
333	35	29	H011V005, H011V006, H012V005, H012V006
334	35	30	H010V006, H010V007, H011V006, H011V007, H012V006, H012V007
335	35	31	H010V007, H010V008, H011V007, H011V008
336	35	32	H009V009, H010V008, H010V009, H011V008, H011V009
337	35	33	H009V009, H009V010, H010V009, H010V010, H011V009

No.	Path	Row	CONUS Tile HV Number
338	35	34	H009V010, H009V011, H010V010, H010V011
339	35	35	H008V011, H008V012, H009V011, H009V012, H010V011, H010V012
340	35	36	H008V012, H008V013, H009V012, H009V013
341	35	37	H008V013, H008V014, H009V013, H009V014
342	35	38	H007V014, H007V015, H008V014, H008V015, H009V014, H009V015
343	35	39	H007V015, H007V016, H008V015, H008V016
344	36	26	H011V001, H011V002, H011V003, H012V002, H012V003, H013V002
345	36	27	H011V002, H011V003, H011V004, H012V003, H012V004
346	36	28	H010V004, H010V005, H011V003, H011V004, H011V005, H012V004, H012V005
347	36	29	H010V004, H010V005, H010V006, H011V005, H011V006
348	36	30	H009V006, H009V007, H010V006, H010V007, H011V006, H011V007
349	36	31	H009V007, H009V008, H010V007, H010V008, H011V007
350	36	32	H009V008, H009V009, H010V008, H010V009
351	36	33	H008V009, H008V010, H009V009, H009V010, H010V009, H010V010
352	36	34	H008V010, H008V011, H009V010, H009V011
353	36	35	H007V011, H007V012, H008V011, H008V012, H009V011, H009V012
354	36	36	H007V012, H007V013, H008V012, H008V013, H009V012
355	36	37	H007V013, H007V014, H008V013, H008V014
356	36	38	H006V014, H006V015, H007V014, H007V015, H008V014, H008V015
357	37	26	H010V002, H010V003, H011V001, H011V002, H011V003, H012V002
358	37	27	H010V002, H010V003, H010V004, H011V002, H011V003, H011V004
359	37	28	H009V004, H010V003, H010V004, H010V005, H011V004, H011V005
360	37	29	H009V004, H009V005, H009V006, H010V004, H010V005, H010V006, H011V005
361	37	30	H009V005, H009V006, H009V007, H010V006, H010V007
362	37	31	H008V007, H008V008, H009V006, H009V007, H009V008, H010V007
363	37	32	H008V007, H008V008, H008V009, H009V008, H009V009
364	37	33	H007V009, H007V010, H008V008, H008V009, H008V010, H009V009, H009V010
365	37	34	H007V009, H007V010, H007V011, H008V010, H008V011
366	37	35	H006V011, H006V012, H007V010, H007V011, H007V012, H008V011, H008V012
367	37	36	H006V011, H006V012, H006V013, H007V011, H007V012, H007V013, H008V012
368	37	37	H006V012, H006V013, H006V014, H007V013, H007V014
369	37	38	H005V014, H005V015, H006V013, H006V014, H006V015, H007V014, H007V015
370	38	26	H009V002, H010V001, H010V002, H010V003, H011V002, H011V003
371	38	27	H009V002, H009V003, H010V002, H010V003, H010V004, H011V003
372	38	28	H009V003, H009V004, H009V005, H010V003, H010V004, H010V005
373	38	29	H008V004, H008V005, H009V004, H009V005, H009V006, H010V005
374	38	30	H008V005, H008V006, H008V007, H009V005, H009V006, H009V007

