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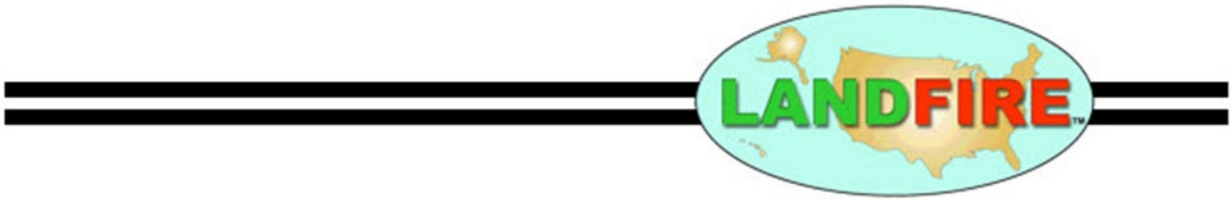

LANDFIRE

DEFINITIONS, QUALITY, AND STANDARDS ANNUAL REPORT

Document History

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Section 1 Introduction to LANDFIRE

Each calendar year the Landscape Fire and Resource Management Planning Tools (LANDFIRE) project produces and delivers more than 65 products for multiple extents including the Conterminous United States (CONUS), Alaska (AK), Hawaii (HI) and the Insular Areas. The uniqueness of LANDFIRE data makes it essential to some government requirements, such as wildfire risk assessments, habitat assessments, and operational firefighting.

The U.S. Geological Survey (USGS) Earth Resources Observation and Science (EROS) Center Technical Support Services Contract (TSSC) is charged with reviewing data definitions, quality, and standards across the program. This is done to validate and verify compliance of LANDFIRE data, including compliance with the 2018 Geospatial Data Act (GDA) and the National Spatial Data Infrastructure (NSDI). This report addresses pertinent requirements from these efforts, including LANDFIRE's lessons learned from past Office of Inspector General (OIG) reports. This report concludes that LANDFIRE is clearly and transparently detailing its applicable standards.

1.1 Partnerships

LANDFIRE is a multi-agency program run by the US Forest Service (USFS) and the Department of the Interior (DOI), with production coordinated by USGS EROS. LANDFIRE's partner, The Nature Conservancy (TNC) is also highly involved in data production and communication.

External partners and stakeholders involved in data management activities include:

- Other federal agencies and projects (USFS, DOI)
    - Missoula Fire Sciences Laboratory
- States
- Local governments
- Regional governments
- Tribal governments
- Non-profits (such as the TNC)

The following processes are in place to ensure partners and stakeholders are involved:

- Partnership outreach activities (e.g., office hours, newsletter)
- Expert consultations
- Network outreach (e.g., Joint Fire Science Program)
- Federal, state, and local outreach (e.g., LANDFIRE's annual data call letter)

1.2 Inputs and Contributors

The LANDFIRE program has a rich history of partnerships with other mapping and data programs. LANDFIRE spatial data incorporates many federally funded national satellite platforms and geospatial datasets from government and private sources. Inputs and

contributors include, but are not limited to, the list below. See the full compiled list of data contributions at LANDFIRE Data Contribution List.

- LANDFIRE relies heavily on Landsat, which is a cooperative effort between the National Aeronautics and Space Administration (NASA) and the USGS. LANDFIRE has access to NASA's Commercial SmallSat Data Acquisition imagery (such as Planet) to help identify vegetation and disturbances, and to augment image interpretation. LANDFIRE also uses Harmonized Landsat Sentinel 2 and the Landsat-based Irrigation Dataset (LANID).
- Other inputs and contributors include, but are not limited to:
    - Monitoring Trends in Burn Severity (MTBS)
    - Burned Area Reflectance Classification (BARC)
    - Rapid Assessment of Vegetation Condition after Wildfire (RAVG)
    - 3D Elevation Program (3DEP)
        - Topographic products
    - North American Land Classification System (NALCMS)
        - Utilized for vegetation type, cover, and height in the 90km buffer area
    - National Agricultural Statistics Service (NASS)
        - Cropland data layer
    - National Land Cover Database (NLCD)
        - Urban and impervious surface data, pasture, and hay
    - National Agriculture Imagery Program (NAIP)
    - U.S. Forest Service Forest Inventory and Analysis (FIA)
        - Plots within LANDFIRE's Reference Database (LFRDB)
    - Microsoft Building Footprint rasterized by USGS
    - Wildland Urban Interface (WUI)
    - U.S. Census Bureau
    - Landsat Burned Area Science Products
    - And Maxar imagery provided with the ESRI license to access high-resolution digital imagery

