Landsat Collection 2 (C2) Level 3 (L3) Dynamic Surface Water Extent (DSWE) Data Format Control Book (DFCB)

Version 2.0

July 2021
Executive Summary

This Data Format Control Book (DFCB) presents detailed data formats for the Landsat Collection 2 (C2) Level 3 (L3) Dynamic Surface Water Extent (DSWE) Science Product to facilitate its use in the land remote sensing community.

Landsat Level 3 Science Products are derived from Landsat C2 U.S. Analysis Ready Data (ARD). Landsat C2 U.S. ARD consist of the most geometrically accurate Landsat 4-5 Thematic Mapper (TM), Landsat 7 Enhanced Thematic Mapper Plus (ETM+), and Landsat 8 Operational Land Imager (OLI) / Thermal Infrared Sensor (TIRS) data that are consistently processed to the highest scientific standards and level of processing required for direct use in monitoring and assessing landscape change. Additional information specific to Landsat C2 U.S. ARD product characteristics can be found in LSDS-1435 Landsat Collection 2 (C2) U.S. Analysis Ready Data (ARD) Data Format Control Book (DFCB).

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 applications-ready datasets. To alleviate this burden, the USGS has initiated an effort to produce a collection of Landsat Science Products to support land surface change studies. These products include terrestrial variables such as Surface Reflectance (SR), Surface Temperature (ST), Burned Area (BA), fractional Snow Covered Area (fSCA), and Dynamic Surface Water Extent (DSWE) that are suitable for monitoring, assessing, and predicting land surface change over time.

Landsat Collection 2 (C2) marks the second major reprocessing effort on the Landsat archive by the USGS that results in several data product improvements that harness recent advancements in data processing, algorithm development, and data access and distribution capabilities.

![Figure 1-1. Examples of Landsat Surface Reflectance (left) and Dynamic Surface Water Extent (right)](image)

In Figure 1-1, the images were derived from Landsat 7 Analysis Ready Data (ARD) Tile H005V013 of the Conterminous U.S. (CONUS), August 16, 2000.
1.2 Purpose and Scope
This Data Format Control Book (DFCB) provides detailed information on data formats for C2 Dynamic Surface Water Extent (DSWE) Science Products, including information on product and file specifications, product packaging, and metadata file examples.

The file formats and data contents are applicable to the DSWE Science Products produced at the U.S. Geological Survey (USGS) Earth Resources Observation and Science (EROS) Center.

1.3 Document Organization
This document contains the following sections:

- Section 1 provides an introduction
- Section 2 provides an overview of DSWE Science Product
- Section 3 provides data format definitions
- Section 4 provides document citation information
- Section 5 provides User Services contact information
- Appendix A provides a list of acronyms
- Appendix B provides excerpts from tile-based DSWE XML metadata
- The References section contains a list of reference documents

1.4 Definitions
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.

Analysis Ready Data – 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. Landsat Collection 2 (C2) U.S. Analysis Ready Data (ARD) are used as input in production of DSWE Science Products. Landsat U.S. ARD consist of the most radiometrically and geometrically accurate Landsat 4-5 Thematic Mapper (TM), Landsat 7 Enhanced Thematic Mapper Plus (ETM+), and Landsat 8 Operational Land Imager (OLI) / Thermal Infrared Sensor (TIRS) data that are consistently processed to the
highest scientific standards and level of processing required for direct use in monitoring and assessing landscape change.

Additional information specific to Landsat C2 U.S. ARD product characteristics can be found on the Landsat Missions Website, in the ARD Data Format Control Book, and in Dwyer et al., 2018.