No.	Path	Row	CONUS Tile HV Number
375	38	31	H007V007, H008V006, H008V007, H008V008, H009V007, H009V008
376	38	32	H007V007, H007V008, H007V009, H008V007, H008V008, H008V009
377	38	33	H006V009, H007V008, H007V009, H007V010, H008V009, H008V010
378	38	34	H006V009, H006V010, H006V011, H007V009, H007V010, H007V011, H008V010
379	38	35	H006V010, H006V011, H006V012, H007V010, H007V011, H007V012
380	38	36	H005V012, H006V011, H006V012, H006V013, H007V012
381	38	37	H005V012, H005V013, H005V014, H006V012, H006V013, H006V014
382	38	38	H004V014, H005V013, H005V014, H005V015, H006V014, H006V015
383	39	26	H009V001, H009V002, H009V003, H010V001, H010V002, H010V003
384	39	27	H008V003, H009V002, H009V003, H009V004, H010V002, H010V003
385	39	28	H008V003, H008V004, H009V003, H009V004, H009V005
386	39	29	H007V005, H008V004, H008V005, H008V006, H009V004, H009V005, H009V006
387	39	30	H007V005, H007V006, H008V005, H008V006, H008V007, H009V006
388	39	31	H006V007, H007V006, H007V007, H007V008, H008V006, H008V007, H008V008
389	39	32	H006V007, H006V008, H007V007, H007V008, H007V009, H008V008
390	39	33	H006V008, H006V009, H006V010, H007V008, H007V009, H007V010
391	39	34	H005V009, H005V010, H006V009, H006V010, H006V011, H007V009, H007V010
392	39	35	H005V010, H005V011, H005V012, H006V010, H006V011, H006V012
393	39	36	H004V012, H005V011, H005V012, H005V013, H006V011, H006V012
394	39	37	H004V012, H004V013, H005V012, H005V013, H005V014
395	39	38	H003V014, H004V013, H004V014, H004V015, H005V013, H005V014
396	40	26	H008V001, H008V002, H009V001, H009V002, H009V003, H010V001, H010V002
397	40	27	H007V003, H008V002, H008V003, H009V002, H009V003
398	40	28	H007V003, H007V004, H008V003, H008V004, H009V003, H009V004
399	40	29	H007V004, H007V005, H008V004, H008V005
400	40	30	H006V005, H006V006, H007V005, H007V006, H008V005, H008V006
401	40	31	H006V006, H006V007, H007V006, H007V007
402	40	32	H005V007, H005V008, H006V007, H006V008, H007V007, H007V008
403	40	33	H005V008, H005V009, H006V008, H006V009
404	40	34	H004V009, H004V010, H005V009, H005V010, H006V009, H006V010
405	40	35	H004V010, H004V011, H005V010, H005V011
406	40	36	H003V012, H004V011, H004V012, H005V011, H005V012
407	40	37	H003V012, H003V013, H004V012, H004V013
408	40	38	H002V014, H003V013, H003V014, H004V013, H004V014
409	41	26	H007V001, H007V002, H008V001, H008V002, H009V001, H009V002
410	41	27	H007V002, H007V003, H008V002, H008V003
411	41	28	H006V003, H006V004, H007V003, H007V004, H008V003, H008V004
412	41	29	H006V004, H006V005, H007V004, H007V005

No.	Path	Row	CONUS Tile HV Number
413	41	30	H005V005, H005V006, H006V005, H006V006, H007V005, H007V006
414	41	31	H005V006, H005V007, H006V006, H006V007
415	41	32	H004V007, H004V008, H005V007, H005V008, H006V007, H006V008
416	41	33	H004V008, H004V009, H005V008, H005V009
417	41	34	H003V009, H003V010, H004V009, H004V010, H005V009, H005V010
418	41	35	H003V010, H003V011, H004V010, H004V011
419	41	36	H002V011, H002V012, H003V011, H003V012, H004V011, H004V012
420	41	37	H002V012, H002V013, H003V012, H003V013, H004V012
421	42	26	H006V002, H007V001, H007V002, H008V001, H008V002
422	42	27	H006V002, H006V003, H007V002, H007V003, H008V002
423	42	28	H005V004, H006V003, H006V004, H007V003, H007V004
424	42	29	H005V004, H005V005, H006V004, H006V005, H007V004
425	42	30	H004V006, H005V005, H005V006, H006V005, H006V006
426	42	31	H004V006, H004V007, H005V006, H005V007, H006V006
427	42	32	H003V007, H003V008, H004V007, H004V008, H005V007, H005V008
428	42	33	H003V008, H003V009, H004V008, H004V009, H005V008
429	42	34	H002V009, H002V010, H003V009, H003V010, H004V009, H004V010
430	42	35	H002V009, H002V010, H002V011, H003V009, H003V010, H003V011, H004V010
431	42	36	H002V010, H002V011, H002V012, H003V011, H003V012, H001V011, H001V012
432	42	37	H002V011, H002V012, H002V013, H003V012, H001V011, H001V012, H001V013
433	43	26	H006V001, H006V002, H007V001, H007V002
434	43	27	H005V002, H005V003, H006V002, H006V003, H007V002, H007V003
435	43	28	H005V002, H005V003, H005V004, H006V003, H006V004
436	43	29	H004V004, H004V005, H005V003, H005V004, H005V005, H006V004
437	43	30	H004V004, H004V005, H004V006, H005V005, H005V006
438	43	31	H003V006, H003V007, H004V005, H004V006, H004V007, H005V006
439	43	32	H003V006, H003V007, H003V008, H004V007, H004V008
440	43	33	H002V008, H002V009, H003V007, H003V008, H003V009, H004V008
441	43	34	H002V008, H002V009, H002V010, H003V008, H003V009, H003V010
442	43	35	H002V009, H002V010, H002V011, H003V010, H001V009, H001V010
443	43	36	H002V010, H002V011, H002V012, H001V010, H001V011, H001V012
444	44	26	H005V000, H005V001, H005V002, H006V000, H006V001, H006V002, H007V001
445	44	27	H004V002, H005V001, H005V002, H005V003, H006V002, H006V003
446	44	28	H004V002, H004V003, H004V004, H005V002, H005V003, H005V004, H006V003
447	44	29	H003V004, H004V003, H004V004, H004V005, H005V004, H005V005
448	44	30	H003V004, H003V005, H003V006, H004V004, H004V005, H004V006
449	44	31	H002V006, H003V005, H003V006, H003V007, H004V005, H004V006
450	44	32	H002V006, H002V007, H003V006, H003V007, H003V008