LANDFIRE employs the following methods to ensure quality in geospatial data collected from non-federal sources:

- Data is evaluated for quality prior to acquisition.
- Geospatial data quality standards are specified in contract documents.
- Independent Verification and Validation (IV&V) methods are conducted.
- Staff data experts review and approve geospatial data deliverables.
- Data standards are enforced through automated processes such as database controls or script tools.
- LANDFIRE acquires data from other federal projects that are responsible for Quality Assessment and Quality Control (QA/QC).

Section 2 Data Creation and Testing

When a new LANDFIRE version is being created (e.g. the LF 2022 Update) the production and distribution teams work together to seamlessly release products to the public. To better understand the workflow building up to a release, see Figure 2-1 and Figure 2-2.

For more information about the methodology behind LANDFIRE, see LANDFIRE Technical Documentation.

2.1 Methodology and Standards for the LF 2022 Update

This section details production and distribution geospatial data and metadata standards for the LF 2022 Update (LF 2022).

2.1.1 Internal Data Standards

LANDFIRE's internal standards include:

- Attribute tables and Attribute Data Dictionaries (ADDs)
    - Attribute tables and ADDs are checked for conformity and consistency across products. They are also tested to ensure they align with each other and correlate appropriately to the version.
- Naming conventions
    - Naming conventions must be easily read by humans, not just by machines, such that people can read and understand what they are looking at. They must describe:
        - Who (LANDFIRE)
        - What (product and version)
        - When (version)
        - Where (extent)
- Data production
    - Rasters are created with:
        - 30 x 30m pixel dimensions that align with a standardized grid
        - Standardized projections in North American Datum of 1983 Albers (NAD83 Albers)
        - Standardized data type, bit depth, and number of bands and consistency among products for common classes such as water, barren, snow/ice, agriculture, and development
        - Consistent 'No Data' and background values among products
        - Full coverage of data extent with bounding box

2.1.2 Quality Assessment and Quality Control (QA/QC)

LANDFIRE performs internal QA/QC on the geospatial data at both the production and distribution stages (Figure 2-2).

- QA/QC includes, but is not limited to:
    - Validating pixels
    - Verifying extents
    - Verifying attribute tables and ensuring they align correctly with data
    - Validating basic file characteristics including file format, bit depth, datum, and projection
    - Validating product coverage, including data and No Data extents
    - Validating product characteristics to ensure that values are within acceptable ranges, and that there are no unexpected values
    - Verifying rows and columns
    - Verifying that lifeform matches between cover and height products

LANDFIRE records results of Data, Integration, and Systems Testing in a Product Acceptance Report (PAR) which is then delivered to program leadership for approval before each public release.

2.1.3 Metadata Standards

LANDFIRE creates and maintains International Organization for Standardization (ISO) 19115 FGDC-STD-001-1998-compliant metadata for all products and extents within a version. USGS guidelines are followed when creating LANDFIRE metadata.