**Tile** – ARD is packaged in tiles, which are units of uniform dimension bounded by static corner points in a defined grid system. 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 Worldwide Reference System-2 (WRS-2) path.
Section 2  Overview of DSWE

The DSWE products are generated from Landsat C2 ARD Surface Reflectance data, and use the cloud, dilated cloud, cloud shadow, cirrus, and snow information provided in the Level 2 Pixel Quality Assessment (QA_PIXEL) band, which is described in detail in the Landsat Collection 2 U.S. ARD Data Format Control Book (DFCB). Products are delivered in various formats, including Cloud Optimized GeoTIFF (COG) files for raster products, and Extensible Markup Language (XML) for metadata files. Spatial reference information is embedded within the COG files. DSWE products are available for 1982 to present for CONUS, Alaska, and Hawaii.

2.1 Available Products

Available DSWE products include six raster layers and an .xml metadata file. Section 2.2 describes specifications for each output raster layer. DSWE products include:

1. Diagnostic layer (DIAG) – Raster Layer: Provides the results of five diagnostic tests used to determine the probability of water presence in each pixel. Technical users interested in raw diagnostic test results may use the Diagnostic layer.

2. Interpreted layer (INTR) – Raster Layer: Provides the recoded results of the five diagnostic tests to identify specific surface water conditions.

3. Interpreted layer with some masks applied (INTSM) – Raster Layer: Similar to the interpreted layer “INTR” but is screened for terrain, snow, and land cover conditions. Areas flagged as hillshade in the mask layer are automatically recoded to “0” (i.e., “Not water”) in this layer. This band will help identify any valid water pixel that is masked out as cloud or cloud shadow in INWAM.

4. Interpreted layer with all masks applied (INWAM) – Raster Layer: Similar to the interpreted layer “INTSM” but applies cloud and cloud shadow information from the Level 2 Quality Assessment (QA_PIXEL) layer. Cloud and/or cloud shadow are flagged as such. Users interested in the highest level of processing can choose the INWAM layer.

5. Mask (MASK) – Raster Layer: Indicates where cloud, cloud shadow, and/or snow are true, or where the Otsu threshold for the hillshade was exceeded or where landcover is not water or wetland. The hillshade flag applies to shadows produced from the terrain. Multiple conditions can exist in any given pixel and therefore, the values of this band are additive. For example, a pixel value of “9” means cloud shadow exists and the hillshade exceeded the Otsu threshold (8 + 1 = 9).

6. Hillshade (SHADE) – Raster Layer: Represents the extent of terrain-produced shadow (percentage) for each pixel.
7. Metadata – Includes DSWE metadata and input Landsat ARD tile, and input scene(s) information in XML format.

2.2 Product Specifications
Table 2-1 describes the overall specifications for the DSWE products.

<table>
<thead>
<tr>
<th>Band Name</th>
<th>Description</th>
<th>Data Type</th>
<th>Units</th>
<th>Range</th>
<th>Valid Range</th>
<th>Fill Value</th>
<th>Scale Factor</th>
<th>Offset</th>
</tr>
</thead>
<tbody>
<tr>
<td>tileID_DIAG</td>
<td>Diagnostic Layer</td>
<td>INT16</td>
<td>Flag</td>
<td>0 - 11111</td>
<td>0 - 11111</td>
<td>-9999</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>tileID_INTR</td>
<td>Interpreted Layer</td>
<td>UINT8</td>
<td>Flag</td>
<td>0 - 4</td>
<td>0 - 4</td>
<td>255</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>tileID_INTSM*</td>
<td>Interpreted Layer with Some Masks applied</td>
<td>UINT8</td>
<td>Flag</td>
<td>0 - 4</td>
<td>0 - 4</td>
<td>255</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>tileID_INWAM**</td>
<td>Interpreted Layer with all Masks applied</td>
<td>UINT8</td>
<td>Flag</td>
<td>0 - 9</td>
<td>0 - 9</td>
<td>255</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>tileID_MASK</td>
<td>Mask Layer</td>
<td>UINT8</td>
<td>Flag</td>
<td>0 - 31</td>
<td>0 - 31</td>
<td>255</td>
<td>NA</td>
<td>NA</td>
</tr>
<tr>
<td>tileID_SHADE</td>
<td>Hillshade</td>
<td>UINT8</td>
<td>NA</td>
<td>0 - 255</td>
<td>0 - 255</td>
<td>255</td>
<td>NA</td>
<td>NA</td>
</tr>
</tbody>
</table>

*INTSM is a new band introduced in Collection 2. **INWAM was INWM in Collection 1 DSWE. SLOPE band was eliminated from C2 DSWE.