No.	Path	Row	CONUS Tile HV Number
451	44	33	H002V007, H002V008, H002V009, H003V007, H003V008, H001V008
452	44	34	H002V008, H002V009, H002V010, H001V008, H001V009
453	44	35	H002V009, H002V010, H001V009, H000V009, H001V010, H000V010, H001V011
454	45	26	H004V001, H005V000, H005V001, H005V002, H006V001
455	45	27	H004V001, H004V002, H004V003, H005V001, H005V002, H005V003
456	45	28	H003V002, H003V003, H004V002, H004V003, H004V004, H005V003
457	45	29	H003V003, H003V004, H003V005, H004V003, H004V004, H004V005
458	45	30	H002V004, H002V005, H003V004, H003V005, H003V006, H004V004, H004V005
459	45	31	H002V005, H002V006, H003V005, H003V006, H001V006
460	45	32	H002V006, H002V007, H003V006, H003V007, H001V006, H001V007
461	45	33	H002V007, H002V008, H001V007, H001V008, H000V008
462	45	34	H001V008, H000V008, H001V009, H000V009
463	46	26	H003V001, H004V000, H004V001, H004V002, H005V000, H005V001, H005V002
464	46	27	H003V001, H003V002, H004V001, H004V002, H005V001, H005V002
465	46	28	H002V003, H003V002, H003V003, H004V002, H004V003
466	46	29	H002V003, H002V004, H003V003, H003V004
467	46	30	H002V004, H002V005, H003V004, H003V005, H001V004, H001V005
468	46	31	H002V005, H002V006, H001V005, H001V006
469	46	32	H002V006, H002V007, H001V006, H000V006, H001V007, H000V007
470	46	33	H001V007, H000V007, H001V008, H000V008
471	47	26	H003V000, H003V001, H004V000, H004V001
472	47	27	H002V001, H002V002, H003V001, H003V002, H004V001, H004V002
473	47	28	H002V002, H002V003, H003V002, H003V003
474	47	29	H002V003, H002V004, H003V003, H001V003, H001V004
475	47	30	H002V004, H002V005, H001V003, H001V004, H000V004, H001V005, H000V005
476	47	31	H002V005, H001V004, H000V004, H001V005, H000V005, H001V006, H000V006
477	48	26	H002V000, H002V001, H003V000, H003V001, H004V000
478	48	27	H002V000, H002V001, H002V002, H003V001, H003V002, H001V001, H001V002
479	48	28	H002V001, H002V002, H002V003, H001V001, H001V002, H001V003
480	49	26	H002V000, H002V001, H003V000, H003V001, H001V000