A general breakdown of the metadata process includes these steps:

1. Produce metadata
    a. Metadata records are unique for each product and extent. For example, Existing Vegetation Type (EVT) has four unique metadata records within the LF 2022 version:
        i. EVT CONUS
        ii. EVT AK
        iii. EVT HI
        iv. EVT Puerto Rico and the Virgin Islands
2. Internal review
    a. Team member within LANDFIRE
3. External review
    a. Someone outside of LANDFIRE
    b. Also includes a review of the geospatial data
4. Release and publish metadata

2.2 Data & Metadata Releases

2.2.1 IPDS

From the Data Release Work Bench official USGS web page: “Information Product Data System (IPDS) is the web-based application that enables USGS to track, monitor, and update progress as an information product works its way through the review, approval, and production steps to its ultimate release. IPDS implements USGS Fundamental Science Practices (FSP) routing processes which allow authors to routinely collaborate to ensure that USGS series information products have met the appropriate FSP and publishing requirements prior to release.”

The process (See Figure 2-1) includes:

1. Create IPDS record for the version (e.g., LF 2022).
2. Populate the record with content, load in metadata records, and add an author list.
3. Find a metadata and geospatial data peer reviewer – each product within an extent release needs a peer review.
4. The reviewer must be one person - within the USGS but outside of the project - who is a data manager or metadata manager familiar with data and metadata.
5. Prepare USGS metadata and data review checklists and generate review documents for each metadata record.
6. Reconcile feedback from peer review.
7. Upload all evidence and documents to IPDS.
8. Once the version is complete (i.e., once all extents have released for LF 2022), request peer review reconciliation and get approval from the Bureau.
9. The IPDS record is then reviewed and moved into a “hold” state.
10. When the ScienceBase landing page is public: Publish the IPDS record; it releases to the IPDS dark archive (an archive that is inaccessible to the public, to preserve record integrity).

2.2.2 Releases on LANDFIRE’s Trusted Digital Repositories

From the Data Release Work Bench official USGS web page: “A data repository is a centralized place to store and maintain data. A repository can consist of one or more databases or files which can be distributed over a network. Data repositories are often overseen by data curation personnel who ensure that files are managed and preserved for the long-term.”

LANDFIRE utilizes two Trusted Digital Repositories (TDRs) for publishing data, Landfire.gov and ScienceBase

A Trusted Digital Repository (TDR) is defined by the USGS as “one whose mission is to provide reliable, long-term access to managed digital resources to its customers, now and in the future.” A USGS TDR must:

- Accept responsibility for the long-term maintenance of digital resources on behalf of its depositors and for the benefit of users
- Be an organizational system that supports and demonstrates not only the long-term fiscal sustainability of the repository but also the digital information for which it has responsibility
- Be designed in accordance with commonly accepted system conventions and standards
- Establish methodologies for system evaluation that meet community expectations for trustworthiness

2.2.2.1 Landfire.gov

Post-release testing on the mosaic download web page includes ensuring that zip downloads are successful, data looks as expected, and that the zip bundles are structured correctly.

Before a LANDFIRE release, the EROS team manually tests the map viewer in the development server.

- Pre-release testing
  - Verify titles, table of contents, attribute labels and colors, pixel display, naming conventions, download functionality, etc.
  - Test download and integrity of download email from the map viewer
  - Once downloaded, verify that rasters look as expected with correct properties, and that the download bundle has all expected components
- Post release testing
  - Spot checks, using the same tests mentioned above

Note that there is no development server for the LANDFIRE Product Service (LFPS) and Image Service (see Figure 2-2); therefore all testing for LFPS is after public release.

- Post release testing
  - Verify titles, attribute labels and colors, pixel values and display, naming conventions, download functionality, etc
  - Once downloaded, verify that rasters look as expected with correct properties and that the download bundle looks as expected

2.2.2.2 ScienceBase

ScienceBase is a collaborative scientific data and management platform used directly by science and project teams within the USGS. According to the ScienceBase web page, “ScienceBase provides access to aggregated information derived from many data and information domains, including feeds from existing data systems, metadata catalogs, and scientists contributing new and original content. ScienceBase architecture is designed to help science teams and data practitioners centralize their data and information resources to create a foundation needed for their work. ScienceBase, both original software and engineered components, is released as an

open source project to promote involvement from the larger scientific programming community both inside and outside the USGS."