Table 2-1. C2 DSWE Product Overall Specifications

Table 2-2 through Table 2-5 describe the pixel value interpretations for the diagnostic and interpreted layers.

<table>
<thead>
<tr>
<th>Pixel Value</th>
<th>Threshold</th>
<th>Interpretation</th>
</tr>
</thead>
<tbody>
<tr>
<td>00000</td>
<td>NA</td>
<td>No conditions met.</td>
</tr>
<tr>
<td>00001</td>
<td>MNDWI &gt; 0.124</td>
<td>MNDWI greater than Wetness Index threshold.</td>
</tr>
<tr>
<td>00010</td>
<td>MBSRV &gt; MBSRN</td>
<td>MBSRV (green + red) greater than MBSRN (NIR + SWIR1).</td>
</tr>
<tr>
<td>00100</td>
<td>AWEsh &gt; 0.0</td>
<td>Automated Water Extent Shadow (AWEsh) equation returns a value greater than Automated Water Extent Shadow Threshold (0).</td>
</tr>
<tr>
<td>01000</td>
<td>MNDWI &gt; -0.44 &amp; SWIR1 &lt; 0.09 &amp; NIR &lt; 0.15 &amp; NDVI &lt; 0.7</td>
<td>Partial Surface Water 1 (PSW1) equations meet specific thresholds.</td>
</tr>
<tr>
<td>10000</td>
<td>MNDWI &gt; -0.5 &amp; SWIR1 &lt; 0.3 &amp; SWIR2 &lt; 0.1 &amp; NIR &lt; 0.25 &amp; Blue &lt; 0.1</td>
<td>Partial Surface Water 2 (PSW2) equations meet specific thresholds.</td>
</tr>
</tbody>
</table>

*MNDWI = Modified Normalized Difference Wetness Index, MBSRV = Multi-band Spectral Relationship Visible, MBSRN = Multi-band Spectral Relationship Near-Infrared, NDVI = Normalized Difference Vegetation Index, NIR = Near Infrared band, SWIR1 = Shortwave Infrared Band 1, SWIR2 = Shortwave Infrared Band 2, AWEsh = Automated Water Extent Shadow, PSW1 = Partial Surface Water 1, PSW2 = Partial Surface Water 2

Table 2-2. Diagnostic Layer Pixel Values
Table 2-3. Interpreted Layer Pixel Values

<table>
<thead>
<tr>
<th>Pixel Value</th>
<th>Threshold</th>
<th>Interpretation</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0-1 tests true (0, 1, 10, 100, 1000)</td>
<td>Not water</td>
</tr>
<tr>
<td>1</td>
<td>4-5 tests true (1111, 10111, 11011, 11110, 11111)</td>
<td>Water – high confidence</td>
</tr>
<tr>
<td>2</td>
<td>3 tests true (111, 1101, 1110, 10011, 10101, 10110, 11001, 11010, 11100)</td>
<td>Water – moderate confidence</td>
</tr>
<tr>
<td>3</td>
<td>Last 2 tests are true (11000)</td>
<td>Partial Surface Water - Conservative</td>
</tr>
<tr>
<td>4</td>
<td>1-2 tests true (11, 101, 110, 1001, 1010, 1100, 10000, 10001, 10010, 10100)</td>
<td>Partial Surface Water - Aggressive</td>
</tr>
<tr>
<td>255</td>
<td>NA</td>
<td>Fill</td>
</tr>
</tbody>
</table>

