Yellowstone National Park

Sustainable Solutions for Visitor Access

Mandi Roberts

Aerial view of the Grand Prismatic Spring, Midway Geyser Basin, Yellowstone National Park

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Sustainable Solutions for Visitor Access

Exploring Shuttling Options with Connecting Hiking and Bicycling Trails and Unique Visitor Experiences in the Geyser Basin Corridor from West Yellowstone to Old Faithful

By Mandi Roberts

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Everyone always says this, but I REALLY mean it—I could not have done this project without you. Thank you!

Dad, enjoying a visit to White Dome Geyser, August 2018, during one of several study trips to the park

"Individually, we are one drop. Together, we are an ocean."
– Ryunosuke Satoro

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Preface

As a professional landscape architect and planner who has worked across the West and beyond for more than 30 years, my project assignments often correlate with the challenges of enhancing visitor access to public lands, while also ensuring that unique resources and features that attract people to these landscapes and places are protected and preserved for future generations.

I grew up in Idaho and was captivated by wilderness at a young age. I obtained my Bachelor of Landscape Architecture from the University of Idaho in 1985 and was proud to return there to pursue my master's degree later in my career.

The process of returning to the university has been a life enriching endeavor that began with a six-week trip to Italy in the summer of 2017, guided by the brilliant Raffaella Sini, Roberto Capecci, and Gary Austin. Thank you for your inspiration and expertise.

I work full time in a rewarding but demanding career, so it took longer than the typical advanced degree timeframe to complete this study. However, this project became a labor of love, and I am grateful to have had the opportunity to do something that could be beneficial for future generations of park visitors—it's well worth the investment of time.

Since 2015, I've been working on several professional assignments at Yellowstone. Interestingly, even though I had grown up in Idaho, I had never been to Yellowstone until my work took me there. I was mesmerized by the epic landscapes and wildness of the place. Wildlife (grizzlies, wolves, herds of bison, and man other species) roam free, representing a time in the West that is only sustained at Yellowstone and few other places.

I also observed that people were flocking to the park in ever-increasing numbers year after year. Like me, they loved this place, but with all of us traveling in lines of cars on roads and circling to find parking in congested lots, the wildness of Yellowstone and the ability to experience its grandeur was shrouded by the overwhelming presence of humanity.

While I had worked in other congested national parks over the years—Yosemite, Rocky Mountain, Arches, and Zion, to name a few—I was drawn to Yellowstone as a place to study the in-depth the challenges of balancing visitor use with preservation. The park became the perfect laboratory for evaluating more sustainable visitor access solutions. I wanted to explore potential solutions that could be adaptable over time as visitation continues to increase, placing demands on the park's transportation system, operations, and staffing. At the same time, I was mindful that visitor access solutions need to support the NPS mission to provide a high-quality visitor experience and protect and preserve the park—one of the most cherished landscapes in America.

Visitors lined up on the boardwalk at Old Faithful, getting ready to watch the geyser to erupt

(Source: Michael Tatman/Shutterstock.com, 2019)

Abstract

Yellowstone National Park is experiencing unprecedented levels of visitation and related congestion, particularly in the heavily-visited geyser basin corridor from West Yellowstone to Old Faithful (with the most intensity from Madison Junction to Old Faithful). Congestion threatens sensitive hydrothermal features, rivers, natural vegetation, and wildlife habitat due to overflow parking outside designated areas and related off-trail foot traffic. Recent park visitor surveys indicate that visitors are becoming more aware of congestion levels, and in some cases, the crowding in parking areas is detrimentally affecting the quality of the visitor experience during peak periods.

Because vehicle volumes are frequently above the capacity of the roadway and parking areas in the summer (particularly between Madison Junction and Old Faithful), this study investigates the potential to introduce a shuttle system, along with connecting trails and unique opportunities that could be offered to shuttle riders to incentivize shuttle use and diversify and enhance the visitor experience.

Research methods include case studies of shuttle systems at other national parks, secondary analyses of visitor surveys and studies of visitor impacts in geyser basins at the park, and interviews with National Park Service (NPS) experts, including those who plan and manage shuttle systems at other parks. The case studies examine visitation levels, system capacity, scheduling, parking, operations, and lessons learned from implementation of these alternative transportation systems.

Research findings suggest that introducing multimodal options into Yellowstone National Park from West Yellowstone to Old Faithful, including a shuttle system with connecting hiking and bicycling loops, would expand and enhance visitor access and experience at the park. Introducing these opportunities while also managing levels of private vehicle use and capacities at existing parking lots and in the corridor could be a more sustainable means for access in this area of the park during peak seasons as visitation continues to increase in the coming years. By metering visitor traffic and managing entry into the corridor (from Madison Junction to Old Faithful) to a level that can be supported by the existing roadway and parking infrastructure, and then delivering additional visitors via a shuttle system during peak summer periods to reach an overall acceptable visitor management capacity, there would be fewer impacts on resources. Additionally, visitors would continue to have opportunities to access and enjoy geothermal features, wildlife, historic sites, and other experiences at the park, even if parking lots are full. Other key findings include:

- Shuttles should connect heavily visited areas, rather than serving the entire park;
- Shuttle system capacity must be carefully planned to avoid pulsing and overcrowding of visitors in resource areas:
- Opportunities to promote hiking, bicycling, and sight-seeing with the shuttle program can enhance visitor experience; and
- The system and related improvements can be sensitively developed and/or retrofitted to existing parking and access areas, with a design approach that follows contextually appropriate best practices.

This project analyzed a conceptual transit system with three types of shuttle services (Express, Explorer, and Trekker) between West Yellowstone and Old Faithful (and a sub- option of service between only Madison and Old Faithful). These services could operate individually or concurrently on synchronized timetables. The analysis concludes that the system could carry a quantity of visitors in the range of 25 to 35 percent or more of those using private vehicles in the congested corridor from May through September. Further, this project provides conceptual designs for shuttle stops and facilities, as well as recommendations for further analysis.

Sharing the road at Yellowstone National Park can have various meanings.

(Source: photosmadebyme.com/Shutterstock.com, n.d.)

A busy day in the park, with visitors traveling on the road from West Yellowstone to Old Faithful

(Source: National Park Service (NPS), Yellowstone National Park, 2018)

1 Introduction and Study Context

Old Faithful at Sunset

(Source: Susanne Pommer/Shutterstock.com, n.d.)

Chapter 1—Introduction and Study Context

Project Background, Overview, and Context

America's national parks preserve, protect, and offer enjoyment of the most extraordinary natural and cultural resources of our country. National parks have always been popular places to visit, but within the last ten years, as the US population has grown and international tourism levels have spiked, more parks and monuments have been facing unprecedented levels of congestion. The NPS has been studying a wide range of management strategies to address increasing congestion and crowding at national parks and sites, with the intent of protecting resources while continuing to offer visitor access and enhance visitors' experiences to these treasured places.

This project seeks to understand how transit and shuttle systems with intermodal connections, trails and bicycling facilities, electronic communications, interpretation and outreach, and other features can be designed and implemented in one of the most popular and most visited of all NPS settings—Yellowstone National Park, and in particular, in the heavily visited geyser basin corridor of the park, from West Yellowstone to Old Faithful. Furthermore, this project examines the potential effectiveness of shuttling as a visitor use management action at the park.

In exploring potential alternative transportation solutions, a primary focus has been to seek a more sustainable means to provide access over the long-term, while also protecting the unique Yellowstone environment that is part of the Greater Yellowstone Ecosystem. Sustainable solutions are those that have the potential to reduce traffic congestion and related impacts to the environment, while at the same time fitting well within the context of the park, protecting natural and cultural resources, and enhancing visitors' experiences.

The *Sustainable Visitor Access Solutions for Yellowstone National Park* project explores multimodal transportation options in the geyser basin corridor, while at the same time studying the broader transportation system from West Yellowstone to Old Faithful. The project assesses existing conditions within this context, key problems and issues, potential multimodal solutions including shuttling options, hiking and bicycling loops connections, and other unique experiences that could be offered to shuttle riders.

Case studies of multimodal transportation and shuttling solutions in operation at other national parks were analyzed, and key experts from throughout the NPS and gateway communities were interviewed to inform study efforts. The project provides recommendations related to planning and design in order to carefully and effectively integrate multimodal solutions into the park context. The project also explores potential roles and opportunities for the NPS and key partners and stakeholders and provides recommendations for next steps.

Figure 1.1 depicts a historical map of Yellowstone and Grand Teton National Parks–the two parks are located in close proximity. Figure 1.2 on the following page depicts the study area for this project.

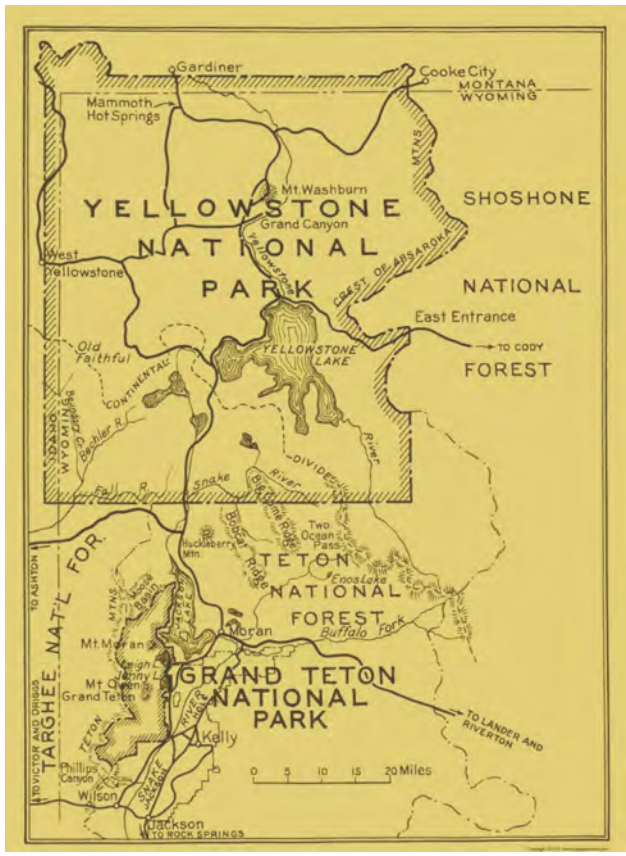
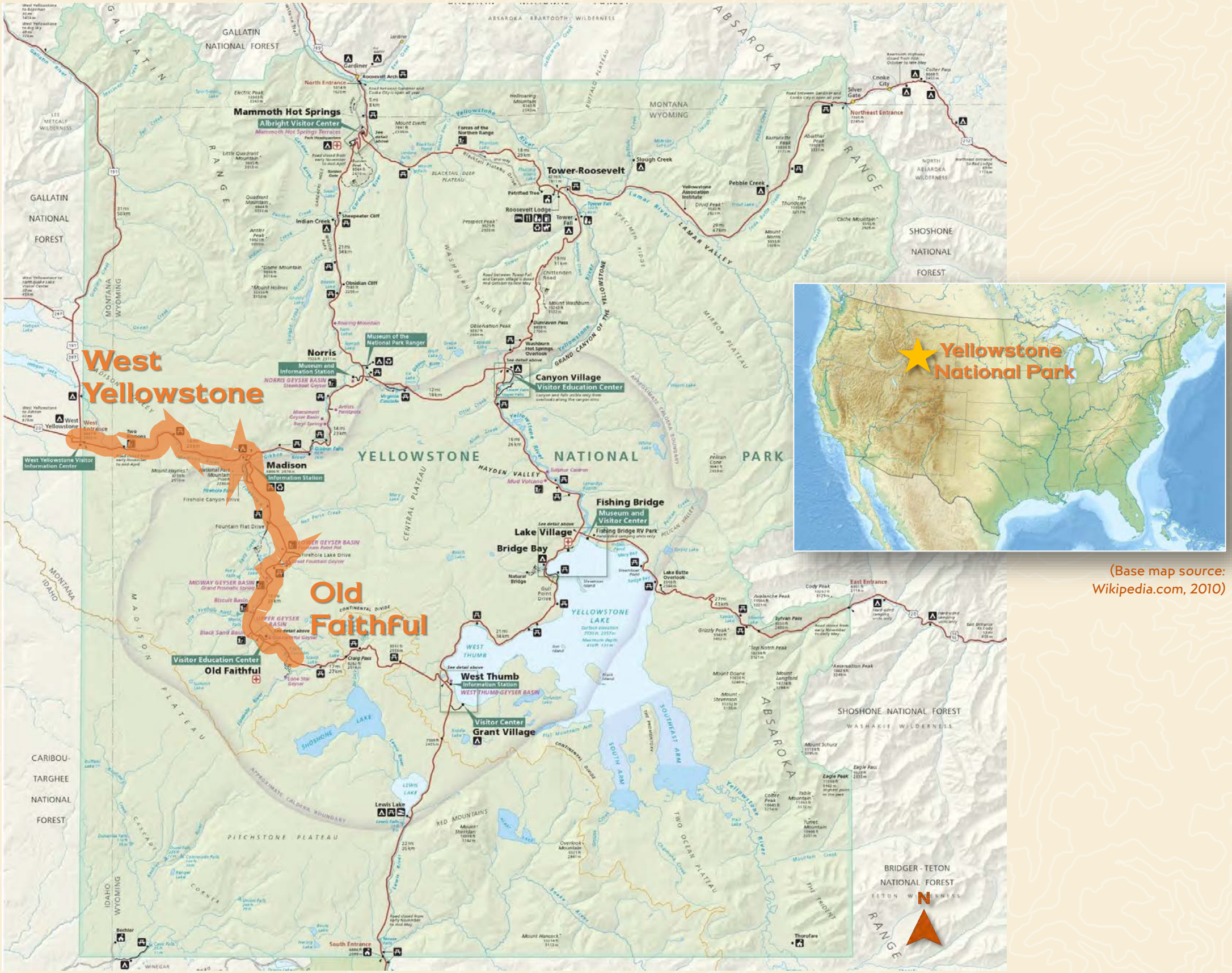


Figure 1.1—Boundaries of Yellowstone National Park as revised by act dated March 1, 1929 and Grand Teton National Park as established by act dated Feb. 26, 1929

(Source: Library of Congress, 1926)

"When we try to pick out anything by itself, we find it hitched to everything else in the universe."
– John Muir



(Base map source: *Wikipedia.com, 2010*)

Figure 1.2—Project Context within Yellowstone National Park

(Base map source: *NPS, 2018*)

Problem Statement

America's national parks continue to experience increasing levels of visitation, and Yellowstone is one of the most visited places in the world. Increasing levels of visitation are difficult to manage given limitations on funding and staffing. Figure 1.3 depicts Yellowstone staffing levels compared to visitation levels since 2000 (NPS, 2021a). As visitation levels continue to increase, the NPS will need to find ways to effectively manage visitor use in order to continue to meet the mission of protecting natural and cultural resources and providing a positive visitor experience.

With increasing visitation, private automobile use is also reaching levels never seen before at Yellowstone. Roads and parking areas are highly congested and frequently reach capacity in the summer months, particularly in the geyser basin corridor from West Yellowstone to Old Faithful. (NPS, 2017b). Traffic congestion and high levels of private vehicle use not only bring increases in greenhouse gas emissions and air pollution, but also affect park resources as a result of overflow parking in undesignated areas. A study by Oregon State University documented degradation of resources related to social trails and other visitor behavior (D'Antonio & Sidder, 2018).

Potential effects on visitor experience are being studied. In 2016, a parkwide visitor survey found that over half the visitors think there are too many people in the park. This survey also found that two thirds of visitors felt that parking was a problem, and over half thought that the amount of roadway traffic and congestion were problematic (NPS, 2017b).

IME SEARCH The New York Times

SundayReview | OPINION

Are We Loving Our National Parks to Death?

By DAYTON DUNCAN AUG. 6, 2016

The scene at Grand Canyon National Park in Arizona, visited by 5.5 million people last year.

NATIONAL

Is Yellowstone National Park In Danger Of Being 'Loved To Death'?

April 18, 2016 · 3:12 PM ET
Heard on Fresh Air

FRESH AIR

PROTECT THIS HOUSE

Various media articles and editorials in recent years have often covered the topic of national parks being "loved to death" as a result of increasing visitation levels.

Sources: D. Duncan, 2016 (New York Times) and Fresh Air, 2016

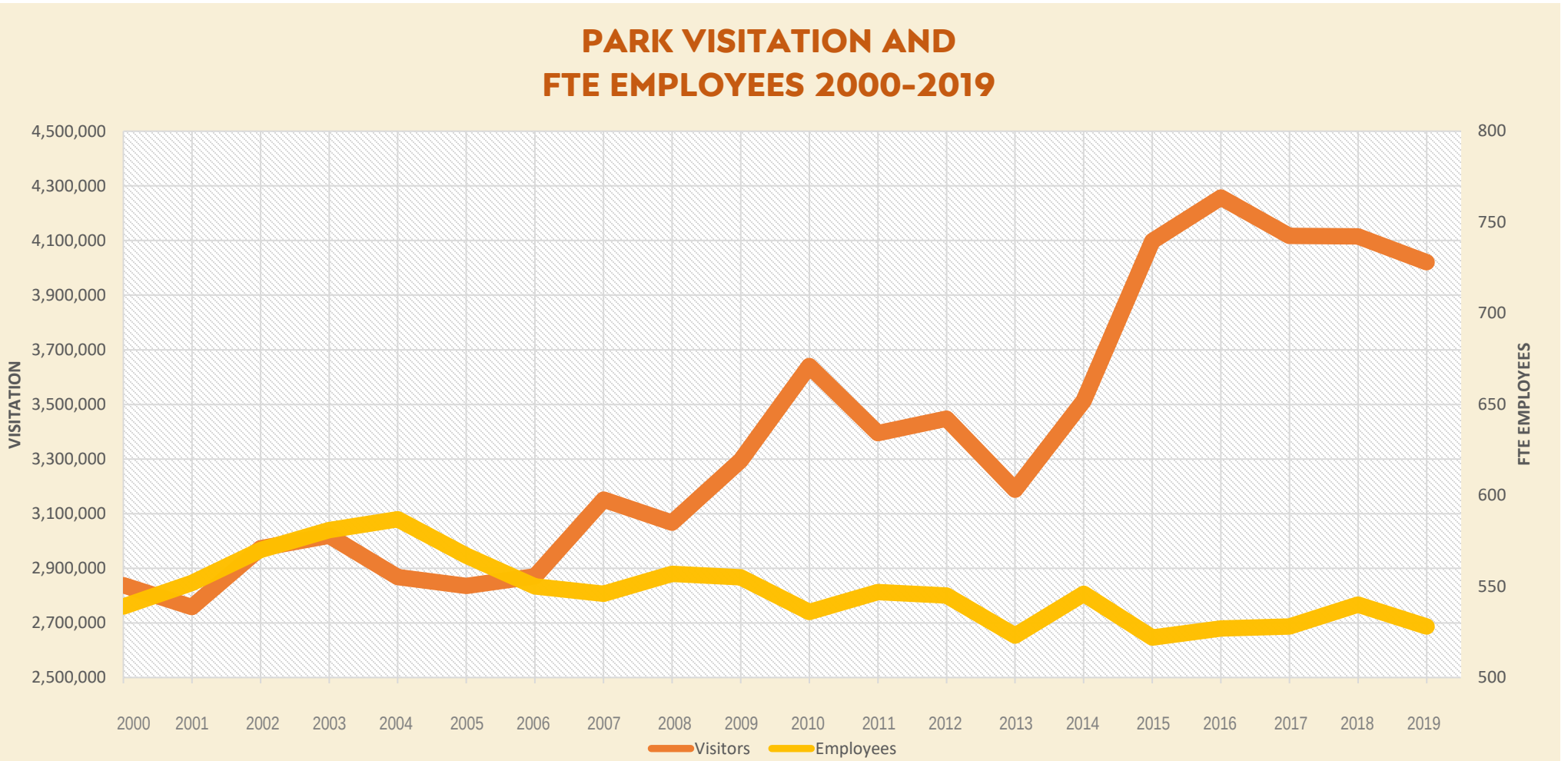


Figure 1.3—Visitation and Staffing Levels at Yellowstone National Park, 2000-2019 *(Data source; National Park Service, 2021a)*

Park rangers' many duties at the park include managing visitor traffic and animal jams on Yellowstone roadways

(Sources: left, NPS, n.d., right, Cinematographer/ Shutterstock.com, n.d.)

Project Goals and Objectives

The following goals and objectives, identified at the outset of this project, served to guide all work efforts.

GOAL 1—Apply research outcomes from literature review, case studies, interviews of experts, and secondary analyses of others' work to the planning, analysis, and design of a multimodal transportation system for Yellowstone, from West Yellowstone to Old Faithful.

Supporting Objectives:

- Prepare case studies based on research of visitor use management and alternative transportation solutions at other national parks.
- Interview experts in transit in national parks and visitor use management.
- Research examples of other transportation demand and visitor use management actions implemented within the national park system and determine the best potential applications for Yellowstone National Park.

GOAL 2—Analyze existing conditions in the study area from West Yellowstone to Old Faithful and understand and analyze how multimodal transportation solutions might support visitor access while also aligning with the NPS mission of protecting natural and cultural resources and enhancing visitors' experiences.

Supporting Objectives:

- Conduct field work at the park and review existing publications, maps, and guides related to the visitor experience in the geyser basin corridor.
- Interview local experts and gather information about visitor use and experiences through other ongoing study efforts.

GOAL 3—Conceptualize and analyze shuttling scenarios in the study area, along with connecting hiking and bicycling loops.

Supporting Objectives:

- Identify potential shuttle vehicles, timetables, stops, and correlating visitor experiences at these locations and analyzing operating scenarios.
- Understand how the experience of shuttling is different from the experience of driving to and from visitor destinations through field work.

GOAL 4—Do the math—analyze shuttle system operating scenarios and related capacity to determine how many visitors could be carried on the system and how this number relates to visitors carried in private vehicles.

Supporting Objectives:

- Through mapping and test drives, understand travel times in the corridor and how these factor into the shuttle system timetable operations and capacities.
- Confirm how the number of people carried in potential shuttling scenarios compares to the number of people in private vehicles.

GOAL 5—Develop and apply best practices in planning design of a shuttle system and related features, including specific design treatments and guidelines for a potential geyser basin corridor shuttle system in Yellowstone National Park.

Supporting Objectives:

- Prepare a plan and conceptual design focused on the West Yellowstone to Old Faithful corridor—the most highly congested area of the park.
- Research and document best practices and regulations that apply to implementing shuttle systems on federal lands.
- Review and analyze existing context and conditions at the park to inform design concepts and ensure that the program could be implemented in a manner that does not impair resources.
- Understand how multimodal solutions could help to preserve and enhance the Yellowstone National Park experience for all time (current and future generations).
- Recommend planning and design solutions that align with protecting Yellowstone's sensitive ecosystem, its waters, landscapes, habitats, and wildlife.
- Develop design templates and concepts for elements of the shuttle system (stops, wayfinding, park-and-ride, etc.) at specific locations.
- Develop park-specific design treatments, such as use of materials, finishes, and other elements that fit the park context and create a set of specific design guidelines.

GOAL 6—Research and describe aspects related to shuttle system implementation and how these could be further studied and potentially implemented at Yellowstone National Park, including feasibility studies and pilot programs.

Supporting Objectives:

- Interview key experts and stakeholders (NPS/park staff, Town of West Yellowstone, Yellowstone Foundation, and others) about the potential for a future feasibility study and pilot program and identify potential roles and responsibilities.
- Review similar feasibility studies and pilot programs in other national parks and define and outline elements to be addressed.
- Begin to identify potential implementation, operational, and financial considerations related to multimodal solutions including shuttling scenarios.
- Complete research, collect data, and provide information through this project so that it may serve as a steppingstone for future feasibility analysis and a pilot program.

GOAL 7—Identify limitations this current study and elements for further study.

Supporting Objectives:

- Clearly describe the limitations of this current study and additional work needed for planning, design, and implementation of multimodal solutions in the study area.
- Set the course for future work by providing a solid, thorough foundation of work for future reference by others.

Visitors on the boardwalk at Fountain Paint Pot in the Lower Geyser Basin

(Source: John Elk III/Alamy stock photo, 2008)

Visitors watch one of Old Faithful's eruptions, which occur several times daily.

(Source: NPS, n.d.)

2 Research and Design Methods

Fountain Paint Pot Area

(Source: Alexey Kamenskiy/Shutterstock.com, n.d.)

Chapter 2—Research and Design Methods

This study uses a complex descriptive strategy for investigating the potential to introduce transit to the West Yellowstone to Old Faithful corridor, encompassing a variety of qualitative methods. The descriptive strategy includes case studies of shuttle systems at Acadia, Rocky Mountain, Yosemite, and Zion National Parks, interviews with experts on transportation throughout the NPS and in gateway communities to national parks, review of internal NPS reports, studies, and visitor data collected at Yellowstone from 2015-2019, and in-the-field observations of existing conditions at Yellowstone and other national parks.

Process

This project comprises multiple phases of work from research through planning and conceptual design and including analysis of potential shuttling scenarios with connecting hiking and bicycling loops. These phases of work provide the basis for conceptual design of shuttle stops and other system elements and development of recommendations for next steps. This process is depicted in Figure 2.1 below. Completion of each phase of work informed progress on subsequent phases.

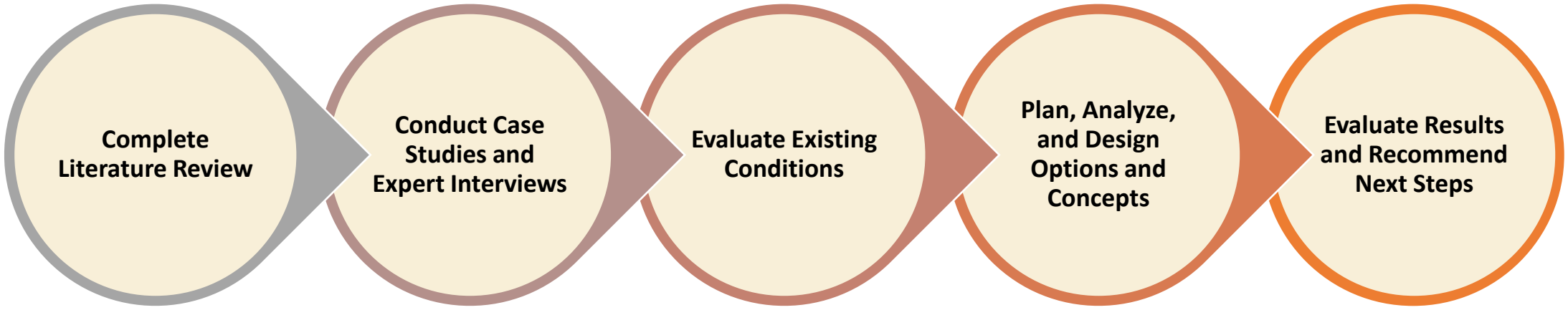


Figure 2.1—Process Chart—"Sustainable Visitor Access Solutions for Yellowstone National Park" Project

Framework of Study and Analysis

Work in national parks is conducted in alignment with the mission of the NPS, the enabling legislation and foundational purposes of the particular park that is the focus of actions and/or improvements, various Director's Orders, and other guiding provisions. The mission of the NPS is to: ***preserve unimpaired the natural and cultural resources and values of the national park system for the enjoyment, education, and inspiration of this and future generations*** (NPS, 1916; NPS, 2014a). This breaks down into two key guiding principles that influence how actions and improvements are implemented in national parks:

- Protecting natural and cultural resources
- Improving and enhancing visitors' experiences

All actions and improvements considered within the project context must apply these guiding principles. In the case of protecting natural and cultural resources, this is accomplished through gaining a strong understanding of the existing setting and conditions and applying context driven or context sensitive design approaches. In the case of improving and enhancing visitor experience, this is accomplished through gaining a strong understanding of visitor characteristics, interests, and needs, and applying experiential driven design approaches.

The framework for study that guided this project was informed by the two key guiding principles of protecting natural and cultural resources and improving and enhancing visitors' experiences. Any options or concepts studied must achieve these basic principles.

Figure 2.2 provides a diagram that illustrates the guiding framework for the study and design efforts of this project.

Figure 2.2—Framework Diagram for the Study
Planning and Design of Sustainable Visitor Access Solutions for Yellowstone National Park—Exploring Multimodal Transportation Options in the Geyser Basin, from West Yellowstone to Old Faithful

Literature Review Topics

This project was informed by an in-depth review of existing publications including research by others. The topic of alternative transportation in national parks has been analyzed extensively, particularly within the last two decades as visitor and traffic congestion rates have climbed in many parks throughout the country.

In addition to the literature review focused on alternative transportation and managing visitor and traffic congestion in national parks, publications pertaining specifically to Yellowstone National Park also provided important background for this project.

Case Studies and Interviews of Experts

Alternative transportation systems, also known as transit and shuttling systems have been functioning in national parks for decades. Some parks operate fairly complex systems, while others operate systems that are simpler and more focused. Some systems connect to regional transit and transportation services, while others provide only shuttling internal to the park in which they are located.

Alternative transportation systems in national parks are all different—planned, designed, and operated to fit the unique context and setting of each park, as well as adjacent gateway communities and surrounding regional characteristics. The case studies presented in Chapter 4 were selected because the systems operating in these parks (Acadia, Rocky Mountain, Yosemite, and Zion) have elements that could be comparable and adaptable to potential shuttling scenarios in Yellowstone.

The case studies evaluate how other national parks have implemented transportation demand management techniques, shuttling systems, trail access, and other actions to help manage visitor congestion and improve visitor experience. The case studies were completed as part of a larger effort to understand NPS staff ideas, concerns, and perceived challenges in implementing some form of transit at Yellowstone. The case studies incorporate information published by the NPS and other sources, site visits to some of the locations studied, and interviews with experts at the parks (park staff) and within the NPS who are knowledgeable about these parks and the alternative transportation systems operated in these locations.

Key concerns and other information gathered from interviews and discussions with NPS staff are incorporated into the case studies and cited where relevant in other chapters of this document. In addition, the case studies summarize visitor statistics at each park to better understand visitor use and demand patterns.

Case studies of shuttle systems at Acadia, Rocky Mountain, Yosemite, and Zion National Parks posed the following questions:

- How have alternative transportation systems been successfully designed and implemented in other national parks? What lessons have been learned?
- What features contribute to the sustainability of these transit systems?
- What components do the case study systems include?
- In what ways do the case study systems enhance the visitor experience (such as by reducing traffic congestion and noise) or offering unique recreational opportunities?
- In what ways do the case study systems protect natural and cultural resources (such as by reducing air pollution and greenhouse gas emissions)?
- Do the system design features fit well within the park context and what are the specific design features that support context sensitive design and other important functions and forms?

Secondary Analyses

Yellowstone National Park is one of the most studied places in the national park system—studies of ecosystem and resource conditions, wildlife, and vegetation are continuously ongoing.

Studies of visitor use and experience and transportation and traffic conditions at Yellowstone have been completed in 2016 through 2019, and there is much ongoing research. Research related to visitor behavior and potential resource impacts in the geyser basin corridor at Yellowstone was completed in 2019. In addition, NPS studies related to transportation, congestion, and visitor use patterns in other national parks were reviewed as part of this project. Observations from secondary analyses of other studies and research in Yellowstone and other national parks are presented where relevant throughout the various chapters of this document.

Refer to the References chapter at the end of this document for a full list of studies and resources reviewed as part of this project.

Zion Canyon Shuttle Stop

(Source: Fagan, M. and E. Road Less Traveled, 2016.)

The Madison River

(Source: NaughtyNut/Shutterstock.com, n.d.)

3 Transportation in National Parks

Yellowstone National Park

Sustainable Solutions for Visitor Access

Morning Glory Pool

(Source: Nina B/Shutterstock.com, n.d.)

Chapter 3—Transportation in National Parks

Introduction

To better understand how transportation solutions studied as part of this project might align with the enabling legislation of the NPS, as well as the agency's mission, values, and policies, relevant background information was reviewed and is summarized below. This review also provided a better understanding of the history of transportation in national parks and the range of current transportation options in operation throughout the NPS and related issues.

Enabling Legislation of the National Park Service

In order to manage and preserve the nation's national park lands, the United States (US) Congress passed the NPS Organic Act in 1916. The Organic Act established the NPS as an agency under the direction of the Secretary of the Interior with the stated purpose of promoting use of national park lands while protecting them from impairment. Specifically, the Act declares that the NPS has a dual mission, both to conserve park resources and provide for their use and enjoyment "in such a manner and by such means as will leave them unimpaired" for future generations (NPS Organic Act, 16 U.S.C.1., 1916).

An amendment to the Organic Act passed in 1970 provides that all of the nation's parks – whether they include natural, cultural, or historic resources – be united under the mission, purpose. and protection of the Organic Act, which directs the NPS to manage park lands in a manner that will not degrade park values.

Each national park unit is created by an individual legislative act of the US Congress, which allows for the specific goals and needs of each place to be addressed in the legislation. Accordingly, the officials for each NPS unit must manage the protected lands both in accordance with the overarching national system as well as the park's own legislation and policies.

In addition to these enabling and establishing legislative actions, many other statutes, policies, director's orders, and protocols influence management decisions made by the NPS, including the General Antiquities Act, the Wilderness Act of 1964, the Wild and Scenic Rivers Act, the National Environmental Policy Act (NEPA), the National Historic Preservation Act (NHPA), and others.

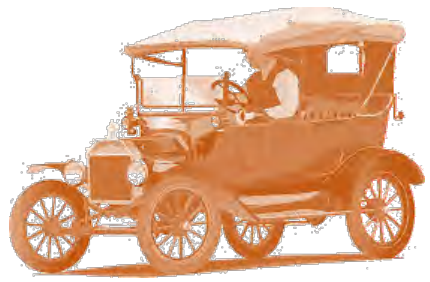
When President Woodrow Wilson signed the Organic Act into law in 1916, the Department of the Interior assumed the responsibility ***"...to promote and regulate the use of the...national parks...which purpose is to conserve the scenery and the natural and historic objects and the wild life therein and to provide for the enjoyment of the same in such manner and by such means as will leave them unimpaired for the enjoyment of future generations."*** (NPS, 1916, Organic Act, 16 U.S.C.1.,1916).

In accordance with this enabling legislation, the NPS mission has always been to preserve unimpaired the natural and cultural resources and values of the national park system for the enjoyment, education, and inspiration of this and future generations.

As stated previously, this mission has a twofold set of actions: protecting natural and cultural resources and enhancing visitor experience. However, sometimes these two actions can be in direct conflict with one another. When millions of visitors descend on national parks, monuments, and other federal lands, and visitation levels continue to increase year after year, the NPS faces challenges in continuing to offer a high-quality visitor experience when roads, parking areas, trailheads, visitor centers, and main attraction sites are overcrowded and congestion. Furthermore, when crowds of visitors and traffic congestion begin to harm or damage natural and cultural resources, the very reasons visitors are drawn to the national parks in the first place, visitor experience can be negatively affected.