The process (see Figure 2-1) includes:

1. Create ScienceBase landing page for the version (e.g., LF 2022) using the IPDS record number.
2. Once created, use the DOI number generated by ScienceBase and implant it within the metadata.
3. Once a version is completed, populate the ScienceBase landing page with content and an author list (that matches IPDS), then make child items for each product and each extent.
4. Request public release from ScienceBase and undergo ScienceBase review.
5. ScienceBase landing page for the version is now public and the DOI number is active.
6. Once the ScienceBase page is public, automated harvests take place for each of these platforms on their individual schedules (in this order):
   a) Science Data Catalog (SDC)
   b) Data.gov
   c) Geoplatform.gov

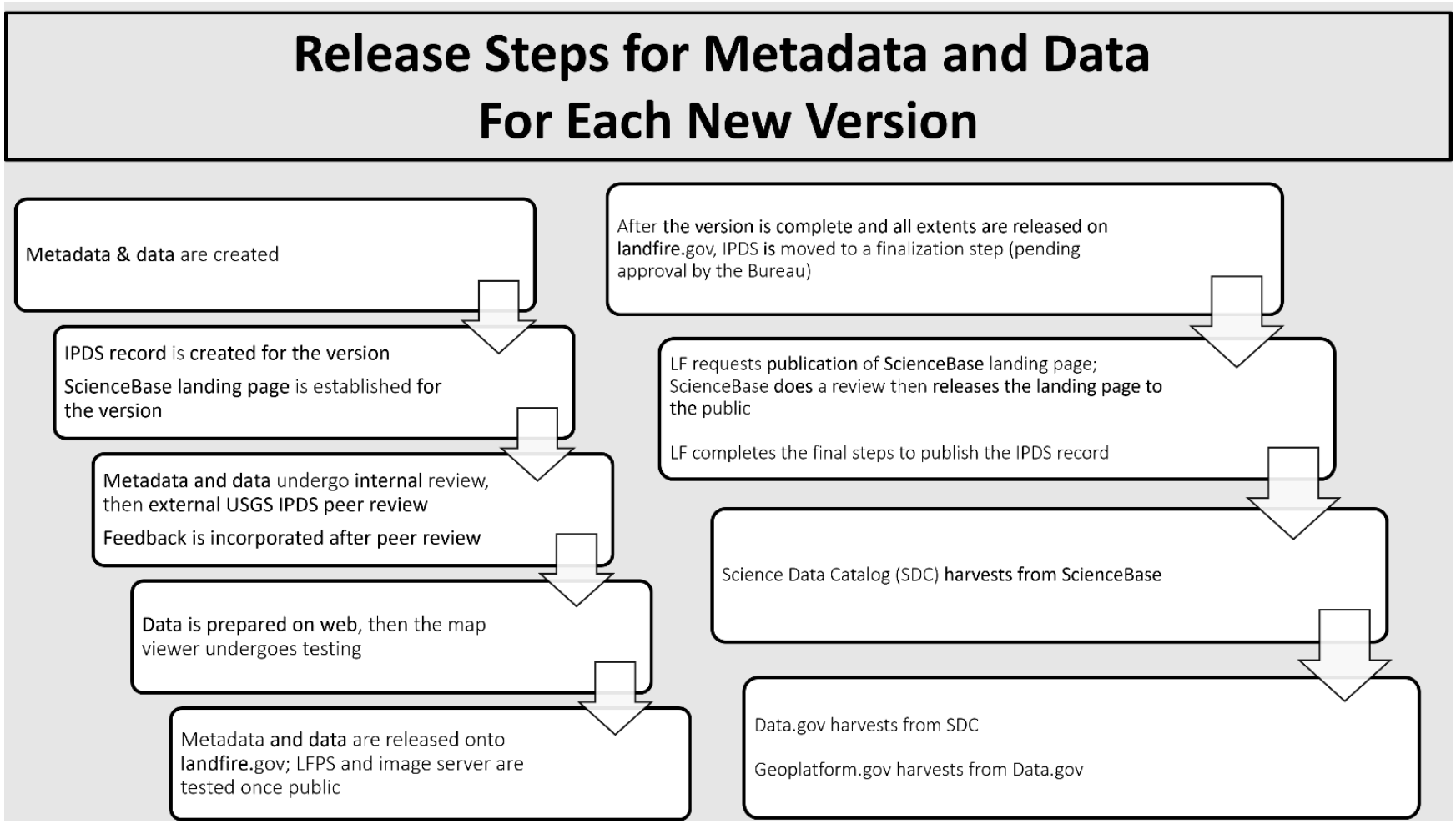

Figure 2-1. Release steps for data and metadata

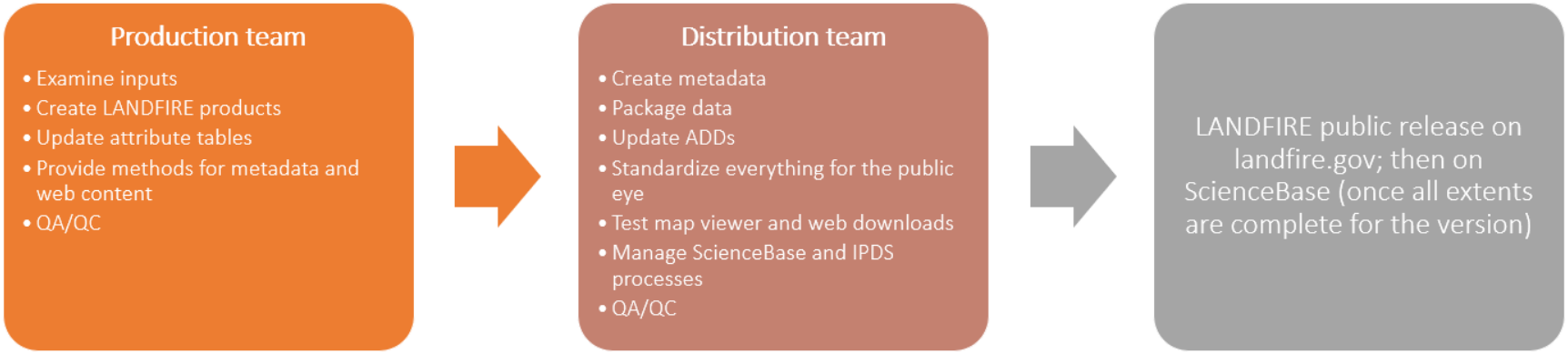

Figure 2-2. LANDFIRE release workflow

Section 3 Retiring Versions and Data Backups in the LANDFIRE Archive

3.1 Retiring Geospatial Data

LANDFIRE follows Findable, Accessible, Interoperable, Reusable (FAIR) principles espoused by the Federal Data Strategy (FDS) and does not remove (or retire) data. Older data that is no longer available immediately on landfire.gov or the map viewer is available by user request, and LANDFIRE data on ScienceBase remains in the public domain. ScienceBase does not currently support an archive or dark archive system for retiring data.

The National Archives and Records Administration (NARA) cannot currently support the large scale of geospatial data and is used when a bureau believes it would have some authority over the data set. It is only used in circumstances where there is a need to completely retire a dataset from online availability. Because LANDFIRE data is never truly retired from public domain, using NARA as an archive system is not applicable.

3.2 Archiving and Backups

LANDFIRE manages and collaborates with USGS EROS resources to maintain two backup processes that occur nightly and utilize the USGS EROS infrastructure.