Table 2-4. Interpreted Layer with Some Masking Applied Pixel Values

<table>
<thead>
<tr>
<th>Pixel Value</th>
<th>Interpretation</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Not water</td>
</tr>
<tr>
<td>1</td>
<td>Water – high confidence</td>
</tr>
<tr>
<td>2</td>
<td>Water – moderate confidence</td>
</tr>
<tr>
<td>3</td>
<td>Partial Surface Water - Conservative</td>
</tr>
<tr>
<td>4</td>
<td>Partial Surface Water - Aggressive</td>
</tr>
<tr>
<td>9</td>
<td>Cloud, cloud shadow</td>
</tr>
<tr>
<td>255</td>
<td>Fill</td>
</tr>
</tbody>
</table>

Table 2-5. Interpreted Layer with All Masks Applied Pixel Values

Table 2-6 shows the bit assignments and their description in Mask layer and Table 2-7 displays the interpretation of possible pixel values expected in the Mask layer after its bits are unpacked.

<table>
<thead>
<tr>
<th>Bit</th>
<th>Flag Description</th>
<th>Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Shadow</td>
<td>0 for no shadow, 1 for terrain shadow</td>
</tr>
<tr>
<td>1</td>
<td>Snow</td>
<td>0 for no snow, 1 for snow</td>
</tr>
<tr>
<td>2</td>
<td>Cloud</td>
<td>0 for no cloud, 1 for cloud</td>
</tr>
<tr>
<td>3</td>
<td>Hillshade*</td>
<td>0 if shade exceeds the Otsu threshold, 1 if shade ≤ Otsu threshold and landcover is not water/wetland</td>
</tr>
<tr>
<td>4</td>
<td>Landcover</td>
<td>0 for default conditions, 1 if 0 &lt; landcover ≤ Image year, INTR is partial surface water, and NIR&gt;0.12 or if landcover = Image year * 10 + 1</td>
</tr>
</tbody>
</table>
Table 2-6. Mask Layer Bit Index

<table>
<thead>
<tr>
<th>Bit</th>
<th>Flag Description</th>
<th>Values</th>
</tr>
</thead>
<tbody>
<tr>
<td>5-7</td>
<td>Unused</td>
<td>NA</td>
</tr>
</tbody>
</table>

*Otsu threshold is calculated for select Landsat U.S. ARD tiles with terrain relief.

Table 2-7. Mask Layer Pixel Values

Table 2-8 summarizes the shade and landcover rules that are used for masking the INTR band.

<table>
<thead>
<tr>
<th>Otsu Result</th>
<th>Landcover</th>
<th>INTR</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>Shade</td>
<td>Not water or wetland (not 25000)</td>
<td>1, 2, 3, or 4</td>
<td>Mask</td>
</tr>
<tr>
<td></td>
<td>25000</td>
<td>All</td>
<td>Ignore OTSU</td>
</tr>
<tr>
<td></td>
<td>30000</td>
<td>All</td>
<td>None</td>
</tr>
<tr>
<td></td>
<td>0 &lt; AND &lt;= Image Year</td>
<td>3 or 4</td>
<td>Mask where NIR &gt; 0.12</td>
</tr>
<tr>
<td></td>
<td>= Image year * 10 + 1</td>
<td>All</td>
<td>Mask</td>
</tr>
</tbody>
</table>