History of Transportation in the NPS and Yellowstone

The establishment of national parks coincided with the emergence of private automobiles in the United States, and ever since the earliest days of visiting national parks, visitors have been traveling to and within the parks predominantly in personal vehicles, according to the NPS online resources about the history of transportation to, from and within national parks (NPS, 2018b, NPS, 2021b).



Private autos have always been the predominant mode for traveling to national parks in the US.

Throughout the twentieth century, visitation by autos continued to intensify. The automobile became more affordable and popular to Americans within the same era as many national parks were dedicated. In fact, the NPS closely ties the history of transportation in national parks to the history of the expansion of transportation across the country.

Even though the private auto/personal vehicle is the predominant means for accessing national parks, other modes have existed and continue to be available. In the early part of the twentieth century, railroad companies promoted national parks in order to entice tourists to travel out west. People could access some national parks by rail, some by boats, and increasingly most all by private automobile as the country's interstate and regional transportation systems grew. Roads to, from, and within national parks were designed and built, along with parking areas, waysides, viewpoints, and other visitor facilities to facilitate visitor access. Today, transportation options include private auto for most parks, but also a range of other access options, including private tour buses, shuttles and transit systems, various types of trails, and some parks are accessible by boats and ferries, air and float planes, and passenger rail systems (NPS, 2018b; NPS, 2021b).

Transportation and national parks became and continue to this day to be intimately and inextricably linked (Manning, Lawson, Newman, Hallo, and Monz, 2014). Roadways became integral components of most national parks providing access to key attractions and recreation areas. Moreover, protection and preservation of parks and wilderness areas in America grew out of providing access by the public, politicians, and key advisors to these areas via roads and trails, and in some cases railways. Through expanded access, public support for preservation gained momentum.

Some of the greatest design accomplishments in the country revolved around the development of scenic roads and parkways to national parks, such as the Blue Ridge Parkway, where the roadway infrastructure was designed to harmonize with the environment while also affording visitors the experience of extraordinary views and immersion in nature Parkways, roads, and waysides have been defining experiences in many national parks since they were established (NPS, 2018b; NPS, 2021b).

Even before the 1916 Organic Act, Yellowstone was established as the world's first national park in 1872. As interest in visiting Yellowstone grew, along with the ownership of private automobiles, the park's roadway and parking system was developed, eventually becoming the "Grand Loop" that it encompasses today, providing access to more than 2.25 million acres of public lands. Private vehicle access to the park has always been an important part of the experience, and given the vast geography, a necessity enabling visitors to experience as much of the park as possible within their planned vacation timeframes.

Shuttling and touring services have always been a part of the visitor experience of Yellowstone National Park. Earlier visitors explored the park in all sorts of vehicles, from stagecoaches to surreys. In the 1920s, the White Motor Company manufactured and supplied fourteen-passenger Model 706 vehicles that were painted yellow and included "blanket chest" located behind the rear seat to store blankets for passengers' comfort.

At one time there were 400 of these coaches traveling on Yellowstone byways in the mid-1920s. At that time, Yellowstone had the second largest bus fleet in the country, second only to Greyhound, and the largest number of buses in any national park. Buses of this style also were

Historic posters and postcards in the 1920s and 1930s promoted motor coach tours at Yellowstone, and today, the Yellow Bus Tour is still offered as a unique experience.

(Source: Yellowstone National Park Lodges, n.d.)

Historic illustration of the old yellow tour bus at Old Faithful

(Source: Yellowstone National Park Lodges, n.d.)

Visitors accompanied by a park ranger view Grotto Geyser in this Northern Pacific Railway photo; the bus is a 1936 Model 706 (Note the historic square-cornered windshield)

(Source: NPS, Yellowstone Park Transportation Company, 1936)

used in Yosemite and Glacier National Parks, and some were still being used during the late 1960s and early 1970s before they were gradually phased out of use.

As more visitors arrived in private vehicles and explored the park on their own, there was less demand for the coaches. However, in 2002, Xanterra, a concession company under contract at Yellowstone purchased 8 of the antique coaches from the Skagway Streetcar Company, which had been using them for tours of the historic mining town. In 2006, the vehicles were refurbished to meet modern safety and mechanical standards and to add amenities such as heaters, and in 2007 they were returned to service in the park. In addition to this fleet, modern coaches, built to resemble the antique vehicles have been created.

The antique vehicles and the modern vehicles carry 13 to 14 passengers to provide Yellow Bus tours throughout the park (NPS, 2018b).

The Yellow Bus tour is a popular experience, providing wildlife-watching tours, photo safaris, sunset tours, and more. The distinctive coaches have retractable canvas roofs (antique vehicles) and sunroof style open tops (modern vehicles), providing for optimal sight-seeing experiences. Regularly scheduled themed tours depart from Old Faithful, Mammoth Hot Springs, and Lake Hotel from late May to October. One of the coaches can be rented for private tours. The unique coaches also have operated in other national parks, including Glacier and Rocky Mountain (painted red in Glacier) as part of concession-based tour programs.

Although Yellowstone historically and currently has provided visitor touring opportunities through the Yellow Bus coaches, snow coaches, wagon rides, and other programs, in addition to ongoing private vehicle access, a transit or shuttling system developed primarily for the purposes of facilitating higher volumes of visitor access and transportation to and from key destinations has never operated in the park.

Managing Congestion in National Parks and at Yellowstone

National parks and other federal lands and protected areas are facing increasing issues related to visitor congestion and access as visitation to these places increases over time. Some articles by national newspapers and magazines have cited these areas as “being loved to death” in recent years (Duncan, 2016; Fresh Air, 2016).

Congestion is a common occurrence at some of our nation’s more popular national parks, such as Yellowstone, where vehicles fill parking lots and then park along roads during the peak summer months. Congestion is also a common problem in gateway communities, or on roadways leading into a park, and such is the case at times in West Yellowstone (Fehr & Peers, 2020).

The NPS has identified a variety of negative outcomes associated with congestion (https://www.nps.gov/orgs/1548/congestion-management-program.htm, 2021c), which include:

- Degradation of visitors’ experiences and diminished visitor enjoyment;
- Potential impacts to park resources;
- Noise and air pollution;
- Greater demand for management and overstretched park staff trying to address congestion issues;
- Potential issues related to visitor safety such as reduction in emergency response times;
- Greater demand for new and expanded park infrastructure and facilities; and
- Concerns among partners and stakeholders in gateway communities and neighboring land managers and owners.

With these concerns, the NPS has stepped up management efforts throughout the agency related to congestion management as well as visitor use planning and management in general. The NPS Congestion Management Program has developed a “Congestion Management Toolkit” that encourages parks to use a wide variety of activities to manage congestion, including adding/changing services, changing how roads and parking are managed, and expanding infrastructure if appropriate (NPS, 2021c).

Photographs of visitors enjoying the Yellow Bus tours in the modern era at Yellowstone National Park

(Sources: Top two, Yellowstone National Park Lodges. 2021; lower right, Xanterra, 2021; and lower left, NPS, 2021)

Implementation of transit and shuttling options can be one of the more comprehensive tools that some parks use to address congestion management problems. However, introducing transit and shuttling systems in national parks comes with a variety of complex considerations that require careful study, planning, design, and ongoing management to avoid unintended consequences and ensure these systems are successful and sustainable visitor access solutions.

Concerns Related to Rising Visitation Levels at Some of the West's Most Popular National Parks

Within the last decade, several of the iconic national parks in the West—Yellowstone, Yosemite, Rocky Mountain, and others—have experienced remarkable increases in visitation. In part this was due to promotional activities and the "Find Your Park" campaign associated with the centennial anniversary of the NPS that occurred in 2016. However, even in the years preceding, and in some cases since 2016, several western national parks exceeded 4 million annual visitors for the first time in their history and visitation levels have continued to remain at these levels. For example, Rocky Mountain National Park's 2010 visitation was 2.96 million and in 2019 it was 4.67 million (in large part attributed to the population growth of the greater Denver metropolitan area).

According to statistics published by the NPS (NPS, 2021a), for the first time ever, Yosemite National Park's visitation exceeded 5 million (5.03 million) annual visitors in 2016, compared to the 2010 visitation level, which was 3.9 million. In 2017 and 2019 annual visitation at Yosemite dropped back down to 4.34 and 4.42 million, respectively. Visitation in 2018, was slightly lower than 2017 and 2019 levels at 4.0 million due to extensive fires in the area, which resulted in closures of some areas of Yosemite.

Zion National Park's visitation in 2010 was 2.67 million compared to nearly 4.5 million in 2019.

Yellowstone National Park's annual visitation grew from 3.64 million in 2010 to 4.02 million in 2019 (slightly down from 4.11 million in 2018). See Table 3.1 for annual visitation levels at the park from 2014 to 2019. Between 2014 and 2015, there was a 16.6 percent increase in visitation, from 3.51 million to 4.09 million. Then, in 2016, Yellowstone experienced its highest annual visitation level ever, coinciding with the NPS Centennial. Visitation growth continues at Yellowstone, but the pace of growth has slowed since the 2015-2016 increase. The 2019 visitation level was the lowest since 2015 and a 2.3 percent decrease from 2018, as well as a 5.6 percent decrease from the record-breaking year of 2016.

Table 3.1 Yellowstone National Park Visitation, 2014-2020

Year	Total Annual Recreation Visits
2020*	3,806,306
2019	4,020,287
2018	4,114,999
2017	4,116,525
2016	4,257,177
2015	4,097,710
2014	3,513,486

*2020 was an atypical year due to the pandemic. The park was closed during April and most of May, and some areas were closed during June.

(Source: NPS, 2021)

With the worldwide COVID-19 pandemic in 2020, many national parks experienced periods of closure, as well as low visitation during certain months. Interestingly, while overall for 2020, Yellowstone's visitation levels were down about 5 percent below 2019 levels (3,806,305 compared to 4,020,287), monthly visitation levels in September and October 2020 represented the highest visitation levels on record at the park for those months, and Yellowstone was the second highest visited national park in the US. The park was basically closed in April and through much of May. If the closure hadn't occurred, visitation in 2020 likely would have exceeded 2019 levels significantly

Refer to Tables 5.1 and 5.2 in Chapter 5 for more information on visitation statistics at the park, including monthly visitation statistics and trends.

The movement to get outdoors during the pandemic was not unique to Yellowstone. All across the US, there has been a substantial increase in outdoor recreation activities such as camping and hiking (Outdoor Industry Association, 2020 and Garth, USA Today, 2020). It is unknown at this time if these trends will continue, but it is something the NPS will be monitoring closely in the post-pandemic, new normal of the near future.

In general, increased visitation to national parks can be attributed to multiple factors: population growth in the United States (US) overall, as well as major urban population centers that are in proximity to national parks; increased international interest and tourism rates in the US; changes in fuel prices over the last decade that have made driving vacations more

Visitation to Yellowstone reached record levels for the months of September and October 2020.

affordable for Americans; and increased urbanization across the country, which some theorize may be driving more visitation to national parks and wilderness areas as people seek to escape the hectic pace of the city in search for the peace and beauty of nature while on vacation. In considering how to plan for these legacy federal lands in the years to come, questions related to future visitation trends are beginning to weigh heavily. Will Yellowstone and other national parks continue to see annual visitation rise to unprecedented levels? Will visitation levels routinely be above 4 million and for some parks, routinely above 5 million ten years from now, or even in less time?

Given population growth projections for urban areas surrounding many national parks and the general trends in visitation patterns over the last 20 to 30 years, it seems highly likely that visitation levels will continue to increase, and that effective visitor use management strategies and actions will be needed to address congestion in the coming years.

While visitation levels at many national parks continue to increase, federal budget allocations for staffing, resource protection, maintenance and operations have often remained flat or in some cases have been reduced (see Figure 1.2 for a comparison of visitation levels to staffing levels at Yellowstone National Park). As a result, national park managers often face a shortfall in capacity and tools to effectively address and manage the continual increases in visitation each year.

Even when visitation levels tend to level off or lower in some years, overall, visitation to national parks is increasing, and is expected to continue to increase as the global and US population levels increase. Only some parks have begun to analyze and define visitor management strategies with set visitor use capacities for select resource areas.

A 2016 study by Public Employees for Environmental Responsibility (PEER) found that of the ten most visited national parks, only Yosemite had established visitor capacities for wilderness zones, and while a 1995 plan for Grand Canyon had set numeric caps on visitors to specified areas, that plan has since lapsed and has not been replaced.

In 2001, Zion National Park adopted "preliminary carrying capacities" which have yet to be finalized and implemented. A few other parks have established visitor capacities for limited areas (such as standards for use at boat launches at Everglades National Park and user limits in specified management zones at Golden Gate National Recreation Area).

Even though Congress directed the NPS to establish carrying capacities for the national park system more than four decades ago, this task has been extremely difficult to implement at a broad level; only in the limited applications discussed above.

As visitation continues to increase at many parks, and the potential for impacts to resources and visitor experience intensifies—the ability to achieve the NPS mission on an ongoing basis becomes more and more challenging. NPS managers are keenly aware of their responsibility to provide public access to the nation's park system and are sensitive to limiting visitor use, which can be a highly controversial public issue. At the same time, they are also keenly aware of their responsibility to preserve resources unimpaired in accordance with the 1916 Organic Act.

Looking ahead and considering that national parks have finite boundaries and resources, it is clear that the NPS will need to apply more intensity to visitor use management approaches and implement more proactive and targeted actions for managing visitor use in ways that ensure the agency can continue to carry out its mission to protect natural and cultural resources and enhance visitor experience.

All federal land management agencies face a diversity of challenges in managing visitation because there are so many influence factors involved over a wide array of settings and contexts. The NPS is now moving away from using the term "visitor carrying capacity" and working to implement visitor use management plans according to the Visitor Use Management Framework (VUM) (Interagency Visitor Use Management Council, 2020).

The Interagency VUM Council is a collaboration of the NPS, Bureau of Land Management, US Fish and Wildlife Service, USDA Forest Service, US Army Corps of Engineers, and the National Oceanic and Atmospheric Administration. The VUM Framework prescribes a planning process for visitor use management that can be incorporated into existing agency planning and decision-making processes and across a wide spectrum of situations that vary in spatial extent and complexity from site-specific decisions to large-scale, comprehensive management plans. It also may be used across multiple, tiered planning efforts.

The primary purpose of the VUM framework is to provide cohesive guidance for managing visitor use on federally managed lands and waters. The framework includes four components as depicted in Figure 3.1 below:

- Build the Foundation–Understand why the project is needed and develop the project approach.
- Define Visitor Use Management Direction–Describe the conditions to be achieved or maintained and how conditions will be tracked over time.
- Identify Management Strategies–Identify strategies to manage visitor use to achieve or maintain desired conditions.
- Implement, Monitor, Evaluate, and Adjust–Implement management strategies and actions, and adjust based on monitoring and evaluation.

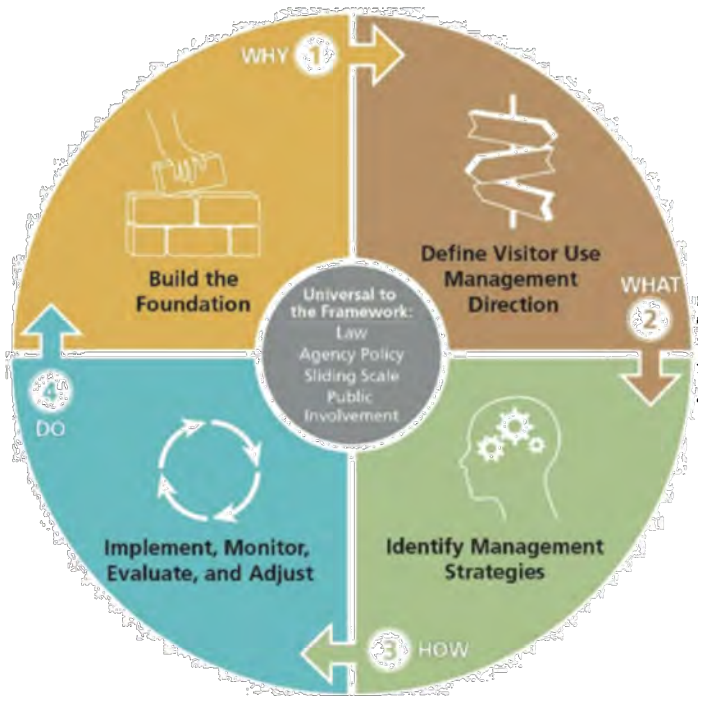


Figure 3.1—VUM Framework Diagram
(Source: Interagency VUM Council, 2020)

Transit and Shuttle Systems in National Parks

Over time, public land management agencies including the NPS have become increasingly concerned about how motor vehicle traffic levels may be affecting the quality of visitors' experiences and aspects of the natural environment. Since the earliest days of national parks, the balance between providing access for the public and preserving critical resources has been an area of concern.

As early as 1920, NPS Director Stephen Mather grappled with these issues. Addressing these issues and the transportation needs of visitors requires a coordinated approach between the lead public land management agency and other agencies and organizations within the sphere of influence of the park or land area, such as state and local transportation departments, local communities and businesses, non-governmental organizations, resource protection and environmental groups, and in some cases, academic researchers.

The concerns include visitor overcrowding, traffic congestion, shortages of parking and overflow parking, air pollution, noise pollution, impacts to wildlife, impacts to roadside vegetation and other sensitive resources, and how to manage access to avoid these impacts (Finnessey, 2012). To address these concerns, federal land managers such as the NPS have been implementing alternative transportation systems and integrated transportation systems that combine traditional and alternative transportation modes in parks.

"Sustainable transportation in national parks makes good, common sense" according to the authors of *Sustainable Transportation in the National Parks: From Acadia to Zion* (Manning, et al, 2014). In this book, Manning and his co-authors explore the history of transportation in national parks and identified best management practices in place throughout NPS units that can help guide planning and management of sustainable transportation in national parks.

Table 3.2 summarizes some of these key best practices and identifies the advantages they may offer related to park operations, visitor experience, and resource protection. Manning and co-authors also identified 21 key guiding principles related to transit in national parks, listed in Table 3.4. Given the extensive body of research compiled by this group of authors, as well as the expertise they have gained from working for the NPS within national parks throughout the country on a diversity of transportation solutions, these best practices provide an excellent foundation in considering potential options for implementation at Yellowstone.

Adaptive management strategies are being applied in many national parks over time to monitor the effectiveness of these systems. In some cases, these strategies include pilot projects or interim actions that are monitored and tested for effectiveness. Shuttle systems are often piloted prior to being placed into full operation to determine if the systems will meet the park's objectives.

National Parks Transit Inventory

The NPS publishes the National Transit Inventory Report annually, which:

- Identifies NPS transit systems across the country,
- Tracks the operational performance (e.g., the boardings) of each system, and
- Inventories NPS and non-NPS owned transit vehicles and vessels, and collects detailed vehicle information.

According to the most recent year that the report was published, 2019, most passenger

Table 3.2 Best Management Practices for Sustainable Transportation in National Parks

Best Management Practices (BMPs)	Advantages of BMPs		
	Operations	Visitor Experience	Resource Protection
Transportation in national parks can have important experiential implications.		X	
Transportation can be an effective management tool in national parks.	X		X
Transportation can be an important form of recreation.		X	
Transportation offers important opportunities to deliver information, education, and interpretation to park visitors.	X	X	X
Transportation management in the national parks should be based on partnerships with important stakeholders.	X		
Transportation management in the national parks needs strong leadership. .	X		
There is growing use and support for alternative transportation systems in the national parks.	X	X	X

(Source: Adapted from Manning, Lawson, Newman, Hallo, and Monz, 2014)

Transportation in national parks can have important experiential implications.

-Manning, Lawson, et al.

boardings in the range of 3 million to 11 million per year occur at five NPS locations (Ellis Island/Statue of Liberty, GRCA South Rim Shuttle Service, Zion Canyon, Washington DC Circulator, and Yosemite Valley). Ten transit systems accounted for 84 percent, or 38.8 of the 45.9 million passenger boardings in 2019. These ten locations with the highest boarding levels are shown in Table 3.3 (NPS, 2019).

Table 3.3 Ten Highest Use NPS Transit Systems (Annual Boardings in 2019)

NPS Locations	2019 Boardings
Ellis Island/Statue of Liberty Ferries	10,370,679
Grand Canyon South Rim Shuttle Service	7,644,231
Zion Canyon Shuttle Service	6,777,100
Washington DC Circulator	5,565,092
Yosemite Valley Shuttle, Yosemite NP	3,161,758
Alcatraz Cruises Ferry	1,680,553
USS Arizona Memorial Tour at Pearl Harbor	1,133,784
Giant Forest Shuttle at Sequoia-Kings NP	940,164
Bryce Canyon Shuttle and Rainbow Point Shuttle	774,010
Bear Lake and Moraine Park Shuttle and Hiker Shuttle to Estes Park, Rocky Mountain NP	764,423

(Source: NPS, 2019)

Note: Acadia landed just shy of the top ten highest use systems with 647,098 boardings in 2019.

Table 3.4 Principles for Sustainable Transportation in National Parks

Principle 1	Transportation and national parks are inextricably linked.
Principle 2	Transportation is central to the foundational twofold mission of the NPS.
Principle 3	Transportation is central to the foundational issue of carrying capacity in the national parks.
Principle 4	Transportation management in the national parks should be guided by a management-by-objectives framework that incorporates formulation of indicators and standards of quality.
Principle 5	Transportation in the national parks can have important environmental implications.
Principle 6	Transportation in the national parks can have important experiential implications.
Principle 7	Transportation is an important form of recreation in the national parks.
Principle 8	Transportation can be an effective management tool in national parks.
Principle 9	There is growing use and support for alternative transportation systems (ATS) in the national parks.
Principle 10	Conventional guidelines for managing transportation may need to be reregistered in the context of national parks.
Principle 11	Transportation research and management in the national parks should be as integrative as possible.
Principle 12	Transportation management in the national parks should be conducted on a park-wide, regional, or landscape scale where appropriate.
Principle 13	Transportation should be incorporated into comprehensive park management plans.
Principle 14	Transportation offers important opportunities to deliver information, education, and interpretive programs to park visitors.
Principle 15	Transportation management in the national parks should be conducted in a proactive manner.
Principle 16	Transportation management in the national parks should be as informed as possible.
Principle 17	Transportation management in the national parks can draw upon an array of research methods and approaches.
Principle 18	Transportation management in the national parks should be based on partnerships with important stakeholders.
Principle 19	Transportation management in the national parks needs strong leadership.
Principle 20	Transportation management in the national parks should address traditionally underserved populations.
Principle 21	Transportation in the national parks should be managed by design, not by default.

(Source: Manning, Lawson, Newman, Hallo, and Monz, 2014)

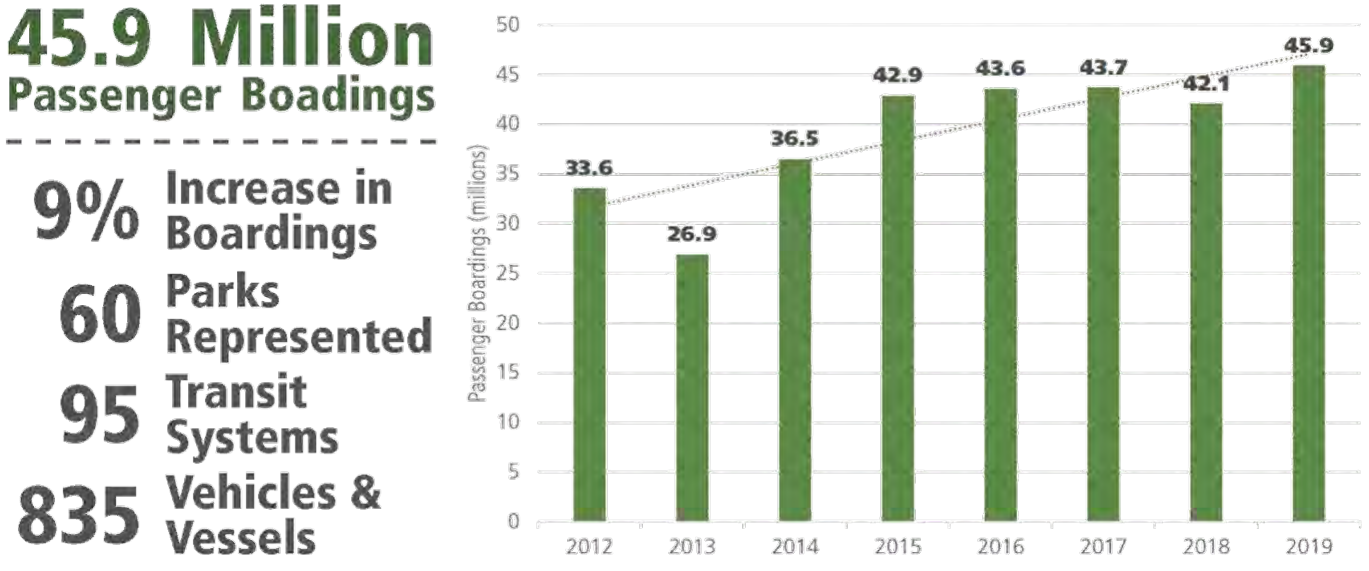


Figure 3.2—National Parks Transit Passenger Boardings by Year

(Source: NPS, 2019)

Figure 3.3—National Parks Transit Boardings by Location

(Source: NPS, 2019)

For the most recent year published (2019), the NPS operated 95 transit systems in 60 NPS units. These systems accommodated 45.9 million passenger boardings with 835 transit vehicles and vessels. Of these vehicles and vessels, 236 were NPS-owned and 599 were non-NPS owned (typically owned by service contractors and concessionaires under contract to the NPS). An additional nine systems were operated by local transit agencies to provide service to and from national parks. Refer to Figures 3.2 through 3.6 (NPS, 2019).

Multiple modes are encompassed with the NPS transit systems:

- 58 percent are shuttle, bus, van, or tram systems
- 37 percent are boat or ferry systems
- 4 percent are train or trolley systems
- 1 percent are aircraft services

NPS transit systems serve many purposes:

- 30 percent provide critical access
- 19 percent facilitate mobility to/from and within NPS units
- 10 percent are primarily a transportation only
- 38 percent feature interpretive tours
- 3 percent serve special needs, such as employee transport and other uses

Of the business models for operating transit systems:

- 50 percent are operated through concession contracts
- 21 percent are owned and operated by the NPS directly
- 15 percent are operated through a cooperative agreement with another agency
- 14 percent are operated through a service agreement

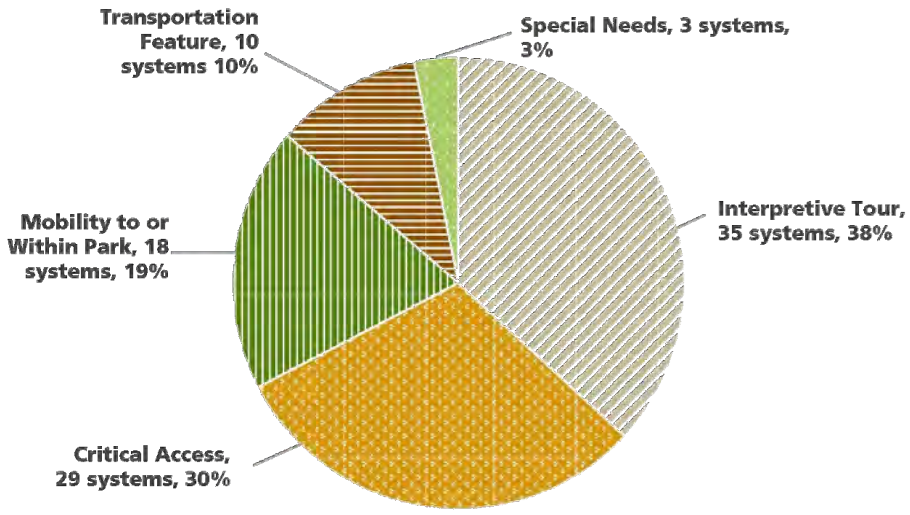


Figure 3.4—Purposes of Transit Systems in the NPS

(Source: NPS, 2019)

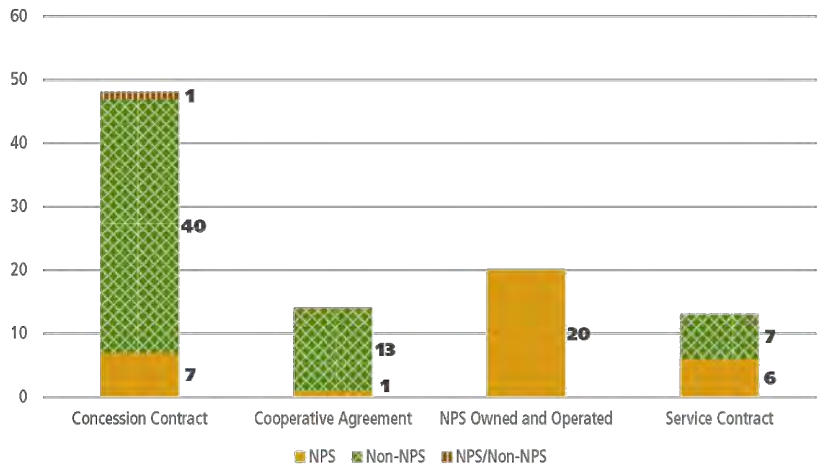


Figure 3.5—Types of Transit Operations/Contracts

(Source: NPS, 2019)

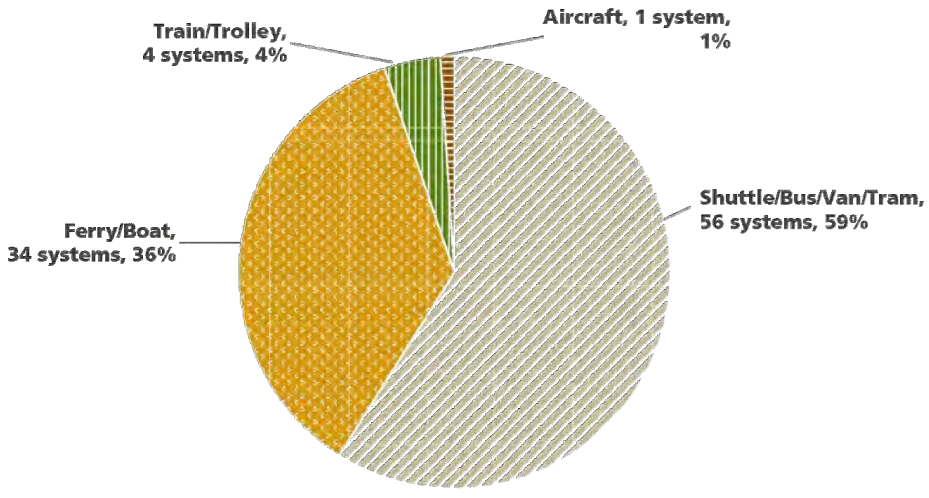


Figure 3.6—Types of Transit Systems in the NPS

(Source: NPS, 2019)

Fleet sizes vary widely depending on the context of each park and areas served by transit. NPS-owned transit vehicles operate on alternative fuels more than non-NPS owned vehicles—48 percent of the NPS-owned vehicles vs. 35 Percent of non-NPS owned vehicles.

NPS transit systems tend to operate according to seasonal visitation trends. Systems operating year-round tend to have the highest ridership, representing 60% of the total boardings. Very few operate in the winter (December to February), with the most period of service occurring over the summer and into early autumn (June to October).

How Transit in National Parks Differs from Transit in Other Contexts

Interviews with NPS transportation experts stationed at the Denver Service Center, Intermountain Region, the Washington Support Office, and at various national parks provided insights into the challenges and opportunities related to transit systems in national parks, as well as best management practices. Transit systems in parks vary widely in many aspects, including the types of vehicles used, service timeframes, length of routes, operational approaches, and level of visitor facilities and improvements in place to serve the public. (E. Cole, personal communication, April 17, 2018).

One of the predominant issues is that transit systems in national parks typically are designed to have a different purpose and carrying capacity than transit systems in urban areas. For example, city transit systems are often designed to carry as many people as efficiently as possible. However, in national parks, it Is often necessary to design the system to deliver a specifically defined number of visitors within

a certain timetable aligned with the park's management strategies or the estimated people at one time that a resource area can serve. (R. Collins, personal communication, March 21, 2018).

With the Zion Canyon shuttle system, the NPS found that pulsing of shuttle visitor loads led to the unintended consequences of overcrowding at bus stops and trailheads. Zion NP management had to adjust the service and implement physical improvements in the bus stop areas to address these concerns. (J. Burns, personal communication, April 17, 2018).

Some park shuttle systems are designed to provide access to special experiences, while others are provided for general transportation and delivery of visitors. A more remote example is the Going-to-the-Sun Road shuttle at Glacier National Park, which is a free hop on, hop off system that delivers visitors to key sight-seeing destinations and visitor centers. It offers an alternative to driving that reduces congestion in this sensitive area of the park. The shuttle vehicles are air conditioned and have large windows for sight-seeing enroute.

The Zion Canyon system includes an audio tour that provides interpretive information and key stewardship messages to visitors. Systems at Yosemite National Park and Rocky Mountain National Park (Rocky Mountain NP) are designed for efficient delivery of visitors to heavily used areas of the parks (E. Cole, personal communication, May 3, 2018).

Partnerships are often crucial to successful implementation of park shuttle programs. At Acadia National Park (Acadia NP), the shuttle system provides service over longer distances to and from multiple gateway communities and is supported through partnerships between the NPS, L.L. Bean, Friends of Acadia, and private donations from local supporters (R. Collins, personal communication March 21, 2018). The National Mall Circulator system was planned through a partnership between the NPS, District of Columbia, and the Washington Metropolitan Area Transit Authority. The NPS is a formal partner that provides staffing at national sites served by system, but the shuttle is operated by other agencies. The NPS also provides Segways, bikeshare stations, and special tours that are interconnected to the Circulator shuttle that serves more than five million visitors each year. (E. Cole, personal communication, May 3, 2018). Because of the high capital costs in starting a shuttle system and ongoing operations costs, including eventually replacing the vehicle fleet, the NPS carefully studies each system opportunity, generally conducting a detailed feasibility study and often followed by a two- to three-year pilot program. Ongoing operations can be funded through various methods such as a portion of entrance fees allocated to transportation.

Yosemite National Park shuttle stop

(Source: Michael Vi/Shutterstock.com, n.d.)

There are a variety of operating and contracting structures for transit systems in national parks. In some cases, the NPS owns and operates shuttles in parks, while in other locations it may manage concession or service contracts to operate the systems (Begley, 2012).

Feasibility studies often involve cost/benefit analysis and examining the potential advantages a shuttle system may offer in enhancing the visitor experience, minimizing congestion and crowding, and reducing potential detrimental effects to natural and cultural resources.

Travel Preferences of National Park Visitors

Some of the most important questions related to introducing shuttling systems into a national park setting revolve around how visitors will perceive their experience of the shuttle and

how this experience may affect their overall experience at the park. Some parks have researched this specifically.