1. Short-term archive
    a. A short-term storage option hosted at EROS makes files easily recoverable for approximately six months.
2. Long-term archive
    a. The other process is a permanent storage option that is always being added to. Files never expire or get automatically removed from this system. With this permanent storage option, there are three copies kept of each file. These copies are stored in unique locations.

Section 4 NGDA Products

Within the LF 2014 Update (LF 2014), four products for the CONUS extent have the status designated by the FGDC Steering Committee of National Geospatial Data Assets (NGDA). These products are:

- LF 2014 Forest Canopy Cover (CC)
- LF 2014 Environmental Site Potential (ESP)
- LF 2014 Existing Vegetation Cover (EVC)
- LF 2014 Fire Regime Groups (FRG)

In CY2023 the metadata for these products was brought into the current standard (ISO 19115 FGDC-STD-001-1998) and released onto a unique ScienceBase landing page with a DOI number (DOI 10.5066/P9YKVN2R). These products then followed the harvest flow outlined in Figure 2-1 to populate Data.gov and Geoplatform.gov.

Section 5 Applicable standards

This section is a LANDFIRE self-assessment of applicable standards within the GDA. LANDFIRE used the FGDC report “Program Annual Report and Self-Assessment" to help guide this portion of the document. Note that LANDFIRE is abbreviated LF in this section to conserve space.

5.1 USC 43 Sec 2808(a)(1) LF Geospatial Strategies

GDA Requirement	LANDFIRE Self-Assessment
Prepare, maintain, publish, and implement a strategy for advancing geographic information and related geospatial data and activities appropriate to the mission of LF, in support of the strategic plan for the NSDI.	**Satisfactory in FY2023. See Section 2.** LF has developed and implemented a plan to produce and disseminate the LF 2022 Update in a manner that meets the guidance provided by USFS and DOI business leads. LF’s plan addresses compliance with the GDA, such as utilizing USGS FSP, posting to ScienceBase, SDC, Data.gov, and Geoplatform.gov. See LANDFIRE Program: Schedule/Versions

5.2 USC 43 Sec 2808(a)(2) Support Data Sharing

GDA Requirement	LANDFIRE Self-Assessment
Collect, maintain, disseminate, and preserve geospatial data such that the resulting data, information, or products can be readily shared with other federal agencies and non-federal users.	**Satisfactory in FY2023. See Section 2.2.** LF data and metadata are currently openly shared to the public. Data are available for download as full extent mosaic zip files on our website, as a user selected area of interest from the LF map viewer, and via streaming formats such as WMS, WCS, and ESRI image services.

5.3 USC 43 Sec 2808(a) (3) Promote Data Integration

GDA Requirement	LANDFIRE Self-Assessment
Promote the integration of geospatial data from all sources.	**Satisfactory in FY2023. See Sections 1.1 and 1.2 .** LF hosts a data sharing infrastructure where partners and/or users can share and discover data. LF provides data in openly standardized readable formats, or as downloadable file packages. LF also develops API's and image services to promote integration of LF data in external applications.

5.4 USC 43 Sec 2808(a) (4) Ensure Records Retention Schedule for Geospatial Data

GDA Requirement	LANDFIRE Self-Assessment
Ensure that data information products and other records created in geospatial data and activities are included on LF record schedules that have been approved by the National Archives and Records Administration (NARA).	**Satisfactory in FY2023. See Section 2.3**. LF utilizes an archive system through the USGS EROS infrastructure and also follows FGDC and USGS ScienceBase guidance.

5.5 USC 43 Sec 2808(a) (5) Allocate Resources for Geospatial Data Management Responsibilities

GDA Requirement	LANDFIRE Self-Assessment
Allocate resources to fulfill the responsibilities of effective geospatial data collection, production, and stewardship with regard to related activities of the covered agency, and as necessary to support the activities of the Committee.	**Satisfactory in FY2023.** LF allocates resources by keeping a data manager on staff who oversees or is involved in all items within this report.

