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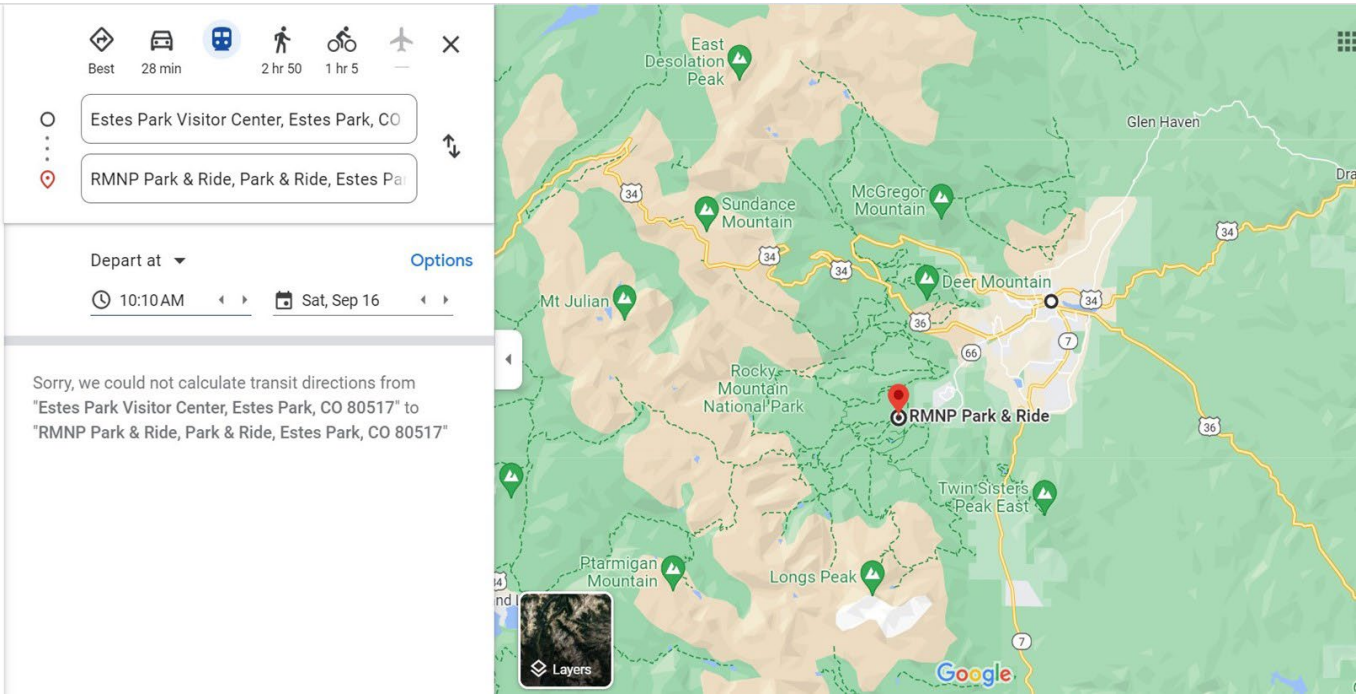
NPS Emerging Mobility Working Group:
General Transit Feed Specification (GTFS) Pilot Report



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14. ABSTRACT

This report provides an overview of the National Park Service (NPS) General Transit Feed Specification (GTFS) 2023 Pilot Project. To better connect people to parks and improve trip planning capabilities, NPS is interested in making transit information more accessible to a broader range of visitors both on third-party applications, such as Google Maps and Apple Maps, and NPS digital products, such as the NPS app and website. Improving visitor access to transit information aligns with the 2017 National Long Range Transportation objective of providing state-of-the-art traveler information and wayfinding and the 2024 National Transportation Strategy objective of improving and expanding trip planning tools.

The General Transit Feed Specification (GTFS) is the standardized and widely accepted method for transmitting transit information to third-party applications. GTFS feeds can either be static, displaying a pre-determined, fixed schedule, or realtime, displaying live updates of bus positions and expected arrival times. Establishing GTFS feeds will improve the traveler experience and further integrate NPS systems into the larger transit network. This project aimed to understand GTFS best practices, build static GTFS for up to 10 park transit systems, and provide recommendations for continuing and improving GTFS feed creation and maintenance.

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Executive Summary

This report provides an overview of the National Park Service (NPS) General Transit Feed Specification (GTFS) 2023 Pilot Project. To better connect people to parks and improve trip planning capabilities, NPS is interested in making transit information more accessible to a broader range of visitors both on third-party applications, such as Google Maps and Apple Maps, and NPS digital products, such as the NPS app and website. Improving visitor access to transit information aligns with the 2017 National Long Range Transportation objective of providing state-of-the-art traveler information and wayfinding and the 2024 National Transportation Strategy objective of improving and expanding trip planning tools.

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Building upon the findings of the 2017 GTFS Pilot Project, this report details lessons learned from the pilot project and outlines recommendations for future GTFS implementation for park transit systems.

Summary of GTFS Pilot Project

For the 2023 GTFS pilot, the project team (NPS and U.S. Department of Transportation Volpe Center) selected parks with a variety of operational contexts. NPS staff initially identified candidate systems based on park interest and ridership. The project team created or compiled static GTFS feeds for systems at Bandelier National Monument, Boston Harbor Islands National Recreation Area, Bryce Canyon National Park, Grand Canyon National Park, Gulf Islands National Seashore, Harpers Ferry National Historical Park, the National Mall, Rocky Mountain National Park, Yosemite National Park, and Zion National Park. All feeds are currently available at NPS's central repository.

Lessons Learned

Through the process of engaging with parks and third-party providers and creating GTFS feeds, the following lessons emerged as best practices.

1. *Start with Quality Data.* The greatest determinant of how difficult GTFS feed creation will be is the quality of existing data. For parks with robust transit system data, the creation of a GTFS feed may be as simple as reformatting existing files. For parks without this data, the process will require additional effort.
2. *Pay Attention to Maintenance.* Feeds require ongoing attention and should be updated annually or when new schedules take effect. Incorporating GTFS feed maintenance as part of regularly scheduled operations is a best practice to ensure consistent updates.
3. *Embrace Standardization*. Establishing a standardized, consistent approach to GTFS feed creation simplifies the creation and maintenance process for parks and enhances the reliability of the feeds for consumers.
4. *Communicate with Partners, Understand Contract Scope*. Many transit partners or contractors can (and in some cases do) maintain GTFS feeds for their NPS routes with little additional effort. While the NPS

should continue to be engaged in GTFS creation and maintenance efforts, it is feasible that these services could be included in transit operation contracts.

Recommendations

Recommendation 1: Feed Maintenance
The project team recommends creating a centralized, recurring process for collecting and updating the park transit data required for the creation and maintenance of a GTFS.

After collecting the updated transit system data, the project team recommends transitioning feed maintenance to transit operating partners when possible, and then having WASO, in collaboration with a contractor, maintain the remaining feeds. The project team also recommends exploring options to automate GTFS data collection and updates.

The project team recommends that all feeds continue to be stored at or linked from NPS's central repository or the NPS API. Having the feeds available in one central location makes it easier for NPS developers and third-party applications to consume the data and ensure that this open data is kept up to date.

Recommendation 2: Continued Static GTFS at High Ridership Transit Systems
The project team recommends continuing to create static GTFS feeds for high-ridership, transportation-focused NPS transit systems. The project team recommends prioritizing 18 transit systems for Phase II: ferries, shuttles, trains, and trolley systems with 2022 annual passenger boardings above 50,000, excluding systems with an interpretive tour primary purpose and systems that already have static GTFS feeds.

Recommendation 3: Integrate GTFS into NPS Digital Products
The project team recommends integrating the GTFS information into NPS digital products, such as the NPS app and NPS.gov, to consistently display accurate transit information. The project team recommends working with the Digital Strategy Division to add the static GTFS information to the park maps on NPS.gov and in the NPS app. Eventually, the project team recommends standardizing the transit information provided on the "Plan Your Visit" section of the park websites using the GTFS fields, such as creating standardized timetables.

Recommendation 4: Pilot GTFS Realtime at Five to 10 Transit Systems
GTFS Realtime (GTFS-rt) incorporates live updates that can greatly improve the transit experience for visitors. The project team recommends piloting GTFS-rt feeds for five to 10 park transit systems, which would allow NPS to understand the value and tradeoffs of realtime tracking. Given the costs associated with installing GPS tracking software, the project team recommends starting with park transit systems that are already equipped for live GPS tracking.

After investigating these items at each potential GTFS Realtime park location, the project team will identify between five and 10 parks where GTFS Realtime will be piloted. Park transit system candidates for the GTFS Realtime pilot include Acadia, Bandelier, Boston Harbor Islands, Bryce Canyon, Grand Canyon, Harpers Ferry, Muir Woods, National Mall (DC Circulator), Yosemite, and Zion park units.

Introduction

This report provides an overview of the National Parks Service (NPS) General Transit Feed Specification (GTFS) 2023 Pilot Project. The report details lessons learned from the pilot and outlines recommendations for future GTFS implementation for park transit systems. The intended audience for this report includes Washington Office (WASO) staff and other NPS staff interested in funding and implementing static and GTFS Realtime at parks.

Project Purpose

At the time of this report, 81 transit systems—consisting of ferries, buses, and other vehicles— operated in NPS units across the country, providing approximately 26.6 million trips each year. To better connect people to parks and improve trip planning capabilities, NPS is interested in making transit information more accessible to a broader range of visitors both on third-party applications, such as Google Maps and Apple Maps, and NPS digital products, such as the NPS app. Improving visitor access to transit information aligns with the 2017 National Long Range Transportation objective of providing state-of-the-art traveler information and wayfinding and the 2024 National Transportation Strategy objective of improving and expanding trip planning tools.

The General Transit Feed Specification (GTFS) is the standardized and widely accepted method for transmitting transit information to third-party applications. This project aimed to understand GTFS best practices, build static GTFS for up to 10 park transit systems, and provide recommendations for continuing and improving GTFS feed creation and maintenance.

Beginning in Reporting Year 2023, the Federal Transit Administration (FTA) required transit agencies that receive FTA funding to submit static GTFS feeds for all fixed routes for inclusion in the National Transit Database (NTD). FTA identified GTFS as the best mechanism to collect geographic service area coverage data for fixed-route service due to its standardized format and wide adoption. While most systems that operate at NPS parks do not receive FTA funding, and thus will not be subject to this requirement, this rule indicates that GTFS is the most prevalent standard for collecting and transmitting transit data, and that the creation of a GTFS feed can be considered a best practice for transit operators. Establishing GTFS feeds will improve the traveler experience and further integrate NPS systems into the larger transit network.