A study completed in 2011 examined visitors' experiences of the transportation system at Yosemite National Park with the following objectives: a) document travel mode choices for visitors entering and traveling through Yosemite National Park, b) identify the importance of transportation modes to visitors and their satisfaction with each mode, c) examine visitors' perceptions of experiential dimensions of traveling via alternative and traditional transportation modes in the park, and d) identify visitors' preferences regarding transportation management.

A random sample survey of adult park visitors was conducted on site and findings indicate that while there is a continuing reliance on private automobiles as the primary mode for travel to and through the park, the ability to use alternative transportation inside the park as very important (White, Aquino, Budruk, and Golub, 2011).

Another study, "From Automobiles to Alternatives: Applying Attitude Theory and Information Technologies to Increase Shuttle Use at Rocky Mountain National Park" by Kourtney K. Collum, 2012, examined potential strategies for increasing voluntary shuttle use at the park and the gateway community of Estes Park. The study examined public awareness of an intelligent transportation system (ITS) pilot project and use of shuttles in Rocky Mountain National Park during the summer of 2011 and explored possible strategies for increasing voluntary shuttle use between the park and the gateway community of Estes Park, Colorado.

Two forms of ITS were used at the park and evaluated: dynamic message signs (DMS) and highway advisory radio (HAR) to inform day visitors to the park about the availability of a new park-and-ride lot in Estes Park and the opportunity to use the connector shuttle to the park. Public surveys were conducted onboard the shuttle and in Estes Park, and the results showed that the DMS contributed to increased public awareness of the shuttles, but the HAR did not contribute substantially to awareness. This work concluded that the use of ITS as a transportation management tool in a national park setting can be effective, but also underscores the importance of selecting the appropriate technologies to reach park visitors.

A second chapter of Collum's thesis examined strategies for optimizing the use of ITS through the theory of planned behavior (Ajzen, 1991). Applying this theory and the outcomes of a mailed survey, perceived behavioral control was found to have a significant influence on the intention to use shuttles. Of the respondents, grouped into three segments (Bus Backers, Potential Mode Shifters, and Shuttle Shunners), Bus Backers held the most positive beliefs about shuttles. Strategies were developed for all three groups toward improving their potential to use shuttles and their experience of shuttles. The study showed that the theory of planned behavior can function as a conceptual framework for predicting shuttle use in park settings and segmenting visitors based on their perceptions and beliefs related to shuttle use. The analysis also offered additional recommendations for increasing voluntary shuttle use, including providing direct routes between the park-and-ride and popular park attractions.

Simulation of a dynamic message sign located upon approach to Estes Park, CO, directing visitors to available parking areas

(Source: Estes Park News, 2012)

In a subsequent article based on similar research by Collum and John J. Daigle, "Combining Attitude Theory and Segmentation Analysis to Understand Travel Mode Choice at a National Park," published in 2015, the following implications were identified to help managers design alternative transportation systems to alleviate congestion caused by private automobiles:

- Alternative transportation must be frequent, dependable, and provide ample space to attract loyal users.
- Direct routes between parking and popular attractions as well as special opportunities such as pick-up/drop-off for one-way treks may increase alternative transportation use.
- Promotional materials and messaging should focus on the ability of alternatives to enhance sightseeing opportunities, reduce stress caused by driving and simplify parking.
- When incentives fail to increase voluntary transportation use, mandatory systems may be necessary at the most popular visitor attractions.

Social scientists who research visitor interests on a regular basis agree that there is a need for more research related to visitors' inclinations to ride shuttles and to use reservation systems (S. Lawson, personal communication, May 3, 2021). If implemented well, a shuttle system can enhance visitor access and experience, and as such, can function as an attractant to visitors, as demonstrated by huge popularity of the Zion Canyon system.

Visitors at Steamboat Geyser

(Source: William Eugene Dummitt/Shutterstock.com, n.d.)

4 Case Studies: Transit in Other National Parks

Sapphire Pool In Biscuit Basin

(Source: Sarah Franczyk/Shutterstock.com, n.d.)

Chapter 4—Case Studies: Transit in Other Parks

Overview

Case studies of other alternative transportation systems such as shuttle services at other national parks were prepared to inform planning and design recommendations for a potential system at Yellowstone. The case studies work confirmed that all national park alternative transportation systems are different, with varying service characteristics and operating scenarios, and each tailored to the specific park context and visitor interests and needs where they are located.

Alternative transportation systems in national parks have different operational and user considerations than those operating in urban environments. Primary among these is the need to protect each park's natural and cultural resources while providing a high-quality visitor experience. The design of the system and supporting facilities needs to be carefully implemented, in a way that blends sensitively with the park's setting and environment and that contributes to visitors' enjoyment. In short, the shuttle systems must support the overall mission of the NPS to preserve "unimpaired the natural and cultural resources and values of the national park system for the enjoyment, education, and inspiration of this and future generations." (NPS, 1916).

A review of alternative transportation systems at other national parks also shows that there are varying structures of funding and operations. In some cases, the systems are owned and operated through service or concession contracts. In some cases, partnering entities operate the systems. A critical factor in each of the shuttle systems studied for this project is the presence of gateway communities that can provide a good base of operations for a shuttle system. Other considerations include

Transit systems in national parks need to be designed and operated to be sustainable and to support the NPS mission.

locations for parking visitors' vehicles, provision of visitor amenities, provision of interpretive information, and connections with trails and/or other park facilities that are common destinations for the visitors.

Another key difference between shuttle systems in national parks compared to those operating in urban areas is that the number of visitors served must be carefully considered in context with visitor capacity analyses for the destinations served in the parks. In urban areas, transit systems are often planned and operated to carry as many people as possible. However, in national parks, it may be detrimental to park resources and visitors' experiences for a system to carry and deliver unlimited numbers of visitors to certain sites. As such, the planning, design, and implementation of alternative transportation systems in national parks needs to occur closely in conjunction with visitor use and capacity analysis and visitor use management planning.

In summary, alternative transportation systems (shuttles, transit, trails, and other transportation demand management treatments) in national parks need to be designed, implemented, and operated differently than urban systems; they must be sustainable, and they must support the NPS mission.

Shuttle picking up visitors in Rocky Mountain National Park to bring them to Bear Lake, one of the park's most-visited sites

(Source: CPR News; FlickR user DavidNKeng/Creative Commons, 2015)

Key Questions Guiding Case Study Work

The case study process began by identifying several key questions to answer through analysis of alternative transportation systems in other national parks, as summarized below.

Given that there are a wide variety of alternative transportation systems in national parks, lessons learned and keys to success are important to guiding implementation of a system at Yellowstone. As such:

- *How have alternative transportation systems been successfully designed and implemented in other national parks?*
- *What features contribute to their sustainability?*

Alternative transportation systems need to include a full complement of supportive features such as maintenance and storage facilities, park and ride areas, bus stops with amenities, connecting trails and pathways, signing and wayfinding, and other elements.

- *What components do the case study systems include?*

Given that the National Park Service mission is to protect natural and cultural resources and to enhance the visitor experience:

- *In what ways do the case study systems enhance the visitor experience (such as by reducing traffic congestion) and protect natural and cultural resources (such as by reducing air pollution and traffic noise)?*

Built features within national parks must blend with the setting and avoid impacts to sensitive resources. As such:

- *Do the system design features fit well within the park context and what are the specific design features that support context sensitive design?*

Park Shuttle Systems Studied

Case studies of alternative transportation systems were conducted for four locations:

- The regional Island Explorer shuttle system serving Acadia National Park and surrounding gateway communities in Maine
- Rocky Mountain National Park's shuttle system, which provides service throughout Rocky Mountain National Park and connects to the gateway community of Estes Park, Colorado to hiking trails within the park
- Yosemite National Park's shuttle system, with a focus on the Yosemite Valley shuttle, as well as the Yosemite Area Regional Transit System (YARTS), connecting the park to surrounding communities in central California
- Zion National Park's shuttle system, which provides service throughout Zion Canyon and connects to the town shuttle system in the gateway community of Springdale, Utah

Each of these case studies is further described below. Table 4.1 toward the end of this chapter summarizes key characteristics of these shuttle systems.

Island Explorer shuttle stop at Acadia National Park Visitor Center

(Source: Bill Trotter, Bangor Daily News. 2018)

Acadia National Park/Island Explorer Shuttle System

Location

Acadia National Park is located along the east coast of Maine on Mount Desert Island, about 45 miles from Bangor (one hour drive). Bar Harbor is the primary gateway community to the park.

Background and Context

Established in 1929, Acadia National Park has always been a popular North American driving destination accessible via miles of old carriage roads and scenic drives in proximity to visitors from both the United States and Canada. Encompassing more than 46,000 acres of Maine coastlands, over 3.4 million (NPS, 2018-2021a) visitors flock to the park to enjoy its beauty and abundant recreation opportunities. Although most visitors traditionally have arrived at the park in private vehicles, the effects of congestion began to tax the park's narrow, remote roads and limited parking system about 20 years ago. As visitation levels increased, transportation infrastructure began reaching capacity and emissions of air pollutants contributed acid precipitation, a concern given how his may potentially damage the rocky soil characteristics and waters in the park. Poor air quality at times also created hazy conditions that affected scenic views from Cadillac Mountain and other locations.

The Island Explorer is a fare-free transportation system linking hotels, campgrounds and inns with destinations in Acadia National Park and area towns. Since 1999, the bus system has transported more than 8 million passengers, reduced private automobile traffic by more than an estimated 2.9 million vehicles and prevented the emission of an estimated 41 tons of smog-causing pollutants and 27,000 tons of greenhouse gases. The shuttle system was established with the intent of reducing traffic congestion and improving air quality in the park. The shuttle system has mitigated these conditions and continues to operate today providing transit service for Acadia National Park destinations, local communities, and the Bar Harbor-Hancock County Regional Airport on Mount Desert Island in Maine (Daigle and Zimmerman, 2004).

In 2019, the Island Explorer set another annual record for ridership, with 643,870 boardings, up 3.3 percent from 2018 and 55 percent from 2010 (NPS, 2019).

The NPS *National Transit Inventory and Performance Report* lists the purpose of the Acadia Island Explorer shuttle system is to provide "mobility to or within the park." However, the Island Explorer accomplishes much more than that, operating as a regional transportation system that provides access within the park as well as between the park and many gateway communities and visitor destinations in the surrounding area. The shuttle system links the park to a variety of community destinations such as village centers, hotels, inns, shops, and restaurants. The service is open for anyone to ride (not just park visitors), so Mount Desert Island residents, employees, and park employees also use the system.

Regularly scheduled buses stop at specific destinations including campgrounds, carriage road entrances, and many trailheads/trails and island beaches (in addition to gateway community destinations). The Island Explorer operates on ten routes, as shown in Figure 4.1. Island Explorer shuttle drivers pick up passengers at designated stops and also will stop for visitors who flag down buses along their routes, as long as the location is a safe place to stop. Island Explorer also provides Bicycle Express service between the Bar Harbor Village Green and Eagle Lake, which transports visitors and their bicycles into the park, where they can then ride on carriage roads and other routes, and then either choose to catch the Express back to town or ride back to town. For the Bicycle Express, each van pulls a trailer that can carry 16 bicycles, and there have been two vans and trailers in service every day from 9 am to 5:30 pm for about seven years (NPS, 2018a).

The popular Bicycle Express service did not operate in 2020 because the Eagle Lake Carriage Road will be under construction for much of the season. Additionally, there have been concerns about the use of Village Green as the base for that service and a new starting point needs to be identified in town that is less congested. The NPS and Downeast Transportation are looking for a new base so that the Bicycle Express service can resume in 2021. In the meantime, bicycles can be carried on the existing buses, with 3 on the front rack and 3 on the back rack; up to 6 total (NPS, 2018-2021a).

Operating Structure

The shuttle system is supported by multiple partners, including the NPS, US Department of Transportation, Maine Department of Transportation, Friends of Acadia, six municipalities surrounding the park, and private corporations and businesses including L.L. Bean, a major outdoor equipment, goods,

The Bicycle Express shuttle has enhanced visitors' experiences and visitor access at Acadia NP.

Figure 4.1—Map of Island Explorer Routes

(Source: Island Explorer, 2018)

and clothing company based in Maine. L.L. Bean has pledged more than $4 million to the bus system since 2002. Park entrance fees also support the system, along with contributions from partners. Downeast Transportation, Inc. is the nonprofit organization that operates the fleet of buses. Annual operating costs are approximately $550,000 to $600,000 in 2020 dollars (Broom, 2017). Ongoing annual operating funding for the Island Explorer continues to be supported through the partnership of the NPS, the U.S. and Maine departments of transportation, contributions from L.L. Bean and Friends of Acadia, local municipal appropriations, fees from businesses that receive front door service and passenger donations. A portion of every weekly and annual Acadia National Park entrance fee is dedicated to funding the Island Explorer's operations.

An important key to the support by multiple partners is the relationship of Acadia National Park to the regional and local economies. A 2017 report by the NPS showed that the park's 3.3 million visitors in 2016 contributed $274 million in spending to the region and that spending supported 4,200 jobs resulting in a cumulative benefit to the local economy of $333 million (Broom, 2017). "Thousands of visitors use the system each year to access hiking trails, the carriage roads, and other destinations in a safe, convenient manner," according to Acadia National Park Superintendent Kevin Schneider. "It's been an incredible 20-year partnership with the Maine Department of Transportation, the U.S. Department of Transportation, local towns, L.L. Bean, Friends of Acadia, Downeast Transportation and more" (Broom, 2017).

Examples of branding, signs, and real time information provided to shuttle riders/park visitors as part of the Island Explorer shuttle system

(Source: left, Ron Buskirk/Alamy stock photo, 2009; middle, pierrerochon/Alamy stock photo, 2018, right, Betty LaRue/Alamy stock photo, 2009)

The Mount Desert Island League of Towns, an affiliation of town managers from cities in the region, played a significant role in the founding of the Island Explorer. The League submitted the original grant application to secure funding for the initial eight Island Explorer buses, and many of the participating towns make annual contributions to support the Island Explorer's operations. Fred Ehrlenbach, Vice Chairman of the League, said, "This is what can be accomplished when municipal, state, and federal governments work together with the private sector."

Paul Murphy, executive director of Downeast Transportation, the operator of the Island Explorer, also recognizes the importance of the company's employees to the success of the Island Explorer. Downeast employs approximately 110 drivers each year to operate the system. "We are so fortunate to have a large group of dedicated drivers who attend to visitor needs and traffic safety," according to Murphy. "Our employees are the heart and soul of the Island Explorer."

Finding qualified drivers year after year can be challenging. A Transportation Plan and Environmental Impact Statement developed by the NPS in 2019 for Acadia NP noted that the season for the Island Explorer is limited by the availability of bus drivers including many who work for schools during the normal school year or university students who are then free during the summer. When the economy is strong, it can be difficult to find people who have full-time jobs year-round. Also, a commercial driver's license is needed to operate the shuttle buses and many young people don't have these or have to get these before they can be retained. While there are many universities and institutions in the northeast, there is always a push to recruit enough drivers each year, and outreach efforts will need to be intensified as the system and services grow in the future.

Timeframe of Operations

The shuttle system generally operates on Mount Desert Island and Trenton from June 23 through late August, and at a reduced schedule through Indigenous Peoples Day in Mid-October each year, but some routes have different operating schedules. The fall service schedule begins August 31. Service on the Schoodic Peninsula begins in late May (Memorial Day weekend) each year to coincide with the opening of the Schoodic Woods campground. In peak season, the buses run on a schedule from 6:45 in the morning to midnight with headways of 15 to 90 minutes, depending on the route. Island Explorer information and schedules are available online at www.exploreacadia.com. A mobile phone application showing the location of Island Explore buses can be downloaded at islandexplorertracker.availtec.com.

System Components

In alignment with Island Explorer's 20th anniversary of service in 2019, the bus system added 21 new propane-powered buses to the fleet. Over the last 20 years, the Island Explorer has grown from eight buses to 31 in operation, plus six spare buses, four vans and two bicycle trailers. Funding for the new buses was supported by the NPS and the state of Maine and the acquisition was managed by the Maine Department of Transportation in conjunction with Downeast Transportation. The buses are 30 feet in length and generally can carry 28 to 30 seated passengers as well as 13 standing passengers (43 total). All vehicles have wheelchair access and visitors are permitted take pets onto the shuttles and into the park. Exterior and interior bicycle racks can carry up to 6 bicycles per vehicles (3 on the front rack and 3 on the back rack), which was somewhat limiting to visitors wanting to tour the park via bicycle. This was one of the reasons the Bicycle Express service was initiated about 7 years ago.

The Bicycle Express shuttle carries 16 bikes on a trailer serving the high demand for bicycling Acadia's carriage roads

Sources: top and middle, Acadiaoutfitters.com, n.d., bottom, Tripadvisor.com, 2021)

One of the new propane-powered Island Explorer buses at Jordan Pond

(Source: NPS, 2019)

The Bicycle Express shuttles are smaller and pull trailers that carry 16 bikes—the service provides more bicycle carrying capacity to serve the high demand for bicycling the park's carriage roads.

Refer to the photographs in this section of the Bicycle Express service and one of the new propane-powered buses.

Downeast Transportation has ordered another 7 buses that will start arriving during the 2020 season. These new buses will be woven into service and will go through a period of testing before older buses are decommissioned. With these 7 new buses, there will be approximately 43 total vehicles operating in the Island Explorer system.

According to a news release issued by Acadia National Park in 2019, as the park celebrated 20 years of service by the Island Explorer, the Propane Education and Research Council (PERC) assisted Downeast Transportation and the NPS in seeking manufacturers willing to develop and build 21 new propane-powered buses to be integrated into Island Explorer operations since the previous Island Explorer bus models were no longer being manufactured. PERC identified Hometown Manufacturing, a Wisconsin third generation, woman-owned business, and went through a selection process to retain them to build the new buses, which were sold through the distributor, Alliance Bus (NPS, 2018-2021a).

According to the Acadia National Park news release, Tucker Perkins, CEO for the Propane Education & Research Council, "Acadia National Park continues to lead the way with its commitment to clean air and a better and healthier environment using propane fueled buses. These propane buses enhance the park experience for everyone because they are cleaner, quieter, and efficient. Propane is an important part of the emerging clean energy economy, and it is an important part of America's clean energy mix. I want to commend Acadia National Park for its innovative leadership and good stewardship of its economic and environmental resources by increasing propane buses in the park."

Context Sensitive Design

The Island Explorer system carries passengers throughout Acadia and to a diversity of gateway communities surrounding the park, so the context changes from the extraordinarily scenic and natural settings of the park to rural, suburban, and town center locations. The stops are generally very low profile, some with shelters, and others with simply a sign and all have only a minimum level of amenities. Design of stops at Jordon Pond and the Acadia Gateway Center has sensitively blended transit shelters and features into those settings as the photographs in this section show.

The Acadia Gateway Center in Trenton, outside the park, was designed to serve as a permanent base of operations for the Island Explorer system. The Gateway Center opened in fall 2011 and planning on the project began in 2007, when Friends of Acadia purchased the 369-acre "Crippens Creek" property in Trenton and sold approximately 150 acres to the Maine Department of Transportation to carry forward the center's construction.

The first phase of the project included construction of the bus maintenance facility, a propane fueling station, and administrative offices for Downeast Transportation. The building was designed to be tucked back, out of sight from Route 3 and received LEED gold certification for its design performance in relation to human and environmental health. The project partnership included Friends of Acadia, Acadia National Park, the Maine Department of Transportation, Downeast

Transportation, the Town of Trenton, L.L.Bean, the Federal Transit Administration, and Maine's Congressional delegation. Funding for the first phase came from several federal and state sources, along with $50,000 from Friends of Acadia to complete the installation of phone lines, security systems, and business equipment.

Plans also call for a welcome center and additional visitor facilities (including a trails network) at the site and this additional phase has been designed, but the partners are seeking funding for construction. The current plan is for a two-story building with the outside appearance of a large Maine barn and inside, an open floor plan where visitors can find information from the NPS and area chambers, purchase park passes, browse historical and informational displays, and wait for Island Explorer buses. The Trenton Trail was developed from the Gateway Center to a wetlands area on a portion of the property in 2013. With the addition of the welcome center, the Gateway Center will become an important starting place for park visitors and a place for tours via motor coaches to stage. Visitors would be able to transfer from their cars and tour buses to smaller shuttle services. The Island Explorer system may be adjusted to better serve welcome center functions in the future.

Sustainability

Island Explorer buses are propane-powered and equipped with bicycle racks. Air quality measurements taken since the year service started, and compared to conditions prior to that year, show that operation of the system has had a positive air quality outcome. And as noted above, the system has reduced private automobile traffic by more than an estimated 2.9 million vehicles and prevented emission of an estimated 41 tons of air pollutants and 27,000 tons of greenhouse gases.

The Jordan Pond bus stop exemplifies context sensitive design in the park.

(Source: Coplon Associates Landscape Architecture and Planning, 2019)

The propane propulsion system is considered to be a clean fuel source, and because the shuttles carry bike racks, some visitors choose to continue travel by bike rather than driving through the park. The Island Explorer system demonstrates how beneficial environmental outcomes can result from shifting visitor traffic from private automobiles to shuttles, reducing the quantity of overall miles traveled by visitors and as such, also reducing traffic and parking congestion and related air pollution and greenhouse gas emissions.

Other Observations

The system enhances the quality of life for residents surrounding the park. The Island Explorer system not only benefits visitors to Acadia NP, but also enhances the quality of life for area residents. "Over two decades and millions of passengers the Island Explorer has helped to reduce congestion and pollution, clearly becoming an integral part of the Acadia experience," according to Friends of Acadia President and CEO David MacDonald, who also applauded the funding of new buses in 2019. "This latest purchase of new equipment, and continued support by the Park Service, the State of Maine, L.L.Bean, FOA and the broader community clearly signals that the Island Explorer will continue to play a vital role in helping to address traffic and transportation issues going forward," said MacDonald. Other key observations include the following.

- **Cadillac Mountain and Related Visitor Use Planning**—The Island Explorer does not provide a route to the summit of Cadillac Mountain, one of the most popular destinations at Acadia. Multiple private tour operators make their living providing access to Cadillac Mountain and as such, it was determined that the shuttle would compromise these business endeavors. The steeper incline requires more robust braking

and heavier duty vehicles to regularly climb up and down the mountain, and private enterprise would be better able to fund the more frequent vehicle maintenance needed. However, moving forward a Transportation Plan and Environmental Impact Statement published by the NPS in 2019 identifies the need to relieve traffic congestion through a vehicle reservation system for cars on Cadillac Mountain. A parking area north of Jordan Pond and the Ocean Drive corridor has been identified as the place where reservation system will be based beginning tentatively in 2021 (NPS, 2018-2021a).

While there is currently no firm plan for service expansion, the transportation plan envisions the potential for the Island Explorer to provide service for those who are not able to get a reservation for their cars. These visitors would be able to migrate to Island Explorer to get to Cadillac Mountain if service were provided since no reservation is needed for the bus system. This expansion of service would require additional funding, which could come from a combination of sources, such as the NPS, Federal Transit Administration, and other partners.

Acadia Gateway Center Bus Stop

(Source: Friends of Acadia, n.d.)

Broad Based Political Support—Maine Congressional delegation members have been highly supportive of the system. An August 2019 article by Betsy Lillian in NextGen Transportation news quoted several of the state's elected officials after the park received funding for new buses.

"Since 1999, the Island Explorer has provided free and convenient transportation between attractions inside Acadia National Park and the surrounding communities," according to Senator Susan Collins. "With ten bus routes serviced by a fleet of clean, propane-powered buses, the Island Explorer has helped to alleviate traffic congestion and improve the park experience for everyone. The addition of 21 new buses to the fleet marks tremendous growth for the Island Explorer system, which will carry its eight millionth rider this summer. You have provided an invaluable service to the community, and I am pleased to congratulate you on all that you have accomplished" (Lillian, quoting others, 2019).

Senator Angus King said, "With over three million visitors a year, Acadia National Park is one of the most visited national parks in our country – but at only 180 square miles, it is also one of the smallest. For two decades, the Island Explorer buses have helped the entire Mount Desert Island community handle this influx of traffic by getting residents and visitors where they need to get to safely and efficiently. As Acadia's yearly visitors steadily increase, we need to make sure we're making the proper investments so this system can continue to encourage important economic activity for Acadia and the surrounding towns. The addition of 21 new Island Explorer buses is an important step...and it is a result of a collaboration between private businesses, community leaders, and state and federal governments – a true testament to the things we can accomplish when we work together toward a common goal."

Representative Chellie Pingree remarked, "Because it's free, accessible, and covers so many of the key Mount Desert Island destinations, visitors from Maine and beyond have been able to enjoy the parts of our treasured public lands, from hikes to beaches to museums. Twenty years after its founding, the Explorer has carried almost eight million riders – an incredible testament to the impact of public transportation for all parts of our state. I can't wait to see how the acquisitions of new buses opens up our wonderful park to many more travelers."

Congressman Jared Golden said "Free, accessible rides from the Island Explorer are part of what make a visit to Acadia National Park and Mount Desert Island such a popular choice for Mainers and visitors from across the country. I'm excited to see the new, low-emission buses in action and I look forward to another 20 years of the Island Explorer."

"Easy, hassle-free travel is part of Maine's state brand," according to Maine Department of Transportation Commissioner Bruce Van Note. "The Island Explorer is a key component to that brand, enabling visitors from all over the country and world to enjoy the natural beauty of Acadia National Park and surrounding region with ease. I am honored to join in the celebration of 20 years of partnership, collaboration, and success, and look forward to decades more" (Lillian, quoting others, 2019).

Overall Evaluation

The Island Explorer system has been effective in reducing traffic and parking congestion in Acadia National Park during the peak season, and the NPS and project partners have documented the environmental benefits related to operating the system, including reductions in air pollution and greenhouse gas emissions. In addition, the system is viewed regionally and locally as beneficial to the quality of life of residents, and there is broad-based political support for its ongoing operation.

The addition of the Bicycle Express shuttle service has enhanced visitor experience by serving the high interest and demand for bicycling the park's carriage roads.

Island Explorer is a successful example that is supported by multiple partners, including a contributing corporate sponsor, L.L. Bean. As such, the NPS does not have to burden the full operational costs and responsibilities of the system, although the agency does contribute financially with a portion of park entrance fees. Cooperation with and service to and from gateway communities promotes a sense of partnership throughout the region.

The Island Explorer shuttle is the result of regional partners successfully working together with corporate financial support from LL Bean.

Jordan Pond House bus stop

(Source: Steven L. Markos, National Park Planner, 2018)

Acadia's regional Island Explorer shuttle system marked its 20th year of service in 2019.

(Source: Friends of Acadia, 2019)

Visitors Enjoying Bicycling in Acadia National Park

(Source: Acadiaoutfitters.com, n.d.)

Rocky Mountain National Park Shuttle System Connecting to Estes Park

Location

The park is located about 70 miles (1.5 hours) north of the Denver metropolitan area in the Rocky Mountains of Colorado. The gateway community of Estes Park is adjacent to the park.

Background and Context

Visitation levels at Rocky Mountain National Park (Rocky Mountain) have continued to increase with the growing population of Denver/Boulder/Fort Collins urban areas. The 416-square-mile national park is considered a "backyard" playground to many Colorado residents and also draws visitors from throughout the US and the world. Hiking, camping, and wildlife watching are some of visitors' favorite activities at Rocky Mountain (NPS, 2018-2021c).

In the mid-1990s, transportation alternatives were studied after traffic and parking congestion in the park began to limit visitor access. Expanding transit service became the preferred alternative. The study concluded that the most significant transportation problem in the park was the shortage of parking spaces to meet visitor demand in the peak season. The study also found that 46 percent of summer visitors who would have liked to have parked at certain trailheads could not do so legally. As a result, visitors were parking in spaces designated for people with disabilities or on road shoulders, on alpine tundra, and in locations that caused other safety concerns and damage to resources. After analysis of various alternatives, the park determined that an expanded shuttle system would be the most sustainable and effective means to get visitors to the places they wanted to go in the park.

A shuttle providing limited service had been operating since 1978, which was originally a fleet of school buses that carried 160,000 passengers to Bear Lake annually. The study of alternative transportation options was initiated because this older system was overburdened, and the vehicles did not meet Americans with Disabilities Act standards for accessible vehicles (NPS, 2018).

Based on the results of the transportation planning process, the modern era of transit service in the park began in 2001 when the Bear Lake and Moraine Park shuttle routes began operating from a park and ride hub constructed in the park to popular sites, trailheads, and campgrounds along the Bear Lake corridor and in the Moraine Park area. The Hiker Shuttle Express was added in 2006 as an express route between Estes Park and the park and ride hub in the park. Estes Park also operates an in-town shuttle system with five shuttle routes (color coded), including the downtown trolley. All shuttle services in the park and in town are free.

Park visitation continues to grow, and in 2019, Rocky Mountain experienced another year of record visitation, 4,678,804 annual visitors. 2019 visitation was 1.7 percent over the record visitation of 4,599,242 visitors in 2018 and represented a 44 percent increase since 2012 (NPS, 2021a).

As visitation has increased at the park over the years, the NPS and the gateway community of Estes Park have continued to expand the free shuttling services that connect to visitor centers and park and ride lots. The park and gateway community have been improving and expanding the shuttle system to better serve visitors by reducing traffic and parking congestion and providing convenient access to trailheads. The shuttle system provides connectivity for visitors staying in Estes Park so that they may more easily get around town, visit the Park, and hike or sightsee, while minimizing the hassles of parking and traffic. Because many of the park's popular trailhead parking areas fill up in the morning on a first come first serve basis during the peak summer season, the shuttle system expands opportunities to hikers that they may not have previously when their access was by private vehicle only.

In 2017, a new parking structure in Estes Park opened adjacent to the new gateway Estes Park Visitor Center and this became the hub for the Hiker Express Shuttle to pick up visitors in town. The parking structure has capacity for 415 vehicles, and visitors can also access all five town shuttles from the Visitor Center location. The Visitor Center also provides restrooms, Wi-Fi, the ability for visitors to purchase park passes, and visitor information. In town shuttle routes stop in convenient locations close to hotels and lodging, so visitors also have the option of being able to easily hop on a town shuttle route from near where they are staying, come to the Visitor Center and catch the Hikers Express without the hassle of having to find a place to park, either at the parking structure or in the park (NPS, 2018-2021c).

Visitors also can park at the Estes Park Fairgrounds and take the Silver route to the Town of Estes Park Visitor Center, transfer to the park's Hikers Express shuttle and then connect to the Bear Lake park and ride. Once at the Bear Lake/Glacier Basin Park and Ride, visitors can transfer to either the Bear Lake Route to access hikes along the Bear Lake Road corridor (Bierstadt Bus Stop, Glacier Gorge Trailhead, and Bear Lake), or the Moraine Park

Route to access Sprague Lake, the Glacier Basin and Moraine Park Campgrounds, Cub Lake, and Fern Lake Trailheads, and Moraine Park Discovery Center, as well as Hollowell Park & Tuxedo Park. Refer to Figure 4.2 for a shuttle routing, stop locations, and schedule information.

Operating Structure

The Bear Lake, Moraine Park, and Hiker shuttles are operated through a service contract and the contractor owns the vehicles. (The NPS does not own the vehicles, and as such is not responsible for maintenance or replacement.) The 2018 *NPS National Transit Inventory and Performance Report* identifies the purpose of the system as providing "critical access" to/from and within the park. Transit services are delivered through a service contract with Rocky Mountain Transit and operations for the service are funded entirely by revenue from a transportation fee that is included in the park entry fee. The service contract was first initiated in 2001 and is renewed every 10 years. The contract requires the park to pay the contractor based on the number of service hours provided, and the contractor is responsible for directly covering all costs to operate the system including costs for the fleet, maintenance, and drivers.

The NPS is responsible for maintaining the shuttle stops and park and ridge hub in the park. The Estes Park shuttle system is funded and operated by the town. A mix of funding sources supported initial planning, design, and construction of facilities in the park and in town, including the NPS Alternative Transportation Program, FTA's ATPPL Transit in the Parks Program, FHWA's ITS program, and funds from the Town of Estes Park, as well as a portion of the park entry fees. Park, town, and agency partners work together to maximize available funding and share expertise and resources.

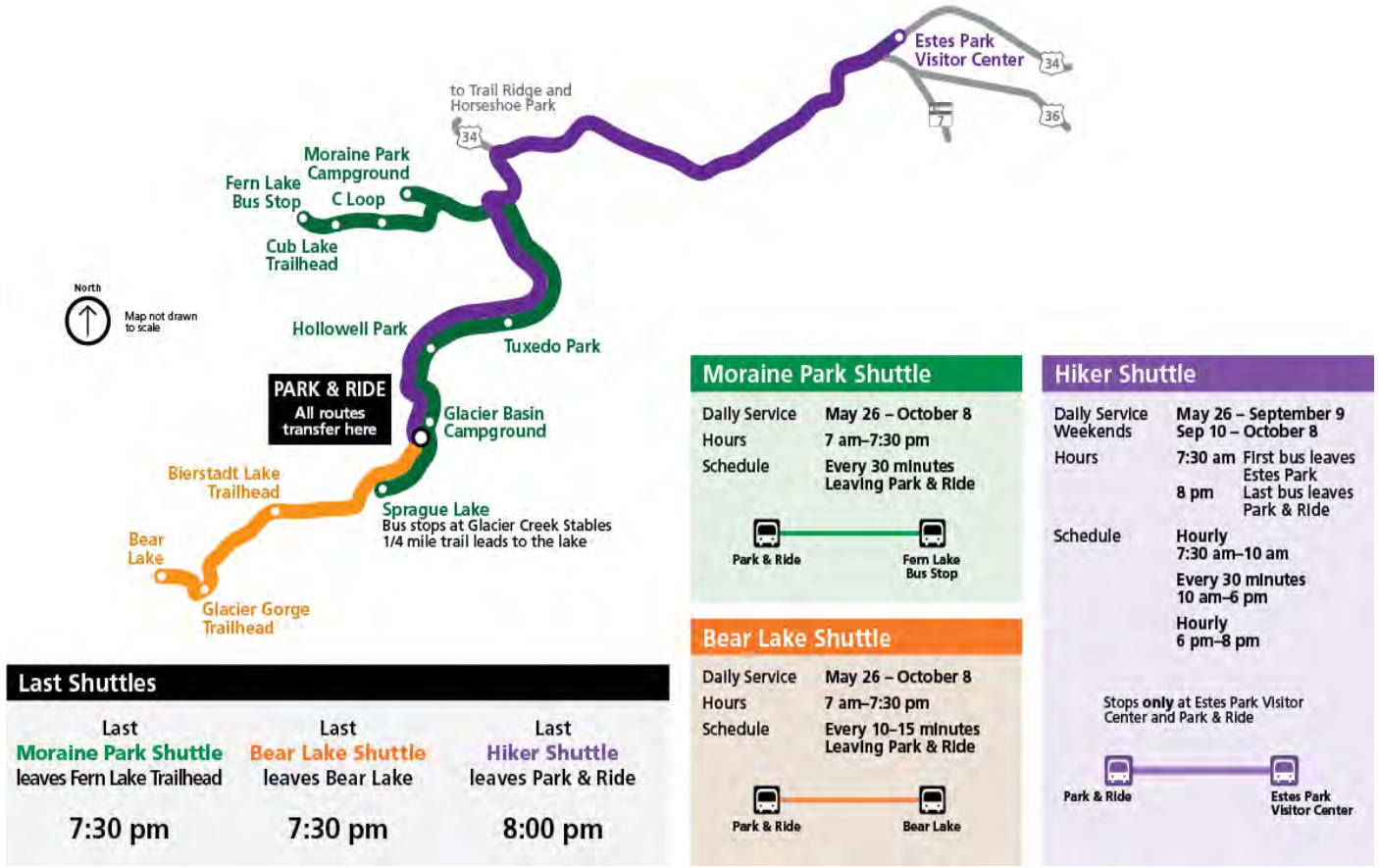


Figure 4.2 Rocky Mountain NP Shuttle System Routing, Stops, and Schedule, 2019

(Source: NPS, Rocky Mountain National Park, 2019)

The service contract, which is often referred to as a "turn-key" contract mechanism, is beneficial to the NPS because the service contractor is responsible for the vehicles and equipment to operate the system. The NPS does not have to set aside base funds for vehicle replacement or for ongoing operation and maintenance of the system, which can be a challenge given the government funding structure. Instead, the service is funded through a portion of the entrance fee. Entrances passes are required of passengers on the shuttle system, and these can be purchased online or in a number of locations in Estes Park.