Table D-1. CONUS Scenes

No.	Path	Row	Alaska Tile HV Number
1	53	21	H024V010, H025V010, H024V009, H025V009
2	53	22	H024V011, H025V011, H024V010, H025V010
3	54	21	H023V011, H023V010, H024V010, H023V009, H024V009
4	54	22	H023V012, H024V012, H023V011, H024V011, H025V011, H023V010, H024V010
5	55	20	H023V010, H024V010, H023V009, H024V009, H023V008, H024V008
6	55	21	H023V011, H024V011, H023V010, H024V010, H024V009
7	55	22	H023V012, H024V012, H023V011, H024V011
8	56	19	H022V009, H023V009, H022V008, H023V008
9	56	20	H022V010, H023V010, H022V009, H023V009
10	56	21	H022V011, H023V011, H022V010, H023V010
11	56	22	H022V012, H023V012, H022V011, H023V011
12	57	19	H021V009, H022V009, H023V009, H021V008, H022V008, H023V008
13	57	20	H021V010, H022V010, H023V010, H021V009, H022V009, H023V009
14	57	21	H021V011, H022V011, H023V011, H021V010, H022V010, H023V010
15	58	18	H021V008, H022V008, H021V007, H022V007
16	58	19	H021V009, H022V009, H021V008, H022V008
17	58	20	H021V010, H022V010, H021V009, H022V009
18	58	21	H021V011, H022V011, H021V010, H022V010
19	59	18	H020V008, H021V008, H022V008, H020V007, H021V007, H022V007
20	59	19	H020V009, H021V009, H020V008, H021V008
21	59	20	H020V010, H021V010, H020V009, H021V009
22	60	18	H020V008, H021V008, H020V007, H021V007
23	60	19	H020V009, H021V009, H020V008, H021V008
24	61	18	H019V008, H020V008, H019V007, H020V007
25	61	19	H019V010, H020V010, H019V009, H020V009, H019V008, H020V008
26	62	17	H020V008, H019V007, H020V007, H019V006, H020V006
27	62	18	H019V009, H020V009, H019V008, H020V008, H019V007, H020V007
28	63	15	H018V005, H019V005, H020V005, H019V004, H020V004
29	63	16	H019V007, H020V007, H018V006, H019V006, H020V006, H018V005, H019V005, H020V005
30	63	17	H018V008, H019V008, H018V007, H019V007, H018V006, H019V006
31	63	18	H018V009, H019V009, H018V008, H019V008, H018V007, H019V007
32	64	14	H019V005, H018V004, H019V004, H018V003, H019V003
33	64	15	H018V006, H019V006, H018V005, H019V005, H018V004, H019V004
34	64	16	H018V007, H019V007, H018V006, H019V006, H018V005, H019V005
35	64	17	H018V008, H019V008, H018V007, H019V007, H018V006
36	64	18	H017V009, H018V009, H019V009, H017V008, H018V008, H019V008
37	65	13	H018V004, H019V004, H018V003, H019V003, H018V002, H019V002
38	65	14	H018V005, H019V005, H018V004, H019V004, H018V003, H019V003
39	65	15	H017V006, H018V006, H019V006, H017V005, H018V005, H019V005, H018V004
40	65	16	H017V007, H018V007, H017V006, H018V006, H019V006, H017V005, H018V005