For this pilot project, on behalf of NPS, the U.S. Department of Transportation Volpe Center (Volpe Center), created or collected static GTFS feeds for the shuttle systems at Bandelier National Monument, Boston Harbor Islands National Recreation Area, Bryce Canyon National Park, Grand Canyon National Park, Gulf Islands National Seashore, Harpers Ferry National Historical Park, the National Mall, Rocky Mountain National Park, Yosemite National Park, and Zion National Park.

Background

About the NPS Emerging Mobility Program

This pilot project was carried out as part of the NPS Emerging Mobility Program. The term "emerging mobility" refers to a quickly evolving and growing landscape of transportation options made possible by advancements in mobile technology, vehicle automation, and new business models. In contrast, traditional mobility includes individual vehicle ownership and established systems like public transit, paratransit, taxis, and rental cars. The NPS is advancing emerging transportation technologies through implementing pilot projects at parks, pursuing partnerships, and sharing information service wide with materials such as this report. The NPS is also considering whether any changes to regulations and policy are needed to address the impact of new transportation technologies.

Visitor Experience Cycle

Visitors can use GTFS transit information throughout the Visitor Experience Cycle, pictured in Figure 1, by consulting third-party applications and NPS Digital Products. During the Travel Planning phase, visitors can learn about existing shuttle options, which will impact how visitors choose to travel to and within the park. During the other phases of the Visitor Experience Cycle, visitors can use third-party applications to check shuttle schedules and locations. With the implementation of GTFS Realtime, visitors would also eventually be able to track the location of the transit vehicles and see an updated time of arrival.

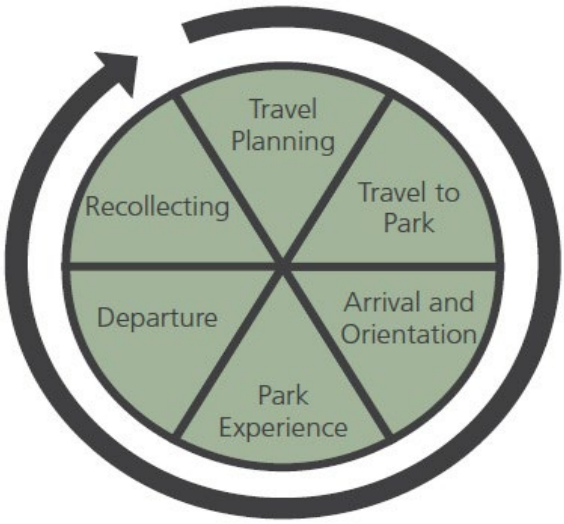

Figure 1. Visitor Experience Cycle
Source: NPS, 2014.

Previous Work

In 2017, NPS, with the assistance of Volpe, piloted GTFS at five parks: Boston Harbor Islands, Cuyahoga Valley, Rocky Mountain, Acadia, and Yosemite. This effort produced static feeds for those five parks and a memo summarizing the project results. Ultimately these transit feeds were not maintained, but the memo includes relevant research and recommendations.

The key areas for further research identified in the 2017 report include collaboration with third parties and navigation applications, standardization, and centralization of an official NPS repository, and integrating GTFS into park transit operations and outreach. This report builds on those recommendations and explores best practices for addressing these goal areas. Since 2017, GTFS has become much more common, in part due to the FTA's pending GTFS requirement, as well as continual improvements in tools to make and view GTFS. As parks seek to improve the visitor experience and increase the visibility of park transit services, GTFS presents a well-established and highly valuable opportunity to integrate the NPS into a large transit data network.

General Transit Feed Specification (GTFS)

GTFS is a standardized data format for transit schedules that allows easy integration with third-party navigation applications, such as Google Maps and Apple Maps, and NPS digital products, such as the NPS app and NPS.gov. Prior to the creation of GTFS, no data standard existed for communicating public transit information across platforms. In 2006, TriMet, the Portland, OR transit agency, "worked with Google to format their transit data into an easily maintainable and consumable format that could be imported into Google Maps."[1] While the G in GTFS originally stood for Google, it has since been changed to General, reflecting that the format is now widely used and is no longer exclusive to Google products.

GTFS feeds consist of a series of text files that communicate transit information, including agency data, routes, and schedules. GTFS feeds can either be "static", displaying a pre-determined, fixed schedule, or "realtime", displaying live updates of bus positions and expected arrival times. GTFS feeds can range in complexity from shuttles having one route with a few stops to large systems with several routes.

Use Cases

Figure 2 illustrates how transit information is distributed via GTFS through multiple channels to reach visitors. First, the park decides to create a GTFS feed for their transit system. The GTFS is then uploaded to NPS.gov, which displays the transit schedule information. The GTFS is then ingested by third-party navigation apps and NPS digital products. Variable messaging signs and other digital signage can also ingest the feeds and display the transit information. Visitors then consult these endpoints to receive important transit information throughout the Visitor Experience Cycle.

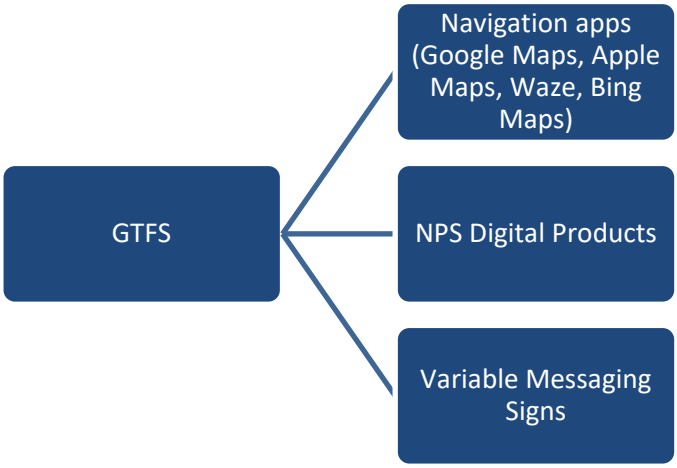

Figure 2. GTFS Process Diagram
Source: U.S. DOT Volpe Center, 2023.

GTFS serves several roles in the trip planning process. Table 2 highlights some use cases where GTFS helps improve the visitor experience based on their existing familiarity with NPS transit systems.

[1] Background. General Transit Feed Specification. https://gtfs.org/background/. *Accessed December 28, 2023*

Table 1. GTFS Use Cases to Improve the Visitor Experience

Familiarity with NPS Transit System	Use Case Example	Major Benefit to Visitors
High	For visitors who are familiar with the NPS transit systems and who are likely already planning to take transit at the park, GTFS offers a convenient way to confirm schedules and routes at the park or prior to arrival. If realtime is enabled, they can track the location of the vehicle, minimize wait times, and follow delays.	Reducing wait times; checking transit status for day/time.
Low	Visitors with limited familiarity with the park may not be aware of available transit options. GTFS integration with popular applications such as Apple and Google Maps can highlight the availability of transit options and communicate information about them to visitors that may not have considered using transit during their visit. Bringing this information directly to visitors on popular third-party navigation apps will increase visitor awareness of and encourage use of park transit services.	Increase confidence that system is operating; mode shift from vehicles to transit.

Source: U.S. DOT Volpe Center, 2023.

Third-Party Navigation Applications

In this report, third-party applications are defined as non-NPS sources of traveler information that can ingest GTFS and display transit information. The most common third-party applications are Google Maps and Apple Maps. Visitors receive transit information from third-party navigation apps throughout the Visitor Experience Cycle.

Overview of Third-Party Navigation Applications

Third-party navigation applications assist users in planning their trips from one location to another, by providing step-by-step information on how to use various multimodal transportation options to reach a given destination. Third-party navigation apps are common, with Google Maps serving as the catalyst for the explosive growth of navigation apps after its introduction of a Google Maps Application Programming Interface (API).[2] NPS visitors use these third-party applications to plan their park visits, especially at urban park or parks served by municipal transit systems.

Third-party navigation apps serve varying audiences and purposes. As such, some apps may make less sense in the NPS transit context or for access within specific parks. For example, Trucker Path and TruckMap are third-party navigation apps geared towards the trucking industry, RV Trip Wizard and Roadtrippers are apps geared towards long-distance road trippers, and Citymapper is an app geared towards urban public transit. Google Maps, Apple Maps, Moovit, Transit, and Bing Maps are all geared towards a broader audience and include multimodal transportation options for route planning. Table 3 provides information on these popular third-party navigation apps. Note that this table is not inclusive of all third-party navigation apps.

[2] What is a Map (Mapping) API? PubNub. https://www.pubnub.com/guides/what-is-a-map-api/. *Accessed November 15, 2023*

Table 2. Third-Party Navigation Apps that Support Transit Users or Agencies

Navigation App	Description
Google Maps	A navigation app that allows users to plan routes, share their location with others, and get trip details such as directions, distances, time required, and tolls. The app provides directions and estimated times of arrival for driving, public transportation, ride sharing services, walking, and cycling. It is the most downloaded third-party navigation app, with over a billion people using Google Maps each month and maps in more than 220 countries and territories. The application also offers offline trip planning capacities.
Apple Maps	A navigation app that is included by default on all Apple Inc. devices. The app provides directions and estimated times of arrival for driving, walking, cycling, and public transportation navigation. The app also offers offline trip planning capacities (for Maps in iOS 17 or later). Maps are available in over 200 regions around the world.
Moovit	A navigation app that helps users plan their trips in an urban area, using different modes of transportation. The app is part of Mobileye, a Mobility as a Service (MaaS) solutions provider. The app serves over 1.7 billion riders in 3,500 cities across 112 countries in 45 languages. The app provides directions for public transportation, ride share services, walking, and cycling navigation. The application also offers offline trip planning capacities.
Transit	A navigation app with the goal to make car-free transportation the default way of getting around and to transform cities for the better. The app provides directions for public transportation, ride share services, cycling, and other modes of micromobility (i.e., scooters) navigation. The app does not offer driving directions. The app only offers offline trip planning capacities for schedule-based transit, biking, and walking options; it does not offer realtime arrivals or trip planning capacities for ridehailing, bikeshare, and scooter trips when offline.
Bing Maps	A navigation app provided as part of Microsoft's Bing suite of search engines and powered by the Bing Maps Platform framework. The map data is provided by TomTom, OpenStreetMap, and others. Although Bing Maps does not offer a mobile application for Android or iOS, it does provide a software development kit (SDK) for creating mapping applications. The app provides directions for driving, public transportation, and walking navigation. However, since the application does not have a trip planner, routes are not optimized in the application. Users have to prioritize and schedule stops based on distance and priority when trip planning. The application does offer offline street maps for some countries when using a Windows 10 application.