Timeframe of Operations

Generally, the Hiker's Shuttle operates daily from about the third week in May through Labor Day and weekends only from Labor Day through Mid-October, but each year, the specific dates of operation are slightly different and published on the park and town websites. The park buses run from 7:00 am to 7:30 pm, every 10 to 15 minutes on the Bear Lake Route, and 7:00 am to 7:30 pm, every 30 minutes on the Moraine Park Route daily from about the third week in May through Mid-October. Shuttle stop locations and operating schedules are summarized on the following page.

Hiker Express Shuttle Service

- Operates daily service from third week in May through Mid-October generally
- Hourly from 7:30 am to 10:00 am; every 30 minutes from 10:00 am to 6:00 pm; hourly from 6:00 pm to 8:00 pm (picking up last round of hikers inside the park at 7:30 pm)
- Stops only at Estes Park Visitor Center and the Park and Ride hub inside Rocky Mountain National Park

Bear Lake Route

- Operates daily service from third week in May through Mid-October generally
- Service every 10 to 15 minutes from 7:00 am to 7:30 pm
- Stops at:
    - Park and Ride hub inside Rocky Mountain National Park
    - Bierstadt Lake Trailhead
    - Glacier Gorge Trailhead
    - Bear Lake

Moraine Park Route

- Operates daily service from third week in May through Mid-October generally
- Service every 30 minutes from 7:00 am to 7:30 pm
- Stops at:
    - Park and Ride hub inside Rocky Mountain National Park
    - Sprague Lake/Glacier Creek Stables
    - Hollowell Park
    - Tuxedo Park
    - Moraine Park Campground (C Loop)
    - Cub Lake Trailhead
    - Fern Lake Bus Stop

System Components

For the three routes in service in the park, the service contractor operates 2 hybrid (electric-diesel), 2 gasoline, and 8 diesel powered shuttle vehicles. Each bus carries 28 to 30 passengers; however, during the pandemic buses operated at about half capacity due to social distancing requirements, carrying 15 passengers. Most buses are accessible and can accommodate wheelchairs. Bike racks are not available, and bikes are not carried on the buses. Pets are not allowed on the buses except service animals that have been individually trained to perform specific tasks for the benefit of people with disabilities.

Context Sensitive Design

Structures at the shuttle stops and park and ride hub were designed in the 2000s in accordance with the park's design guidelines that call for appropriate design styles, materials, and colors for the mountain setting. With the more recently purchased hybrid shuttles, the buses have a graphic wrap designed to celebrate the mountain environment. See photographs of the Bear Lake bus stop and the bus wraps in this section.

Sustainability

In addition to reducing vehicle miles traveled by private automobiles in the park, the NPS has called for a "greening" of the shuttle fleet through renewals of the service contract, so the service contractor installed diesel filters to the existing diesel buses and added 2 new hybrid electric buses to the fleet. These actions reduced vehicle emissions and increased the overall fuel efficiency of the fleet, as well as reduced air and noise pollution.

Other Elements

- **Park roads and parking areas are managed in conjunction with shuttle operations**—The park implements restrictions on park roads limited private automobiles when parking lots are full during peak periods. This occurs on a more frequent basis as visitation levels continue to rise. The park has made the decision to retain the current capacity levels provided by the parking areas and does not intend to expand these areas in the sensitive park environment—as such they provide finite, predictable capacity, and when the parking areas are full vehicles are restricted. This results in heavy shuttle use, particularly on the most crowded days because the shuttle becomes the only way to access popular sites in the park. Use of the shuttle then helps eliminate the safety hazards, congestion, and visual intrusions caused by overflow parking (roadside parking at trailheads).

- **Trail Ridge Road interpretive tour experience**—There are no shuttle services on the west side of the park or across the Trail Ridge Road area; several commercial tours provide access to this area, including a five-hour interpretive tour with park rangers providing a narrative of the history and geology of the Trail Ridge Road, the highest, continuously paved road in North America. This is an example of how distinct tour experiences in other areas of the park continue to be offered independently and separately from the shuttle access.

- **Concerns about delivery of more people at trailheads**—When the shuttle system started, concerns about too many vehicles in trailhead parking areas and overflowing onto the roadways were alleviated. However, another concern and unintended

consequence was raised about the number of people being delivered at popular sites and trailheads as a result of the shuttle service schedule. Previously, the parking area had somewhat acted as a management tool, regulating the number of visitors at the site at anyone time. With the shuttle, more visitors could be delivered even after the lot was full. This issue underscores the need for visitor capacity analysis and a visitor management plan for park sites in conjunction with shuttle operations. Shuttle systems can be operated to deliver predictable, measured levels of visitors at scheduled frequencies. As such, the shuttle service capacity can be adjusted to fit the desired visitor capacity at specific sites based on visitor use management planning.

- **Strong promotions, outreach, and messaging to visitors**—both the park and the Town of Estes Park provide extensive information about the shuttle systems on their websites and heavily promote and encourage the use of the systems. Several other tourism websites also post information, and a real-time tracker of the Estes Park shuttles is also available online. Consistent messaging is key. This is a message on the park's website:

Why Should You Take the Park Shuttle Bus?

- *Access many destinations and loop hikes along the Bear Lake Road Corridor.*
- *Cut down on vehicle emissions in the park.*
- *Enjoy the beautiful scenery without the distraction and hassle of traffic congestion and limited parking.*
- *Parking areas long the Bear Lake Road fill most days during the summer and the buses provide the only access during those peak hours each day.*

Another Message:

- *If you've visited Rocky Mountain National Park and the gateway community of Estes Park, Colorado during the summer, you know that traffic can be a challenge at times. A nicely integrated shuttle bus is available in Estes Park to take visitors into the park.*

Overall Evaluation

Over its many years of operation, the Rocky Mountain shuttle system has been successful. Ongoing partnership and close coordination between the NPS, the Town of Estes Park, and other partners has been an important key to this success. Seamless operations between the park shuttle and the town shuttle services is also critical to maximize convenience for visitors and encourage ridership.

Through service contract renewals, the park has been able to require upgrades that have helped to make the system greener and more sustainable. Ongoing visitor use planning efforts are helping the park dial in shuttling services and visitor access on roads and parking to deliver visitors at capacities that are consistent with management objectives.

Top: Bear Lake Shuttle; middle and bottom: new hybrid shuttle buses operating in the park; note "clean air bus" message and graphic wrap design

(Source: NPS, Rocky Mountain National Park, 2019)

Yosemite National Park Shuttle Services and Yosemite Area Regional Transit System (YARTS)

Location

Yosemite National Park is located in the central Sierra Nevada Mountains of California, about 140 miles (2 hours, 42 minutes) southeast of Sacramento.

A number of shuttle services are operated to and from gateway communities and within Yosemite National Park (Yosemite) in California. In addition, the Yosemite Area Regional Transit System provides longer-range service between outlying metropolitan areas and the park. The Yosemite Valley Shuttle, which carries the most visitors on a regular basis in the park, is a primary focus of this case study. See Figure 4.3 for a map of the system and stops in Yosemite Valley.

Background and Context

Given the location of Yosemite, within a few hours of driving time from the major metropolitan cities of San Francisco/Bay Area and Sacramento, and the park's establishment in the decades following California's growing popularity as a place to settle in the West, transportation to, from, and within the park has always been a going concern. Historically, various stage, shuttle, and tour services were organized to carry city folks to experience the fascinating and epic scenery of the national park.

Public transit services first began at the park in the 1960s, and in the 1970s, the park closed some roadways and increased transit service to continue meeting visitor transportation demand. As the decades passed and Yosemite's annual visitation continued to rise, the shuttle system has expanded. Based in Merced, YARTS was first proposed and planned in 1992 to reduce traffic and increase accessibility to the park. In May 2000, after eight years of planning, the system officially commenced service.

Today, visitors arrive by private automobile, a large number of tour buses, the YARTS regional bus system, and other means. Park visitors provide substantial economic benefits to gateway communities surrounding the park—more than $690 million in contributions to the regional economy in 2019 (NPS, 2018-2021g).

With the centennial celebration of the National Park Service in 2016, Yosemite National Park's visitation reached over 5 million visitors for the first time ever. Between 2017 and 2019, visitation levels were around 4 million (just over 4 million in 2018 when fires limited access to portions of the park during peak season; 4.34 million in 2017, and 4.67 million in 2019. The visitation levels in 2016 were extremely challenging for the NPS to manage, and as annual visitation levels continue to rise again with population growth, they eventually will be expected to reach over 5 million again.

The park has implemented a number of transportation and visitor management planning objectives, including those within the Merced Wild and Scenic River Comprehensive Management Plan and Environmental Impact Statement, completed in 2014. The Merced River Plan identifies a peak visitation management level of 18,710 people at one time in Yosemite Valley or 20,100 people per day in the valley. A number of objectives and actions are proposed to support management of visitor capacity to these levels, including the capacity of shuttle services (NPS, 2014b).

Visitors are encouraged to park their vehicles in a day-parking area, at their campground, or lodging and ride the park's free shuttle to explore Yosemite Valley. These shuttle buses help alleviate traffic congestion throughout the park, cut down on fuel emissions, and provide visitors with easy transportation to popular destinations. Park visitors utilizing the free shuttle bus can visit popular Yosemite Valley

Yosemite has a long history of transit service—this photograph from the early 1900s shows the "autostage" shuttle that carried visitors from Merced to the Park.

(Source: www.nps.gov/parkhistory/online_books/hih/yosemite/yosemite2.htm, accessed 2021)

destinations, such as Yosemite Falls, Yosemite Village, and El Capitan. The shuttle service in Tuolumne Meadows provides access to the visitor center, Lembert Dome, and other popular trailheads. The shuttle bus to Glacier Point brings visitors to the iconic location, where visitors can view Yosemite Valley, as well as Vernal, Nevada, and Yosemite Falls.

Operating Structure and Timeframes of Operation

All shuttle services inside the park are operated through either concession contracts or service contracts for the purposes of providing mobility to/from and within the park, with the exception of YARTS, which is operated through a cooperative agreement. Each of these services are listed below. The Yosemite Valley Shuttle is by far the largest service, carrying 3.7 million passengers in 2016 and 2.2 million passengers in 2018 (which was a down year for visitation due to the fires that limited access during peak periods). The NPS owns the Yosemite Valley shuttle vehicles, and that service is specifically operated and maintained through a concessions contract. The park's shuttle fleet is operated by Yosemite Hospitality, Inc. (a subsidiary of Aramark), the park's primary concessionaire.

Given weather conditions due to the higher elevations in the park compared to California's Central Valley, shuttle services tend to operate on a more frequent basis during the spring, summer, and fall seasons compared to winter, with the exception of the Yosemite Valley Shuttle which operates year-round. Shuttle services and schedules vary and are summarized below.

Yosemite Valley Shuttle—Provides service around eastern Yosemite Valley, including stops at or near all overnight accommodations, stores, and major vistas. This shuttle operates all year from 7 am to 10 pm. Refer to Figure 4.3 for a map of the Yosemite Valley Shuttle route and stops.

El Capitan Shuttle—Stops at El Capitan, Four Mile trailhead, and the Valley Visitor Center. This shuttle operates from mid-June through early October from 9 am to 5 pm.

Mariposa Grove Shuttle—Provides service from the Mariposa Grove Welcome Plaza (near South Entrance) to the Mariposa Grove. This is the primary way to get to the Mariposa Grove. The shuttle can operate starting no earlier than March 15 and ending no later than November 30, but dates vary from year to year, especially in spring. The previous shuttle from Wawona to Mariposa Grove is no longer in service.

Wawona Hotel—Limited shuttle service is also available from Wawona Hotel from June 15 through September 7, 2018 between 9 am and 5 pm, with pick-ups/drop-offs about every two hours. This service is available to visitors staying overnight in Wawona.

Badger Pass Ski Area—Shuttle provides service twice daily between Yosemite Valley and Badger Pass whenever the facilities at the ski area are open (typically mid-December through March). The previous Badger Pass to Glacier Point shuttle is no longer in service.

Glacier Point Tour—Many people purchase a one-way ticket on the Glacier Point Tour and take it from Yosemite Valley Lodge to Glacier Point, then hike back down to Yosemite Valley. This bus does not make stops at other trailheads. Service is available when the Glacier Point Road is open (typically late May through October).

Tuolumne Meadows Shuttle—Provides convenient access throughout the Tuolumne Meadows area between the Tioga Pass and

When Automobiles Were Banned from Yosemite National Park

In 1900, Oliver Lippincott drove his new steam-powered Locomobile into the park along the Wawona Road, heralding a new form of transportation within the park. Over the next several years, a number of other automobiles endured the rough roads and steep grades in order to reach the Valley and nearby attractions.

Park officials felt that automobiles and motorcycles were incompatible with horse-drawn coaches and carriages still in general use in the park. They were worried allowing motor vehicles in the park would result in accidents, so in 1907 acting superintendent H.C. Benson banned autos from the park.

Outraged, motorists and the California Automobile Association soon convinced the Department of the Interior to reverse the decision. Even conservationist John Muir initially supported allowing vehicles into the park. In April 1913, the Secretary of the Interior announced that cars once more could enter Yosemite National Park.

"This form of transportation has come to stay, and to close the park to automobiles would be as absurd as the fight for many years made by old naval men against the adoption of steam in the navy. Before we know it, they will be dropping into Yosemite Valley by airship."

— Secretary of the Interior,
Franklin K. Lance. 1913

(Source: NPS, 2018-2021g)

The Yosemite Valley Visitor Shuttle operates from 7 am to 10 pm and serves stops in numerical order. Shuttles run daily every 20 to 30 minutes, depending on time of day.
In the event of snow and ice, busses may suspend service to shuttle stops #15 - #19.

Stop #	Location
1	Visitor Parking
2, 10	Yosemite Village
3 YARTS	The Ahwahnee
4	Degnan's Deli
5, 9 YARTS	Valley Visitor Center
6	Lower Yosemite Fall
7	Camp 4
8 YARTS	Yosemite Lodge
11	Sentinel Bridge
12	LeConte / Housekeeping Camp
13a, 21	Recreation Rentals
13b YARTS	Curry Village
14, 20	Curry Village Parking
15	Upper Pines Campground
16	Happy Isles
17	Mirror Lake Trailhead
18	Stable
19	Pines Campgrounds

Figure 4.3—Map Showing Routing and Stops of the Yosemite Valley Shuttle System
(Provides Free and Convenient Access around Yosemite Valley)
(Source: NPS, Yosemite National Park, accessed 2021)

Olmsted Point (including Tenaya Lake) during the summer (typically mid-June through early September).

Yosemite Valley-Tuolumne Meadows Hiker's Bus—Provides service from Yosemite Valley to Tuolumne Meadows Visitor Center and stops at various trailheads on the Tioga Road. Service is available from approximately mid-June to early September.

YARTS Highway 120 East Bus—Provides fare-based service between Yosemite Village and Mammoth Lakes, with stops at Crane Flat, White Wolf, and Tuolumne Meadows. This service operates daily in July and August and weekends only in June and September (conditions permitting).

YARTS Highway 120 North Bus—Provides fare-based service between Yosemite Village and Sonora, with stops at Crane Flat, Big Oak Flat (Hodgdon Meadow), Buck Meadows area, Groveland, and Sonora/Jamestown. This service operates daily from mid-May through September. Service to Sonora/ Jamestown is not available on weekends and holidays.

YARTS Highway 41 Bus—Provides fare-based service between Fresno and Yosemite Valley, with stops in Wawona. This service operates daily during summer.

System Components

The Yosemite Valley Shuttle operates with a fleet of 20 hybrid electric-diesel buses. Stops provide shelters of varying design and capacity throughout the valley. The shuttle system is designed primarily to provide connectivity to lodging, campgrounds, and various trailheads throughout the valley. The Yosemite Valley Shuttle system connects to YARTS, and the valley shuttle is the only form of transportation to access certain trailheads and hikes in the park such as the Mist Trial to Vernal Falls, John Muir Trail, Happy Isles Nature Trail, and Mirror Lake.

Yosemite Valley shuttle stop, view of Yosemite Falls in the background

(Source: AP photo/Kathy Matheson, n.d.)

Yosemite added two new shuttle buses to the park's fleet in 2019. With the addition of these two new electric-diesel hybrid buses, Yosemite operates 27 shuttle buses that serve visitors in Yosemite Valley, Tuolumne Meadows, and Glacier Point. These new buses were manufactured by New Flyer in St. Cloud, MN. The buses are 40-feet long, fully accessible and accommodate up to 74 passengers. They are powered by an electric-diesel hybrid engine that is 50 percent more efficient than standard diesel engines.

"The shuttle bus system in Yosemite National Park provides visitors with easy access to popular destinations and alleviates the need to drive from one point to another throughout the park," according to the former Acting Superintendent Chip Jenkins. "These shuttle buses are an essential component of our visitor services operation in Yosemite National Park. We are excited to add two new buses to the fleet" (NPS, 2018-2021g).

The Valley Shuttle hybrid buses are not designed to carry bicycles, primarily due to the large capacity of pedestrian riders served (insufficient time to load/unload bicycles). The Valley Shuttle buses are all accessible to people in wheelchairs. All YARTS buses also are wheelchair-accessible, however, during the regular season wheelchair-users are advised to contact YARTS at least 48 hours in advance to insure an accessible spot on the bus. This is not true for the fee-free days where passengers are boarded on a first-come basis. No pets are allowed on the buses except for service animals.

Context Sensitive Design

Yosemite Valley is known for its exquisite scenic values. All visitor facilities are carefully designed to blend into the setting. Shuttle stops all have unique designs, with one of the most recent located at Yosemite Falls and designed by the Bay Area landscape architecture firm of Lawrence Halprin. See photograph at right.

Sustainability

The NPS invested in the hybrid electric-diesel vehicles to reduce the environmental impacts of the shuttle system—the buses now in operation are more fuel efficient and produce less emissions and air pollution, and they are quieter than the older diesel buses. Refer to Chapter 6 for discussion on potential reductions greenhouse gas emissions that can result from shuttle operations compared to private vehicle traffic.

Other Elements

- **Clear information about shuttle services and limitations of public transportation in Yosemite**—Since high numbers of international and US visitors come to Yosemite, with many arriving by tour bus or expecting to be able to access places without their car, the park, YARTS, and surrounding communities do a good job of publishing information about the shuttle services as well as the limitations of the service, such as:
  - Glacier Point is a fee-based tour available late May/June through October and reservations are required.
  - Wawona is accessible via YARTs in summer only.
  - Badger Pass Ski Area is accessible via free shuttle from Mid-December through March.
  - Yosemite Valley/Tioga Road/Tuolumne Meadows is accessible June to mid-September fee-based tour and YARTS Highway 120 East bus.
  - Tuolumne Meadows is accessible in summer via shuttle service in the Tuolumne Meadows area.
  - Hetch Hetchy Valley has no public transportation.
  - Hodgdon Meadow accessible summer only via fee-based public transportation and YARTS Highway 120 North bus.
- **Systems continue to evolve and expand to fit changes in visitor use**—Both the Yosemite Valley shuttle and YARTS have adjusted and expanded services over time to fit visitor use patterns. YARTS added runs between El Portal (Cedar Lodge) and Yosemite Valley and also added service over the Tioga Road into Mammoth Lakes during the summer season. Visitors staying in El Portal at Cedar Lodge or Yosemite View Lodge are highly encouraged to take the YARTS bus into Yosemite Valley. All bicycles, hiking gear, and other outdoor gear can be brought onto the YARTS buses.

Yosemite Falls Shuttle Stop, designed by landscape architecture firm of Lawrence Halprin, is an excellent example of contextual design and emblematic of architectural style common throughout national parks

(Source: Photo by Daniel Wright, 2014)

- **Traffic congestion and circulation continue to need ongoing adjustments and improvements in Yosemite Valley**—The park has adjusted the Valley shuttle system to provide an exclusive lane for the buses through most portions of the valley during the peak summer season. The park has revised several two-way roads in the valley to be a one-way loop with one lane for cars and one lane for buses. Parking areas have been moved and changed to better fit shuttle operations and improve traffic circulation. Even with the shuttle service and adjustments to parking and circulation, congestion continues to disrupt access and negatively affect visitors' experiences. Louis Sahagun wrote in the *Los Angeles Times* that tourists who expect "serene walks along trails where pine trees threw shadows across streams and picturesque meadows teem[ing] with wildlife" are shocked to find "diesel smoke, honking horns and miles-long processions of buses and cars" (Sahagun, *Los Angeles Times*, 2017).

- **Communications to visitors**—The NPS website provides information to visitors about what to expect "extended traffic delays" including "delays of an hour or more at entrance stations and up to two to three hours in Yosemite Valley." The NPS recommends that visitors arrive before 9 a.m., park once, and take the bus within the park.

In addition to actively messaging park conditions and managing the valley circulation, parking, and shuttle systems, Yosemite continues to study and develop strategies and objectives to improve congestion issues on an ongoing basis, piloting various actions in the near term and planning and designing longer term solutions to support ongoing visitor access. The park is always in the process of considering and designing new solutions—bus pull offs with concrete braking pads and accessible platforms, parking, wayfinding, pedestrian paths and connections, bicycling routes and connections. This is an ongoing process to address congestion in the most heavily used area of the park, Yosemite Valley (J. Donovan, personal communication, April 19, 2018).

Overall Evaluation

The Yosemite and YARTS shuttling and transit services are an interesting comparison to study given the international and national stature of the park and the volumes of visitors managed year after year. Overall, the transit and shuttling network is well connected to trails, trailheads, campgrounds, lodges, and other key visitor destinations. The network itself provides seamless access from outlying towns and cities to Yosemite Valley.

Traffic congestion in the valley continues to be an ongoing management challenge even with implementation of one-way loops and bus only lanes in the summer. The shuttle system works fairly efficiently with buses running on time even with the traffic congestion, but those arriving by private automobile can face extended traffic delays. In a way, this is not necessarily a bad situation in that it tends to encourage the use of the shuttle system; however, this in turn pushes the shuttle system over capacity during peak periods.

Yosemite Valley shuttle bus crossing the historic Merced River bridge (top); a stop in the Valley (middle); newer hybrid bus (bottom)

(Sources: top, Daniel Wright , 2019; middle, NPS. n.d.; and bottom, and Joe Braun Photography, n.d.)

Theodore Roosevelt and John Muir at Glacier Point in Yosemite National Park, 1903

(Source: NPS, 1903; accessed 2021)

Zion National Park—Zion Canyon Shuttle System and Connecting Springdale Shuttle

Location

Zion National Park is located in southeastern Utah, about 310 miles (4.5 hours driving time) from Salt Lake City. The park's adjacent gateway community is Springdale. Refer to Figure 4.4 for a map and guide of the Zion Canyon and Springdale shuttle routes and of Zion National Park.

Background and Context

Zion National Park (Zion) was established by Congress in 1919, and 100 years later in 2019, nearly 4.5 million annual visitors came to enjoy the park's spectacular scenery, deep cool canyons, hiking trails, wildlife viewing opportunities, and a wide variety of other recreational activities. The number of visitors to Zion National Park has continually increased. The 2019 visitation level was up from the previous year's 4.32 million annual visitors (NPS, 2021a).

As visitation to Zion escalated in the late 1990s, congestion along Zion Canyon Scenic Drive and in adjoining parking areas became a major issue, and visitors had difficulty finding places to park and access park trails and destinations, particularly during the peak season (Memorial Day through fall). In 1999, the annual visitation reached 2.4 million and on an average day, more than 5,000 cars and tour buses were using the scenic drive with only 400 parking spots available. As a consequence, visitors began double and triple parking in parking areas and all along roadway shoulders and parking lot perimeters. The congestion and overflow parking led to major erosion problems in the sensitive canyon environment, which is home to the north fork of the Virgin River, as well as damage to vegetation and wildlife habitat. Frustrations among park visitors also intensified with the congestion (NPS 2018-2021h).

After studying a range of alternatives to protect resources in the canyon while also continuing to provide visitor access and enhance the experience of the national park for visitors. Alternatives considered included increasing parking in the canyon, closing the scenic drive once the parking filled, and providing a voluntary shuttle system. After extensive analysis of these alternatives and a public review process, the park selected an alternative that would implement a mandatory shuttle system to provide access between the gateway community of Springdale and Zion Canyon destinations during the peak tourist system. The shuttle system was subsequently developed and began operating on May 26, 2000. (J. Burns, personal communication, April 17, 2018)

Operating Structure

The free shuttle system includes two loops—the park loop, which is about 7 miles in length, and the town loop, which is about 2.9 miles in length and operates throughout Springdale. The Springdale loop stops at nine locations in town, and the Zion Canyon shuttle loop stops at nine locations in the park including the Zion Human History Museum and the Zion Lodge (Upper Lodge). A transfer point between loops is made at the Zion Canyon Visitor Center just inside the park. The shuttle system provides convenient and frequent access to numerous hiking trails, scenic points, picnicking, horseback riding and the Upper Lodge.

Shuttle stops are conveniently located throughout Springdale. The town shuttle takes visitors to a stop near the entrance to the park where they can disembark and walk across the footbridge into the park to the visitor center. A park entrance fee is charged at the walk-in

Visitors waiting to board (top); Town shuttle stop (middle) and park shuttle stop (bottom)—color coded signs (left) and numbers for each stop are used to help visitors navigate the two connected routes

(Sources: Kristi Blokhin/Shutterstock.com 2019, top; Raksy D/ Shutterstock.com, 2018, middle; ParkRangerJohn.com, 2020, bottom)

entrance station. Visitors can then proceed to the visitor center where there are exhibits, AV programs, a backcountry permit desk, an information desk, and numerous books, maps and other publications to assist in planning a visit in the canyon. The shuttle bus stop where visitors board buses to upper Zion Canyon is directly adjacent to the visitor center.

The system was planned and funded through cooperative efforts between Zion NP, the Town of Springdale, the NPS Denver Service Center, the Utah Department of Transportation, the Federal Highway Administration, the Zion National History Association (ZNHA), and other organizations. The park purchased the shuttle buses and received funding for capital construction of the shuttle maintenance barn and storage area in the park. Federal transportation funding helped cover the cost of shuttle stop improvements in Springdale, supported by matching funds from the town and ZNHA (NPS, 2016b).

The shuttle system continues to be operated and maintained by a private contractor through a service contract between the contractor and the NPS that is renewed every five to ten years. Annual operating costs for the shuttle service average approximately $2.5 million per year for transit operations, not including vehicle replacement and infrastructure maintenance. To support operation costs, the park charges a transportation fee that is part of the park entrance fees.

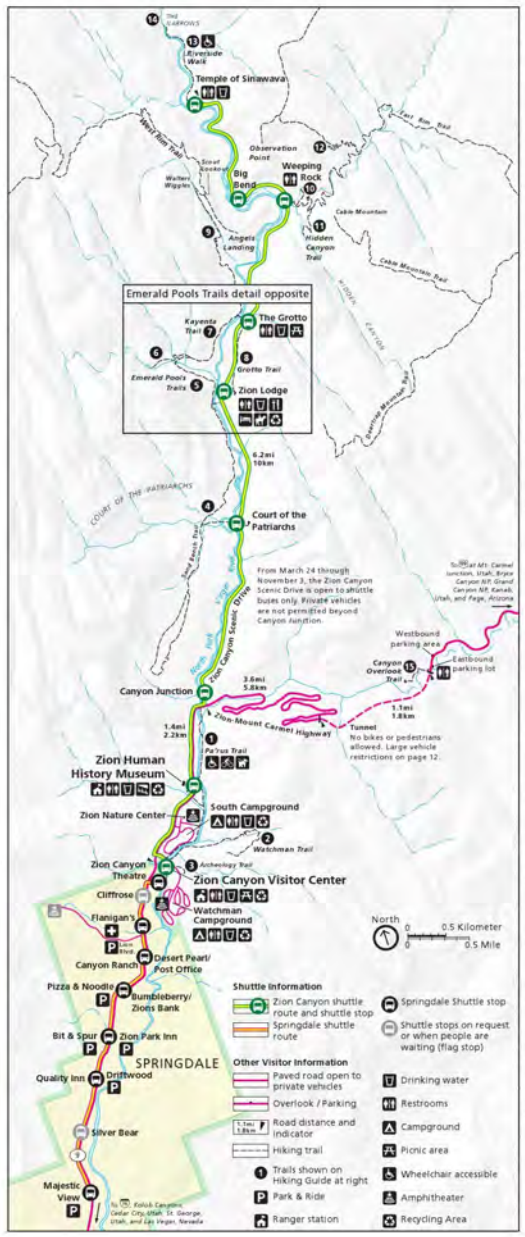
The financial structure for operations has had to be adjusted since the service began in 2000. Entrance fees were formerly $10 per vehicle or group of visitors, of which the park kept 80 percent and sent 20 percent to the NPS in Washington, D.C. Special legislation (public law 102.03) allowed the Park to add a $10 transportation fee on top of the $10 entrance fee and allowed the park to keep 100 percent of the transportation fee to pay for the shuttle. The park could thus keep $18 for every $20 paid by visitors. This would have been sufficient to cover the annual operating costs of the system (based on 1999 visitation, the park would have $2.5 million per year to pay for transit operations). However, in the same year that Zion Canyon Shuttle service started, the National Park Foundation started offering the National Parks Pass, which allowed visitors entrance to any national park in the system for a year for a fee of $50. Because Zion sits in close proximity to several other parks, many visitors started appearing with the National Parks Pass, and as such, these funds were

Visitors lined up waiting to board a Zion Canyon shuttle in August 2019; the large covered waiting areas provide shade and protection from the sun and other weather

(Source: Kristi Blokhin/Shutterstock, 2019)

The Zion Canyon Shuttle connects visitors to a variety of hiking and scenic viewing experiences and has been extremely popular since service began in 2000.

Zion Canyon



Hiking Guide

Hike Location	Round Trip Average time mi / km	Elevation Change ft / m	Description
Easy			
❶ **Pa'rus Trail** Zion Canyon Visitor Center	2 hours 3.5 / 5.6	50 / 15	Paved trail follows the Virgin River from the South Campground to Canyon Junction. Wheelchairs may need assistance.
❸ **Archeology Trail** Zion Canyon Visitor Center	0.5 hour 0.4 / 0.6	80 / 24	Short, but steep. Starts across from the entrance to the visitor center parking lot. Climbs to the outlines of several prehistoric buildings. Trailside exhibits.
❺ **Lower Emerald Pool Trail** Zion Lodge	1 hour 1.2 / 1.9	69 / 21	Minor drop-offs. Paved trail leads to the Lower Emerald Pool and waterfalls. Connects to the Kayenta and Upper Emerald Pool Trails.
❽ **The Grotto Trail** Zion Lodge The Grotto	0.5 hour 1.0 / 1.6	35 / 11	The trail connects the Zion Lodge to The Grotto. Can be combined with the Lower Emerald Pool and Kayenta Trails to create a 2.5-mile loop.
❿ **Weeping Rock Trail** Weeping Rock	0.5 hour 0.4 / 0.6	98 / 30	Short, but steep. Minor drop-offs. Paved trail ends at a rock alcove with dripping springs. Trailside exhibits.
⓭ **Riverside Walk** Temple of Sinawava	1.5 hours 2.2 / 3.5	57 / 17	Minor drop-offs. Paved trail follows the Virgin River along the bottom of a narrow canyon. Trailside exhibits. Wheelchairs may need assistance.
Moderate			
❷ **Watchman Trail** Zion Canyon Visitor Center	2 hours 2.7 / 4.3	368 / 112	Minor drop-offs. Ends at viewpoint of the Towers of the Virgin, lower Zion Canyon, and Springdale.
❹ **Sand Bench Trail** Zion Lodge	5 hours 7.6 / 12.2	466 / 142	Commercial horse trail from March to October. Hike atop a massive landslide under The Sentinel. Deep sand and little shade.
❻ **Upper Emerald Pool Trail** Zion Lodge	1 hour 1.0 / 1.6	200 / 61	Minor drop-offs. A sandy and rocky trail that climbs to the Upper Emerald Pool at the base of a cliff.
❼ **Kayenta Trail** The Grotto	2 hours 2.0 / 3.2	150 / 46	Long drop-offs. An unpaved climb to the Emerald Pools. Connects The Grotto to the Emerald Pools Trails.
⓯ **Canyon Overlook Trail** Zion-Mt. Carmel Hwy	1 hour 1.0 / 1.6	163 / 50	Long drop-offs, mostly fenced. Rocky and uneven trail ends at viewpoint of Pine Creek Canyon and lower Zion Canyon. Parking lot is right turn only.
⓰ **Taylor Creek Trail** Kolob Canyons Road	4 hours 5.0 / 8.0	450 / 137	Limited to 12 people per group. Follows the Middle Fork of Taylor Creek past two homestead cabins to Double Arch Alcove.
⓱ **Timber Creek Overlook Trail** Kolob Canyons Road	0.5 hour 1.0 / 1.6	100 / 30	Follows a ridge to a small peak with views of Timber Creek, Kolob Terrace, and Pine Valley Mountains.
Strenuous			
❾ **Angels Landing via West Rim Trail** The Grotto	4 hours 5.4 / 8.7	1488 / 453	Long drop-offs. Not for young children or anyone fearful of heights. Last section is a route along a steep, narrow ridge to the summit.
⓫ **Hidden Canyon Trail** Weeping Rock	3 hours 2.4 / 3.9	850 / 259	Long drop-offs. Not for anyone fearful of heights. Follows along a cliff face to the mouth of a narrow canyon.
⓬ **Observation Point via East Rim Trail** Weeping Rock	6 hours 8.0 / 12.9	2148 / 655	Long drop-offs. Climbs through Echo Canyon to viewpoint of Zion Canyon. Access to Cable Mountain, Deertrap Mountain, and East Mesa Trails.
⓮ **The Narrows via Riverside Walk** Temple of Sinawava	8 hours 9.4 / 15.1	334 / 102	Check conditions at the visitor center before attempting. High water levels can prevent access to The Narrows.
⓲ **Kolob Arch via La Verkin Creek Trail** Kolob Canyons Road	8 hours 14.0 / 22.5	1037 / 316	Limited to 12 people per group. Follows Timber and La Verkin Creeks. A side trail leads to Kolob Arch, one of the world's largest freestanding arches.