5.6 USC 43 Sec 2808(a) (6) Use Data Standards

GDA Requirement	LANDFIRE Self-Assessment
Use the geospatial data standards, including the standards for metadata for geospatial data, and other appropriate standards, including documenting geospatial data with the relevant metadata and making metadata available through the GeoPlatform. Include information about all geospatial datasets owned or managed by LF that are, or should be, available to the public in accordance with statutory authorities and missions; not just NGDA Datasets.	**Satisfactory in FY2023. See Sections 2.1 and 2.2.** Eligible geospatial datasets use FGDC-endorsed data standards under OMB A-16, 2002, or more current versions of those endorsed standards. LF metadata is available through landfire.gov, ScienceBase, Data.gov, and the Geoplatform.

5.7 USC 43 Sec 2808(a) (7) Support Coordination and Partnerships

GDA Requirement	LANDFIRE Self-Assessment
Coordinate and work in partnership with other federal agencies, agencies of state, tribal, and local governments, institutions of higher education, and the private sector to efficiently and cost-effectively collect, integrate, maintain, disseminate, and preserve geospatial data, building upon existing non-federal geospatial data to the extent possible.	**Satisfactory. See Sections 1.1 and 1.2.** LF has many partners and collaborators and is always striving to improve coordination and communication.

5.8 USC 43 Sec 2808(a) (8) Promote Application of Geospatial Data Assets

GDA Requirement	LANDFIRE Self-Assessment
Use geospatial information to: • make federal geospatial information and services more useful to the public; • enhance operations; • support decision making; and • enhance reporting to the public and to Congress	**Satisfactory in FY2023.** LF leverages geospatial information to enhance reporting via public reports, (e.g., fact sheets, data briefs, annual reports, and other published LF reports), Congressional reports, and internal LF plans, reports, and communications. See the LF Communication page and the LF Technical Documentation for more information.

5.9 USC 43 Sec 2808(a) (9) Protection of Privacy and Confidentiality

GDA Requirement	LANDFIRE Self-Assessment
Protect personal privacy and maintain confidentiality in accordance with Federal policy and law.	**Satisfactory in FY2023.** LF's Privacy Threshold Analysis (PTA) / Privacy Impact Assessment (PIA) processes are inclusive of all LF data. All LF geospatial data is housed in a system covered by a current Authorization to Operate (ATO) and is appropriately protected in accordance with applicable laws and regulations. The DOI has an established privacy program with a publicly available privacy policy. Each individual bureau in the DOI has also established guidance for protecting privacy information. The web mapping platform ESRI ArcGIS Online (AGOL) is accredited a Federal Information Security Management Act (FISMA) rating of "low" and does not contain any privacy-related or sensitive data. The GeoPlatform and the Amazon Web Services made available to federal agencies are rated at FISMA "moderate" to protect a limited amount of privacy-related data. The DOI is working with the software company ESRI to increase the AGOL FISMA rating to allow expanded capability of this web mapping service by 2023.

5.10 USC 43 Sec 2808(a) (10) Declassified Data

GDA Requirement	LANDFIRE Self-Assessment
Participate in determining, when applicable, whether declassified data can contribute to and become a part of the NSDI.	**Satisfactory in FY2023.** LF data is not classified; it is freely available and in the public domain. LF contributes to the NSDI by following FGDC standards and by being present on the Geoplatform.

5.11 USC 43 Sec 2808(a) (11) Non-Duplication of Data

GDA Requirement	LANDFIRE Self-Assessment
Search all sources, including the GeoPlatform, to determine if existing Federal, State, local, or private geospatial data meets the needs of the covered agency before expending funds for geospatial data collection.	**Satisfactory in FY2023.** In FY2021 the DOI issued Department of the Interior Acquisition, Arts, and Asset Policy (DOI-AAAP) 0169. This policy applied to all planned acquisition action within the Department (including LF) and required that any purchase of geospatial data comply with metadata guidance issued by the FGDC. Additionally, it specified that any request for geospatial data be accompanied by a written affirmation that a search was conducted on GeoPlatform.gov to determine that no existing Federal, State, local or private data meets the Government's needs.