Source: U.S. DOT Volpe Center, 2023.

Data Sharing and Legal Agreements

Third-party navigation applications have different types of legal agreements and terms of services in place for partnerships and data sharing. NPS GTFS feeds released as open data under a clear public domain license allow data consumption by third-party navigation apps. Most third-party navigation apps do not require a formal licensing agreement to ingest the data. However, Google Maps usually requires an agency to agree to the terms of its License Agreement as part of the Google Transit Program (a sample agreement can be reviewed here: Google

Transit Agreement (cdn-website.com)).[3] There is no fee to sign the agreement, but it must be digitally signed by an authorized agency representative.

Feed Registries

GTFS feed registries provide feed consumers, such as third-party navigation apps, a way to easily search for existing transit feeds. Data producers submit their validated GTFS feeds to the registries. The most popular GTFS feed registries include The Mobility Database and Transitland.

The Mobility Database, maintained by MobilityData, includes more than 1,800 official GTFS and GTFS realtime feeds from around the globe. The Mobility Database catalog's code is licensed under the Apache 2.0 License and all its metadata is made available under Creative Commons CC0 (CC0), with individual transit feeds subject to the terms & conditions of their own respective data provider.[4]

Transitland, an active registry since 2014, collects and maintains a directory of GTFS, GTFS Realtime, General Bikeshare Feed Specification (GBFS), and other open mobility data feeds from over 2,500 operators in over 55 countries. It provides both an interactive website and APIs for querying feed contents. This registry is maintained by Interline Technologies. Transitland uses an open data platform, meaning that anyone can input feed submissions simply by providing the link to a feed that points to a .zip file hosted by a transit operator or other authoritative source. Once the submitted feed is accepted, the Transitland servers will periodically check this URL for any updates to the contents of the feed. By allowing anyone to submit to the feed rather than just transit organization representative helps Transitland expands its coverage worldwide.[5, 6, 7] Transitland data files are made available under the Community Data License Agreement – Permissive, Version 1.0. This license allows one to use this data for commercial, educational, or research purposes and be able to trust that it's cleanly licensed; duplicate data, as long as you mention (attribute) the source; and use this data to create analyses and derived data (such as geocoding), without needing to provide attribution.[8] Figure 3 illustrates a search for "Grand Canyon National Park" within the Transitland Operators feed registry.

[3] Google Transit Partners Help. Google. https://support.google.com/transitpartners/#topic=3521043. *Accessed November 15, 2023.*
[4] The Mobility Database Catalogs. GitHub. https://github.com/MobilityData/mobility-database-catalogs#license. *Accessed November 15, 2023.*
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[6] Transitland Source Feeds. Transitland. https://www.transit.land/feeds. *Accessed on November 14, 2023.*
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[8] How to Add a New Feed. GitHub. https://github.com/transitland/transitland-atlas#how-to-add-a-new-feed. *Accessed November 30, 2023.*

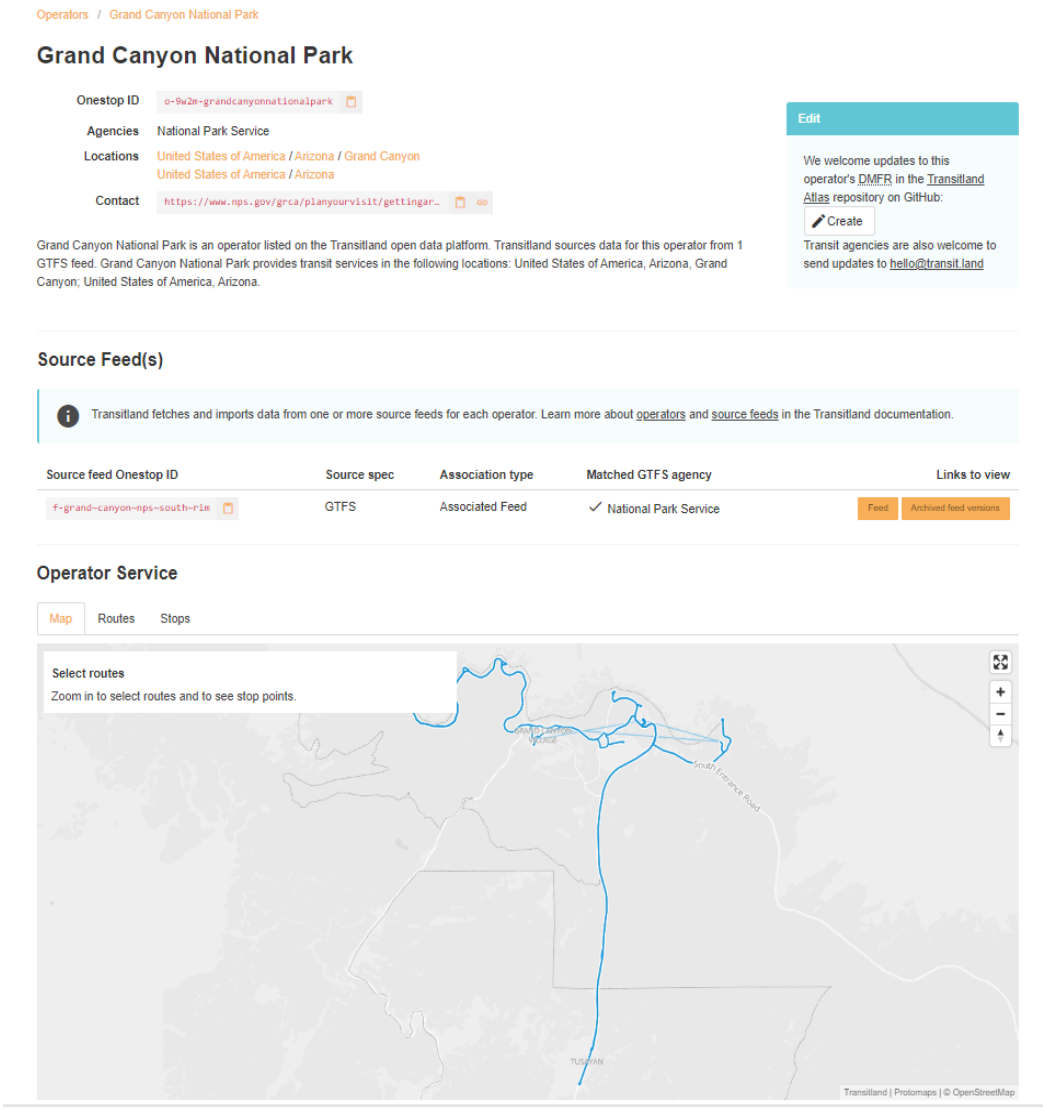

Figure 3. Transitland Feed Registry Search Result for "Grand Canyon National Park"
Source: Screenshot of the TransitLand Database, December 18, 2023.

NPS Digital Products

Currently, the existing static GTFS feeds are hosted on the NPS.gov developer resources page. GTFS could be further integrated into NPS digital products to consistently display transit information on the park maps and the "Plan Your Visit" section of park websites. NPS.gov particularly reaches visitors in the Travel Planning and Park Experience phases. Visitors can consult the NPS.gov website and NPS app to learn about park transit service and connectivity, and potentially choose to visit the park via transit. During the Park Experience phase, visitors could use the NPS mobile application to navigate the transit system when there is limited cell service because static GTFS along with park maps could be downloaded for offline use.

Pilot Summary and Lessons Learned

The parks selected for the GTFS pilot include a variety of operational contexts. NPS staff initially identified suitable park systems based on park interest, ridership, and transit system characteristics. Preference was given to parks that do not require reservations and either have no fee to ride or offer on-site ticket purchases for all trips. A range of modes and system complexities were considered to explore how the process for GTFS feed creation may differ across operational contexts.

Summary of Pilot Parks

Table 3. Summary of Pilot Parks

Park	Transit Contract	Service Dates	Collaborators	Routes	Mode	2022 Ridership	Notes
ACAD	Cooperative	Summer	Downeast Transportation	13	Bus	414,808	Uses Avail Technologies creates and maintains static and GTFS Realtime.
BAND	Cooperative	Summer	Atomic City Transit (ACT)	1	Bus	70,295	ACT creates and maintains static GTFS.
BOHA	Cooperative & Concession	Spring-Fall	Boston Harbor City Cruises	2	Ferry	4,096	Ferries share loading dock with Massachusetts Bay Transportation Authority (MBTA) ferries.
BRCA	Service	Summer	Red Canyon Transit	1	Bus	586,163	Uses TransLoc telematics.
DEWA	Cooperative	Summer	Monroe County Transit Authority	3	Bus	5,434	Feed was not created during pilot due to uncertainty about future operations.
GRCA	Service	Year-round	Paul Revere Transportation	5	Bus	4,348,518	Uses Clever Devices telematics.
GUIS	Concession	Summer	Pan Isles (MS), HMS Ferries (FL)	3*	Ferry	57,529	GUIS owns the FL ferries, but not the MS ferries. Different concessionaires for FL and MS ferries.
HAFE	Service	Year-Round	Eastern Panhandle Transit Authority	1	Bus	356,826	Procuring new buses to be delivered early 2025. Possibility to add CAD/AVL system to new buses.

Park	Transit Contract	Service Dates	Collaborators	Routes	Mode	2022 Ridership	Notes
NAMA	Cooperative	Year-Round	District Department of Transportation (DDOT)	1	Bus	1,201,986	NAMA route is one of several DC Circulator routes operated by DDOT.
ROMO	Service	Summer	Colorado DOT, RATP Dev, and Trillium Transit	3*	Bus	618,464	Trillium Transit creates and maintains static GTFS in partnership with CDOT.
YOSE (Mariposa Grove)	Service	Year-Round	Yosemite Hospitality	2*	Bus	1,015,082	YOSE shuttles have CAD/AVL systems on 16 new-model buses (since 2022). The CAD/AVL systems are under- or not used because the system requires that drivers log on to the onboard units with a four-digit pass code, which they are not doing. Park is determining whether to maintain the system in the future (~$58K per year).
YOSE (YOSE Valley)	Concession	Summer-Fall	Yosemite Hospitality	1	Bus	305,458	See YOSE CAD/AVL note above.
ZION	Service	Spring-Fall	RATP Dev	2	Bus	4,383,151	Recently replaced fleet with electric buses. The possibility to add telematics to new buses. Contract written as 1 year contract with 9 years of options.

Source: NPS and U.S. DOT Volpe Center, 2023.

* Park has additional routes not included in this pilot (i.e., routes not currently operating or not managed by the NPS).

Through the process of engaging with parks and third-party providers and creating GTFS feeds, the following lessons emerged as best practices that are especially relevant in the NPS context.