Stay on established trails and watch your footing, especially at overlooks and near drop-offs. Avoid cliff edges. Watch children closely. People uncertain about heights should stop if they become uncomfortable. Never throw or roll rocks because there may be hikers below.

Zion National Park

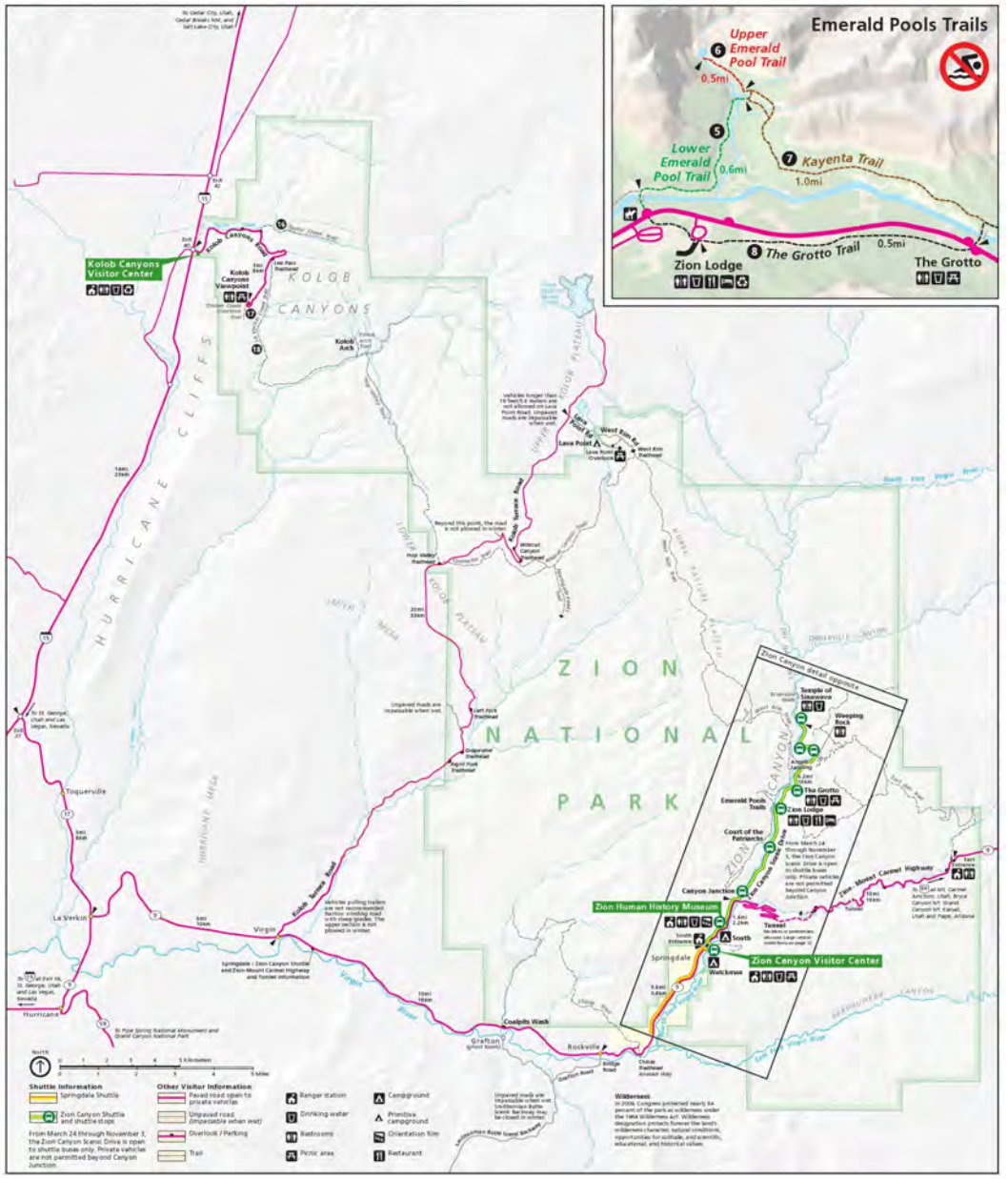


Figure 4.4—Zion Canyon and Springdale Shuttle Map/Zion National Park Map and Guide, 2019

(Source: NPS,/Zion National Park, 2019)

dispersed throughout the system and not directly to Zion National Park. As such, the transportation account started to fall short by approximately $800,000 per year, and additional funding sources had to be identified in the to support ongoing shuttle operations (NPS, 2016b).

Timeframe of Operations

The shuttle system operates from April through October and sometimes extends into November (park loop only) depending on fall shoulder season visitation levels. During the peak season (summer months), Zion Canyon Scenic Drive is closed to private vehicles and is only accessible by shuttle bus. Visitors may not drive their private vehicles on the scenic drive in upper Zion Canyon unless they are guests at the Upper Lodge. At other times of the year, private vehicles may be driven into upper Zion Canyon.

Buses run at four- to six-minute intervals during the middle of the day, so visitors do not need to worry about hurrying to catch the bus. Shuttles generally operate from 6:30 am to 11:00 pm daily during the summer months, allowing visitors a variety of options for early day, evening, and a variety of visit durations. The four-minute headways occur during peak season to help reduce waiting times and long lines at shuttle bus stops.

System Components

The shuttle system includes the vehicles, which are owned by the park, shuttle stops with shelters, seating areas, and other amenities (in the park and in Springdale), an in-park maintenance and storage area, and a wayfinding/signing system that helps visitors determine where to park and ride the shuttle either from locations in Springdale or by accessing the visitor center and parking there to catch the shuttle. The system operates with 30 propane-powered buses. Inside the park, passenger-carrying trailers are connected to the buses to increase visitor capacity along the route. There are also 27 trailers, and when combined with the trailer, the double length shuttle has the capacity for 66 passengers.

The park conveys a robust system of communications to visitors related to the shuttle. This includes website information, information in the park visitors guide and brochure, which are printed materials, information posted on signs in Springdale and at the visitor center, and other methods. Visitors are made aware through multiple sources that they may drive their vehicles through the park year-round, but during the summer season, the Zion Canyon Scenic Drive is accessible by shuttle only.

The park helps visitors understand how and where to find parking to access the shuttle system, and important information about the busses, including that they are fully accessible and designed to carry bicycles. Shuttle schedules and frequencies are consistent during the summer peak season but vary during the shoulder seasons. Shuttle schedules are posted at each shuttle stop. Visitors can refer to exhibits at the visitor center and bus stops that help them in planning their visit based on the duration of time they will be in the park for sightseeing, hiking, and other activities. Itineraries for visits of less than three hours and visits of more than three hours are provided on the outdoor, self-guided exhibits.

Context Sensitive Design

The shuttle stops are constructed of natural materials including timber and quarried rock from local sources. The bus stop shelters are simple structures with timber posts and beams and peaked roofs designed in materials and colors that blend well with the park setting. The color palette includes earth tones from various red rock sandstone colors to neutral gray and dark brown colors. Shuttle buses are also designed and branded with an attractive graphic template that blends with the park scenery and enhance the visual connectivity between the shuttle system and the park experience.

Route information sign for the Zion Canyon Shuttle

(Source: parkrangerjohn.com, 2020.)

Low walls provided at each bus stop location. These have been attractively designed with natural stone facing to blend into the setting. These walls serve to provide extra space for seating while waiting for the shuttles, as well as to help guide and funnel visitors to trails and pathways located beyond the Blochian transit stop areas.

Sustainability

The Zion Canyon shuttle system was established to eliminate traffic and parking problems, protect vegetation, and restore tranquility to the canyon and river environs. The park has documented that resource conditions have improved and that visitors report a high level of satisfaction with the shuttle system.

One double length shuttle carrying 66 passengers replaces approximately 25 private vehicles that without the shuttle system would be competing for parking spaces and contributing to traffic congestion in the upper canyon. The vehicles have excellent ventilation with a top-opening window system, so no air conditioning is required, reducing energy use. They also have large window spaces so visitors have excellent views of the park scenery during their trip (NPS 2018-2021h).

Other Elements

- **Initial concerns about pulsing of off-loading visitors at trailheads—**Pulsing patterns of visitors deboarding the shuttle at trailhead stops in the canyon was closely monitored after the shuttle service started. While the park had carefully designed most shuttle stops and trailheads to accommodate the full capacity of the vehicles, some locations had to be improved to handle a greater number of visitors after the shuttle system was in operation. Design also integrated features such as low walls and curbs to contain visitor traffic and protect adjacent resources as visitors travel to the trails and other park destinations.
- **Strong partnership with the gateway Town of Springdale and successful promotion of the shuttle system—**Visitors are encouraged to avoid the problem of trying to find a parking space at the visitor center by leaving their cars in the town of Springdale and riding the free town shuttle to the park. Some lodging facilities in the area allow their overnight guests to leave their cars in the lodging parking lots for limited amounts of time, and day-use visitors may park in designated shuttle parking areas and along the main road in Springdale.
- **The shuttle has become an experience unto itself**—The Zion Canyon shuttle system has become a sought-after experience for international and national visitors, park officials are now struggling with how to handle crowded conditions for those waiting to board and ride the shuttle. Long lines can affect visitors' experiences. In 2019, record-setting visitation at the park brought more than half-million visitors per month. The Spectrum newspaper in St. George reported that yearly park visitation has more than doubled over the last decade. The NPS is studying options for traffic and visitor management at Zion, Arches, and several other parks in the Intermountain West. One strategy is to look for opportunities to encourage a different distribution of visitation through expanded access to the east side of the park, an area that is less visited currently.

Visitors getting ready to board the Zion Canyon Shuttle; top windows open for air circulation; large side windows allow for scenic viewing while seated on the bus.
(Source: NPS, accessed 2021.)

Overall Evaluation

The Zion Canyon shuttle system has been effective in reducing traffic congestion in the upper canyon portion of the park and studies have documented that the visitor experience is enhanced by the shuttle system, which provides onboard interpretation and excellent scenic viewing opportunities. The park reports that evidence from visitor surveys shows a positive relationship between the shuttle and overall park experience. A greater degree of solitude and tranquility were reported by visitors in the canyon after the shuttle system was implemented compared to the years preceding the shuttle, and noise readings taken by park staff confirm these perceptions. In addition, park studies of natural resources in the canyon including vegetation, wildlife habitat, water quality, and other elements show that conditions improved with implementation of the shuttle system.

Even though the shuttle has been successful in helping to protect natural resources in the canyon and enhancing visitor experience, ongoing operation of the system encounters periodic challenges. The visitor center and several other popular stops where visitors board the shuttle become crowded on peak visitation days and at times, visitors have to wait in longer lines for the shuttle. Buses and waiting areas can become crowded due to the huge popularity of the shuttle. During the 2020 and 2021 seasons, the park implemented a reservation system to limit the capacity of people per bus due to the COVID-19 outbreak, and while the reservations system has to be instituted for public safety, there is still very high demand for the shuttle and some frustrations occur when visitors are not able to get a reservation at their preferred dates and times.

The Zion Canyon Shuttle provides exceptional scenic sight seeing opportunities for visitors—the large windows on the vehicles optimize views.

(Source: Leon Werdinger/Alamy stock photo, 2016)

The lack of available space for parking in town becomes a concern during peak visitation as well. Merchants and property owners in town have been known to complain about visitors parking illegally in private parking lots. Financial constraints have been reported related to the park's ownership of the bus vehicles, which were due for major repairs and some replacements as they approached 20 years in service.

These issues aside, the Zion Canyon shuttle system is known throughout the NPS as a highly effective and successful example of an alternative transportation system that has been effective in helping the park manage congestion and protect sensitive resources while also improving and enhancing visitor experience.

Findings and Lessons Learned from Case Studies Research

A review of alternative transportation systems at other national parks shows that a wide variety of approaches and systems are in place. Each system is tailored to the context, and there are varying structures of funding and operations, as summarized in Table 4.1.

Within the NPS, a variety of operational and implementation challenges arise with shuttle systems in national parks, including:

- Securing funding for initial capital costs associated with improvements, such as the need to develop a bus maintenance and staging/storage facility; purchase of the rolling stock; improvements for park and ride and bus stop locations.
- Ongoing funding and budget management related to year-to-year operational and maintenance costs, including upkeep of facilities, costs of service, and replacement of vehicles.
- For seasonal systems, it is often difficult to find enough qualified/trained employees to operate the system during peak season and extra outreach and recruitment efforts are needed.
- Replacement of shuttle vehicles is a significant cost to the NPS (if they are the owners of the vehicles). A rolling cycle of replacement is recommended over trying to replace a full fleet nearing the end of its life cycle. Budgeting for shuttle vehicle replacements needs to be proactively considered and set aside as part of the operations program.
- Solutions may need to be multi-faceted, such as shuttling scenarios coupled with trails/paths that connect key features and/or shuttling coupled with metering of traffic at key gates into the park that could have nearby park and ride facilities developed for visitor use once traffic reaches a certain level.
- Shuttle systems need to be planned integrally with implementation of the park's visitor use management goals and strategies related to the capacities of destinations served as an important factor in planning for offloading/loading capacity (and timing) of shuttle services.
- There is extensive information available to guide this project and a strong background of information to build on.

There are a variety of methods for covering costs of shuttle systems in national parks, including allocating a portion of park fees, working with partners such as private corporations and non-profit/friends groups, obtaining grants and donations, and leveraging services through regional and local transit agencies.

Another critical factor in each of the shuttle systems studied for this project is the presence of gateway communities that provides a good base of operations for the shuttles. These gateway communities vary in size from a few hundred people (Springdale, UT) to a few thousand people (Estes Park, CO, Bar Harbor, ME).

The YARTS regional bus system is a public transportation system that connects with Yosemite's NPS-operated shuttle, and has major intermodal connections in the cities of Merced and Fresno, CA. The system regularly serves destinations in three counties, with expanded service during peak summer months.

At Acadia NP, a concessionaire (Downeast Transportation, Inc.) operates a shuttle system that is supported by multiple partners including the National Park Service, US Department of Transportation, Maine Department of Transportation, Friends of Acadia, six municipalities surrounding the park, and private corporations and businesses including L.L. Bean. Park entrance fees support the system, along with contributions from these partners.

Similarly, Rocky Mountain NP's shuttle system is supported in part by the town of Estes Park, Colorado Department of Transportation, and other sources. This shuttle leaves from Estes Park, CO, allowing visitors to leave their vehicles outside of the park, and to take advantage of the services and other tourism opportunities in town when they return.

Despite differences in population, demographics, seasonality and climate, employment resources, and other characteristics, each gateway community provides a range of partnerships that prove essential to the successful operation of the shuttle systems. Gateway communities also are often the location and operating base for

transit systems, as well as full-time and seasonal employees who operate the systems. Just as the parks themselves contribute greatly to the local economy, the parks' shuttle systems play important roles in their communities.

Funding for ongoing maintenance and operations is a primary consideration for the NPS when considering system implementation. The systems rely on some combination of park entrance fees, federal, state and/or regional transportation funding, and grants or donations. Whether operated under a commercial service agreement or by a concessionaire, challenges in maintaining adequate levels of funding persist. Acadia NP's partnership with L.L. Bean and non-profit supporters suggests that private-public partnerships may be the most sustainable way to achieve stable long-term funding.

Each of the parks studied for this project implemented a shuttle system to reduce congestion from personal vehicle use and to prevent degradation to natural and cultural resources because of overuse and/or undesirable visitor behavior within the park. It has been common for social trails and parking outside of designated areas to lead to erosion and runoff impacting waterways and aquatic life (Zion, Yosemite, Rocky Mountain) or cultural resources (Zion, Yosemite, Acadia), for unrestricted personal vehicle access to impact wildlife and vegetation (Zion, Yosemite, Acadia), and for air quality to suffer from congestion (Zion, Rocky Mountain, Acadia).

Environmental benefits have been observed and documented following the implementation of the shuttle systems. Acadia NP has seen air quality improvements since implementing the Island Explorer shuttle in the late 1990s, in part because the system also encourages greater bicycle use. Zion NP has restored previously degraded habitat in Zion Canyon, and has restricted visitors from feeding wildlife such as deer, squirrels, and birds using educational information, and in some cases, fines. Rocky Mountain NP can now control parking in areas where visitors used to park haphazardly when lots were full.

Yellowstone faces all these types of impacts (picture tourists stopping along the highway to feed the bears) as well as degradation to its unique geothermal resources. Transit solutions aimed at reducing congestion and other impacts from personal vehicle use need to be multi-faceted, such as shuttling scenarios coupled with trails and paths that connect key features, and/or shuttling coupled with metering of traffic at key gates into the park that could have nearby park-and-ride facilities developed for visitor use once traffic reaches a certain level.

There is much interest in and support for this work, including Yellowstone staff, as well as staff at the NPS Region, Denver Service Center (DSC), and Washington Support Office (WSO). Partners with Yellowstone are also interested and engaged, including the gateway community of West Yellowstone and representatives from Yellowstone Forever, the Northern Rocky Mountain Economic Development District, and others. These stakeholders have been engaged through workshops and expert interviews during the source of this project. It is recommended that as future analysis, planning, and potential implementation of shuttle services are explored at Yellowstone, these entities should continue to be engaged and involved as key partners and stakeholders.

Yosemite Valley Shuttle with Half Dome in the background; some park roads have been converted to one way to allow the shuttle an exclusive lane for travel during peak summer months. Some portions of the roadway system revert back to two way during the off-seasons.

(Source: Martyn Goddard/Alamy stock photos, 2010)

Table 4.1 Summary of Case Studies—Transit Systems at Other National Parks

	Acadia Island Explorer and Bicycle Express Shuttles, Maine	Rocky Mountain National Park and Estes Park Shuttles, Colorado	Yosemite National Park Shuttle Services, including the Valley Shuttle, and YARTS, California	Zion Canyon Shuttle, Zion National Park, Utah
				
Visitation (2019):	3.4+ million	4.67 million	4.42 million	4.5 million
Primary Purpose of Shuttle System	Mobility to/from and within the park	Provides critical access to the Bear Lake and Moraine Park, and offers a Hiker Shuttle to/from Estes Park	Mobility to/from and within the park; YARTS: Primarily provides connectivity to the greater region	Provides critical access to the Zion Canyon area of the park
Size of Shuttle Fleet:	17 buses for up to 28 passengers; up to 5 bikes/bus; replaced on rotating cycle	23 shuttle buses replaced on a rotating cycle	28 valley shuttle buses; replaced on a rotating cycle; other vehicles	39 power units and 23 trailers (18 doubles in park; singles in Springdale)
Passenger Boardings (Annual)	643,870	733,589	2,280,198 (2,189,437 Yosemite Valley Shuttle; 90,761 YARTS)	6,601,022
Miles Served by System:	Overall for the 10 routes operating and the Bicycle express route, 121 miles of service one way for all routes total (242 miles round trip) for each repetition of service; individual route distances range from 2 miles to 18 miles one way.	The overall distance from Estes Park to the Bear Lake trailhead parking lot is 29 miles one way; combined, all the shuttle routes serve 48 miles one way (96 miles round trip) for each service; individual routes range from 9.1 miles to 11.5 miles one way.	The Yosemite Valley loop is approximately 12 miles in length (through the 7-mile- long valley). YARTS transports passengers from surrounding gateway communities at one-way distances of between 45 and 75 miles.	The Zion Canyon route is approximately 7 miles one way and 14 miles two way; the Springdale route is approximately 2.9 miles one way and 5.8 miles total.
Operated By:	Cooperative Agreement; vehicles are not owned by the NPS	Service Contract; vehicles are not owned by the NPS	Concession Contract; buses owned by NPS (YARTS operates via a cooperative agreement, non-NPS owned buses)	Service Contract with vehicles owned by the NPS
Strategic Approach:	Private sector and non-profit partner supported system	Shuttle created around visitors' needs and experiences; improved backcountry access	Provides alternative Yosemite Valley sight-seeing opportunities	Originally created to reduce environmental impacts in Zion Canyon
Other Notes:	▪ Good connectivity to gateway communities regionally. ▪ Successful air quality improvement outcomes.	▪ Careful consideration of stop locations. ▪ Park transit different from urban transit. ▪ Hiking trailheads as focus.	▪ Connects to regional transit and work with regional partners. ▪ Gives transit priority on the park roads.	▪ Frequently cited as a model for other parks. ▪ High level of visitor satisfaction ▪ Management of visitor pulsing at stops.

5 Historical and Existing Conditions in the Study Area

Trees Near Fountain Paint Pot Trail

(Source: Sergioboccardo/Shutterstock.com, n.d.)

Chapter 5—Historical and Existing Conditions in the Study Area

Introduction

Understanding the context of Yellowstone National Park is critical as a foundation for planning and designing potential transportation solutions. Existing conditions in the study area for this project—from West Yellowstone to Old Faithful—are described in this chapter, including information about the park history and setting, natural and cultural conditions, characteristics of visitor destinations in the corridor, visitation statistics and trends, existing transportation facilities and congestion issues, and other descriptions related to the existing setting.

Park History and Setting

Designated as the world's first national park on March 1, 1872, Yellowstone was set aside as protected federal land in recognition of its unique hydrothermal features and for the benefit and enjoyment of the people. Through the designation of Yellowstone National Park, the US Congress set the groundwork for establishing future national parks in this country and around the world.

According to the NPS Foundation Document for the park (NPS, 2014a), Yellowstone is known worldwide for its concentration of more than 10,000 hydrothermal features, with the iconic Old Faithful geyser as the best known of these and most heavily visited place in the park. A supervolcano lies beneath the surface of these bubbling, gurgling, and spouting features of the landscape. About 631,000 years ago, after a series of massive volcanic eruptions occurred in what is now the central area of the park, a 30-mile-wide by 45-mile-wide caldera formed, and heat still rises through geysers, hot springs, fumaroles, and mudpots throughout the basin of the caldera and beyond. When Euro-American explorers of the West first came upon this startling landscape in the 1800s, they were astounded by the steaming pools, bubbling mudpots, shooting geysers, and stinking sulfur vapors. Frontiersman Jim Bridger described it as a "place where Hell bubbled up" in 1856 (NPS, 2014a).

The national park encompasses more than 2.25 million acres or 3,472 square miles, located in the heart of the Greater Yellowstone Ecosystem, populated by a variety of wildlife, including predators such as grizzly bears and gray wolves long since vanished from other places across the West.

Along with Yellowstone National Park, the Greater Yellowstone Ecosystem encompasses six national forests, private and reservation lands, and over two million acres of designated wilderness. This vast area is one of the last, largest, mostly intact temperate-zone ecosystems on Earth. In Yellowstone, 90 percent of the park lands are managed as wilderness, where human intrusion and intervention into natural processes are managed and minimized.

A variety of ecosystem conditions in the park create diverse habitats, from near-desert vegetation at the north entrance to subalpine meadows and forests on Mount Washburn and other higher ground areas in the park.

In 1972, the United Nations Educational, Social, and Cultural Organization (UNESCO) named Yellowstone the first area in the US to be designated as a Biosphere Reserve, and in 1978

Yellowstone National Park Significance

- World's first national park
- The planet's most active, diverse, and intact collection of geothermal, geologic, and hydrologic features
- Core of the Greater Yellowstone Ecosystem, one of the largest and last remaining mostly intact natural ecosystems in the temperate zone of Earth
- Human history that spans thousands of years
- Unparalleled opportunities to experience free-roaming wildlife, scenic views, and wilderness

(Source: NPS, 2014a)

the park was designated as a World Heritage Site. Yellowstone serves as a global resource conservation and tourism model for public land management (NPS, 2014a).

Natural Conditions in the Study Area

The natural history of Yellowstone shapes its role as one of the nation's most popular national parks visited by millions of people each year. Natural characteristics related to geology, topography, hydrothermal features, hydrology, vegetation, and wildlife are described below and on the following pages (NPS, 2018-2021e).

Natural History/Geology—Various geologic processes have shaped the Greater Yellowstone Ecosystem over the last 150 million years. Glaciers, volcanoes, erosion, seismic events, and other natural processes have formed the mountains, valleys, plateaus, and other features. What is most interesting about Yellowstone, is that some of the Earth's most active hydrothermal (water and heat), volcanic, and seismic systems create a dynamic and variable landscape, particularly in the study area that is the focus of this project. This includes the concentration of more than 10,000 hydrothermal features (and more undisturbed hydrothermal features than anywhere else on the planet) and more than 500 active geysers (the largest concentration of active geysers in the world, more than half the world's total).

These features are located within a giant caldera of a supervolcanic eruption that occurred about 640,000 years ago. The volcanic history of the area goes back millions of years, with three extremely large explosive eruptions occurring at Yellowstone in the past 2.1 million years. Scientists have estimated that past eruptions previously occurred about every 600,000 to 800,000 years. Since the caldera was formed, approximately 80 relatively nonexplosive eruptions have occurred in the vicinity of the caldera according to the US Geological Survey, with the most recent occurring 70,000 years ago.

Figure 5.1 shows the limits of the caldera in proximity to the study area.

Topography–While Yellowstone National Park has a diversity of terrain, the central portion of the park that encompasses the geyser basin corridor is essentially a broad, elevated, volcanic plateau. This area is between 7,000 and 8,500 feet above sea level, and with an average elevation of about 8,000 feet. Surrounding this central plateau on the south, east, north, and northwest are mountain ranges with culminating peaks and ridges rising from 2,000 to 4,000 feet above the general level of the plateau (NPS, 2018-2021e).

Figures 5.2 through 5.6 show the terrain of the park, a panoramic view of the park, a geographic map of the geyser basin corridor study area, and geologic conditions in the park.

Hydrothermal Features–A diversity of hydrothermal features can be viewed throughout the study area Geologists have categorized these as hot springs, geysers, fumaroles, and mudpots (NPS, 2018-2021e).

Hot Springs: The most common hydrothermal features in the park, hot springs vary from frothing, mocha-like boiling water to clear and calm pools that can be very deep. As surface waters seep underground, they are heated by a deep source of magma and rise to the surface as superheated water. Because hot springs have no constrictions, as the water rises, it cools and sinks back down freely, without pressure.

Geysers: Rising team and eruptions are the signature of geysers where hot springs are confined to narrower rocky spaces, usually near the surface of the land. With geysers, constrictions prevent water from circulating easily to the surface, so heat has limited options for escape. Waters below the surface can exceed the surface boiling point of 199° F. Some eruptions can be fairly consistently predicted, such as for the Old Faithful geyser. Others erupt on a varying time schedule and may go dormant for years without eruption.

Figure 5.1—Map of the Yellowstone Caldera

(Source: National Geographic Society,2021)

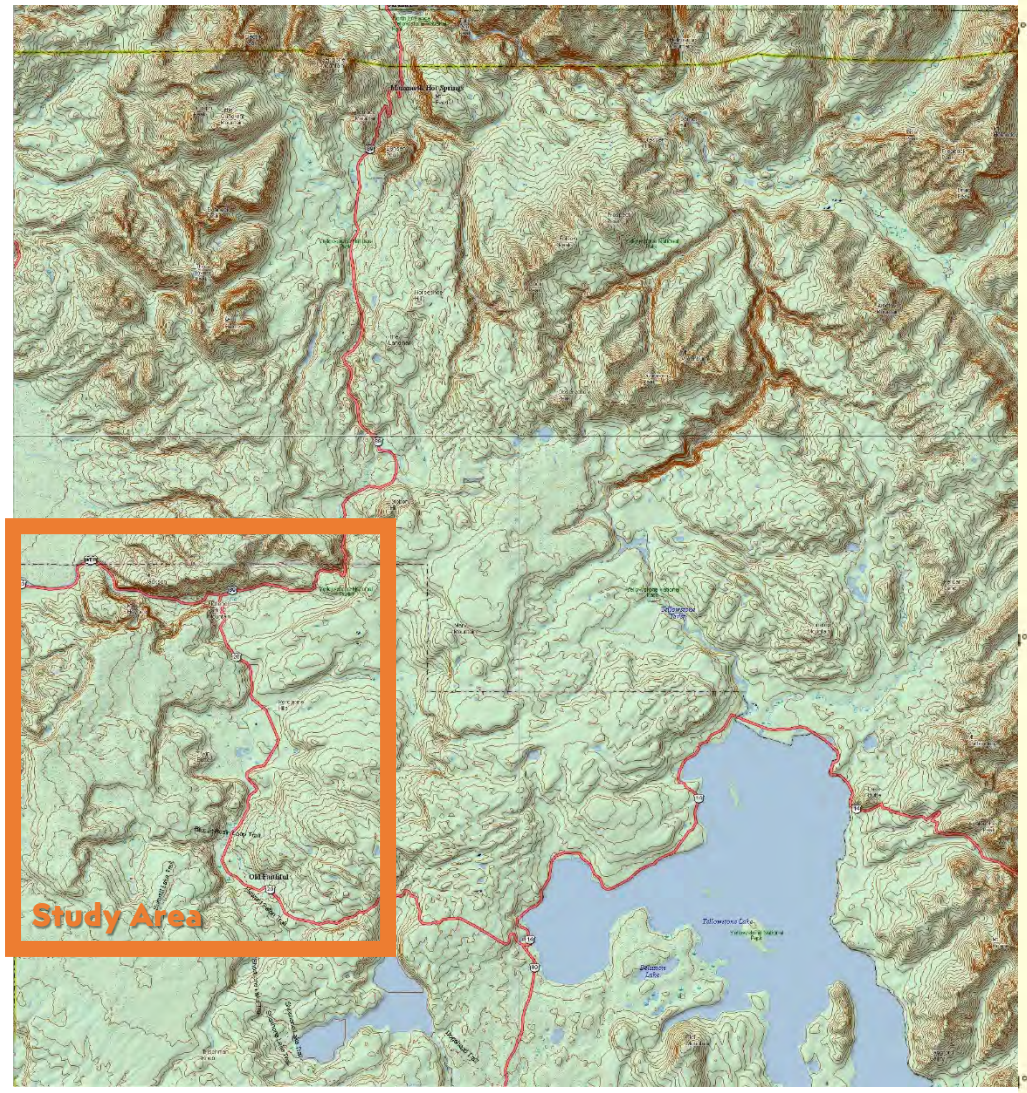


Figure 5.4—Topographic Relief Map of Study Area, Yellowstone

(Source: NPS, 2021)

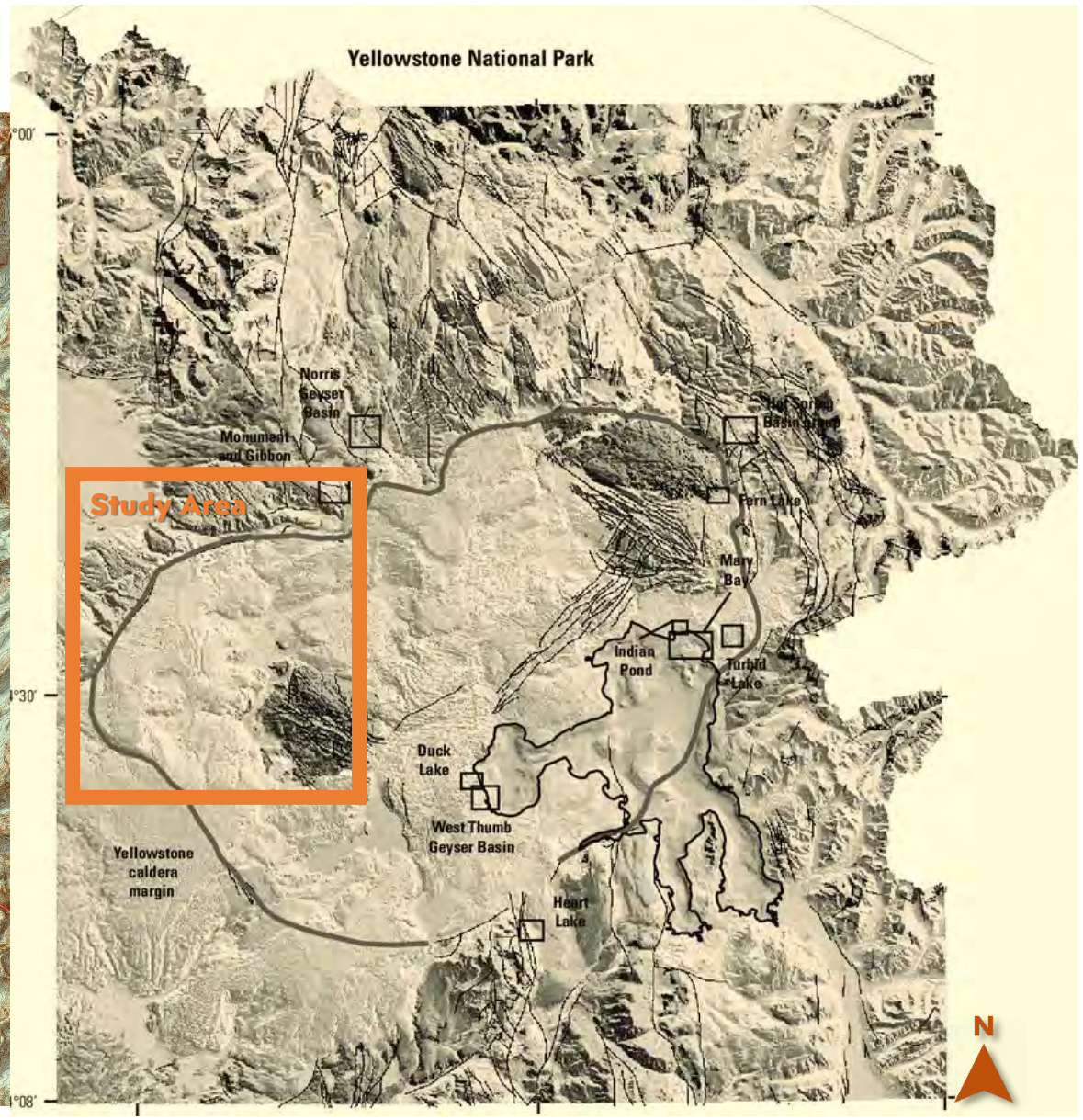


Figure 5.3—Map of Topography and Fault Lines

(Source: Shanks, 2007)

Figure 5.4-Panoramic Topographic Relief Map, Yellowstone (Looking South)

(Source: NPS, Original Artist, Berann, 2017)

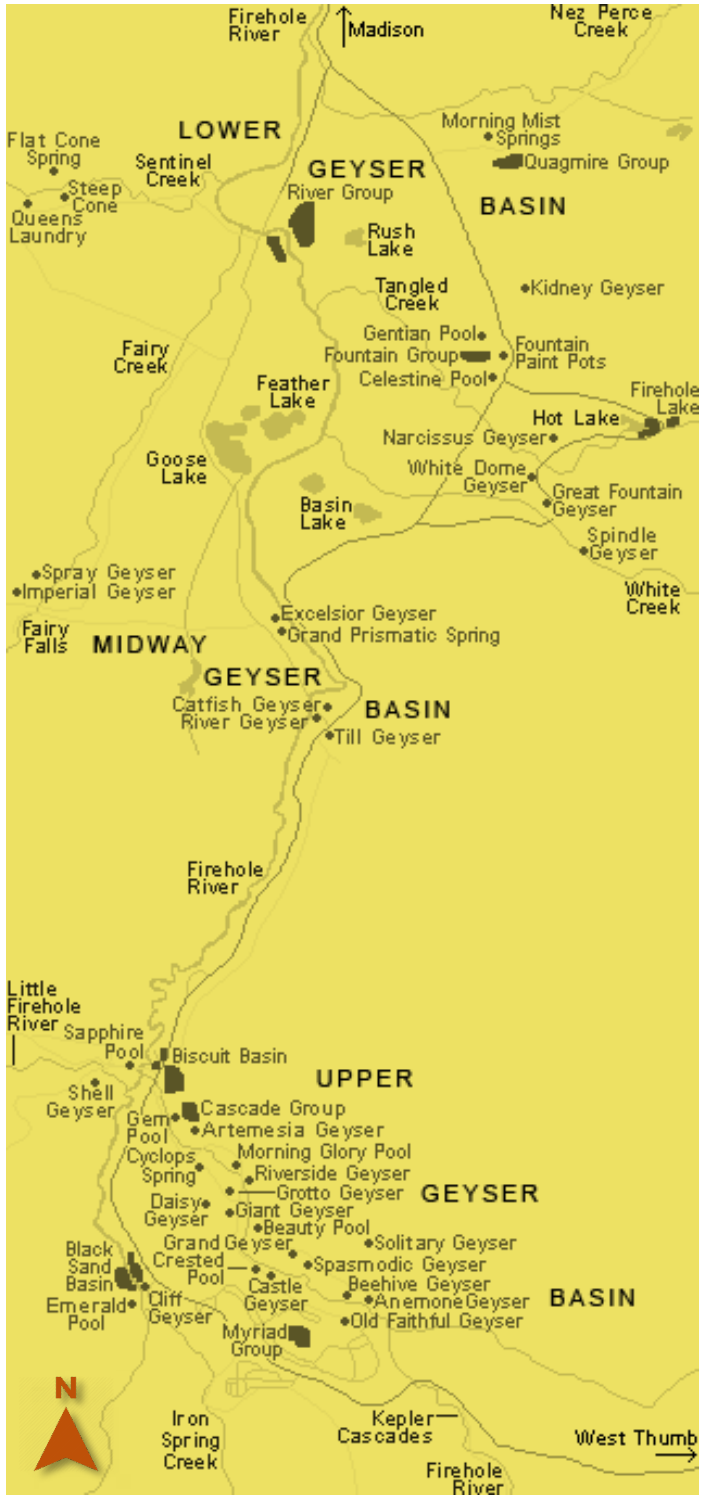


Figure 5.5—Map of the Lower, Midway, and Upper Geyser Basins—the Geyser Basin Corridor Study Area

(Source:www.americansouthwest.net, n.d.)