No.	Path	Row	Alaska Tile HV Number
41	65	17	H017V008, H018V008, H017V007, H018V007
42	65	18	H017V009, H018V009, H017V008, H018V008
43	66	12	H018V003, H019V003, H018V002, H019V002, H018V001, H019V001
44	66	13	H017V004, H018V004, H019V004, H017V003, H018V003, H019V003, H018V002
45	66	14	H017V005, H018V005, H017V004, H018V004, H019V004, H017V003, H018V003
46	66	15	H017V006, H018V006, H017V005, H018V005, H017V004
47	66	16	H017V007, H018V007, H017V006, H018V006
48	66	17	H016V008, H017V008, H018V008, H017V007, H018V007
49	66	18	H016V009, H017V009, H018V009, H016V008, H017V008, H018V008
50	67	11	H018V002, H019V002, H017V001, H018V001, H019V001, H018V000
51	67	12	H017V003, H018V003, H017V002, H018V002, H019V002, H017V001, H018V001
52	67	13	H017V004, H018V004, H017V003, H018V003, H017V002
53	67	14	H017V005, H018V005, H017V004, H018V004, H017V003
54	67	15	H016V006, H017V006, H018V006, H016V005, H017V005, H018V005
55	67	16	H016V007, H017V007, H016V006, H017V006, H018V006
56	67	17	H016V008, H017V008, H016V007, H017V007
57	67	18	H016V009, H017V009, H016V008, H017V008
58	68	11	H017V002, H018V002, H017V001, H018V001, H017V000, H018V000
59	68	12	H017V003, H018V003, H017V002, H018V002, H017V001
60	68	13	H016V004, H017V004, H018V004, H016V003, H017V003, H018V003
61	68	14	H016V005, H017V005, H016V004, H017V004, H018V004
62	68	15	H016V006, H017V006, H016V005, H017V005
63	68	16	H016V007, H017V007, H016V006, H017V006
64	68	17	H015V008, H016V008, H017V008, H015V007, H016V007, H017V007
65	68	18	H015V009, H016V009, H015V008, H016V008, H017V008
66	68	19	H015V010, H016V010, H015V009, H016V009
67	68	20	H015V011, H016V011, H015V010, H016V010
68	69	11	H017V002, H018V002, H017V001, H018V001, H017V000
69	69	12	H016V003, H017V003, H018V003, H016V002, H017V002, H018V002
70	69	13	H016V004, H017V004, H016V003, H017V003
71	69	14	H016V005, H017V005, H016V004, H017V004
72	69	15	H015V006, H016V006, H017V006, H015V005, H016V005, H017V005
73	69	16	H015V007, H016V007, H015V006, H016V006, H017V006
74	69	17	H015V008, H016V008, H015V007, H016V007
75	69	18	H015V009, H016V009, H015V008, H016V008
76	69	19	H014V010, H015V010, H016V010, H014V009, H015V009, H016V009
77	69	20	H014V011, H015V011, H014V010, H015V010
78	69	21	H014V012, H015V012, H014V011, H015V011
79	70	10	H016V001, H017V001, H018V001, H016V000, H017V000, H018V000
80	70	11	H016V002, H017V002, H016V001, H017V001, H018V001

No.	Path	Row	Alaska Tile HV Number
81	70	12	H016V003, H017V003, H016V002, H017V002
82	70	13	H016V004, H017V004, H016V003, H017V003
83	70	14	H015V005, H016V005, H017V005, H015V004, H016V004, H017V004
84	70	15	H015V006, H016V006, H015V005, H016V005
85	70	16	H015V007, H016V007, H015V006, H016V006
86	70	17	H014V008, H015V008, H016V008, H014V007, H015V007, H016V007
87	70	18	H014V009, H015V009, H014V008, H015V008
88	70	19	H014V010, H015V010, H014V009, H015V009
89	70	20	H013V011, H014V011, H015V011, H013V010, H014V010, H015V010
90	70	21	H013V012, H014V012, H013V011, H014V011
91	71	10	H016V001, H017V001, H016V000, H017V000, H018V000
92	71	11	H016V002, H017V002, H016V001, H017V001
93	71	12	H015V003, H016V003, H017V003, H015V002, H016V002, H017V002
94	71	13	H015V004, H016V004, H015V003, H016V003, H017V003
95	71	14	H015V005, H016V005, H015V004, H016V004
96	71	15	H014V006, H015V006, H016V006, H014V005, H015V005, H016V005
97	71	16	H014V007, H015V007, H014V006, H015V006, H016V006
98	71	17	H014V008, H015V008, H014V007, H015V007
99	71	18	H013V009, H014V009, H015V009, H013V008, H014V008, H015V008
100	71	19	H013V010, H014V010, H013V009, H014V009, H015V009
101	71	20	H013V011, H014V011, H013V010, H014V010
102	71	21	H012V012, H013V012, H014V012, H012V011, H013V011, H014V011
103	72	10	H016V001, H017V001, H016V000, H017V000
104	72	11	H015V002, H016V002, H017V002, H015V001, H016V001, H017V001
105	72	12	H015V003, H016V003, H015V002, H016V002, H017V002
106	72	13	H015V004, H016V004, H015V003, H016V003
107	72	14	H014V005, H015V005, H016V005, H014V004, H015V004, H016V004
108	72	15	H014V006, H015V006, H014V005, H015V005
109	72	16	H014V007, H015V007, H014V006, H015V006
110	72	17	H013V008, H014V008, H015V008, H013V007, H014V007, H015V007
111	72	18	H013V009, H014V009, H013V008, H014V008
112	72	19	H012V010, H013V010, H014V010, H013V009, H014V009
113	72	20	H012V011, H013V011, H012V010, H013V010, H014V010
114	72	21	H012V012, H013V012, H012V011, H013V011
115	72	22	H011V013, H012V013, H013V013, H011V012, H012V012, H013V012
116	73	10	H015V001, H016V001, H017V001, H015V000, H016V000, H017V000
117	73	11	H015V002, H016V002, H015V001, H016V001
118	73	12	H015V003, H016V003, H015V002, H016V002
119	73	13	H014V004, H015V004, H016V004, H014V003, H015V003, H016V003
120	73	14	H014V005, H015V005, H014V004, H015V004
121	73	15	H013V006, H014V006, H015V006, H013V005, H014V005, H015V005
122	73	16	H013V007, H014V007, H013V006, H014V006, H015V006