Lesson One: Start with Quality Data

The greatest determinant of how difficult GTFS feed creation will be is the quality of existing data. For parks with robust transit system data, such as stop locations, schedules, and route shapefiles, the creation of a GTFS feed may be as simple as reformatting existing files. In such cases, the emphasis is on data validation and ensuring that the information aligns with GTFS inputs. For parks without this data, the process will require additional effort to collect high-quality information. Emphasis should be placed on ensuring the accuracy of stop locations and route data, as this can greatly reduce future effort and avoid errors. Parks may also look to external partners or contractors to independently collect or verify initial data.

Lesson Two: Pay Attention to GTFS Feed Maintenance

While the initial feed creation is technically more difficult than ongoing maintenance, this does not mean that a GTFS feed can be neglected. GTFS feeds require ongoing maintenance and should be updated regularly when new schedules take effect. The dynamic nature of transit systems, including changes in schedules, routes, and stop locations, necessitates a proactive approach to maintenance. Regular audits and updates ensure that the GTFS feed remains accurate and reflects the current state of the transit network. Implementing a systematic approach to maintenance, including version control and documentation of modifications, contributes to the feed's reliability and effectiveness over time. Consistent maintenance of GTFS feeds is also valuable to partners. Feeds that are not maintained will be considered “lapsed” by third party navigation apps and may have to undergo additional review before being added, creating more work and confusion for park personnel and partners. Consistent maintenance can avoid this issue. Incorporating GTFS feed maintenance as part of regularly scheduled operations or during seasonal service changes is a recommended best practice to ensure consistent updates.

Lesson Three: Embrace Standardization

Establishing a standardized, consistent approach to GTFS feed creation is valuable for both NPS and feed consumers. Standardization provides a clear framework that simplifies the feed creation and maintenance processes for individual parks, ensuring they understand and follow uniform procedures. A standardized approach also makes it easier to disseminate best practices, fostering a community of learning where experiences and insights can be exchanged, ultimately improving the overall quality of GTFS feeds for all parks. Furthermore, standardization enhances the reliability of the feeds, making them more compatible with various platforms and applications. This, in turn, increases the visibility of NPS transit information to publishers, contributing to a broader dissemination of accurate and consistent data for the benefit of park visitors and the public.

Lesson Four: Communicate with Partners, Understand Contract Scope

Unlike many other emerging technologies, GTFS is already a widespread, well-established standard. As such, the NPS does not need to be the key driver in implementation. In fact, many transit partners or contractors can (and in some cases do) maintain GTFS feeds for their NPS routes with little additional effort, especially compared to the effort required to train new NPS personnel. This underscores the need for clear communication between NPS personnel and the contractor to understand the extent of existing GTFS work to avoid unnecessary duplication of efforts. It is also important to understand the park’s operating model and how the scope of existing contracts impacts the feasibility of creating a GTFS feed in collaboration with the contractor. While the NPS should continue to be engaged in GTFS creation and data validation efforts, it is feasible that these services could be included in the contracts for non-NPS operated systems. The type of contract awarded, and the scope of that contract significantly can impact the GTFS feed creation process. The following section explores the implications of NPS contracting models for parks seeking to create a GTFS feed.

Transit Contracts

NPS transit systems are procured under one of four business models, detailed in Table 5. The implications for each of the transit contract models are discussed below.

Table 4. Transit Contract Types

Model	Description	Number of Systems (Operating in 2022)
NPS Owned and Operated	Fleets are entirely owned and managed by the NPS without the assistance of an outside partner, with staffing by NPS personnel.	20 (owned), 15 (owned and operated)
Cooperative Agreement	The NPS and a local, state, or private nonprofit entity formalize a relationship which involves a transfer of assets and/or services and substantial involvement by both parties, without an expectation of profit.	15
Concession Contract	A private operator pays the NPS a franchise fee to operate inside of the park.	42
Service Contract	The NPS contracts with and pays an outside agency to operate and manage the transit fleet.	9

Source: National Transit Inventory, 2023.

NPS Owned and Operated

Due to the lack of external partners, NPS Owned and Operated fleets will face limited NPS administrative hurdles in incorporating GTFS. However, the lack of partners also means that NPS personnel must become familiar with and maintain the GTFS feed. Most NPS Owned and Operated systems are small or specialized services, meaning that it could be feasible to train an employee to create a basic feed or to create the feed with support from WASO. However, these parks also have limited staff capacity. NPS may consider contracting with a third-party to create and maintain the feed.

Cooperative Agreements

Cooperative Agreements should similarly be able to incorporate GTFS without much difficulty, with the addition of an external partner to assist. There may still be legal implications (i.e., if the partner contracts with a third-party to create their GTFS feeds, rather than making them themselves), but systems operating under a cooperative agreement should discuss the feasibility of GTFS with their partners. Many partners already maintain GTFS feeds for their non-NPS routes and would be able to assist without much additional work.

Concession and Service Contracts

Concession and Service Contracts are comparatively more restrictive. If GTFS was not included in the contracted scope of work, it may not be possible to request it without formally modifying the agreement. Parks may be able to create the feed under their own initiative but should consult with their partners about the best course of action and potential implications of creating a feed external to the contract. Where possible, parks should aim to incorporate the creation of GTFS feeds into future contracts. As GTFS becomes an industry standard, it is expected that most partners will have the technical capacity to create GTFS feeds relatively easily.

Regardless of the business model, park GTFS feeds should be hosted on the NPS website or NPS API. Maintaining a central database will improve access to information for developers and visitors.

GTFS Realtime

GTFS Realtime, or GTFS-rt, is an extension of the static GTFS format. Like static GTFS, it is designed to provide interoperable, standardized access to travel data. However, GTFS-rt also incorporates dynamic data and live updates, including current bus positions, route deviations, vehicle loads and congestion, and service alerts. This can greatly improve the transit experience for visitors, especially for systems with frequent updates to service or deviations from scheduled arrival times. GTFS-rt has many potential benefits in the NPS context, including lowering the barrier to entry for new riders[9], improving the perception of the transit agency[10], and increasing ridership.[11]

To transmit this information, vehicles will need to install a form of onboard trackers to capture and transmit live positioning data. Analysis by Trillium Transit, a transit data company, and the Oregon DOT found that costs to install this software can vary greatly depending on the provider and specifications requested. A basic GPS unit to communicate live position data can range from $250-$1,500 per vehicle, while full Computer Aided Dispatch and Automatic Vehicle Locator (CAD/AVL) systems can start at $500-$3,000 per vehicle for basic tablet-enabled systems, to $8,000 and beyond per vehicle for more complex systems with in-vehicle processing services. N-Catt also found that there are additional costs associated with hardware installation and ongoing support fees. CAD/AVL systems require full integration across the transit fleet and additional operator/manager training, meaning that costs to install can quickly become prohibitive. Yosemite's contract with Avail Technologies includes $58,000 in annual maintenance fees for web hosting and mobile data accounts. Unless parks are interested in pursuing CAD/AVL systems for reasons other than GTFS, the project team recommends that they first explore the simpler, single unit GPS model for real time GTFS. At the time of this report, Acadia, Bryce Canyon, Bandelier, and Yosemite's systems were equipped for live GPS tracking but did not maintain GTFS-rt feeds. CAD/AVL system data is not GTFS-rt compliant by default, and collaboration with the provider will be necessary to determine the steps required to create a valid GTFS-rt feed that integrates with third-party navigation apps.

Since the 2017 report, there have been several improvements to increase the adoption of GTFS-rt and make it easier for transit agencies to create reliable GTFS-rt feeds. Most notably, MobilityData and the University of Southern Florida partnered to create a GTFS Realtime Validator tool, similar to the MobilityData tool recommended for static feed validation. While the tool is still being refined, its creation represents important progress in the widespread viability of quality GTFS-rt data. However, current tools do require a level of familiarity with GTFS and a coding language (protocol buffers) that is higher than would be reasonably expected of most NPS park staff. Most tools available for creating GTFS-rt are designed to run in coding languages like Python and Java. The project team did not identify any tools that are designed to be accessible to users without such experience, comparable to those that exist for static GTFS feed creation. Parks seeking to implement GTFS-rt could consult with a partner experienced in feed creation and validation.

Ferries and other vessels can also be included as GTFS-rt feeds. As part of international situational awareness systems, the vast majority of vessels provide automatic realtime vessel movement between ships and shore stations. For NPS, many vessels' movement is tracked and generally available for public purposes through the

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[9] Cluett, C., Bregman, s., and Richman, J. (2003). Customer preferences for transit ATIS: research report. Battelle Memorial Institute and Multisystems, Inc. https://rosap.ntl.bts.gov/view/dot/4138. *Accessed November 15, 2023.*

[10] Brakewood, C., Barbeau, S., and Watkins, K. (2014). An experiment evaluating the impacts of realtime transit information on bus riders in Tampa, Florida. *Transportation Research Part A: Policy and Practice, 69*, 409-422. https://doi.org/10.1016/j.tra.2014.09.003. *Accessed November 15, 2023.*

[11] Brakewood, C., Macfarlane, G. S., and Watkins, K. (2015). The impact of realtime information on bus ridership in New York City. *Transportation Research Part C: Emerging Technologies, 53*, 59-75. https://doi.org/10.1016/j.trc.2015.01.021. *Accessed November 15, 2023.*

Maritime Safety and Security Information System (MSSIS)[12] and SeaVision.[13] NPS ferries and other vessels are included in these datasets, which could provide an input for GTFS Realtime in the future.