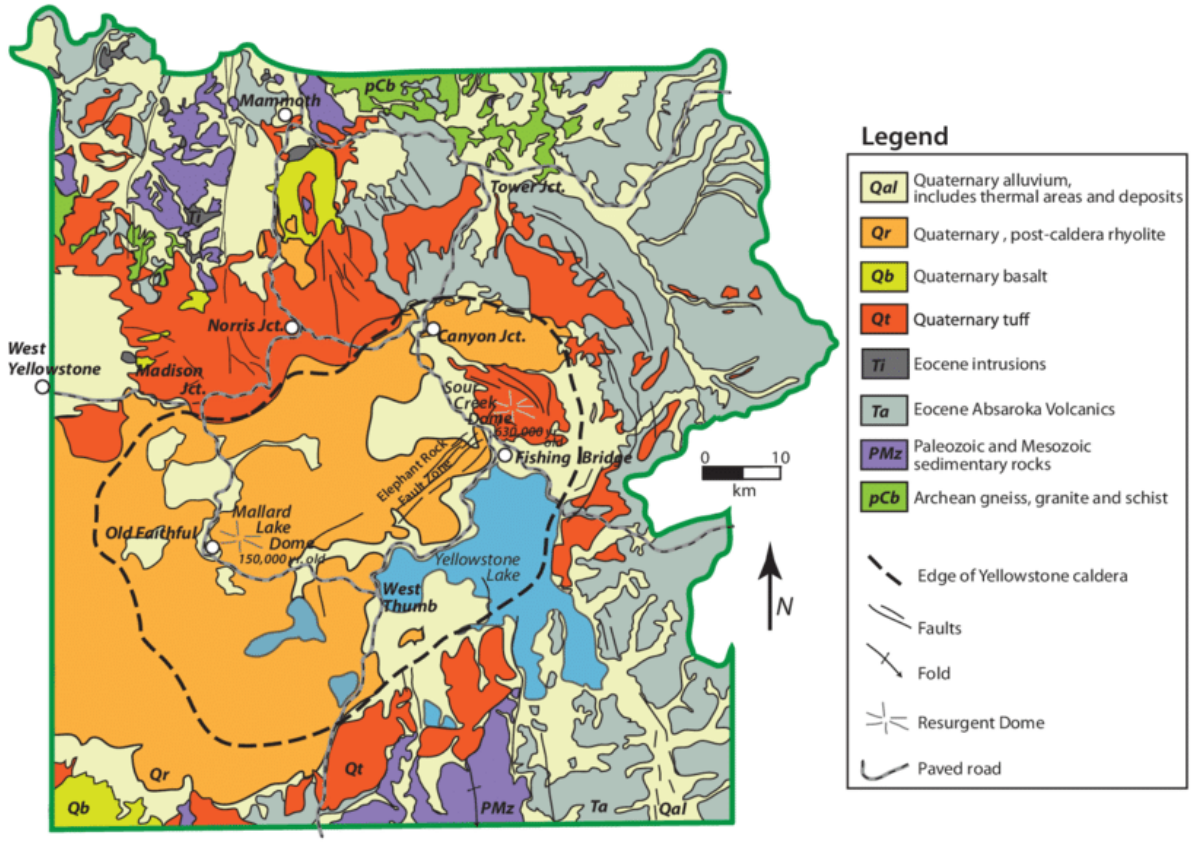


Figure 5.6—Geologic Map of the Park, Showing Distributions of Types of Rock

(Source: Mueller, 2012)

Fumaroles: These are steam vents and are the hottest hydrothermal features in the park. The small amount of water in fumaroles flashes into steam before it reaches the Surface, and hissing, whistling, and thumping noises are heard if the steam pathway is restricted at the surface. Fumaroles are more visible in cool weather.

Mudpots: Acidic hot springs with limited water supply, the consistency and activity of mudpots vary with the seasons and precipitation. Acid from volcanic gases and micro-organisms decompose the surrounding rock into mud and clay, sometimes resulting in an array of colors. Mudpots are visible at the Fountain Paint Pot area and many other locations in the park.

Hydrology—Water is a critical component of the diverse wildlife habitats and hydrothermal features of the park. It is also an important aspect of the park's scenic beauty. Yellowstone contains more than 600 lakes and ponds, 1,000 rivers and streams, and thousands of small wetlands—habitats that are intermittently wet and dry, and many lakes, ponds, rivers, streams, and wetlands exist in the study area and in the near proximity (NPS, 2018-2021e).

Water is an integral element of the complex geothermal systems in the park. As precipitation and groundwater seep down into the geothermal system, the water becomes superheated and rises back to the surface through hot springs, geysers, mudpots, and fumaroles.

The study area is located primarily within the Missouri River watershed, fed by the tributaries of the Madison River, Firehole River, and Gibbon River (NPS, 2018-2021e). See Figure 5.7.

Listed in order of from northwest to southwest the following more prominent hydrologic features are visible in the study area—in some cases, from roadways and parking lots, and other cases, from trails and overlook points:

- Madison River
- Gibbon River/Confluence with Madison River
- Firehole River
- Firehole Falls
- Nez Perce Creek
- Fairy Creek
- Fairy Falls
- Goose Lake
- Little Firehole River
- Mystic Falls
- Mallard Lake

Vegetation—Vegetation communities in the park and the Greater Yellowstone Ecosystem include a diversity of overlapping combinations of species that are typical of the Rocky Mountains, as well as the Great Plains to the east and the Intermountain region to the west. The types of plant communities in various areas of the park interrelate to the underlying geology, climate characteristics, soils and substrates, and ongoing changes and disturbances to nature as a result of climate change, fire, floods, landslides, blowdowns, insect infestations, and invasions of nonnative species (NPS, 2018-2021e).

Overall, there are nearly 1,400 native plant taxa in the park, including species that have persisted in the area for thousands of years, surviving dramatic geologic events (glaciers, volcanic eruptions, lava flows, geyser and other hydrothermal activities, and of course, fires).

In the study area, from West Yellowstone to Old Faithful, most of the vegetation communities identified in the park can be seen, although some intermittently. Sagebrush-steppe, wetlands, hydrothermal, and higher- and lower-elevation forest and understory vegetation communities are dominated by various species. Lodgepole pine, spruce-fir, whitebark pine, and Douglas fir forests have been mapped by the NPS, as shown in Figure 5.8, with lodgepole pine as the predominant forest type throughout the park. Other conifers in the park include Engelmann spruce, white spruce, subalpine fir, Rocky Mountain juniper, common juniper, and limber pine. Deciduous trees include quaking aspen, cottonwood, and a variety of other species.

Shrubs include common juniper, numerous sagebrush species, Rocky Mountain maple, a wide variety of grasses, rushes and other wetland species, hundreds of wildflowers, and other plants. There are three endemic plant species only found in Yellowstone: Ross's bentgrass, Yellowstone sand verbena, and Yellowstone sulfur wild buckwheat. Ross's bentgrass and Yellowstone sulfur wild buckwheat both grow in the Firehole River drainage that extends through the study area.

The hydrothermal areas create unique ecosystem conditions that support a variety of other unusual and rare species, such as the warm springs spike rush, which grows in warm water and Tweedy's rush, which is sometimes the only vascular plant growing in the acidic hydrothermal areas.

The park's vegetation management activities focus on minimizing human-caused impacts on native plant communities to the maximum extent feasible. (There are over 200 nonnative plant species in the park.)

The Vegetation and Resources Management staff at the park inventory, monitor, manage, and conduct research on the plant communities in Yellowstone. Specific ongoing activities include invasive, non-native plant inventory and control, wetland communities and rare plant survey and protection, vegetation monitoring and ecological restoration, hazard tree management, and aquatic invasive species prevention from establishment in park waters.

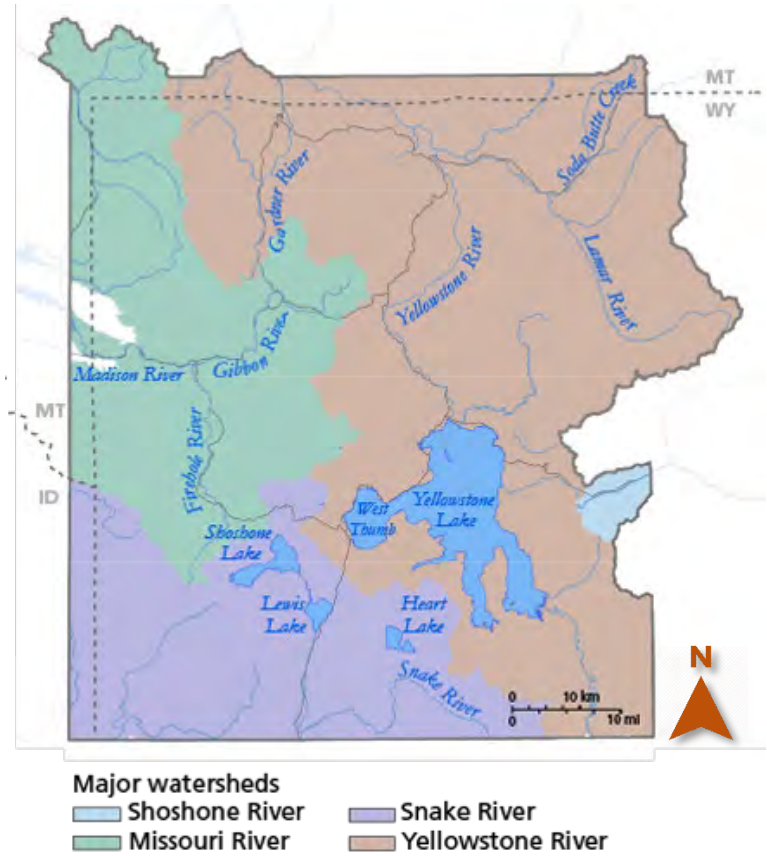


Figure 5.7—Yellowstone Watersheds and Major Water Features
(Source: NPS, n.d.)

Biological Soil Crust—Often, terrestrial surfaces have a ground layer composed of lichens, mosses, liverworts, hornworts, free-living algae, free-living cyanobacteria, bacteria and/or micro-fungi (Elbert et al., 2012; Smith et al., 2015). These materials that are contained in the soil surface are referred to as "biological soil crust." These materials occupy the wood, rock, and organic material on the ground surface, and together this network of organisms provides many valuable biological and ecological functions, representing a large percentage of biological diversity on the Earth.

A 2016 study of biological soil crust conditions in Montana, including areas around Yellowstone found that materials such as cyanobacteria, either as free-living or in symbiosis with fungi (lichens) or mosses contribute fixed nitrogen to the soil and serve a key role in the cycling of nitrogen (Belnap et al., 2001; Elbert et al., 2012; Smith et al., 2015).

Biological soil crust materials and ground layer materials also contribute to significantly carbon uptake, sequestration (storage), and release (Elbert et al., 2012).

Biological soil crusts enrich habitat for a variety of species and soil dwelling lichens that provide food for mammals such as pronghorn (Antilocapra americana) and other species (Sharnoff and Rosentreter, 1998; Yellowstone Science, 2007). Biological soil crusts serve as indicators of rangeland health (Belnap et al. 2001), and the structure and composition of the crust provides information indicative of a site's characteristics and disturbance history.

Once damaged, the ecological value of biological soil crusts are greatly diminished, and they can be extremely slow to regenerate.

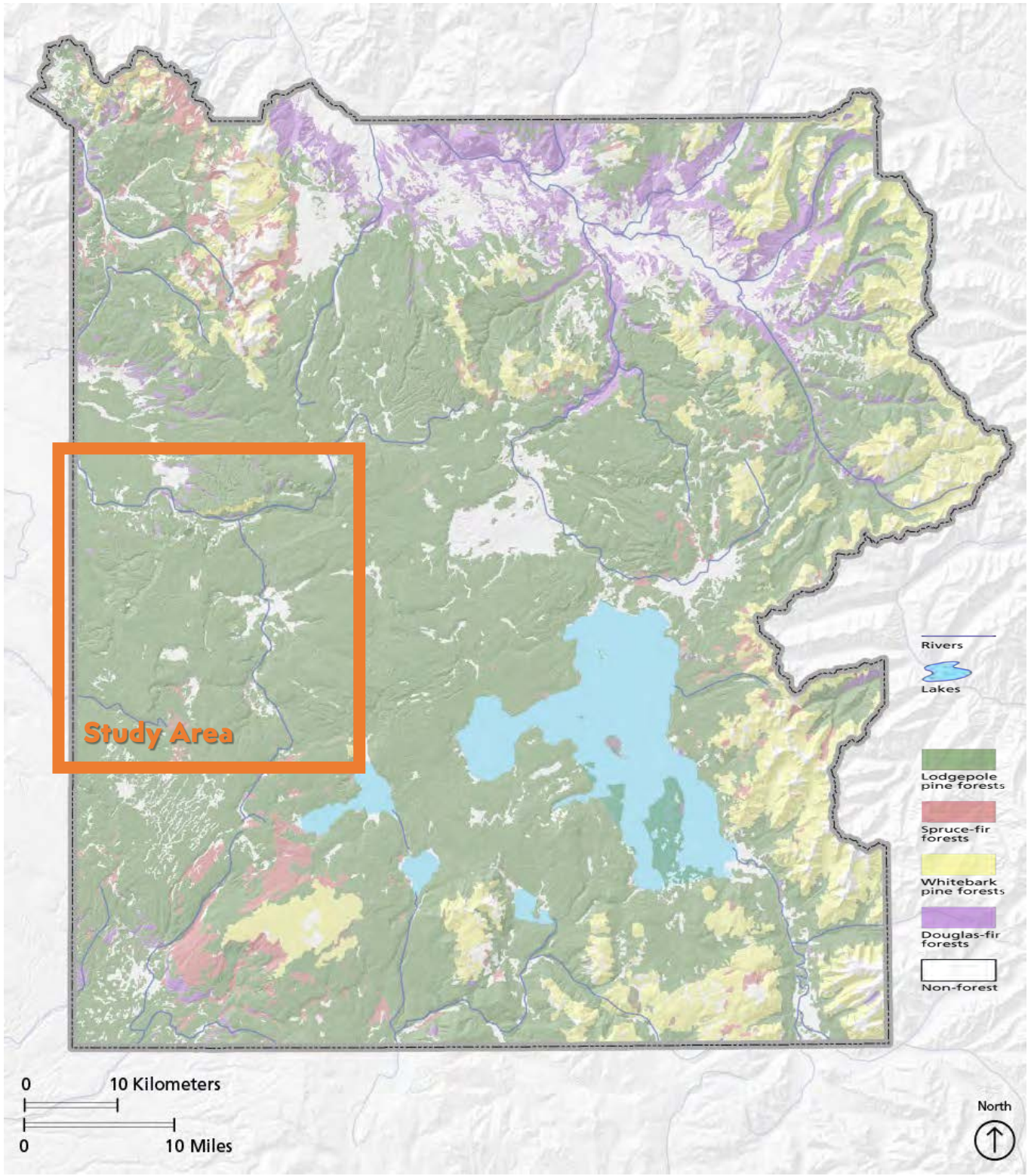


Figure 5.8—Yellowstone Vegetation Communities
(Source: NPS, Yellowstone Spatial Analysis Center, 2021)

Wildlife—Throughout the park, herds of bison and elk roam epic valleys, while grizzly bears and gray wolves (reintroduced at Yellowstone in the 1990s) support healthy predator/prey relationships, evoking a sense of wilderness not found in this magnitude at any other national park and only a few places on the continent (NPS, 2018-2021e).

Other species such as bighorn sheep, otters, coyotes, moose, and black bears inhabit their own spaces in the park. Other mammals such as deer, pronghorn, beavers, weasels, foxes, rabbits, pikas, lynx, badgers, martens, bobcats, cougars, raccoons, marmots, bats, and other smaller creatures also live in Yellowstone.

The rivers traversing this area of the park provide habitat for a diversity of fish, water-loving mammals, and waterfowl. Yellowstone's rivers and lakes are home to the Yellowstone cutthroat trout and other species of fish, and the lands and waters of Yellowstone also support a diversity of birds including migrating waterfowl such as trumpeter swans.

Figure 5.9 shows typical locations where various large mammals are found in the park, but this can vary over time. For example, grizzly bears and wolves, as well as other animals, tend to roam widely across the region, as shown in Figures 5.10 through 5.12. Bison and elk are frequently sighted roaming throughout the park and are common in the geyser basin corridor.

Although sightings are less frequent, wolves, bears, coyotes, and other mammals also pass through the study area. Visitors are constantly advised to keep their distance from wildlife in the park—at least 100 yards away from bears and wolves, and at least 25 yards away from all other wild animals. In spite of park staff's diligent efforts, visitors' intrusions and too-close interactions with wildlife happen on a fairly regular basis.

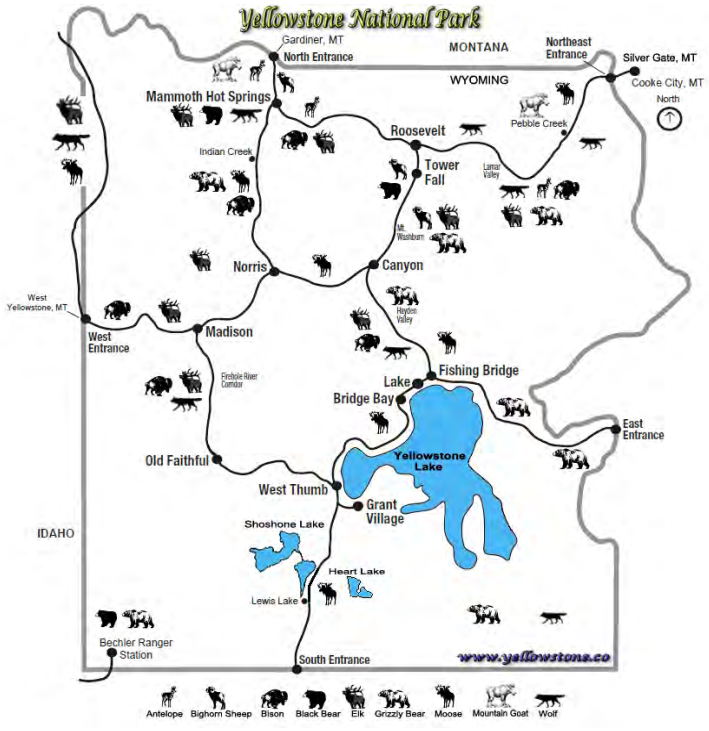


Figure 5.9—Typical Areas Where Large Mammals Are Found in the Park

(Source: Yellowstone.co/animals, 2021)

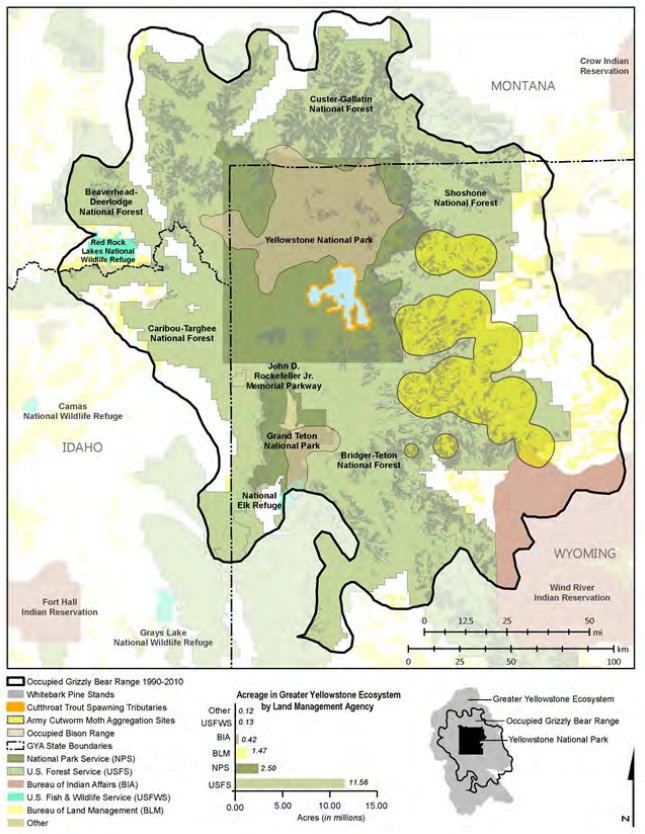


Figure 5.11—Occupied Grizzly Bear Areas

(Source: NPS, 2020)

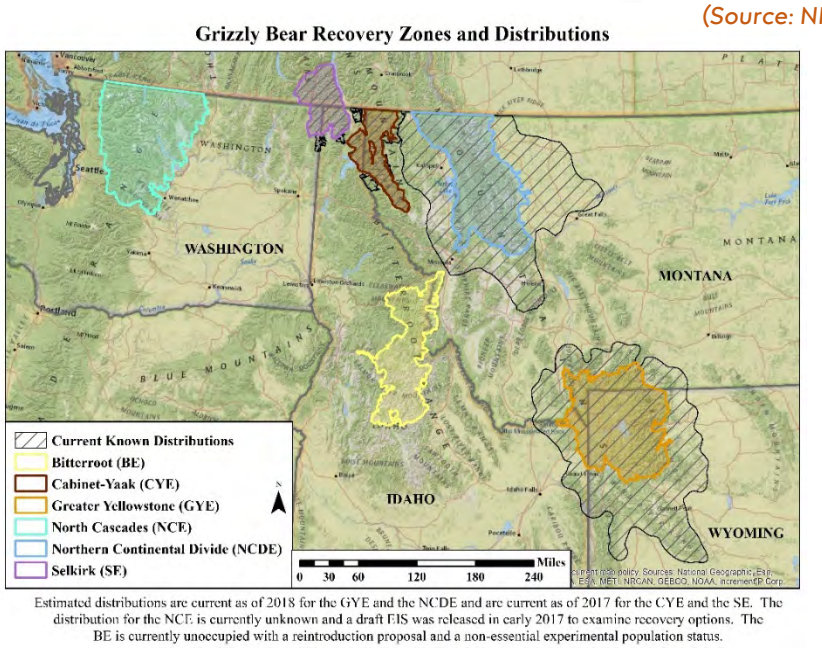


Figure 5.10—Grizzly Bear Recovery Zones and Distributions

(Source: US Fish and Wildlife Service, 2017-2018)

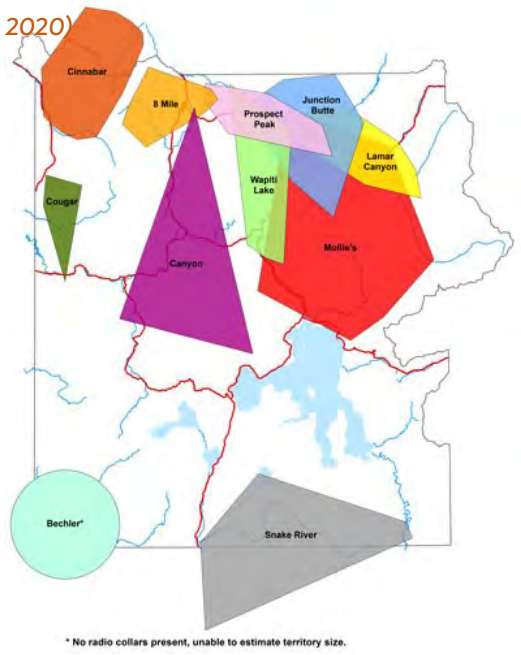


Figure 5.12—Gray Wolf Territories, 2016

(Source: NPS, 2016, accessed 2021)

Just a few of the many species of wildlife in Yellowstone NP

(Source for all photos: NPS, 2021; Fleming, J. photograph of spawning cutthroat trout, Lamar Valley, 2021)

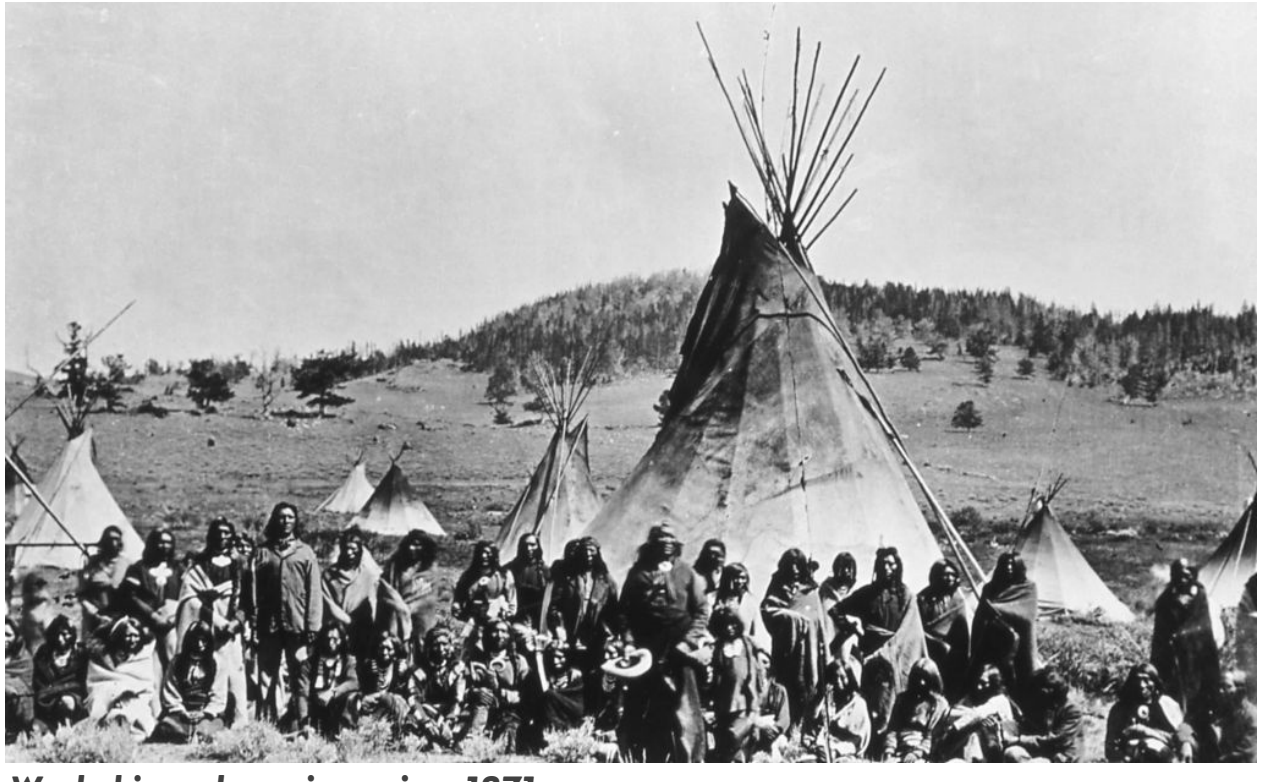
Human History

The Yellowstone region has a rich human history that extends back through time immemorial as a place of importance to various Native American tribes, many of whom still have deep connections to the area. Evidence such as stone tools and projectile points of human occupation in the greater Yellowstone area seems to indicate that after glaciers receded around 15,000 to 12,000 years ago, people came into the area in pursuit of Ice Age mammals such as the mammoth and the giant bison in the area (NPS, 2018-2021).

These first people to the area hunted and foraged, subsisting on meat, berries, seeds, roots, and other plant-based foods. Then as the climate continued to become warmer and drier, the ecosystem changed. The larger Ice Age animals that were adapted to cold and wet conditions became extinct. People became more reliant on smaller animals such as deer and bighorn sheep. Other plant species such as bitterroot and prickly pear became an important part of the diet.

Oral histories gathered by the NPS indicate extensive use of the Yellowstone area by Native Americans. The Kiowa lived here, ancestors to the tribes today known as the Blackfeet, Cayuse, Coeur d'Alene, Bannock, Nez Perce, Shoshone, Umatilla, and other groups.

People established trails throughout the region and followed these seasonally for hunting, gathering, special ceremonies, trade, and other activities. After area tribes acquired horses in the early 1700s, lifestyles changed because tribes could travel faster and farther to hunt bison and other animals of the plains.



Washakie and warriors, circa 1871

(Source: NPS, Yellowstone National Park photo Collection, 1871)

Although, some groups chose not to acquire horses and preferred to stay in mountainous terrain, such as the Sheep Eaters or Tukudika of the Shoshone people, whose lifestyles tended to revolve around bighorn sheep.

In the 1800s, this fascinating landscape attracted Euro-American explorers, trappers, military encampments, miners, and finally pioneers, who came to settle the West. John Colter and Jim Bridger were famous trappers in the area and frequent traders with tribes.

After the national park was established in 1872, lodges, inns, cabins, museums, and visitor centers were constructed, including the historic Old Faithful Inn, built in 1903-1904 and named for the famous geyser located nearby.

The Old Faithful Historic District includes the inn and many of the surrounding buildings and was listed on the National Register of Historic Places in 1982. The Inn and the historic district were deemed to be historically significant because of the rustic architecture of the buildings and their role in the development of concessions to accommodate growing tourism in the early 1900s.

The Old Faithful Lodge, located near the Inn, reached its present configuration in 1928 after numerous changes. Old Faithful Inn exemplifies rustic architecture with its steeply sloping roof and hand-crafted details. The six-story structure is flanked by a dining room and two three-story wings of guest rooms. Historic preservation has maintained the appearance and condition of the famous Old Faithful Inn

Jim Bridger, mountain man and trapper—one of the first Euro-American explorers to see the geysers of Yellowstone in the mid-1820s

(Source: NPS, circa mid-1820s)

The historic Old Faithful Inn, photograph from 1912, Yellowstone NP

(Source: NPS, 1912)

lobby so that generations of park visitors have been able to enjoy its splendor.

Seismic activities and fires have affected the district's historic buildings over time. The August 1959 Hebgen Lake earthquake resulted in damaged foundations, roofs, and chimneys, and in September 1988, the North Fork Fire destroyed some small buildings, but the Old Faithful Inn was preserved with the help of firefighters, roof sprinklers installed the previous year, and a shift in wind direction.

The Old Faithful geyser was named by the first official expedition to Yellowstone, the Washburn Expedition of 1870, whose members were impressed by the size of the geyser and its frequent activity. Old Faithful erupts every 35 to 120 minutes for 1.5 to 5 minutes in duration. Old Faithful's maximum height ranges from 90 to 184 feet. The geyser is the most famous feature of the area, located in close proximity to the historic district, but hundreds of other geysers and hydrothermal features are scattered throughout the area and are visible via an extensive trail and boardwalk network that connects to other visitor sites along the Grand Loop Road (2018-2021f).

West Yellowstone to Old Faithful Context—Visitor Destinations and Characteristics of Key Sites

Existing characteristics in the study area, and specifically along the corridor from West Yellowstone to Old Faithful in Yellowstone, are described below and on the following pages (NPS, 2018-2021d and 2018-2-21f).

West Yellowstone—A gateway community to Yellowstone National Park, West Yellowstone sits just outside the west gate to the park. Approximately 42 percent of visitors to the park use this entrance, more than double the traffic of any other entrance, which is substantial, especially considering that this entrance is typically closed from early November to mid-April each year. About 54 percent of all visitors enter and exit from this gate, and 55 percent of day users enter and exit, indicating that a high number of visitors to the park likely lodge and/or dine and obtain services and information in West Yellowstone (NPS, 2017b).