No.	Path	Row	Alaska Tile HV Number
123	73	17	H013V008, H014V008, H013V007, H014V007
124	73	18	H012V009, H013V009, H014V009, H012V008, H013V008, H014V008
125	73	19	H012V010, H013V010, H012V009, H013V009
126	73	20	H011V011, H012V011, H013V011, H012V010, H013V010
127	73	21	H011V012, H012V012, H011V011, H012V011, H013V011
128	73	22	H011V013, H012V013, H011V012, H012V012
129	74	10	H015V001, H016V001, H015V000, H016V000
130	74	11	H014V002, H015V002, H016V002, H015V001, H016V001
131	74	12	H014V003, H015V003, H016V003, H014V002, H015V002, H016V002
132	74	13	H014V004, H015V004, H014V003, H015V003
133	74	14	H013V005, H014V005, H015V005, H013V004, H014V004, H015V004
134	74	15	H013V006, H014V006, H013V005, H014V005
135	74	16	H012V007, H013V007, H014V007, H013V006, H014V006
136	74	17	H012V008, H013V008, H012V007, H013V007, H014V007
137	74	18	H012V009, H013V009, H012V008, H013V008
138	74	19	H011V010, H012V010, H013V010, H011V009, H012V009, H013V009
139	74	20	H011V011, H012V011, H011V010, H012V010
140	74	21	H010V012, H011V012, H012V012, H010V011, H011V011, H012V011
141	74	22	H010V013, H011V013, H010V012, H011V012, H012V012
142	75	10	H014V001, H015V001, H016V001, H015V000, H016V000
143	75	11	H014V002, H015V002, H016V002, H014V001, H015V001, H016V001
144	75	12	H014V003, H015V003, H014V002, H015V002
145	75	13	H013V004, H014V004, H015V004, H013V003, H014V003, H015V003
146	75	14	H013V005, H014V005, H013V004, H014V004
147	75	15	H012V006, H013V006, H014V006, H012V005, H013V005, H014V005
148	75	16	H012V007, H013V007, H012V006, H013V006, H014V006
149	75	17	H011V008, H012V008, H013V008, H012V007, H013V007
150	75	18	H011V009, H012V009, H011V008, H012V008, H013V008
151	75	19	H011V010, H012V010, H011V009, H012V009
152	75	21	H010V012, H011V012, H010V011, H011V011
153	75	22	H009V013, H010V013, H011V013, H009V012, H010V012, H011V012
154	76	10	H014V001, H015V001, H016V001, H014V000, H015V000, H016V000
155	76	11	H014V002, H015V002, H014V001, H015V001
156	76	12	H013V003, H014V003, H015V003, H013V002, H014V002, H015V002
157	76	13	H013V004, H014V004, H013V003, H014V003
158	76	14	H012V005, H013V005, H014V005, H012V004, H013V004, H014V004
159	76	15	H012V006, H013V006, H012V005, H013V005
160	76	16	H011V007, H012V007, H013V007, H011V006, H012V006, H013V006
161	76	17	H011V008, H012V008, H011V007, H012V007, H013V007
162	76	18	H010V009, H011V009, H012V009, H011V008, H012V008
163	76	19	H010V010, H011V010, H010V009, H011V009, H012V009
164	76	21	H009V012, H010V012, H009V011, H010V011, H011V011