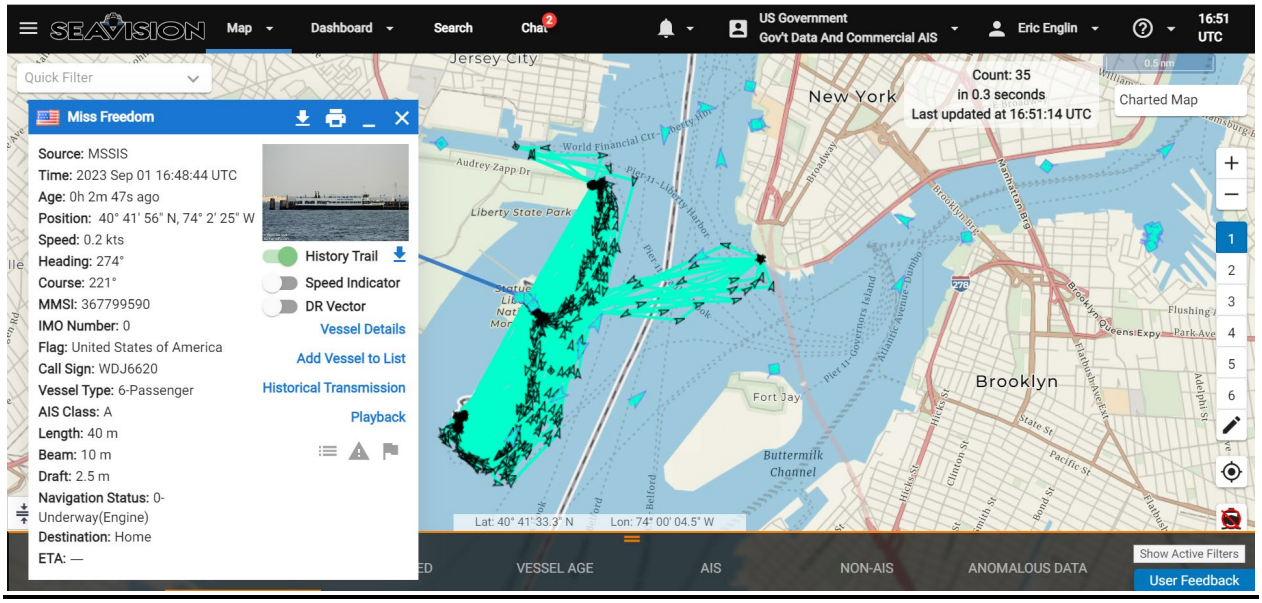

Figure 4. SeaVision Tool Showing Realtime and Historical Locations of Miss Freedom, a Statue of Liberty Vessel
Source: SeaVision, 2023.

[12] Maritime Safety & Security Information System (MSSIS) home page. US DOT Volpe Center. https://mssis.volpe.dot.gov/Main/index.html. *Accessed November 15, 2023.*

[13] SeaVision home page. US DOT Volpe Center. https://seavision.volpe.dot.gov/auth/login. *Accessed November 15, 2023.*

Case Studies

The project team visited Harpers Ferry National Historical Park and Rocky Mountain National Park to better understand potential opportunities and challenges to implementing GTFS in different park contexts.

Harpers Ferry National Historical Park

Harpers Ferry National Park has a simple transit system with one loop route that runs between the central Visitor Center and Lower Town, every 10-15 minutes when the park is open. The cost of riding the bus is included in the park entrance fee. The park implemented this shuttle system because there is limited parking in the Lower Town.

Figure 5. Harpers Ferry National Historical Park Shuttle System
Source: U.S. DOT Volpe Center, 2023.

Despite the consistent and convenient service, there is limited information about the shuttle on the park website or in the visitor center parking lot. The project team talked to several visitors who were unaware of the shuttle service and instead walked the several mile-long trail to and from the Lower Town. To better share traveler information with visitors, the project team created a static GTFS feed for the route. Once the GTFS route is ingested by third-party navigation apps and NPS digital products, visitors will be better informed about transit options. This improvement will dovetail with future improved trip planning information on NPS.gov and signage at the park.

The project team also identified that this transit system could be appropriate for future GTFS-rt implementation. Harpers Ferry is in the process of procuring new transit vehicles. Scheduled to be integrated in 2025, these new buses could be outfitted with GPS-tracking technology. Given that the route is simple and there is already a static GTFS feed, this system could be suitable for GTFS-rt development in 2025. The GTFS-rt could pair nicely with new realtime transit signage at the bus shelters. Park staff acknowledged that this could be beneficial for visitors, but that the signage would need to comply with the park's historical and cultural preservation standards.

Rocky Mountain National Park

Rocky Mountain National Park has three shuttle routes that operate within the park: Bear Lake, Moraine Park, and Hiker Shuttles. Additionally, Bustang operates bus service from Denver Union Station to the Rocky Mountain visitor center during the summer on weekends and holidays. While riding these shuttles is not required, there is limited parking in the popular areas of the park served by the shuttle system. The shuttle systems are an essential component of the park's congestion management strategy.

Figure 6. Visitors Boarding the Bear Lake Shuttle at Rocky Mountain National Park

Source: NPS, 2023.

Despite the convenient service, there is limited information about the shuttle on the park website. For visitors who are unfamiliar with the shuttle system, the information on NPS.gov can be somewhat confusing. For example, the Hikers Shuttle requires paid reservations, but the Bear Lake and Moraine Park shuttle routes do not and are free with the purchase of a park entrance fee.

To better share traveler information with visitors, the project team advocated for creating a static GTFS feed for the park transit system. After talking with park staff, the project team found that Rocky Mountain was already collaborating with the Colorado Department of Transportation (CDOT) and their transit data contractor, Trillium Transit, to create a static GTFS for the park transit system. CDOT had an agreement with Trillium Transit to create static GTFS for all smaller, rural transit agencies in Colorado, including the Rocky Mountain transit system. The project team met with Trillium Transit to secure a copy of the static GTFS feed to include in the NPS repository, to ensure that NPS has a complete dataset of all park GTFS feeds.

During the visit, the project team also noted limited cell connectivity throughout the park. While getting the static GTFS feed on third-party applications will be helpful for visitors when planning their trip, adding the shuttle information in the NPS app will be especially helpful for offline navigation within the park. Therefore, NPS must retain a copy of the Rocky Mountain GTFS feed to integrate in the NPS app. The project team suggests checking-in with CDOT and Trillium Transit annually to collect an updated version of the feed. This case study is an important example of how to best collaborate with regional partners, while maintaining a complete set of GTFS feeds.

Recommendations

This section describes options for the maintenance of static GTFS feeds moving forward, outlines a methodology for prioritizing NPS transit systems for future static GTFS implementation, proposes starting GTFS-rt development, and suggests integrating GTFS information into the NPS digital products.

Recommendation 1: Feed Maintenance Processes

Transit service changes between years and seasons, especially for parks that run seasonal transit. As such, it is important to maintain the static GTFS feeds to ensure visitors receive the most accurate information. For visitors, inaccurate information can be worse than no information. In recognition of this, many partners, such as Google, will proactively pull feeds that are out of date and mark them as lapsed or inactive. Reactivating the feed requires additional review and communication, leading to delays and additional work before the feed can be visible. To keep the transit service information up to date and available, static GTFS feeds should be maintained regularly to reflect any changes to transit routes, schedules, stops, and frequencies. This section outlines possible strategies to ensure that NPS static GTFS feeds are maintained moving forward.

Data Collection Recommendations

To determine how to best optimize service-wide data collection efforts, a better understanding will be needed of what time of the year and how frequently parks update their transit schedules, and whether parks could shift their timing to accommodate process standardization. Three approaches to integrating GTFS data collection are described below.

1. *Coordinate with the National Transit Inventory Process*. The annual NPS National Transit Inventory (NTI) process provides an opportunity to streamline the information gathering required for the creation and maintenance of a GTFS feed. As parks engage in the NTI submission, proactively requesting information such as routes, stops, and schedules can reduce the burden of feed creation and maintenance. This integration aligns with the NTI's overarching goal of maintaining a comprehensive database of transit-related information.
    - Potential challenges with this option include that the Denver Service Center (DSC) currently collects information about the previous year for the NTI, only some of the parks included in the NTI will have a GTFS feed, and the NTI outreach timing might not align with the park transit schedule updating process.
2. *Coordinate with the Transit System Funding Process.* Every year, a subset of parks that support transit systems through use of entrance fee or tickets sale revenue must work with regions and coordinate with WASO to ensure financial sustainability and fund operations. Coordinating this funding process with GTFS data collection could be an efficient opportunity to align processes.
    - Potential challenges with this option include that the transit system funding process outreach timing might not align with the park transit schedule updating process, and that not all transit systems undergo this transit system funding process if the system does not use entrance fees or ticket sales revenue.
3. *Establish a new Outreach Process*. WASO could choose to establish a new process, separate from the NTI or transit system funding process, to collect updated GTFS information. The WASO transit and ferry lead would reach out to the contact at each transit system with an existing GTFS and request updated transit schedule information. This outreach would ideally occur at the same time each year before the spring season and after transit scheduling has been completed at the park.

- Potential challenges with this option include WASO capacity to complete this outreach and increasing the reporting burden on parks.

Regardless of which process NPS chooses, the project team noticed that many park transit systems update their transit schedule multiple times a year at different times, making a single point of communication and data collection challenging.

The project team recommends that the following data fields be integrated in the data collection process to facilitate static GTFS feed creation.

- Public facing agency phone number and contact email (if applicable)
- Public facing agency website URL (if applicable)
- Number of routes
- For each route:
  - Route name
  - Color associated with each route (hex code if applicable)
  - Route timetable (stop names, latitudes and longitudes, first stop times)
  - Days of operation
  - Seasons of operation (specific start and end dates or indicate year-round operation)
  - Whether the vehicle always stops at each stop on the route or whether it changes depending on the day of the week or time of day
  - Special days when the route is not in service (federal holidays, etc.)
  - Whether the route is a loop or if it has distinct inbound and outbound patterns
  - Frequency (time between vehicles) and whether it changes with certain days of the week, seasons, or times of day.
  - Dwell time (time spent at scheduled stops)
  - Whether riders can bring bikes on the vehicle
  - Whether the route is wheelchair accessible
  - Information about fares
  - Route shapefile

The project team also recommends integrating the presence of working GPS tracking software and a shuttle telematics provider as data fields to facilitate future GTFS-rt feed creation.

Maintenance Recommendations

Using the data collected in the previous section, the project team recommends that GTFS feeds be updated at least once a year, or any time the transit schedule is updated, to ensure that visitors engage with up-to-date traveler information. Several approaches to maintaining the GTFS feeds are described below.

1. *Operating Partners Maintain the Feeds.* Parks that operate transit through a service, concession contract, or agreement should consider requiring the contractor to create and maintain a GTFS feed. Given GTFS' widespread adoption and the new NTD requirement, contractors should be familiar with the format and be able to do this at a low cost. This task could be written into the individual contracts and agreements between the parks and service providers. The exact costs will change depending on the specifics of the agreement and the complexity of the route.

2. *WASO Maintains the Feeds***.** The additional labor and cost could be a burden on some parks, and so, to support the parks and achieve efficiency, WASO could assume annual maintenance responsibilities of all GTFS feeds. A transportation contractor or partner could perform the annual updates for all GTFS feeds in coordination with WASO, regions, and parks.
3. *Park Units Maintain the Feeds***.** Static GTFS feed creation and maintenance can be straightforward for those familiar with the process, so the parks themselves could potentially maintain the feeds. This would require one staff member, typically on an annual basis, to ensure the routes, stops, and schedules are up to date from year to year. Once the transit schedule is finalized, updating the GTFS should only take two or three hours. Most parks' annual update cycles mean that staff, specifically seasonal staff, would essentially need to re-learn the details of GTFS feeds every year. As such, it would be the least preferred option of the three recommendations.