Table 2-8. Shade and Landcover Masking Rules

2.3 Caveats and Constraints

1. DSWE products are derived from available [Landsat C2 U.S. ARD Surface Reflectance products](https://landsat.usgs.gov/landsat2). Surface Reflectance products are generated using two algorithms, the Landsat Ecosystem Disturbance Adaptive Processing System (LEDAPS) for Landsat 4-7 and the Land Surface Reflectance Code (LaSRC) for Landsat 8. Occasionally, Landsat data cannot be processed to Surface Reflectance due to missing auxiliary data. More information pertaining to the auxiliary data characteristics is described in the [Landsat Atmospheric Auxiliary Data DFCB](https://landsat.usgs.gov/landsat2). Date ranges of missing auxiliary data are listed under "Caveats and Constraints" on the [Landsat Collection 2 Surface Reflectance](https://landsat.usgs.gov/landsat2) webpage.
2. Unlike the standard Landsat Level 1 Worldwide Reference System (WRS) scenes in Universal Transverse Mercator (UTM) projection into which Landsat data have always been processed, Landsat U.S. ARD products are processed to Albers Equal Area Conic (AEA) projection and divided into equal-sized tiles with static extents. C2 DSWE Science Products are generated from C2 U.S. ARD in AEA tile format and are available for all three U.S. ARD regions. The [Landsat C2 U.S. ARD](#) webpage describes the use of AEA and tiling grids in more detail.

3. Landsat U.S. ARD products are generated from the highest quality data in the Landsat Level 1 Collection 2 inventory structure. Landsat 4-7 Tier 1 (T1) and Landsat 8 T1 and Tier 2 (T2) scenes are processed to ARD. Newly acquired scenes in the collection archive are given a Real-Time (RT) designation. These newly acquired data are not processed to ARD until radiometric and geometric parameters are finalized and reprocessed into their appropriate Tier (~26 days for Landsat 7 and ~15 days for Landsat 8 after acquisition).

4. Landsat 7 ETM+ inputs are not gap-filled in Surface Reflectance production; therefore, gapped areas are not processed for DSWE. See the [Landsat 7](#) webpage for information on Landsat 7 Scan Line Corrector-off (SLC-off) data products.

5. Efficacy of the Surface Reflectance correction is likely to be reduced in areas where atmospheric correction is affected by adverse conditions:
   a. Hyper-arid or snow-covered regions
   b. Low sun angle conditions
   c. Coastal regions where land area is small relative to adjacent water
   d. Areas with extensive cloud contamination
   e. Users are cautioned against correcting data acquired over high latitudes (> 65°)

Refer to the Surface Reflectance Quality Assessment (QA) bands for pixel-level condition and validity flags.

Additional details pertaining to Surface Reflectance data products are found in the [Landsat 4-7 Collection 2 Surface Reflectance Product Guide](#) and [Landsat 8 OLI/TIRS Collection 2 Surface Reflectance Product Guide](#).

6. Overcorrection of aerosol path radiance over water in Landsat 8 Collection 2 Surface Reflectance near clouds or other bright targets may adversely impact the quality of DSWE science product. Initial analysis showed that the C2 Landsat 8 DSWE may erroneously classify a pixel as non-water as a result of overcorrected Surface Reflectance over water. For additional information please see the [Landsat Collection 2 Known Issues](#) webpage.
Section 3  Data Format Definition

3.1  Product Packaging

This DFCB is specific to the Landsat C2 Level 3 DSWE Science Product. Details of other Landsat Science Products are covered in separate DFCBs.

3.1.1  Package Filename

Users will be able to download all Landsat C2 Level 3 DSWE bands in a compressed tar bundle or select and download the desired raster bands. The tar package filenames are structured similar to the original ARD tile identifiers (IDs) appended with the DSWE package name suffix. The following is an example of a typical DSWE package filename.

LXSS_US_HHHVVV_YYYYMMDD_yyyymmdd_CC_PACKAGE.tar
(e.g., LC08_CU_006006_20160715_20171205_02_DSWE.tar)

L  Landsat
X  Sensor ("C" = OLI / TIRS, "E" = ETM+, "T" = TM)
SS Satellite ("08" = Landsat 8, "07" = Landsat 7, "05" = Landsat 5, "04" = Landsat 4)
US  Regional grid of the U.S. ("CU" = CONUS, "AK" = Alaska, "HI" = Hawaii)
HHH Horizontal tile number
VVV Vertical tile number
YYYY Acquisition year
MM Acquisition month
DD Acquisition day
yyyy ARD tile Production year
mm ARD tile Production month
dd ARD tile Production day
CC Collection number ("02")
PACKAGE Data product package ("DSWE" = Dynamic Surface Water Extent package)