According to the Town of West Yellowstone, annually more than 2.5 million people travel through West Yellowstone, and in some cases stay overnight, when they are visiting the park and other destinations in the area. This large influx expands the town's population from its

Old Faithful Geyser

(Source: fIIPhoto/Shutterstock.com, n.d.)

West Yellowstone is a key gateway community to Yellowstone NP and a hub for lodging, dining, services, and visitor activities.

(Source: Pinterest/Yellowstonepark.com, n.d.)

year-round level of 1,400 people to upwards of 10,000 people per night during the peak period of visitation in the summer. A 2017 study by Otak, Inc. and Fehr & Peers found that there were 3,053 overnight lodging units in West Yellowstone, a number that has likely increased since that time. Jackson Hole to the south had the most lodging units of any town within a half day drive of the park, with over 5,000 (NPS, 2017b).

West Yellowstone was incorporated in 1966 but has served as a gateway community since the early 1900s. The town provides a variety of lodging, dining, grocery, entertainment, and services for visitors to the park, as well as housing for year-round residents. The town's economy and employment opportunities are strongly linked with regional tourism opportunities, including visitation to Yellowstone.

Visitors can access park information at multiple places in West Yellowstone, including the West Yellowstone Visitor Information center, located just outside the park, west of the west park entrance. The center is managed jointly by the NPS, the West Yellowstone Chamber of Commerce, and the USDA Forest Service, and serves as a good location for visitors to get oriented to the park, forests, and businesses and services available in town.

The Town of West Yellowstone reports concerns about the lack of affordable housing in the community, particularly for the seasonal employees in town and that work in the park. The town is proactively planning to find partners and funding to support affordable housing development in the near-term future (D. Sabolsky, personal communication, June, 2018).

Madison River Corridor—From the west entrance departing West Yellowstone, the park road follows the Madison River. Several river access sites (also used as trailheads, picnic, day use, and wildlife watching sites) are located along the corridor between West Yellowstone and the Madison Junction. These sites include the Two Ribbons trailhead and various other waysides. Mount Haynes is visible to the south from portions of this corridor and the Madison River is visible along portions of the corridor, on the north side and on the south side after it crosses under at the Seven Mile Bridge.

Bison enjoy congregating in this area of the park particularly in the Harlequin Lake area, about two miles west of Madison Junction. "Bison jams" or "animal jams" occur frequently here and in other places throughout the aprk. These are traffic jams when vehicles slow or stop because bison or other animals are either standing at the roadside and visitors are slowing to observe or photograph them, or they are standing IN the roadway, causing an even longer delay in traffic. In addition to bison, other wildlife also can be observed in this area of the park, including elk, waterfowl, and infrequently, there have been sightings of wolves passing through.

Madison Junction—A key hub in the park, a Visitor Information Station and Trailside Museum, and the Madison Campground are located in the vicinity of Madison Junction, where the West Entrance Road joins the Grand Loop. The Information Station and Trailside Museum were built in 1929-1930, and this small building houses a Junior Ranger Station and Yellowstone Forever bookstore. The parking and infrastructure in this area provides space for buses to circulate through as well as to stop and drop-off/pick-up passengers. National Park Mountain is visible from this

THE FIREHOLE

Early explorers and mountain men named the geyser basin area "Firehole" or "Fire Hole" for the boiling hot hydrothermal features visible at every turn. The name stuck as the place name for many geographic features in the area, including the Firehole River and Firehole Lake.

(Source: NPS, 2014a)

Firehole River swimming area

(Source: NPS, photograph by Jacob W. Frank, n.d.)

Firehole Canyon Drive is a busy place in summer at Yellowstone.

(Source: NPS, photograph by Jacob W. Frank, n.d.)

area. The Madison Campground provides 278 campsites, open typically from late April to mid-October.

Firehole Canyon Drive—Just south of the Madison junction, Firehole Canyon Drive is accessible from the Grand Loop Road (right turn, southbound). This two-mile, one-way southbound road provides visitors the opportunity to get off the main road and follow the Firehole River. Access to a river swimming area and the waterfall overlook of Firehole Falls is provided, along with fishing access points. Firehole Falls, located in the central segment of Firehole Canyon Drive (a loop road off the Grand Loop), is a 40-foot waterfall amidst 800-foot-thick lava flows forming the canyon walls. There is a small parking area near the falls and several small pull-offs along the road.

The swimming hole in Firehole Canyon is one of only two swimming areas in Yellowstone. (The other, the Boiling River, is located north of Mammoth and is only open in fall and winter due to water levels.) There is no parking lot at the Firehole swimming area, but there are roadside pull offs and changing rooms near the road. The rocky beach area is accessed via a wooden staircase. The water temperature is cool, similar to an unheated swimming pool, but not warm or hot as the name Firehole would suggest. The narrow road has limited pull offs for viewing the river and falls can get extremely congested during the peak summer visitor season. This area is located in the southern segment of Firehole Canyon Drive.

Fountain Flat Drive and the Lower Geyser Basin—The second largest geyser basin in the park, the Lower Geyser Basin is home to the Fountain area, Sentinel Meadows, Firehole Lake, Morning Mist Springs, the Quagmire group, and other nearby geysers, as well as the Firehole River corridor (described above).

Fountain Flat Drive is accessible off the Grand Loop (right turn, southbound) and takes visitors out of the fray of the busy main road traffic, across the Nez Perce Creek bridge (near the creek's confluence with the Firehole River), and to pull off areas and a trailhead parking area along the creek. This is a popular place for fishing, wildlife watching, picnicking (there is a picnic spot near the bridge open 6:00 a.m. to 11:00 p.m.), and other activities. The paved road extends about 3 miles to the trailhead parking area, which provides sufficient turn- around space for buses. From here, visitors can hike or flat tire bike on a wide gravel path that is 3.9 miles long and leads to the Fairy Falls Trail system in the Midway Geyser Basin.

Visitors can see Ojo Caliente Springs, located one third of a mile down the path, and scenic views not available from the main road. The trail also leads to the Sentinel Meadows Trail and thermal features such as the Queen's Laundry, Imperial Geyser, and Fairy Falls. Elk and bison frequently graze in the meadows in this area, particularly in spring. This area is also a Bear Management Area with trails typically closed to visitors until the Saturday of Memorial Day Weekend.

The Lower Geyser Basin extends over an area that is five miles by two miles along both sides of the Firehole River, mostly open meadows of level terrain with rolling hills on the periphery. Geyser groups are scattered throughout the area including in the surrounding hills.

The Fountain Paint Pot area is a popular visitor stop with a variety of colorful hydrothermal features. The same 1959 earthquake that damaged buildings in the Old Faithful Historic District also caused gravel and soils to vibrate and shift in this area, changing the complexion of many features. Thermophiles, heat-loving mats of microorganisms such as bacteria thrive in the warm waters of this area and produce ribbons of color. Green, orange, and brown

Silex Spring, Lower Geyser Basin

(Source: Zach Alan, n.d.)

colors are mostly created by cyanobacteria, which can live in water temperatures as high as 167° F. A thermophile organism that revolutionized DNA processes was discovered in this area, Thermus aquaticus (NPS, 2021).

Geysers in the Fountain Paint Pot area visible from the boardwalk/trail network (which is partially accessible to those in wheelchairs) include Morning Geyser, Clepsydra Geyser, Spasm Geyser, Jet Geyser, Red Spouter, and Twig Geyser, and other features are visible such as Leather Pool, Silex Spring, Celestine Pool, and various bacterial mats.

Firehole Lake Drive—Located on the east side of the Grand Loop, south of Fountain Paint Pot is a two-mile-long, one-way loop road, accessible to visitors' private vehicles, but challenging to maintain given the constant geothermal forces in the area. The Great Fountain Geyser is visible from Firehole Lake Drive and is the only geyser outside of the Old Faithful area with a forecasted eruption schedule in summer. Other features in this area include Firehole Spring, Surprise Pool, White Dome Geyser, Pink Cone Geyser, Hot Lake, Black Warrior Lake, Steady Geyser, and Firehole Lake. There are so many interesting features in this area—these are only the most visible and predominant in the landscape, frequently noted on maps and in trail guides.

Figure 5.13, on the next page shows some of the many hydrothermal features of the Lower Geyser Basin. Figure 5.14 shows the Midway Geyser Basin, and Figure 5.15 shows the Upper Geyser Basin.

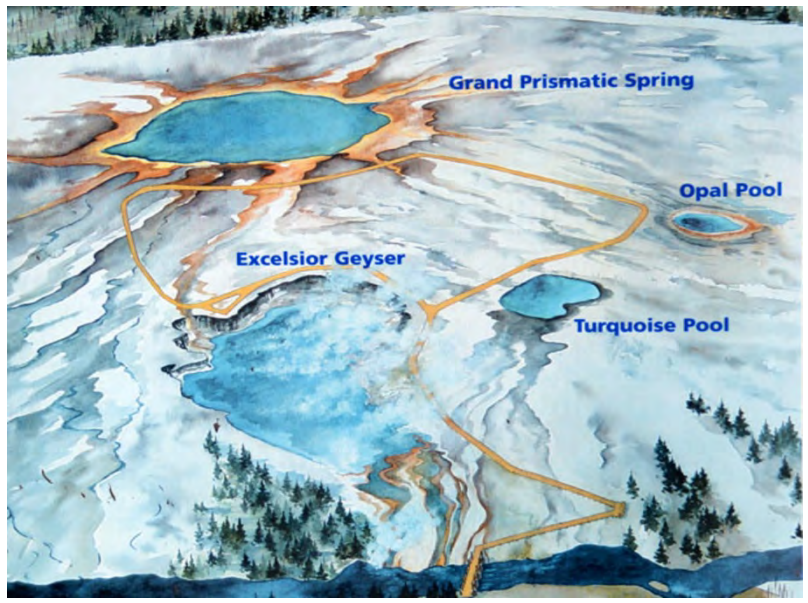
Midway Geyser Basin, Grand Prismatic Spring and Fairy Falls—Located two miles south of the entrance to Firehole Lake Drive, the Midway Geyser Basin has become one of the most visited locations in the park, largely due to publicized bird's eye photos of the Grand Prismatic Spring that appeared in National Geographic and other magazines and newspapers earlier in this

Figure 5.13—Map of the Lower Geyser Basin

(Source: www.americansouthwest.net, 2021)

decade. Grand Prismatic is thought to be the world's largest hot springs. A trail from the main parking area leads visitors to an elevated view of the colorful Grand Prismatic, a sought-after photography opportunity. Before the trail was constructed, visitors created social trails to reach the same viewpoint as published in magazines and newspapers. The hot springs' brilliant rainbow colors have made it the most photographed feature in the park, even more so than Old Faithful.

The world's largest geyser, Excelsior, an enormous geyser crater, is also located the Midway Geyser Basin, along with Turquoise Pool and Opal Pool. While the Midway Geyser Basin in smaller in area than the Lower Geyser Basin, the scenic quality and mystique of these features draw huge throngs of visitors, who access the area via parking lots connected to networks of trails and boardwalks.



An illustration showing some of the hydrothermal features of the Midway Geyser Basin

(Source: Wadzinski. G., NPS, n.d.)

Aerial view of the Grand Prismatic Spring, Midway Geyser Basin

(Source: Peter Adams Photography/Alamy stock photo, 2013)

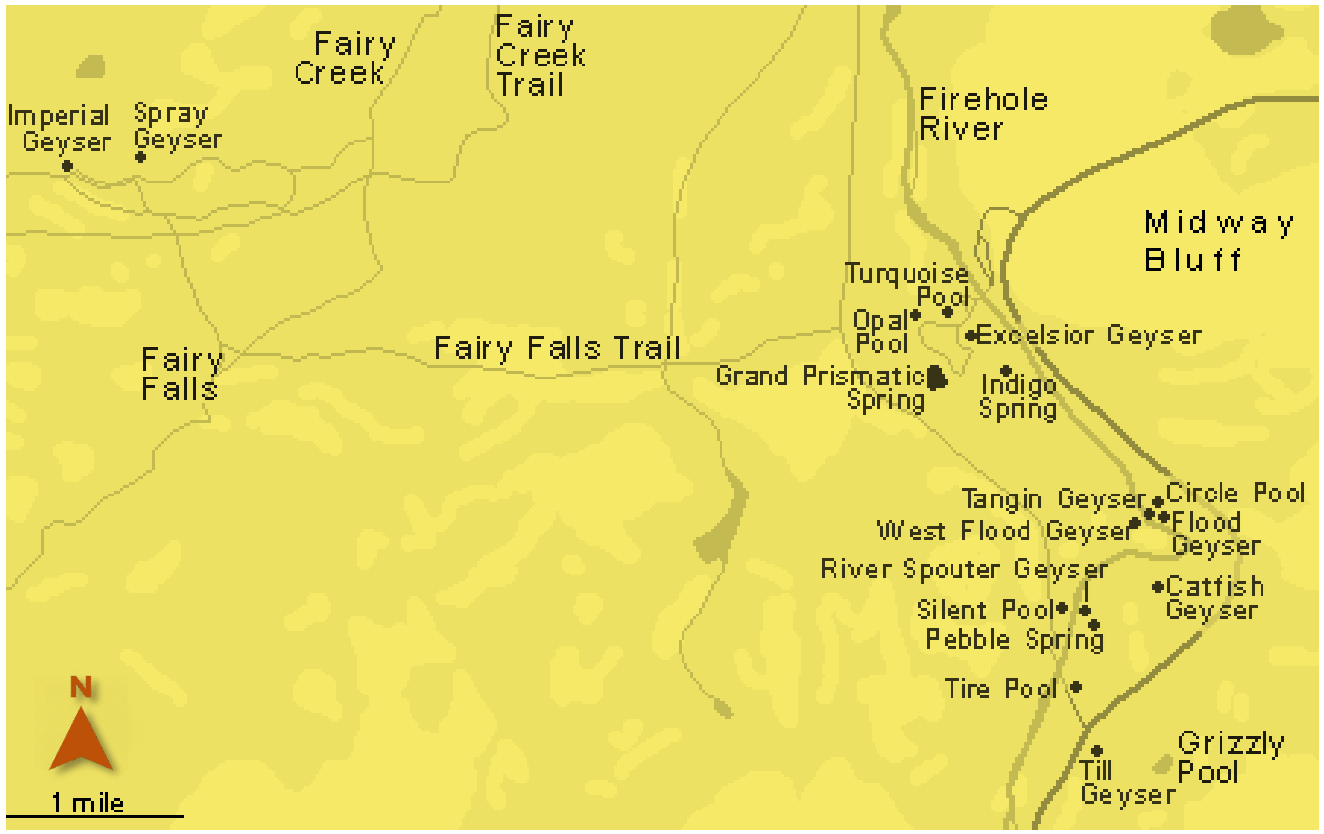


Figure 5.14 Map of the Midway Geyser Basin
(*Source: www.americansouthwest.net, 2021*)

The Fairy Falls Trail is accessible throughout this area. The trail takes visitors to the 200-foot-high Fairy Falls, one of the park's most spectacular waterfalls. The falls can be reached 1.6 miles from the trailhead at the Fairy Falls parking area (south of Midway Geyser Basin), after a hike through a young lodgepole pine forest. The trail continues beyond the falls to Spray and Imperial Geysers, which adds 1.2 miles to the hike. You can also park at the end of Fountain Flat Drive and hike to the trail from the north.

Upper Geyser Basin and Old Faithful—The Upper Geyser Basin is home to the largest concentrations of geysers in the world, including those in the Old Faithful area as well as features in Biscuit Basin and Black Sand Basin, and places such as Morning Glory Pool, Daisy, Riverside, Castle, Chromatic Pool, Beauty Pool, and many others (many labeled in Figure 5.15). This area is interconnected via a network of trails that provide the opportunity for extensive day hiking based from Old Faithful. There are a multitude of trailheads and picnic spots, including the trail to Mystic Falls on the Little Firehole River. Many of the world's largest geysers are found in this basin. Of course, the most famous of these is Old Faithful. Besides Old Faithful, there are hundreds of other geysers and hot springs throughout the area that visitors can see.

A visit to the Old Faithful area represents the quintessential Yellowstone National Park experience. Multiple studies have shown that Old Faithful is the most visited place in the park (NPS, 2018-2021f).

Similar to West Yellowstone, but on a smaller scale, the Old Faithful complex (as park staff call the area) functions as an important lodging and information hub for visitors. A self-guided tour of the historic district provides interpretation about the historic Old Faithful Inn. The Old Faithful Visitor Education Center, which opened in 2010, is a busy hub and informative place to visit to learn more about the Old Faithful District, geysers in the area, and the park in general. The Visitor Education Center also includes interpretive exhibits related to Yellowstone's hydrothermal features and a Young Scientist room for visitors of all ages. There is a theater that features frequent showings of park-related videos.

Lodging is available at the Old Faithful Inn, Old Faithful Lodge Cabins, and the Old Faithful Snow Lodge and Cabins. Dining and food services are provided in the Old Faithful Dining Room, Bear Paw Deli at Old Faithful Inn, Bear Pit Lounge at the Old Faithful Inn, the Mezzanine Coffee Cart and Bar, Old Faithful Lodge Cafeteria, Old Faithful Lodge Bake Shop and Ice Cream, Obsidian Dining Room at Snow Lodge, Geyser Grill at Snow Lodge, and Firehole Lounge. There are multiple stories with groceries, gifts, hiking supplies, and other products.

Various tours originate from the area, including the Circle of Fire Tour, Yellowstone in a Day, Firehole Basin Adventure, Picture Perfect Photo Safari, Geyser Gazers, Old Faithful Inn Walking Tour, Ranger-Led Interpretive Walks, and others). Evening programs include interpretive talks, videos, and tours, such as "Twilight on the Firehole" that treats visitors to the golden hour hues of Firehole area.

The NPS reports that a popular activity on a summer day is to watch the Old Faithful Geyser eruption and then grab an ice cream cone

and walk around the historic Old Faithful Inn or sit out on the viewing deck to take in the geyser basin scenery.

Visitors also can take the Lone Star Geyser Trail, for a 4.8-mile-round-trip hike from the trailhead (south of the Kepler Cascades parking area) to the Firehole River and cone geyser, which erupts for 30 minutes about every 3 hours. There is also an Observation Point for the Kepler Cascades, accessible via the boardwalk across the Firehole River and a steep 1-mile-round-trip hike, which affords a bird's eye view of the geyser basin and Old Faithful eruptions, or via a pull-off area along the Grand Loop Road.

Research on visitor travel patterns show that many visitors simply come to the park to visit Old Faithful only. A large percentage of park visitors travel from West Yellowstone to Old Faithful and back to West Yellowstone (NPS, 2017b). This is significant given that this portion of the Grand Loop Road is typically only open May through October, with the exception of snow coach tours that take visitors to Old Faithful in the winter.

Visitors in the vicinity of the Old Faithful complex and Old Faithful geyser viewing area

(Source: NPS, photograph by Neal Herbert, n.d.)

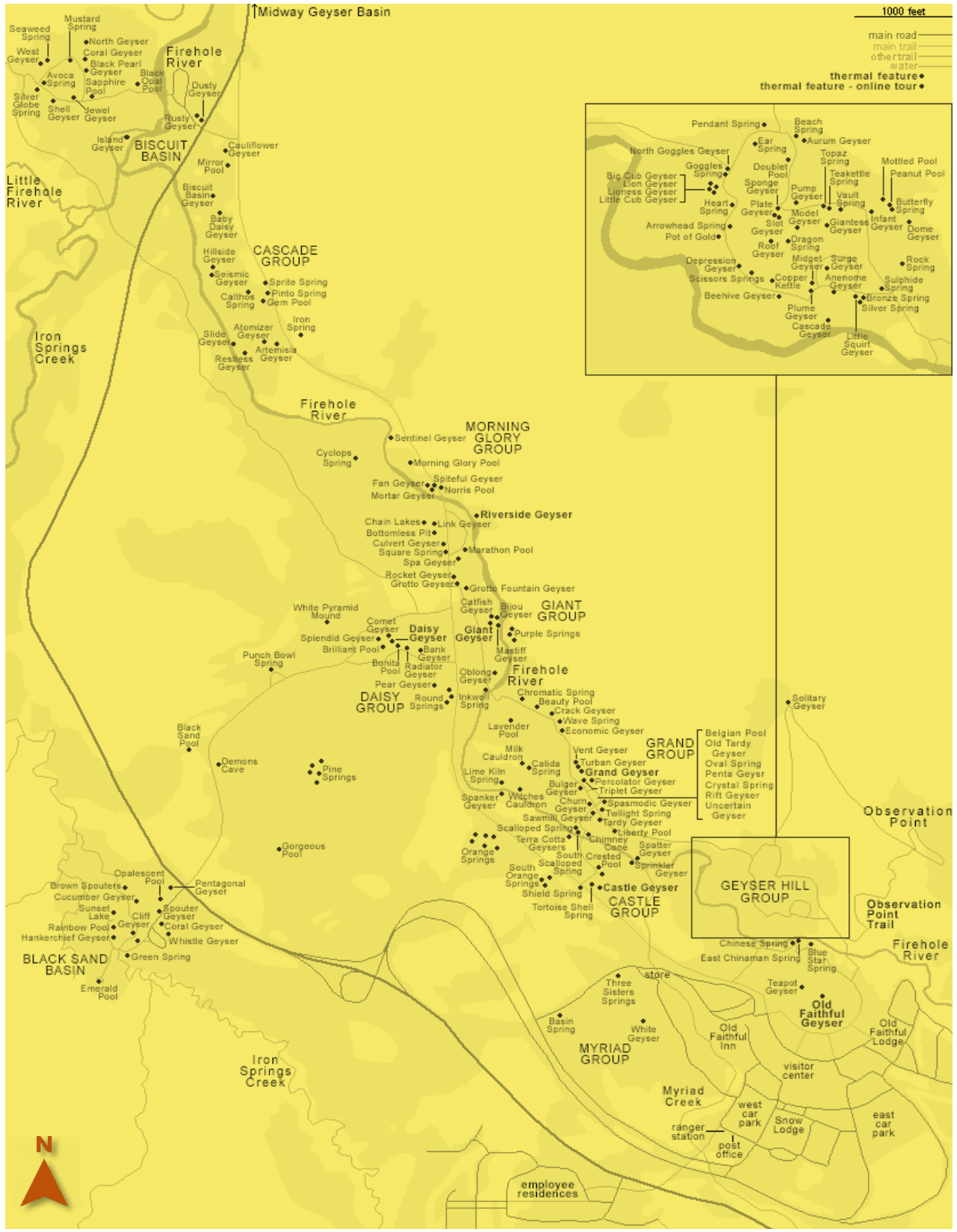


Figure 5.15—Map of the Upper Geyser Basin

(Source: www.americansouthwest.net, 2021)

Figure 5.17 shows a more detailed view of the Upper Geyser Basin in the vicinity of and north of the Old Faithful complex. Figure 5.16 below shows the main trails in the Upper Geyser Basin.

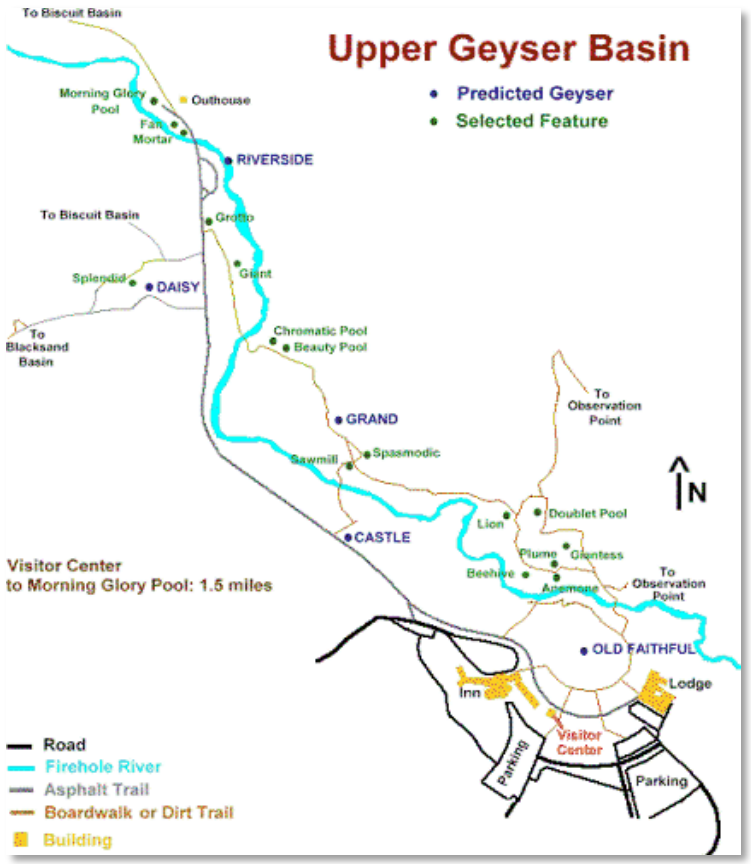


Figure 5.16—Upper Geyser Basin Trails
(Source: NPS, n.d., retrieved 2021)

WONDERFUL FOUNTAINS

"...The largest of these wonderful fountains projects a column of boiling water several feet in diameter, to the height of more than one hundred and fifty feet accompanied with tremendous noise..."

Warren Ferris, May 1834
(Source: NPS, 2014a)

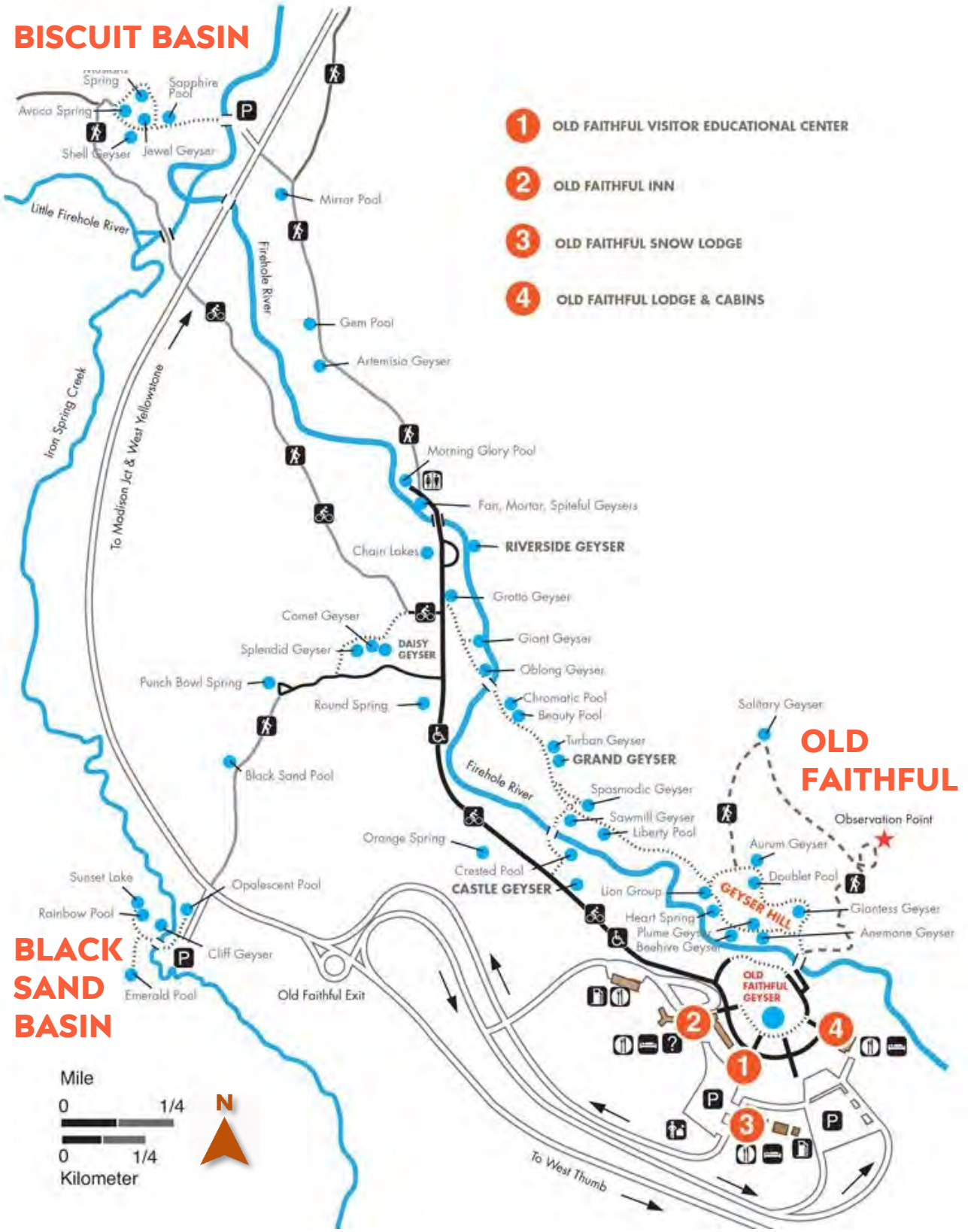


Figure 5.17—Detailed Map of the Upper Geyser Basin
(Source: Earth Trekkers, n.d., retrieved 2021)

Yellowstone Visitation Trends

Annual visitation to Yellowstone is now consistently over 4 million people, having reached that level for the first time in 2015, and continuing to receive this number of visitors annually through the present. Yellowstone National Park had 4,020,287 recreation visits in 2019 (NPS, 2021a).

Yellowstone consistently ranks in the top ten visited national park locations in the US. In statistics published for 2019, Yellowstone was the sixth most visited national park. For comparative purposes, these numbers are provided in Table 5.1. The traditional "national park" designation applies to 62 of the total 419 NPS units. Of those, the ten parks shown in Table 5.1 received the most recreation visits in 2019.

Because Yellowstone is a unique and precious place, more and more people want to experience it. Since 2008, annual visitation to Yellowstone has increased by more than 40 percent, causing overflowing parking lots, a rise in traffic jams, roadside soil erosion and vegetation trampling, and unsanitary conditions around busy bathrooms. Half of this increase in visitation occurred in just two years (2014 to 2016), coupled by an even greater rise in motor vehicle accidents (+90 percent), ambulance use (+60 percent), and search and rescue efforts (+130 percent). Meanwhile, staffing levels and funding have remained flat over the years.

In 2020, while the annual visitation level was down from 2019 due to the pandemic, visitation levels in September and October were the highest ever on record for those months. In spite of the pandemic, Yellowstone was the second most visited national park in the US in 2020.

As visitation levels and the correlating need for increases in service continue to rise, funding for staffing, facilities, and maintenance at national parks actually declined in the early 2000s and has remained at approximately that level since. Although park staff do an excellent and efficient job managing resources and supporting visitors, the level of funding seems insufficient to address the ongoing increases in visitation (see Figure 1.2 in Chapter 1, page 6).

While people can visit Yellowstone year-round, many areas of the park are closed. As such, most people visit the park during the summer months between May and August. However, springtime offers opportunities to glimpse newly born wildlife and fall months provide opportunities for viewing rutting behavior in elk and bison, including dramatic combat between males of these species.

Winter visitors get to observe some wildlife in the extreme cold and snow-covered landscape while also being able to enjoy hydrothermal pools and geysers that never freeze. That said, the summer months are by far the most visited at the park, as shown Table 5.2. This table uses color to show visitation intensity by month, with red as the most intensive period of visitation and green as the least intensive. The chart shows how visitation patterns have changed over the last two decades. With increases in annual visitation, the shoulder seasons on either side of summer have become more intensely visited than in previous years. (Note how the red and orange colors spread over more months in recent years compared to previous years.)

Visitation levels between 2014-2016 showed a 5.3 percent annual growth rate, but between 2017-2019 visitation growth tended to level off more from the 2014-2016 period.

Table 5.1 Top Ten Most Visited Parks in 2019 and 2020 Comparison Visitation Levels

	Park	Recreational Visits in Millions	
		2019	2020*
1	Great Smoky Mountains National Park	12.5	12.1
2	Grand Canyon National Park	5.97	2.9
3	Rocky Mountain National Park	4.67	3.3
4	Zion National Park	4.5	3.6
5	Yosemite National Park	4.42	2.26
6	Yellowstone National Park	4	3.8
7	Acadia National Park	3.4	2.7
8	Grand Teton National Park	3.4	3.3
9	Olympic National Park	3.2	2.5
10	Glacier National Park	3	1.7

2020 was an atypical year due to the pandemic. Yellowstone was closed during April and most of May, and some areas were closed during June. Several other parks on the list also were closed for long periods.

(Source: NPS, 2021a)

Given that 2016 was the centennial anniversary of the NPS and the "Find Your Park" campaign attracted more visitors, the 2016 peak represented a skew in the visitation trend. None the less, visitation has steadily increased over the long term, on the order of the 3.7 percent average annually. Refer to Chapter 1 for additional visitation statistics.

Table 5.2 Monthly Visitation at Yellowstone National Park from 1990-2020—Orange and Red Colors Represent Highest Levels

	JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC
2020	25,234	41,880	32,516	0	46,219	573,205	955,645	881,829	837,114	359,889	24,132	28,643
2019	33,896	31,650	28,695	48,150	434,385	781,853	936,062	820,006	693,118	171,339	15,628	25,506
2018	29,179	34,263	22,741	37,766	446,875	810,884	940,563	813,970	724,454	218,076	13,849	22,380
2017	29,518	32,275	23,897	45,160	419,635	803,652	962,404	916,166	640,068	211,987	10,468	21,294
2016	30,621	36,327	22,924	59,253	444,630	838,316	995,917	841,036	701,754	242,004	24,710	19,685
2015	28,091	34,343	22,989	46,600	386,064	780,768	980,702	854,408	680,213	252,013	11,049	20,470
2014	26,778	28,233	18,778	31,356	310,039	669,642	858,856	773,357	571,764	194,804	11,537	18,340
2013	24,699	31,053	18,613	24,606	293,250	624,429	812,212	725,136	557,925	47,560	11,169	17,378
2012	24,766	27,752	20,248	29,056	268,251	671,825	888,335	780,286	527,610	177,069	14,059	18,472
2011	24,517	28,174	18,728	28,147	207,842	634,316	906,935	805,173	536,349	175,433	12,198	16,514
2010	25,595	29,108	21,028	32,763	250,445	694,841	957,785	854,837	550,504	189,072	16,819	17,388
2009	24,770	28,355	17,317	24,831	261,763	643,844	900,515	752,983	489,438	123,867	9,397	18,107
2008	26,864	33,557	19,147	24,433	217,938	593,405	808,110	731,063	437,552	145,488	12,671	16,352
2007	25,476	30,928	20,225	27,798	264,203	609,606	822,773	710,781	463,994	139,789	15,362	20,408
2006	23,989	29,011	18,879	29,381	230,762	557,213	738,807	635,666	428,369	146,790	12,382	19,046
2005	22,297	29,018	17,324	26,116	225,811	560,014	743,165	647,288	393,362	142,912	11,505	16,839
2004	22,817	30,030	20,187	32,434	216,905	584,925	732,682	657,869	406,327	135,605	13,939	14,597
2003	36,387	39,494	17,718	28,877	206,245	580,919	809,689	698,753	404,498	175,877	7,967	12,951
2002	40,465	52,002	23,305	15,904	228,642	568,144	794,929	663,266	413,960	142,702	11,235	19,123
2001	44,356	48,980	18,485	28,341	229,085	507,737	724,735	613,965	373,583	121,958	19,585	27,716
2000	37,301	47,573	20,404	27,869	214,814	553,892	768,040	634,104	353,728	139,784	13,422	27,302
1999	34,346	41,120	23,067	27,128	203,727	580,624	832,685	760,062	445,057	142,049	16,230	25,286
1998	33,845	43,032	17,894	29,689	222,385	549,396	829,683	764,238	445,741	150,079	9,106	25,742
1997	31,155	42,392	19,324	21,526	191,985	512,895	774,327	737,973	403,184	120,266	9,983	24,503
1996	32,871	51,692	27,162	24,321	187,045	539,368	818,964	753,934	426,806	118,902	10,473	20,633
1995	40,868	48,034	21,157	26,147	201,797	550,978	847,003	773,307	468,062	128,483	11,635	7,814
1994	40,757	44,946	27,859	36,280	233,737	541,704	831,152	731,012	414,848	106,646	7,953	29,251
1993	38,100	44,049	31,768	24,013	191,222	525,378	768,164	714,408	401,124	125,107	18,899	29,961
1992	33,552	40,245	19,615	51,933	257,951	539,959	799,411	742,879	462,788	159,842	8,646	27,584
1991	28,851	38,050	19,946	19,875	188,798	499,107	796,656	721,103	432,948	144,944	6,261	23,998
1990	25,884	33,285	19,372	29,242	203,712	526,586	760,520	674,454	414,563	111,145	8,117	16,692

(Source: NPS, 2021a, https://irma.nps.gov/STATS/)

As visitation levels increase, approaching one million people in the month of July in the park, identifying strategies to ensure that Yellowstone remains an exceptional experience as a place where people can experience a more primitive America will be important. Yellowstone's essence as a place where humans share an open landscape with thousands of wild animals, including bison, bears, elk, and wolves could be jeopardized if the number of humans reaches a level that affects the careful balance of the ecosystem and the wildlife living there.