Given these three approaches, the project team recommends transitioning feed maintenance to the operating partners when possible (approach #1) and then having a support partner fill in the gaps as needed (approach #2). The project team also recommends that NPS explore developing an automated GTFS creation tool to ideally integrate GTFS data collection and feed maintenance. Parks would submit their transit schedule information in a structured format through an NPS form or application, and that would trigger an automatic update of the GTFS feed (via the NPS API) and the transit schedules on the NPS.gov website.

Regardless of which options are chosen for long-term data collection and feed maintenance, the project team recommends that all feeds continue to be stored at or linked from NPS's central repository. Having the feeds available in one central location makes it easier for NPS developers and third-party applications to consume the data and ensure that this open data is kept up to date. NPS could also start integrating the GTFS feeds into the NPS API to further facilitate feed consumption.

Recommendation 2: Continued Static GTFS Creation

The project team developed the following prioritization methodology to determine which park transit systems should be considered for future GTFS feed creation. To develop these options, the project team considered several data fields identified in the 2022 NTI, including: mode, ridership, purpose of the transit system, and fleet system ownership by business model.

NTI Fields

Vehicle Type

The NTI included 43 shuttle/bus/van/tram, 32 ferry/boat, 4 train/trolley, and 2 aircraft systems that operated in 2022. The project team determined that all vehicle types are eligible for static GTFS, except aircraft systems. Visitors who are interested in using aircraft systems are more likely to consult NPS.gov and other information sources to plan their engagement with the aircraft system. GTFS is likely less useful to these users because aircraft systems do not allow for "hop on / hop off" usage in the way that shuttles, ferries, and trains do.

Ridership

The highest ridership transit system, the Statue of Liberty Ferries, saw 6,993,000 annual passenger boardings in 2022, and several transit systems included in the NTI saw zero passenger boardings because the system did not operate. The project team found that ridership should be weighed heavily when prioritizing park systems for GTFS feed implementation. By prioritizing high ridership park transit systems, NPS can provide the largest benefit to visitors and maximize limited resources. Additionally, parks with higher ridership are likely to have park personnel

dedicated to working on transit and have the data needed to easily create GTFS feeds. Larger systems are also likely to be attractive for partners, who will be interested in sharing system information with a larger audience.

For the purpose of selecting park systems for the next phase of static GTFS creation, the project team considered systems with ridership above 50,000 as high ridership systems. A higher cutoff could be considered if resources are limited.

Primary Purpose
In the NTI, staff identified each park transit system's primary purpose as one of five options:

- Guided interpretive tours,
- Providing critical access to a park or site not readily accessible due to geographic constraints, park resource management decisions, or parking lot congestion,
- Providing mobility to or within a park as a supplement to private automobile access
- Transportation feature, where the transit system is considered a primary attraction of the park,
- Meeting the accessibility needs of a visitor with special needs.

The project team recommends that providing critical access and mobility to or within a park be prioritized for GTFS creation, and the project team recommends excluding systems categorized as guided interpretive tours from future GTFS creation.

Fleet System Ownership by Business Model
In the NTI, staff identified four types of business models under which NPS transit systems operate, which are detailed in Table 5. The project team proposes that park transit systems first be prioritized for static GTFS implementation by purpose and ridership, as described in the next section. However, as NPS works to establish formalized GTFS feed creation and maintenance processes, it may be easier to implement GTFS feeds for some parks in the short term based on their business model. The project team proposes that ownership type should not be used to prioritize parks, but that NPS should consider each park's business model and context throughout the GTFS feed creation process, as ownership type strongly impacts the feasibility of GTFS feed implementation.

Phase II Static GTFS Options
The project team developed several options for the next phase of park transit system static GTFS creation. These options are outlined in greater detail in the sections below.

A. All ferry systems with passenger boardings over 50,000 (excluding interpretive tours).
B. Shuttle, train, and trolley systems with passenger boardings above 50,000 (excluding interpretive tours).
C. Shuttle, train, and trolley systems with passenger boardings below 10,000 (excluding interpretive tours).
D. Non-transportation transit (e.g. interpretive tours) with passenger boardings over 50,000.

Option A: High Ridership Ferries
This option includes creating static GTFS feeds for high ridership ferry systems. Ferry systems are often simple, with one or two routes and seasonal service. Creating GTFS feeds for these systems would be a low level of effort for the project team. The MSISS system described in the Pilot Summary and Lessons Learned section would also enable the project team to create GTFS-rt for many of the ferry systems in future phases and having static GTFS for these ferry systems is a necessary basis for creating the realtime feeds. There are 32 ferry systems included in the 2022 NTI that were operating in 2022, 14 of which are interpretive tours and three of which already have a static

GTFS. The remaining nine non-interpretive tour ferry systems with ridership above 50,000 recommended as Option A are detailed in Table 11 in Appendix B.

Option B: High Ridership Shuttle, Train, and Trolley Systems
This option includes shuttle, bus, van, tram, train, or trolley systems with 2022 annual passenger boardings above 50,000. This option includes 22 systems that were operating in 2022, two of which are interpretive tours and 11 of which already have static GTFS. The remaining nine non-interpretive tour shuttle and train systems recommended as Option B are detailed in Table 12 in Appendix B.

Option C: Low Ridership Shuttles, Trains, and Trolley Systems
This option includes shuttle, train, and trolley systems with annual passenger boardings below 50,000. This option includes 24 systems that were operating in 2022, twelve of which are interpretive tours and one of which was already considered for static GTFS (DEWA Hiker Shuttle). The remaining 11 non-interpretive tour shuttle and train systems listed as Option C are detailed in Table 13 in Appendix B.

Option D: Non-Transportation Transit (Interpretive Tours)
This option includes any vehicle type with 2022 annual passenger boardings above 50,000 with an interpretive tour primary purpose. This option includes five systems that were operating in 2022. The interpretive tour systems listed as Option D are detailed in Table 14 in Appendix B.

Phase II Static GTFS Creation Recommendation
For Phase II static GTFS creation, the project team recommends prioritizing high ridership ferry, boat, shuttle, bus, tram, train, and trolly systems (Options A and B), excluding systems with an interpretive tour primary purpose and systems that already have static GTFS feeds. The project team proposed excluding guided interpretive tours, because these types of transit systems are not necessarily a part of a visitor's travel to or within the park. Visitors who are interested in using these systems are more likely to consult NPS.gov and other information sources to plan their engagement with the interpretive tours. For the purpose of selecting park systems for the next phase of static GTFS creation, the project team considered systems with ridership above 50,000 as high ridership systems. Focusing on the higher ridership systems will ensure that investment in traveler information will reach the greatest number of visitors. The 18 transit systems recommended for Phase II Static GTFS Implementation are detailed in Table 7. During the next phase of work, the project team will further explore the appropriateness of GTFS for each recommended park system, given the specific system context.

Table 5. Recommended NPS Transit Systems for Phase II, Sorted by 2022 Passenger Boardings

Park Code	System Name	Vehicle Type	2022 Passenger Boardings	Vehicle Ownership	Agreement Type	Purpose
STLI	Statue of Liberty Ferries	Ferry/Boat	6,993,087	Non-NPS	Concession Contract	Critical Access
GOGA/ ALCA	Alcatraz Cruises Ferry	Ferry/Boat	1,327,939	Non-NPS	Concession Contract	Critical Access
SEKI	Giant Forest Shuttle	Shuttle/ Bus/ Van/ Tram	733,477	Non-NPS	Cooperative Agreement	Critical Access
DINO	Tram Transit	Shuttle/ Bus/ Van/ Tram	350,668	Non-NPS	Service Contract	Critical Access

DENA	Bus Tours and Shuttle Service	Shuttle/ Bus/ Van/ Tram	340,258	Non-NPS	Concession Contract	Critical Access
FOSU	FOSU Ferry Service	Ferry/Boat	284,380	Non-NPS	Concession Contract	Critical Access
GRTE	Jenny Lake Shuttle Boat	Ferry/Boat	238,920	Non-NPS	Concession Contract	Mobility to or within Park
MACA	Green River Ferry	Ferry/Boat	189,310	NPS	NPS Owned and Operated	Transportation Feature
GLAC	Visitor Transportation System	Shuttle/ Bus/ Van/ Tram	165,631	NPS	NPS Owned and Operated	Mobility to or within Park
CUVA	Cuyahoga Valley Scenic Railroad	Train/Trolley	100,481	Non-NPS	Cooperative Agreement	Mobility to or within Park
CALO	CALO Ferry Service	Ferry/Boat	97,484	Non-NPS	Concession Contract	Critical Access
CHIS	Island Packers	Ferry/Boat	80,223	Non-NPS	Concession Contract	Critical Access
MUWO	Muir Woods Shuttle	Shuttle/ Bus/ Van/ Tram	75,310	Non-NPS	Cooperative Agreement	Mobility to Or Within Park
FOMA	FOMA Ferry Service	Ferry/Boat	71,464	NPS	NPS Owned and Operated	Critical Access
DRTO	DRTO Ferry Service	Ferry/Boat	59,782	Non-NPS	Concession Contract	Critical Access
DEPO	Reds Meadow Shuttle Bus	Shuttle/ Bus/ Van/ Tram	54,013	Non-NPS	Cooperative Agreement	Critical Access
CACO	Coastguard Beach Shuttle	Shuttle/ Bus/ Van/ Tram	53,988	NPS	NPS owned and operated	Critical Access
PINN	Pinnacle Shuttle	Shuttle/ Bus/ Van/ Tram	52,475	NPS	NPS Owned and Operated	Mobility to or within Park

Source: National Transit Inventory, 2022.

Recommendation 3: GTFS on NPS Digital Products

The project team also recommends integrating the GTFS information into NPS digital products, such as the NPS app and NPS.gov, to consistently display accurate transit information. The project team recommends working with the NPS Digital Strategy Division to add the static GTFS information to the park maps on NPS.gov and in the NPS app. Visitors could consult the NPS.gov website and NPS app to learn about park transit service and connectivity more easily, and potentially choose to visit the park via transit. Visitors could also use the NPS app to navigate the transit system when there is limited cell service because the park maps can be downloaded for offline use.

Eventually, the project team recommends standardizing the transit information provided on the "Plan Your Visit" section of park websites using the GTFS fields, such as standardized timetables. The project team also recommends incorporating GTFS-rt in the NPS app.