5.12 USC 43 Sec 2808(a) (12) Ensuring High-Quality Data

GDA Requirement	LANDFIRE Self-Assessment
To the maximum extent practicable, ensure that a person receiving federal funds for geospatial data collection provides high-quality data.	**Satisfactory in FY2023**. **See Section 1.2**. LF utilizes geospatial data within the public domain that is held to quality standards and expectations. The DOI follows acquisition policy set forth in IAAP-0169 for Geospatial data. Most data acquisitions are for airborne and satellite imagery data. * "a person receiving federal funds" has been interpreted to mean non-federal organizations or corporations; for example, contract or grant recipients

5.13 USC 43 Sec 2808(a) (13) Point of Contact

GDA Requirement	LANDFIRE Self-Assessment
Appoint a contact to coordinate with the lead covered agencies for collection, acquisition, maintenance, and dissemination of the NGDA data themes used by LF.	**Satisfactory in FY2023.** A LF Point of Contact (POC) has been appointed for all records that are currently designated as NGDA. The DOI coordinates with the FGDC for the development, maintenance, and dissemination of the NGDA data themes. The DOI contributes data for 11 of the NGDA data themes and has a theme lead for each. These data themes are compiled of data from six bureaus within the DOI. Final data coordination is led by the FGDC before incorporation into the GeoPlatform.

Section 6 Acronyms

3DEP	3D Elevation Program
ADD	Attribute Data Dictionary
AGOL	ArcGIS Online
AK	Alaska
ATO	Authorization to Operate
BAER	Burned Area Emergency Response
BARC	Burned Area Reflectance Classification
CC	Canopy Cover
CONUS	Conterminous United States
CY	Calendar Year
DOI	Department of the Interior
DOI-AAAP	Department of the Interior Acquisition, Arts, and Asset Policy
EROS	Earth Resources Observation and Science
ESP	Environmental Site Potential
ESRI	Earth Science Research Institute
EVC	Existing Vegetation Cover
EVT	Existing Vegetation Type
FAIR	Findable, Accessible, Interoperable, Reusable
FDS	Federal Data Strategy
FGDC	Federal Geospatial Data Committee
FIA	Forest Inventory Analysis

FISMA	Federal Information Security Management Act
FRG	Fire Regime Group
FSP	Fundamental Science Processes
FY	Fiscal Year
GDA	Geospatial Data Act
HI	Hawaii
IPDS	Information Product Data System
ISO	International Organization for Standardization
LANDFIRE	Landscape Fire and Resource Management Planning Tools
LANID	Landsat-based Irrigation Dataset
LFPS	LANDFIRE Product Service
LFRDB	LF Reference Database
m	Meter
MTBS	Monitoring Trends in Burn Severity
NAD83	North American Datum of 1983
NAIP	National Agriculture Imagery Program
NALCMS	North American Land Change Monitoring System
NARA	National Archives and Records Administration
NASS	National Agricultural Statistics Service
NGDA	National Geospatial Data Asset
NLCD	National Land Cover Database
NSDI	National Spatial Data Infrastructure

OIG	Office of Inspector General
OIG	Office of Inspector General
PAR	Product Acceptance Report
PIA	Privacy Impact Assessment
POC	Point of Contact
PTA	Privacy Threshold Analysis
QA/QC	Quality Assessment/Quality Control
RAVG	Rapid Assessment of Vegetative Condition after Wildfire
SDC	Science Data Catalog
TDR	Trusted Digital Repository
TNC	The Nature Conservancy
TSSC	Technical Support Services Contract
USFS	U.S. Forest Service
USGS	U.S. Geological Survey
WUI	Wildland Urban Interface