No.	Path	Row	Alaska Tile HV Number
165	76	22	H009V013, H010V013, H009V012, H010V012
166	76	23	H008V013, H009V013, H010V013, H009V012
167	77	10	H014V001, H015V001, H014V000, H015V000
168	77	11	H013V002, H014V002, H015V002, H013V001, H014V001, H015V001
169	77	12	H013V003, H014V003, H013V002, H014V002
170	77	13	H012V004, H013V004, H014V004, H012V003, H013V003, H014V003
171	77	14	H012V005, H013V005, H012V004, H013V004
172	77	15	H011V006, H012V006, H013V006, H011V005, H012V005, H013V005
173	77	16	H011V007, H012V007, H011V006, H012V006
174	77	17	H010V008, H011V008, H012V008, H010V007, H011V007, H012V007
175	77	18	H010V009, H011V009, H010V008, H011V008, H012V008, H010V007
176	77	22	H008V013, H009V013, H008V012, H009V012, H010V012, H008V011, H009V011
177	77	23	H007V013, H008V013, H009V013, H008V012
178	78	10	H013V001, H014V001, H015V001, H013V000, H014V000, H015V000
179	78	11	H013V002, H014V002, H013V001, H014V001
180	78	12	H012V003, H013V003, H014V003, H012V002, H013V002, H014V002
181	78	13	H012V004, H013V004, H012V003, H013V003
182	78	14	H011V005, H012V005, H013V005, H011V004, H012V004, H013V004
183	78	15	H011V006, H012V006, H011V005, H012V005
184	78	16	H010V007, H011V007, H012V007, H010V006, H011V006, H012V006, H011V005
185	78	17	H010V008, H011V008, H010V007, H011V007, H010V006, H011V006
186	78	18	H010V009, H011V009, H009V008, H010V008, H011V008, H010V007
187	78	22	H008V013, H009V013, H007V012, H008V012, H009V012, H008V011
188	78	23	H007V013, H008V013, H007V012, H008V012
189	79	10	H013V001, H014V001, H013V000, H014V000, H015V000
190	79	11	H012V002, H013V002, H014V002, H012V001, H013V001, H014V001
191	79	12	H012V003, H013V003, H012V002, H013V002, H014V002
192	79	13	H011V004, H012V004, H013V004, H011V003, H012V003, H013V003
193	79	14	H011V005, H012V005, H011V004, H012V004, H013V004, H011V003
194	79	15	H010V006, H011V006, H012V006, H010V005, H011V005, H012V005, H011V004
195	79	16	H010V007, H011V007, H010V006, H011V006, H010V005, H011V005
196	79	17	H010V008, H011V008, H009V007, H010V007, H011V007, H010V006
197	79	18	H009V009, H010V009, H009V008, H010V008, H009V007, H010V007
198	79	21	H008V012, H007V011, H008V011, H009V011, H008V010
199	79	23	H006V013, H007V013, H008V013, H006V012, H007V012, H008V012
200	79	24	H006V013, H007V013
201	80	9	H013V000, H014V000, H015V000
202	80	10	H013V001, H014V001, H013V000, H014V000
203	80	11	H012V002, H013V002, H014V002, H012V001, H013V001, H014V001
204	80	12	H011V003, H012V003, H013V003, H011V002, H012V002, H013V002

No.	Path	Row	Alaska Tile HV Number
205	80	13	H011V004, H012V004, H011V003, H012V003, H013V003, H011V002, H012V002
206	80	14	H011V005, H012V005, H010V004, H011V004, H012V004, H011V003
207	80	15	H010V006, H011V006, H010V005, H011V005, H010V004, H011V004
208	80	16	H010V007, H011V007, H009V006, H010V006, H011V006, H010V005
209	80	17	H009V008, H010V008, H009V007, H010V007, H009V006, H010V006
210	80	18	H009V009, H008V008, H009V008, H010V008, H009V007
211	80	20	H008V011, H007V010, H008V010, H009V010, H007V009, H008V009
212	80	21	H008V012, H007V011, H008V011, H007V010, H008V010
213	80	23	H005V013, H006V013, H007V013, H006V012, H007V012
214	80	24	H005V013, H006V013, H007V013
215	81	9	H013V000, H014V000
216	81	10	H012V001, H013V001, H014V001, H012V000, H013V000, H014V000
217	81	11	H012V002, H013V002, H012V001, H013V001
218	81	12	H011V003, H012V003, H011V002, H012V002, H013V002, H012V001
219	81	13	H011V004, H012V004, H010V003, H011V003, H012V003, H011V002
220	81	14	H010V005, H011V005, H010V004, H011V004, H012V004, H010V003, H011V003
221	81	15	H010V006, H011V006, H009V005, H010V005, H011V005, H010V004
222	81	16	H009V007, H010V007, H009V006, H010V006, H009V005, H010V005
223	81	20	H006V010, H007V010, H008V010, H007V009, H008V009
224	81	23	H005V013, H006V013, H005V012, H006V012
225	81	24	H004V013, H005V013, H006V013
226	82	9	H012V000, H013V000, H014V000
227	82	10	H012V001, H013V001, H012V000, H013V000
228	82	11	H011V002, H012V002, H013V002, H011V001, H012V001, H013V001
229	82	12	H011V003, H012V003, H011V002, H012V002, H011V001
230	82	13	H010V004, H011V004, H010V003, H011V003, H012V003, H011V002
231	82	14	H010V005, H011V005, H009V004, H010V004, H011V004, H010V003
232	82	15	H009V006, H010V006, H009V005, H010V005, H011V005, H009V004, H010V004
233	82	16	H009V007, H008V006, H009V006, H010V006, H009V005, H010V005
234	82	18	H007V008, H008V008, H009V008, H007V007, H008V007, H009V007
235	82	23	H004V013, H005V013, H004V012, H005V012, H006V012, H005V011
236	82	24	H003V013, H004V013, H005V013, H004V012
237	83	10	H011V001, H012V001, H013V001, H011V000, H012V000, H013V000
238	83	11	H011V002, H012V002, H011V001, H012V001, H011V000
239	83	12	H011V003, H012V003, H010V002, H011V002, H012V002, H011V001
240	83	13	H010V004, H011V004, H010V003, H011V003, H010V002, H011V002
241	83	14	H010V005, H009V004, H010V004, H011V004, H009V003, H010V003
242	83	15	H009V006, H008V005, H009V005, H010V005, H009V004, H010V004
243	83	16	H009V007, H008V006, H009V006, H008V005, H009V005
244	83	18	H007V008, H008V008, H007V007, H008V007