Recommendation 4: Realtime GTFS

In addition to maintaining the existing static GTFS feeds and creating static GTFS feeds for the next round of applicable park transit systems, the project team recommends creating and/or sharing GTFS-rt feeds for five to 10 transit systems. GTFS-rt incorporates dynamic data and live updates, including current bus positions, route deviations, vehicle loads and congestion, and service alerts. This can greatly improve the transit experience for visitors, especially for systems with frequent updates to service or deviations from scheduled arrival times. GTFS-rt is discussed in more detail in Pilot Summary and Lessons Learned Section.

Recommendation: Pilot Realtime GTFS at Five to Ten Transit Systems

GTFS-rt requires onboard vehicle trackers to capture and transmit live positioning data. Given the costs associated with installing GPS tracking software, the project team recommends starting by creating a GTFS-rt for park transit system that are already equipped for live GPS tracking, to initially demonstrate the value of GTFS-rt. At the time of this report, Acadia, Bandelier, Bryce Canyon, Grand Canyon, and Yosemite's transit systems were equipped for live GPS tracking but did not maintain GTFS-rt feeds. Table 8 illustrates considerations related to GTFS-rt for each of these park transit systems.

Table 6. Park Transit System Options for GTFS-rt

Park Code	Transit System Name	Number of Routes	Status of GPS Tracking System	Percent of Transit Route Covered by Three or More 4G LTE Carriers	Static GTFS
ACAD	Island Explorer and Bicycle Express	11	Working	49%	Yes, maintained by Downeast Transportation
BAND	Bandelier National Monument	1	Working	65%	Yes, maintained by Atomic City Transit
BRCA	Bryce Canyon Shuttle	1	Working	86%	Yes
GRCA	South Rim Shuttle	5	Broken	26%	Yes
YOSE	Yosemite Valley Shuttle	2	Implementation issues with bus drivers.	82%	Yes

Source: NPS and U.S. DOT Volpe Center, 2023.

Based on this comparison, the project team recommends starting with creating GTFS-rt for Acadia and Bryce Canyon's transit systems.

Acadia's transit operation partner, Downeast Transportation, contracts with Avail Technologies. The Downeast Transportation buses already have CAD/AVL systems, and Avail Technologies maintains static GTFS and GTFS-rt feeds. Starting with Acadia will allow the project team to familiarize themselves with GTFS-rt and determine a hosting location and process for GTFS-rt on NPS.gov.

After gaining familiarity with the GTFS-rt format and determining a hosting location and process, the project team recommends creating GTFS-rt for the Bryce Canyon Shuttle system. The Bryce Canyon Shuttle system is simple,

with only one route, and has working GPS location trackers as demonstrated by this dedicated shuttle tracking website. Ideally this information can be integrated into BRCA's trip planning pages. Adding this information to the NPS.gov website as the authoritative realtime source will address some of these data security concerns while also providing realtime traveler information to a broader audience of park visitors.

Figure 7. Bryce Canyon National Park Shuttle Logo
Source: Bryce Canyon National Park, 2023.

Approximately 86% of the Bryce Canyon transit system is covered by three or more 4G LTE carriers, the highest percentage of coverage of the park transit systems considered. Park visitors will need cell reception to utilize GTFS-rt, therefore making Bryce Canyon a good option for piloting GTFS-rt.

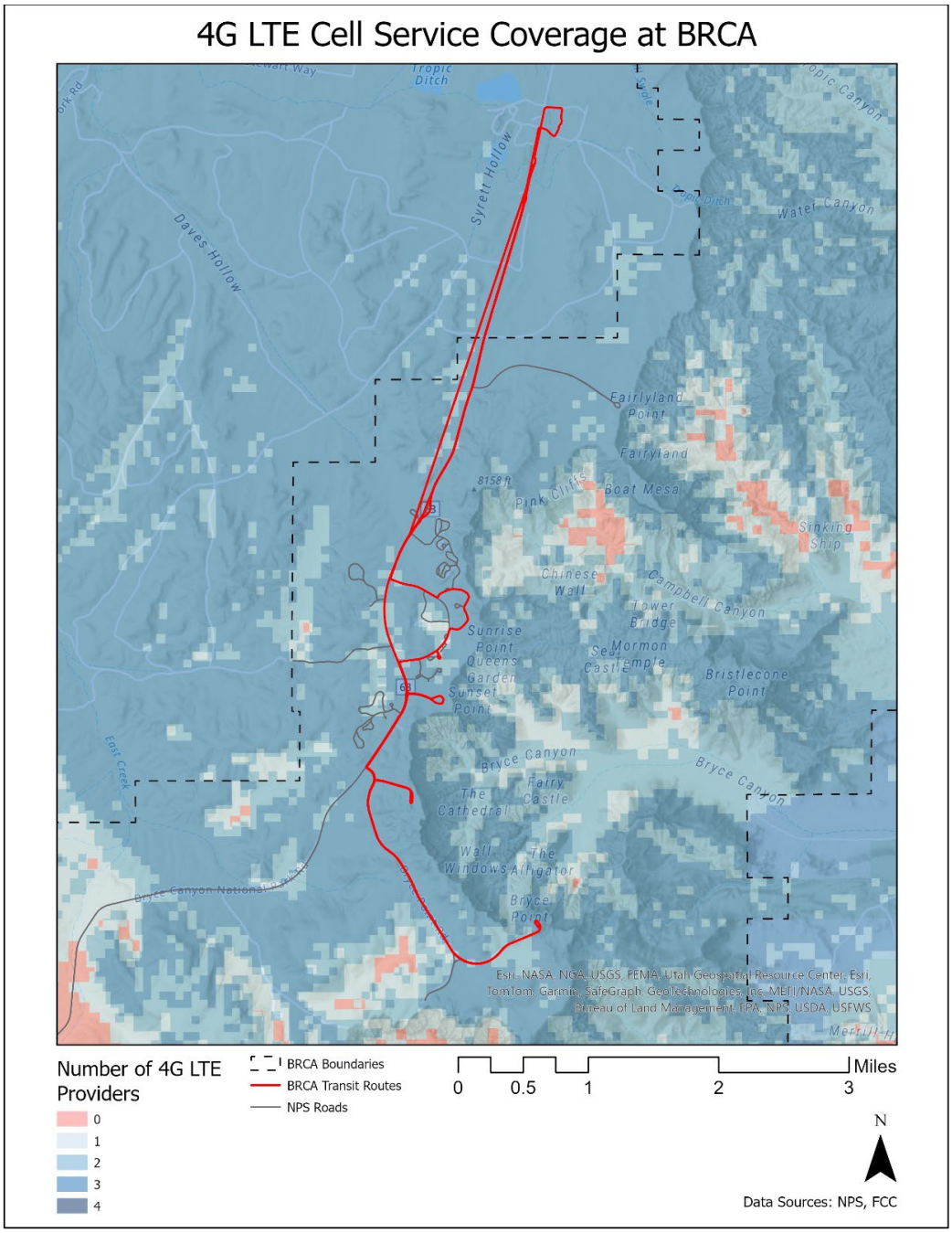

Figure 8. Cell Coverage at Bryce Canyon

Source: Federal Communications Commission, 2023.

Red Canyon Transit operates Bryce Canyon's shuttle bus operation, with a contract in effect through March 2027. As part of the contract, Red Canyon Transit is required to provide shuttles with telematics and maintain a dedicated shuttle tracking website. Red Canyon Transit partnered with RideSystems , which was acquired by TransLoc to provide the shuttle tracking website service. Collaborating with Red Canyon Transit and TransLoc will be an essential component of implementing GTFS-rt at Bryce Canyon.

In addition to the transit systems that are already equipped for live GPS tracking, the project team recommends exploring creating GTFS-rt for the Boston Harbor Islands, Harpers Ferry, Muir Woods, and the National Mall (DC Circulator) transit systems.

- The static GTFS for Boston Harbor Islands was created as part of this initial pilot, and the realtime position data for the ferries should be available on SeaVision or MSSIS. This will be a good case study for understanding the feasibility of creating GTFS-rt based on MSISS information, discussed in further detail in the sections below.
- Harpers Ferry and Muir Woods are not yet equipped for live GPS tracking. During this phase of the pilot the project team may explore options for procuring GPS tracking equipment in the context of these systems.
- Finally, the project team recommends using the National Mall (DC Circulator) system to explore GTFS-rt creation in partnership with a local agency. The project team would coordinate with the District Department of Transportation (DDOT) to understand their GPS location tracking system, or lack thereof.

GTFS-rt Implementation

Current tools to create GTFS are based on protocol buffers, a language-neutral structured data type, and the required and optional field elements are described in detail at the Mobility Data GTFS-rt website. The project team recommends that the first step to implement the GTFS-rt feeds would be to meet with the Information Resources Directorate to determine how to best host the GTFS-rt data on NPS.gov. Continued collaboration with the Information Resources Division will be needed to understand the best practices for data storage and security, as well as how to best integrate the GTFS-rt feed with the NPS digital products.

Consider Piloting GTFS-rt for all Ferries in 2025/2026

The project team recommends that WASO begin to explore ferry vessel locations using MSSIS data (i.e. SeaVision). These tools can provide vessel locations updated up to every 10 seconds. The project team coordinated with the Massachusetts Bay Transportation Authority (MBTA) who is exploring MSSIS data integration into their ferry GTFS-rt feeds. If successful, NPS may be able to leverage their processes and lessons learned to integrate NPS ferry locations into a GTFS-rt feed for all NPS ferries.

Conclusion

This report provided an overview of the 2023 GTFS Pilot Project, detailed lessons learned from the pilot project, and outlined recommendations for future GTFS implementation for park transit systems. By investing in static and GTFS-rt creation, the NPS can continue to improve traveler information and the visitor experience.

Figure 9. Harpers Ferry National Historical Park Shuttle

Source: U.S. DOT Volpe Center, 2023.

Appendix A: Best Practices for Creating Static GTFS

Although GTFS is intended to serve as a standardized solution for transit information, unique operational contexts specific to each park, such as transit contract status, frequency of schedule changes, and park organization, may impact the procedure used to create a GTFS feed. Nonetheless, the following best practices serve as a useful starting point for parks intending to create a static GTFS feed.

Creating and Managing GTFS Feeds

GTFS feeds require a minimum of six text files, described in Table 9.

Table 7. Required GTFS Text Files

File	Description
Agency	This file provides information about the transit operator, including their name and contact information.
Routes	This file lists the routes served by the transit agency and includes basic information like their name, route type, and color to be used on mapping software.
Trips	This file lists each individual trip operated by the transit agency and the route that it follows. This also includes accessibility information for the entire trip.
Stops	This file lists the name and coordinates of each stop that is served by the transit agency. It can also include stop by stop accessibility information for trips with limited wheelchair accessibility.
Stop Times	This file lists the time that the transit vehicle is scheduled to arrive at each stop along its route. This table can also include any scheduled dwell/rest times at certain stops.
Calendar	This file lists the dates that each service schedule is in operation. For example, this table will contain information about when a route switches from a summer schedule to a fall schedule.