3.1.2  Product Filename

The DSWE .tar packages “untar” (unzip) into six individual COG raster files and an Extensible Markup Language (XML) (.xml) metadata file. The raster files include a diagnostic layer, interpreted layer, interpreted layer with some masking, interpreted layer with all masks applied, mask layer, and hillshade. The following is an example of a C2 DSWE Science Product filename:

LXSS_US_HHHVVV_YYYYMMDD_yyyymmdd_CC_PRODUCT.ext
(e.g., LC08_CU_006006_20160715_20171205_02_INTR.TIF)

L  Landsat
X  Sensor ("C" = OLI / TIRS, "E" = ETM+, "T" = TM)
SS Satellite ("08" = Landsat 8, “07” = Landsat 7, “05” = Landsat 5, “04” = Landsat 4)
HHH Horizontal tile number
VVV Vertical tile number
YYYY Acquisition year
MM Acquisition month
DD Acquisition day
yyyy ARD tile Production year
mm ARD tile Production month
dd ARD tile Production day
CC Collection number “02”
PRODUCT Data product (“DIAG” = diagnostic layer, “INTR” = interpreted layer, “INTSM” = Interpreted with some masking, “INWAM” = interpreted layer with all masks applied, “MASK” = mask layer, “SHADE” = hillshade)
ext File extension (“.TIF” = Cloud Optimized GeoTIFF, “.xml” = Extensible Markup Language)

3.2 Spatial Attributes

3.2.1 Map Projection
DSWE Science Products utilize Landsat C2 U.S. ARD that are 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 products cover the Conterminous U.S, Alaska, and Hawaii. Table 3-1 lists the projection parameters that are carried through from ARD into DSWE final products.

<table>
<thead>
<tr>
<th>USGS Analysis Ready Data (ARD) Projection Parameters</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Projection: Albers Equal Area Conic (AEA)</td>
<td></td>
</tr>
<tr>
<td>Datum: World Geodetic System 1984 (WGS84)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Conterminous U.S.</td>
</tr>
<tr>
<td>First standard parallel</td>
<td>29.5°</td>
</tr>
<tr>
<td>Second standard parallel</td>
<td>45.5°</td>
</tr>
<tr>
<td>Longitude of central meridian</td>
<td>-96.0°</td>
</tr>
<tr>
<td>Latitude of projection origin</td>
<td>23.0°</td>
</tr>
<tr>
<td>False Easting (meters)</td>
<td>0.0</td>
</tr>
<tr>
<td>False Northing (meters)</td>
<td>0.0</td>
</tr>
</tbody>
</table>

Table 3-1. Landsat ARD Projection Parameters

3.2.2 Tile Grid System
All DSWE Science Products are derived from Albers Equal Area (AEA)-projected ARD products 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 Database (NLCD), except that WELD is based on WGS84 and NLCD uses 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 the NLCD. The ARD is gridded into tiles of 5,000 x 5,000 30m pixels (or expressed 150 x 150-kilometer (km) tile size) and is anchored to the coordinates listed in Table 3-2.

<table>
<thead>
<tr>
<th></th>
<th>Upper Left Tile (UL Corner)</th>
<th>Lower Right Tile (LR Corner)</th>
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<tr>
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<td>(h)</td>
<td>(v)</td>
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<td>0</td>
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<tr>
<td>Alaska</td>
<td>0</td>
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</tr>
<tr>
<td>Hawaii</td>
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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 3-2. Landsat ARD Tile Grid Extents**

### 3.3 COG Specifications

#### 3.3.1 COG Image Preparation

The Landsat C2 DSWE Science Product is stored in a 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](https://example.com).
Section 4  Citation Information

There are no restrictions on the use of Landsat Science Products. It is not a requirement of data use, but the following citation may be used in publication or presentation materials to acknowledge the USGS as a data source and to credit the original research.