No.	Path	Row	Alaska Tile HV Number
245	83	24	H003V013, H004V013, H003V012, H004V012
246	84	10	H011V001, H012V001, H011V000, H012V000, H013V000
247	84	11	H011V002, H012V002, H010V001, H011V001, H012V001, H011V000
248	84	12	H010V003, H011V003, H010V002, H011V002, H010V001, H011V001
249	84	13	H010V004, H009V003, H010V003, H011V003, H010V002
250	84	14	H009V005, H010V005, H009V004, H010V004, H009V003, H010V003
251	84	15	H009V006, H008V005, H009V005, H010V005, H008V004, H009V004
252	84	16	H007V006, H008V006, H009V006, H007V005, H008V005, H009V005
253	84	17	H007V007, H008V007, H007V006, H008V006
254	84	18	H006V008, H007V008, H006V007, H007V007, H008V007
255	84	24	H002V013, H003V013, H004V013, H002V012, H003V012, H004V012
256	85	11	H010V002, H011V002, H010V001, H011V001, H012V001, H011V000
257	85	12	H010V003, H011V003, H009V002, H010V002, H011V002, H010V001
258	85	13	H009V004, H010V004, H009V003, H010V003, H009V002, H010V002
259	85	14	H009V005, H008V004, H009V004, H010V004, H008V003, H009V003, H010V003
260	85	15	H007V005, H008V005, H009V005, H008V004, H009V004
261	85	16	H007V006, H008V006, H007V005, H008V005
262	85	24	H002V013, H003V013, H001V012, H002V012, H003V012
263	86	24	H001V013, H002V013, H001V012, H002V012, H001V011, H002V011
264	87	24	H001V013, H000V012, H001V012, H002V012, H000V011, H001V011, H002V011
265	88	23	H000V011, H001V011, H002V011, H000V010, H001V010, H002V010
266	88	24	H000V012, H001V012, H000V011, H001V011
267	89	23	H000V011, H001V011, H000V010, H001V010
268	89	24	H000V012, H000V011, H001V011, H000V010
269	90	23	H000V011, H000V010, H001V010, H000V009

Table D-2. Alaska Scenes

No.	Path	Row	Hawaii Tile HV Number
1	62	46	H004V001, H004V002
2	62	47	H003V002, H004V002
3	63	45	H003V000, H003V001, H004V000, H004V001
4	63	46	H002V001, H002V002, H003V001, H003V002, H004V001, H004V002
5	63	47	H002V002, H003V002, H004V002
6	64	45	H002V000, H002V001, H003V000, H003V001
7	64	46	H001V001, H001V002, H002V001, H002V002, H003V001, H003V002
8	65	45	H001V000, H001V001, H002V000, H002V001
9	66	44	H000V000, H001V000
10	66	45	H000V000, H000V001, H001V000, H001V001

Table D-3. Hawaii Scenes

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