Source: National Rural Transit Assistance Program GTFS Builder, 2023.

GTFS feeds can contain several optional files that provide additional details about the transit system and route. The following fields are likely to be useful for NPS GTFS feeds:

Table 8. Optional GTFS Text Files

File	Description
Calendar Dates	This file lists dates with exceptions to regularly scheduled service, such as holiday or special event schedules.
Shapes	This file contains information about the route that the transit vehicle will follow. Without a completed shapes table, the route will not display the path it travels on mapping software.
Feed Info	This file contains information about the developer and the version history of the feed. This field is especially recommended if the feed is created and maintained by a contractor outside of the transit agency.

Fare Attributes	This file contains fare payment information and details on how fares are collected. While many NPS shuttles are free, this table is recommended for routes that collect fares.
Fare Rules	This table communicates how the Fare Attributes table will be applied. This table helps communicate when fares are variable based on attributes like trip distance or route choice.

Source: National Rural Transit Assistance Program GTFS Builder, 2023.

A full list of GTFS files and more information on required fields within in each file can be found on the GTFS reference page.[14]

Compared to municipal or regional transit agencies, which typically operate many routes with frequent schedule changes, NPS transit agencies usually operate only a few routes and have a relatively limited number of schedule changes. NPS transit systems typically operate seasonal service and update their transit schedules a few times a year.

Some park transit services operate in partnership with State DOTs, Metropolitan Planning Organizations (MPOs), or private contractors. While ongoing communication and cooperation between partners is essential, the NPS should serve as the authoritative source of any NPS specific feed data. This means that park staff should proactively update GTFS information as new transit schedule information becomes available and check the published feed for any errors on at least an annual basis. Ongoing communication with partners can help avoid any discrepancies in feed data.

Tools and Software

The authors of the 2017 GTFS pilot report identified two primary categories of GTFS-creation software:

- Proprietary transit schedule management software. These perform many transit scheduling tasks, including generating a GTFS feed.
- Stand-alone management tools, which are often open source.

For parks with an existing partnership with a transit data contractor, such as Trillium Transit or Avail Technologies, using propriety transit schedule management software may be a viable option, depending on the scope of the partnership and transit contract. While NPS would remain the provider and owner of the information for the feed, the park's role in creating, publishing, and maintaining the feed would be limited. Many contractors offer GTFS feed creation for little to no additional cost on top of their standard offerings, making this an attractive option for parks that have already committed to paying for an external transit contractor. However, this option is less viable for parks with smaller systems or limited budgets.

Stand-alone, open-source tools offer a convenient way for park staff to create a GTFS feed without external assistance. Since the 2017 report, GTFS tools have improved and continually lowered the barrier for new feed creation. While several tools are in various stages of development, the project team explored two recommended tools due to their longevity and quality of documentation, making them reliable choices for new feed creation.

[14] GTFS Schedule Reference. General Transit Feed Specification. https://gtfs.org/schedule/reference/. *Accessed December 28, 2023*

The primary open-source tool recommendation is the National Rural Transit Assistance Program (RTAP)'s GTFS Builder.[15] National RTAP offers extensive, step-by-step documentation for their tool and offers consistent maintenance and support for users. The tool is best for smaller systems but has the capacity to handle larger systems. National RTAP's tool also contains internal verification mechanisms and macros to help automate and ensure the consistency of many steps of the feed building process.

For parks utilizing GIS software, ESRI (the developer of the ArcGIS product line) has released a GTFS toolkit that can assist in creating stop data and shapefiles.[16] This requires some experience with ArcGIS/GIS software but can be a more efficient method for parks already utilizing these systems for other purposes. Due to the need to combine the ESRI toolkit with another tool to create the rest of the feed and the potential learning curve, this method is not recommended for parks without existing GIS infrastructure in place.

Once the feed has been created, it should be tested using an external validator to ensure consistency and catch any errors prior to publication. For this pilot, the research team utilized the Mobility Data Canonical GTFS Validator, which checks for both required fields and best practices and contains useful documentation explaining any errors and how to resolve them.[17] Several other verification tools exist; however, this is the most recommended and well-maintained tool for static GTFS validation.

Feed Storage

Maintaining a consistent, easily accessible online location to host GTFS feeds is important to ensure that external developers can incorporate the feed into their products. Discussions with third-party navigation apps confirmed that if there is a reliable, well-maintained source of GTFS data, they will be significantly more likely to utilize that feed in their product. Following the recommendations from the 2017 report, this pilot resulted in the creation of a centralized NPS repository to host the feeds that have been created. The NPS GTFS repository contains links to zipped GTFS feeds the park homepage, the park transit page, and contains information about the feed validity and any special notes.[18] Third-party navigation apps can pull directly from the NPS database and may set up automatic refreshes to receive timely updates. This creates a definitive source of information about park transit feeds and reduces ambiguity and confusion over where to find the most current schedules.

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[15] GTFS Builder. National Rural Transit Assistance Program. https://www.nationalrtap.org/Technology-Tools/GTFS-Builder. *Accessed December 28, 2023.*

[16] An overview of the Transit Feed (GTFS) toolset. Esri ArcGIS Pro. https://pro.arcgis.com/en/pro-app/latest/tool-reference/conversion/an-overview-of-the-transit-feed-gtfs-toolset.htm. *Accessed December 28, 2023.*

[17] Canonical GTFS Schedule Validator. MobilityData. https://gtfs-validator.mobilitydata.org/. *Accessed December 28, 2023.*

[18] General Transit Feed Specification Files. National Park Service. https://www.nps.gov/subjects/developer/gtfs.htm. *Accessed December 28, 2023.*

Appendix B: Static Feed Creation Options

Option A: High Ridership Ferries

Table 9. Option A, Sorted by 2022 Passenger Boardings

Park Code	System Name	2022 Passenger Boardings	Vehicle Ownership	Agreement Type	Purpose
STLI	Statue of Liberty Ferries	6,993,087	Non-NPS	Concession Contract	Critical Access
GOGA/ ALCA	Alcatraz Cruises Ferry	1,327,939	Non-NPS	Concession Contract	Critical Access
FOSU	FOSU Ferry Service	284,380	Non-NPS	Concession Contract	Critical Access
GRTE	Jenny Lake Shuttle Boat	238,920	Non-NPS	Concession Contract	Mobility to or within Park
MACA	Green River Ferry	189,310	NPS	NPS Owned and Operated	Transportation Feature
CALO	CALO Ferry Service	97,484	Non-NPS	Concession Contract	Critical Access
CHIS	Island Packers	80,223	Non-NPS	Concession Contract	Critical Access
FOMA	FOMA Ferry Service	71,464	NPS	NPS Owned and Operated	Critical Access
DRTO	DRTO Ferry Service	59,782	Non-NPS	Concession Contract	Critical Access

Source: National Transit Inventory, 2022.

Option B: High Ridership Shuttles, Trains, and Trolleys

Table 10. Option B, Sorted by 2022 Passenger Boardings

Park Code	System Name	2022 Passenger Boardings	Vehicle Ownership	Agreement Type	Purpose
SEKI	Giant Forest Shuttle	733,477	Non-NPS	Cooperative Agreement	Critical Access
DINO	Tram Transit	350,668	Non-NPS	Service Contract	Critical Access
DENA	Bus Tours and Shuttle Service	340,258	Non-NPS	Concession Contract	Critical Access
GLAC	Visitor Transportation System	165,631	NPS	NPS Owned and Operated	Mobility to or within Park

CUVA	Cuyahoga Valley Scenic Railroad	100,481	Non-NPS	Cooperative Agreement	Mobility to or within Park
MUWO	Muir Woods Shuttle	75,310	Non-NPS	Cooperative Agreement	Mobility to Or Within Park
DEPO	Reds Meadow Shuttle Bus	54,013	Non-NPS	Cooperative Agreement	Critical Access
CACO	Coastguard Beach Shuttle	53,988	NPS	NPS owned and operated	Critical Access
PINN	Pinnacle Shuttle	52,475	NPS	NPS Owned and Operated	Mobility to or within Park

Source: National Transit Inventory, 2022.

Option C: Low Ridership Shuttles, Trains, and Trolleys

Table 11. Option C, Sorted by 2022 Passenger Boardings

Park Code	System Name	2022 Passenger Boardings	Vehicle Ownership	Agreement Type	Purpose
LOWE	LOWE Historic Trolley	17,838	NPS	NPS Owned and Operated	Mobility to or within Park
EISE	EISE Shuttle	9,945	Non-NPS	Concession Contract	Critical Access
GLBA	Airport Shuttle	8,782	Non-NPS	Concession Contract	Transportation Feature
SEKI	Gateway Shuttle	7,438	Non-NPS	Cooperative Agreement	Mobility to or within Park
HOER	FDR Tram	5,254	NPS	NPS Owned and Operated	Mobility to or within Park
BLRI	Sharp Top Mountain Shuttle	5,138	Non-NPS	Concession Contract	Transportation Feature
GLAC	GLAC Hiker Shuttle	3,007	NPS	Concession Contract	Mobility to or within Park
WOTR	Fairfax Connectors Wolf Trap Express	2,663	Non-NPS	Service Contract	Mobility to or within Park
EUON	NPS Shuttle	1,386	NPS	NPS Owned and Operated	Critical Access
YOSE	Winter Ski Shuttle	419	Non-NPS	Concession Contract	Mobility to or within Park
SCBL	SCBL Free Shuttle Service	15	NPS	NPS Owned and Operated	Mobility to or within Park

Source: NPS National Transit Inventory, 2022.

Option D: High Ridership Non-Transportation (Interpretive Tours)

Table 12. Option D, Sorted by 2022 Passenger Boardings

Park Code	System Name	Vehicle Type	2022 Passenger Boardings	Vehicle Ownership	Agreement Type
PERL	USS Arizona Memorial Tour	Ferry/Boat	766,055	Non-NPS	Cooperative Agreement
PERL	Missouri/PHAM Shuttle	Shuttle / Bus / Van / Tram	294,601	Non-NPS	Cooperative Agreement
NAMA	Big Bus Tours Washington DC	Shuttle / Bus / Van / Tram	167,097	Non-NPS	Concession Contract
GLAC	Glacier Park Boat Company interpretive boat tours	Ferry/Boat	120,676	Non-NPS	Concession Contract
PIRO	Pictured Rocks Cruises	Ferry/Boat	103,543	Non-NPS	Concession Contract

Source: National Transit Inventory, 2022.