Reprints or citations of papers or oral presentations based on USGS data are welcome to help the USGS stay informed of how data are being used. These can be sent to the contact information provided in Section 5.
Section 5  User Services

Landsat Science Products and associated interfaces are supported by USGS User Services staff at the USGS Earth Resources Observation and Science (EROS) Center. Questions or comments regarding Landsat Science Products or interfaces are welcome through the Landsat “Contact Us” online correspondence form. Email can also be sent to the USGS User Services address with the same indication of topic.

**USGS User Services**
605-594-6151
1-800-252-4547
custserv@usgs.gov

User support is available Monday through Friday from 8:00 a.m. – 4:00 p.m. Central Time. Inquiries received outside of these hours are addressed during the next business day.
# Appendix A  Acronyms

<table>
<thead>
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<th>Acronym</th>
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<td>Albers Equal Area</td>
</tr>
<tr>
<td>ARD</td>
<td>Analysis Ready Data</td>
</tr>
<tr>
<td>AWEsh</td>
<td>Automated Water Extent Shadow</td>
</tr>
<tr>
<td>BA</td>
<td>Burned Area</td>
</tr>
<tr>
<td>BT</td>
<td>Brightness Temperature</td>
</tr>
<tr>
<td>C2</td>
<td>Collection 2</td>
</tr>
<tr>
<td>CCB</td>
<td>Configuration Control Board</td>
</tr>
<tr>
<td>COG</td>
<td>Cloud Optimized GeoTIFF</td>
</tr>
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<td>CONUS</td>
<td>Conterminous United States</td>
</tr>
<tr>
<td>CR</td>
<td>Change Request</td>
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<tr>
<td>DFCB</td>
<td>Data Format Control Book</td>
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<tr>
<td>DIAG</td>
<td>Diagnostic Layer</td>
</tr>
<tr>
<td>DN</td>
<td>Digital Number</td>
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<td>DPAS</td>
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<td>DSWE</td>
<td>Dynamic Surface Water Extent</td>
</tr>
<tr>
<td>EROS</td>
<td>Earth Resources Observation and Science</td>
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<tr>
<td>ETM+</td>
<td>Enhanced Thematic Mapper Plus</td>
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<td>.ext</td>
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<tr>
<td>fSCA</td>
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<td>GeoTIFF</td>
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<tr>
<td>ID</td>
<td>Identifier</td>
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<tr>
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<td>Signed Integer</td>
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<tr>
<td>INTR</td>
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<tr>
<td>INTSM</td>
<td>Interpreted Layer with Some Masks Applied</td>
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<tr>
<td>INWAM</td>
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<td>LaSRC</td>
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<td>LEDAPS</td>
<td>Landsat Ecosystem Disturbance Adaptive Processing System</td>
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<tr>
<td>LSDS</td>
<td>Land Satellites Data System</td>
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<tr>
<td>MBSRN</td>
<td>Multi-band Spectral Relationship Near-Infrared</td>
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<tr>
<td>MBSRV</td>
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<tr>
<td>MNDWI</td>
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<tr>
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<td>PIXELQA</td>
<td>Level 2 Pixel Quality Assessment Band</td>
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<td>SLC</td>
<td>Scan Line Corrector</td>
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<td>SR</td>
<td>Surface Reflectance</td>
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<td>UINT</td>
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Appendix B  Example Metadata

Example of DSWE tile metadata:

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References

Please see https://www.usgs.gov/core-science-systems/nli/landsat/landsat-acronyms for a complete list of acronyms.

USGS/EROS. LSDS-1435 Landsat Collection 2 (C2) U.S. Analysis Ready Data (ARD) Data Format Control Book (DFCB)

USGS/EROS. LSDS-1388. Landsat Cloud Optimized GeoTIFF (COG) Data Format Control Book (DFCB)


GeoTIFF Specification https://trac.osgeo.org/geotiff