The NPS mission requires that park managers provide people the opportunities to enjoy Yellowstone without allowing that enjoyment to damage or diminish the very things they came to see. Many visitors want a park with fewer people and less traffic, but they don't necessarily want limits on visitation or the use of private cars in the park (NPS, 2017b and NPS, 2018c).

The challenges posed by high levels of summer visitation and changing visitor use patterns are comprehensive, complex, and affect not only Yellowstone visitors and employees, but gateway communities surrounding public lands, and other national and regional stakeholders.

The NPS and Yellowstone staff recognize that difficult decisions lie ahead and have started the process of understanding and analyzing the potential problems that need to be solved through the variety of study efforts summarized in this chapter. The NPS will continue to reach out to the public, partners, and nearby communities to get involved in preparing for the future.

The park continues to plan toward proactive visitor use management, and various study efforts are helping the NPS to better understand the impacts of increasing visitation on: 1) park resources, 2) staffing, operations, and infrastructure, 3) the visitor experience, and 4) gateway communities and partners (NPS, 2014a; 2018-2021f).

Park management is focusing efforts in the near term on improving operations to protect resources and provide a better visitor experience in key congested areas, while also looking toward visitor use management strategies over the long term. The NPS and Yellowstone management staff have indicated that if visitation continues to rise, future management strategies could include (but would not be limited to): operational and staffing changes; communication and traffic management systems; shuttle systems or other transportation alternatives; reservations or timed-entry systems at specific sites where demand exceeds capacity, and/or potential combinations of these approaches (NPS, 2018-2021f).

The park continues to test a range of pilot projects that alter traffic, parking, and visitor flow configurations and has been adding staff to highly congested areas to improve resource protection, safety, operations, and the visitor experience. For example, a shuttle service in the Canyon area is being tested this summer as a pilot for fully electric-powered shuttles in national parks (see Chapter 6).

The park is planning for researchers to survey people's opinions about potential scenarios that could be used to manage visitation in the future. Participants will consider "trade-offs" and will be asked which scenarios they prefer if a hypothetical local shuttle service were to be available.

Effects of High Levels of Visitor Use and Recreation on Park Resources

Yellowstone National Park routinely monitors visitor use and potential effects on park resources. The park partners with researchers through cooperative agreements on special studies of conditions in the park. For example, during the summers of 2017 and 2018, the Oregon State University, College of Forestry assisted by Youth Conservation Corps (YCC) crews assisted with a citizen science-based, visitor use monitoring project at focal sites in the park including multiple locations in the geyser basin corridor (D'Antonio & Sidder, 2018 and Sidder & D'Antonio, 2019).

The multi-year study efforts provided insights into visitor volumes and behaviors at high-use attraction sites by monitoring and documenting the numbers and density of people, how they use the areas, observations of undesirable visitor behavior, and instances of resource impacts. Monitoring occurred at Norris Geyser Basin, the Fairy Falls Trail to the Grand Prismatic Overlook, the Grand Prismatic (Midway Geyser Basin) parking area, Old Faithful area, and Artist Point in the Canyon area.

Crews specifically collected social science and resource-related data at four focal attraction sites in the park: Fairy Falls Trail and Grand Prismatic Spring Overlook, Midway Geyser Basin, Norris Geyser Basin, and Old Faithful Geyser Basin (focused mostly on the Upper Geyser Basin and Geyser Hill).

Data collection methodologies included: visitor use estimations via parking lot counts and automatic trail counters, measures of visitor experience including counts of encounters on

trails and people-at-one-time (PAOT), measurements of restroom use and wait times at restrooms, as well as measures of the spatial behavior and impacts of visitors using GPS-based methodologies.

Visitor Use Patterns Observed—The 2017-2018 OSU study confirmed that across all focal attraction sites, visitor use begins to peak around 11:00 a.m. and remains high throughout the day, slowly tapering off in the afternoon. Continuous data collection from the trail counter installation shows that use at some of the locations monitored remains close to peak levels until 5:00 p.m. to 6:00 p.m.

Overall, these sites have high use levels with visitors spending on average 30 minutes to 1.5 hours at these focal attraction sites. This indicates relatively rapid turnover of visitors at each of these focal attraction sites, and yet even with this turnover, parking lots were over capacity.

There is a small increase in visitor use across all sites during the second half of July, as well as increased use around the Fourth of July holiday, evident in some data collection methods from 2018 (including encounters and PAOT). For example, at Fairy Falls, visitor counts in June ranged between approximately 2,000 counts and just below 6,000 counts. In July, visitor counts never dropped below 4,000 counts and maxed at approximately 6,500 counts at Fairy Falls. For context, total recreation visits to YELL in 2018 were 810,884 in June, 940,563 in July, and 813,970 in August (Sidder & D'Antonio, 2019).

Fairy Falls and Midway Geyser Basin Visitor Use Observations—According to the 2017-2018 study, parking lot infrastructure at Fairy Falls and Midway Geyser Basin is not sufficiently matched to the level of visitor use at these sites; thus, these parking

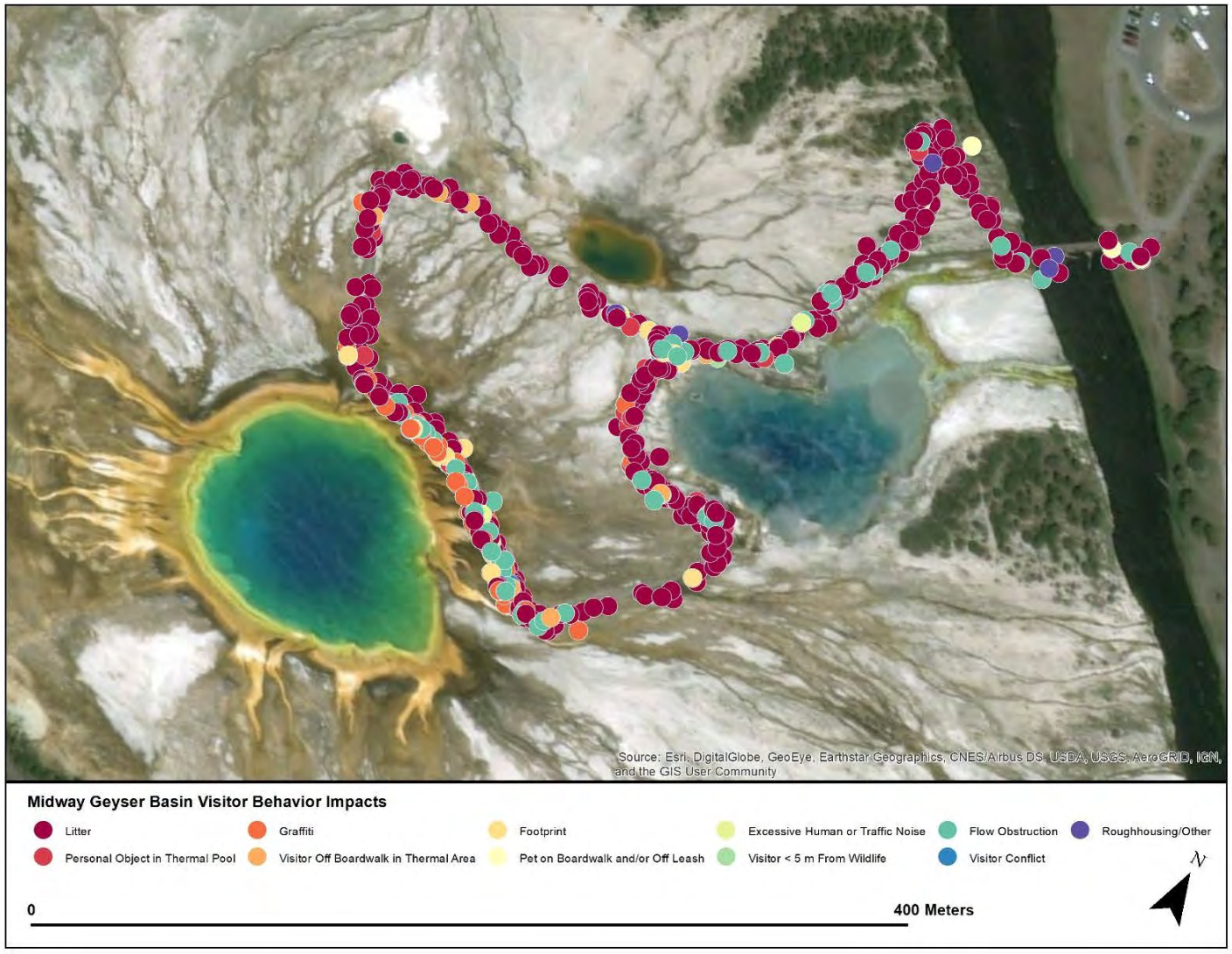


Figure 5.18—Location of Specific Visitor Behavior and Resource Impacts Waypoints at Midway Geyser Basin

(Source: D'Antonio & Sidder, Summer 2017 data collection; study published 2018)

lots fill early in the day. Undesignated and roadside overflow parking behavior was frequently observed at Fairy Falls, Midway Geyser Basin, and Norris Geyser Basin.

Continuous trail counter data also indicated at many of these focal attraction sites, weekday use is slightly higher than weekend use. Parking lots at Fairy Falls (97 gravel and paved parking spaces combined) and Midway Geyser Basin (55 designated parking spaces) were often full or close to full when Crews arrived and began their counts (around 9:00 a.m.).

Conditions observed and documented in these studies are depicted in Figures 5.18 through 5.21, reprinted with permission of the authors. Undesignated and roadside parking at these destinations begins to peak around midday. At Fairy Falls the maximum average observed

undesignated parking was 28 vehicles and the maximum average roadside parking was 50 vehicles (averaged across an entire day). At Midway Geyser Basin, the maximum average roadside parking observed was 117 vehicles and the maximum average undesignated parking was 16 vehicles (averaged across an entire day).

On average, during peak use time the Fairy Falls trail receives approximate 600 visitor counts/hour. Visitor encounters along the Fairy Falls trail average 250 people for the length of the trail to the Grand Prismatic Overlook. Use is relatively dispersed along this trail, but visitors concentrate at the Grand Prismatic Overlook platform and, on average, 50 visitors at one time are observed at the platform area. Midway Geyser Basin has the highest peak, hourly use levels on average with 1,400 visitor counts. Midway also has one of the most concentrated trail systems of all focal attraction sites resulting in high counts for trail encounters (586 encounters on average) and PAOT (approx. 40 to sometimes over 100 PAOT at Grand Prismatic).

Crew data collection at Old Faithful was concentrated near Geyser Hill. At this location of the Old Faithful Geyser Basin boardwalk complex, visitors on average encounter approximately 400 other visitors and can experience 45–55 other visitors at the PAOT locations (Beehive Geyser and the "Z" Bridge). Overall, all visitor use level measures at Old Faithful Geyser Basin were dynamic, often driven by the timing of eruptions of Old Faithful Geyser.

Restroom wait times were measured in 2018 at Norris Geyser Basin and Midway Geyser Basin. At Norris Geyser Basin during peak use, the wait time in restroom lines ranges from 5 minutes to 12.5 minutes on average. At Midway

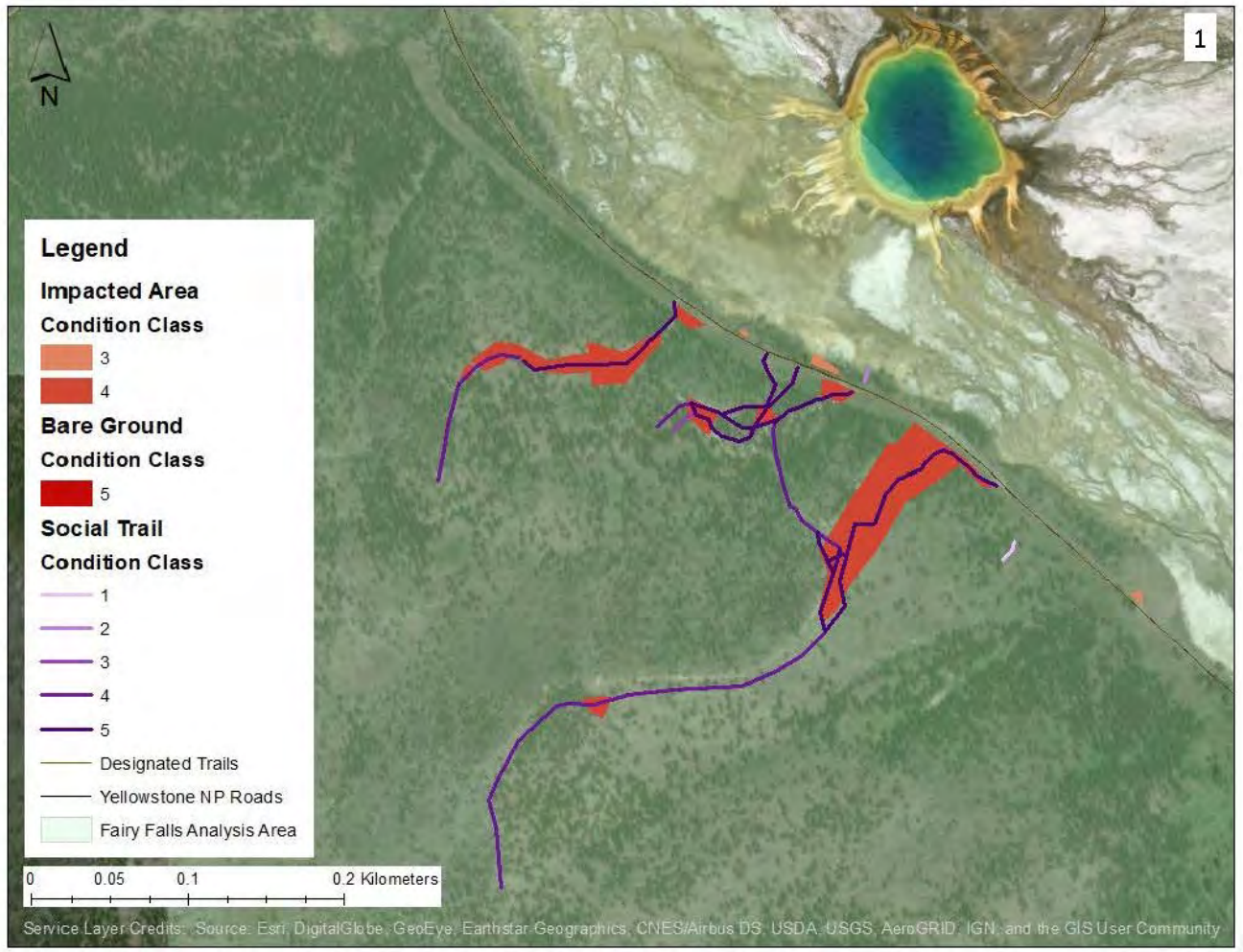


Figure 5.19—Resource Impact Locations and Levels of Impact Related to Social Trails Activity at the Grand Prismatic Overlook Area

(Source: D'Antonio & Sidder, Summer 2017 data collection; study published 2018)

Research conducted by Oregon State University with the support of the Youth Conservation Corps in the summers of 2017 and 2018 documented resource impacts associated with high visitor use levels at focal sites in Yellowstone, including locations in the geyser basin corridor.

Geyser Basin, during peak use, the wait time in restroom lines ranges from 15 minutes to 34.5 minutes on average.

Fairy Falls and Midway Geyser Basin Visitor Behavior Observations—Visitor behaviors and resource intrusions were documented, mapped and analyzed for key use areas. Refer to Figures 5.18 through 5.21 for the mapping at Midway Geyser Basin. Negative visitor behaviors observed tended to be associated with the locations that had the highest densities of visitor use. Littering and seeing litter (both in and outside thermal areas) was by far the most common resource impact observed and mapped by the crews across all focal attraction sites. At Midway Geyser Basin, litter was found throughout the trail system, but observations of individuals littering were concentrated closer to the trailhead. For all other focal attraction sites, there does not appear to be any consistent patterns in the location of litter or the act of littering; littering related impacts were observed consistently throughout the trail systems.

Visitors were also frequently observed at short distances (< 1 m) off boardwalks. Groups were sometimes observed blocking the flow of pedestrian traffic on boardwalks. Visitors were sometimes viewed in areas that were closed to visitor use. There were instances of personal objects (hats, water bottles, etc.) left behind in thermal areas and thermal pools. Occasionally, footprints and graffiti were observed in the geyser areas off trail, such as in the thermal mat. Other behaviors of interest, such as interacting with wildlife, excessive human noise, and/or visitor conflict, were occasionally observed by the crews.

Researchers also documented instances of

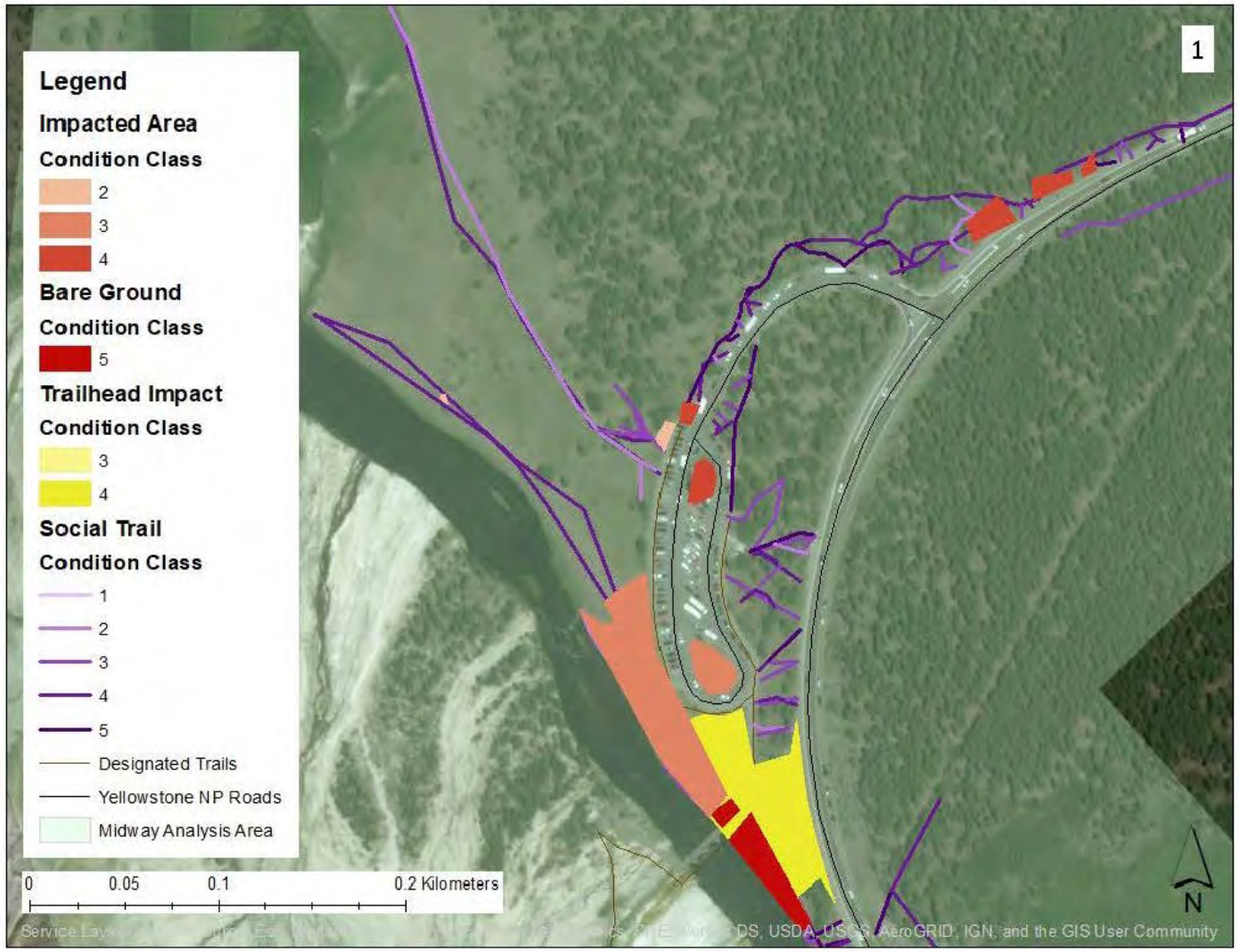


Figure 5.20—Resource Impact Locations and Levels of Impact Associated with the Roadway and Parking Lot in the Northern Area of the Midway Geyser Basin

(Source: D'Antonio & Sidder, Summer 2017 data collection; study published 2018)

One of the most pertinent observations from this project was that overflow parking along the main park loop road occurs frequently, when parking areas are full. Visitors then walk across resource areas to get to boardwalks and trails, creating social trails. With potential visitor use management actions, such as maintaining parking areas at capacity, shuttling visitors to reduce congestion in parking areas, and creating hard edges to deter overflow parking on the roadside, these impacts could potentially be avoided.

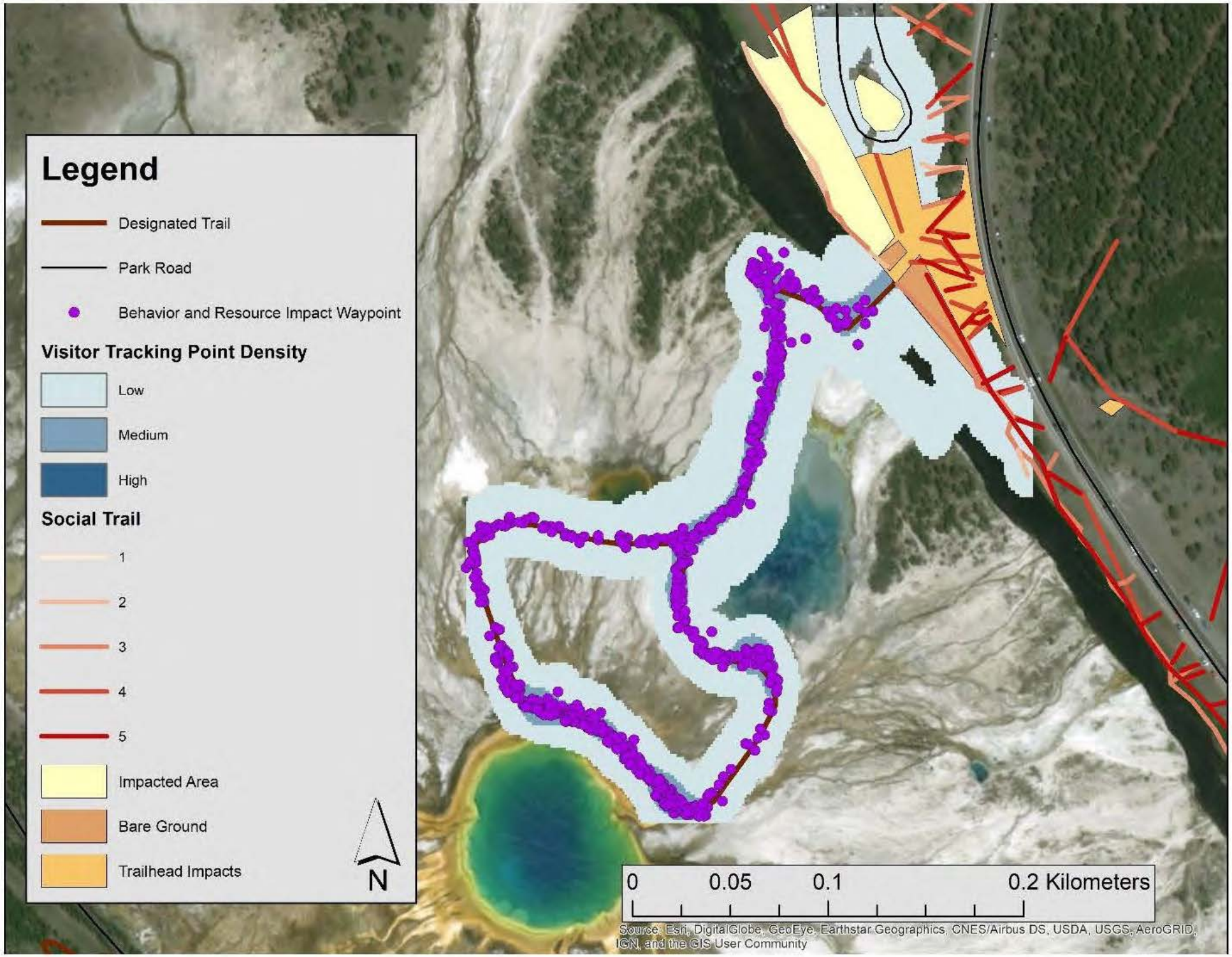


Figure 5.21—Integrative Map Showing Visitor Use, Marked Waypoints, and Resource Impacts Related to Social Trails at the Midway Geyser Basin Area

(Source: D'Antonio & Sidder, Summer 2017 data collection; study published 2018)

social trails activity in the same areas as the waypoints data collection. Social trails impacts as a result of people overflow parking along roadsides and outside of parking areas and then hiking/ walking over previously undisturbed land to get to trailheads were documented. Figures 5.19, 5.20, and 5.21 show the results of this analysis in the vicinity of the primary Midway Geyser Basin parking area, near the Grand Prismatic Spring (Fairy Falls Trail, Grand Prismatic overlook areas, and the parking area). Extensive social trails activity was observed as shown in the figures. Social trails create resource impacts to vegetation, biological soil crust, and therefore undesirable effects to habitat and ecosystem health.

Documentation of social trails impacts will help the park in determining where more active visitor management is needed, as well as treatments such as edge barriers, revegetation, fencing, and other actions that could be used to restore the landscape.

Increased Tourism Effects on National Parks—A number of research efforts in recent years have addressed the potential for negative effects related to increased visitation and tourism on national parks. In her thesis, "The Negative Effects of Tourism on National Parks in the United States" (Finnessey, 2012) identified three main sources of impact left on national parks by tourists: depletion of natural resources, pollution, and physical impacts. The analysis specifically referenced visitor congestion and traffic problems escalating in national parks such as Acadia, Yosemite, and Yellowstone.

In her 2019 article in the Notre Dame Law Review, "Too Much of a Good Thing: Overcrowding at America's National Parks," Timmons (2019) examined a range of potential contributing factors to overcrowding in national parks, as well as potential solutions, including mandatory use of shuttle systems as is in operation at Zion National Park. Timmons stated, "Shuttle systems are controversial, and their success is likely to differ on a park-by-park basis, with one of the main considerations being the size of the park." The article includes a discussion of the Zion Canyon shuttle system and how implementation has helped visitors avoid the problems of trying to find parking at popular trailheads.

Crowded conditions at Cadillac Mountain in Acadia National Park also are mentioned in the article by Timmons, with a visitor statement, "I think they need to manage the people better in a way that cars don't go in there' when no parking is available." Another strategy relevant to Acadia National Park was the creation of "car-free morning[s]" during which local bus tour companies were allowed vehicular entry to the park, but all other vehicles were prohibited. The car-free mornings were meant to stimulate suggestions to Acadia officials as to how to solve the congestion issues, with the two primary solutions offered being (1) expanding parking, which is unlikely, and (2) increasing carrying capacity of the local bus system.

Timmons also noted that Grand Canyon National Park has started encouraging visitors to use a neighboring city's bus system. As a result, the bus service has become so well-used that its times of operation have been extended by almost two months. According to Timmons, expansion of existing parking lots is not a strong option for NPS officials, who consider the idea to be inconsistent with their mission for lands they are called upon to preserve.

While shuttle systems can create a separate set of problems that need to be addressed, the article found that they could do much to improve the current situations of other parks. Reducing the number of personal vehicles in parks also reduces demand on parking areas, not to mention related pollution and emission levels generated by the automobiles. Notably, the article quoted Executive Director of Public Employees for Environmental Responsibility, Jeff Ruch, who cleverly coined a new slogan as a play on words of the 2016 NPS Centennial slogan "Find Your Park." Ruch suggested the slogan should instead be "Find a Place to Park."

Implementing public transportation systems in parks can bring a variety of benefits. Such systems need not be mandatory with proactive visitor use management that right-sizes visitation levels to fit park resources. Properly planned, designed, and implemented, shuttle systems can reduce visitor frustrations and complaints and enhance visitor experience, while also create more sustainable visitor access solutions with reduced environmental impacts.

Visitor Experiences and Perspectives from Recent Studies

Studies over the last few years at Yellowstone National Park have focused on the objective of obtaining a better understanding visitors' perspectives and perceptions related to their visits to the park.

2016 Visitor Use Study—The park commissioned a survey of 2016 summer visitors to better understand who's coming to Yellowstone, how they plan their trips, what they come to see, their perceptions of the park (including attitudes about access and transportation), and their level of satisfaction with park services and facilities (NPS, 2017c).

Visitors crossing the Firehole River bridge in the Midway Geyser Basin

(Source: Spring Images/Alamy stock photo, 2015)

When understanding the results of this survey, it is important to consider that 2016 was a year of high visitation in the park, coinciding with the Centennial of the NPS and the "Find Your Park" campaign. Given that the park had more visitation (4,257,177 visitors) in 2016 than in subsequent years (4,116,524 in 2017, 4,115,000 in 2018, and 4,020,288 in 2019), this may have influenced visitors' perceptions and responses (NPS, 2017c).

The 2016 visitor survey resulted in the following findings.

- Over half the visitors surveyed responded that there were too many people in the park.
- Two thirds of visitors surveyed stated that parking was a problem and over half stated that the amount of roadway traffic and
- Many visitors stated that they would like to see these challenges addressed through voluntary public transportation and expansion of parking options.
- "Finding a parking space" was the highest-ranking problem identified by visitors, with 67 percent indicating that was a problem.
- Most visitors coming through the West and South gates are coming to see Old Faithful.

2018 Visitor Use Study Compared to the 2016 Visitor Use Study—Researchers conducted a study to explore how people experience and move through the park in real-time and how their experiences vary across the season (May to September of 2018) and across different places in the park. A second phase of this study is planned for the near future (NPS, 2019a).

This peer-reviewed study found that the majority of park visitors didn't report experiencing much frustration due to traffic congestion in the park in 2018, based on over 4,000 responses. Overall visitation was down in 2018 compared to the two years previous (2016-2017), which may have resulted in some of the differences in findings between the 2018 and 2016 studies. That said, there were some interesting results that could help guide the park in considering future transportation solutions:

- 85 percent of the respondents reported that their experience in the park was good or excellent.
- The top three reasons for visiting were reported as scenery, wildlife, and thermal features.
- 67 percent of the visitors participating in the survey were first-time visitors to the park.
- Overall, 92 percent waited less than ten minutes to enter the park and 86 percent waited less than ten minutes to find parking.
- Respondents were more likely to experience a greater sense of crowding, traffic congestion, and limitations on parking availability at Midway Geyser Basin and Fairy Falls.
- Visitors responded that of the more popular attractions in the park, Old Faithful and Canyon Village were the least problematic in terms of having sufficient infrastructure to support a high volume of visitors.
- First time visitors were less critical of issues at specific sites compared to repeat visitors, and the longer the visitor stay, the more likely they were to show a decline in satisfaction level (less favorable evaluations).

The 2018 study was conducted differently from the previous 2016 visitor study. The 2016 study surveyed visitors in early August upon their departure from the park. The 2018 study used in-person interviews and GPS-based

tablets to survey visitors in real time as they traveled through the park during one week each month from May through September 2018.

Park management is carefully weighing the results of these various visitor studies, as well as the results of transportation studies summarized later in this chapter, to determine ongoing and future management decisions related to visitor use management at Yellowstone.

Pertaining to the 2018 study, park superintendent Cam Sholly said, *"This study gives us very actionable information on how we can better manage and plan for increasing visitation at Yellowstone. I largely credit the National Park Service team and our partners for the high visitor satisfaction levels. That said, there is no question that increasing congestion in the park were problems. visitation levels are having higher impacts on resources, our staff and infrastructure, and our gateway communities."*

Infrastructure and Maintenance Demands

With increases in visitation levels year after year, the intensity of use of the park's roadway and parking systems require an ongoing regimen of maintenance and improvements The estimated cost for required maintenance of the structures and roads in Yellowstone National Park has topped $633 million and surpasses $200 million in Grand Teton National Park to the south (Pew Charitable Trust, 2017).

In the geyser basin corridor, the heat and expansion and contraction associated with hydrothermal and geothermal activities also creates a constant need for repair of many of the roadways, parking areas, trails, and boardwalks. In the field work completed for this study, extensive buckling and wear and tear of asphalt pavement surfaces was observed along the Firehole Lake Drive loop, which is an active hydrothermal area.

Regional Tourism Growth and Economic Importance

Yellowstone National Park is the predominant tourism draw for the region and visitor spending is a major driver in the regional economy. Government and independent economists place the combined value of nature-based tourism in Yellowstone and Grand Teton at close to one billion dollars annually (Pew Charitable Trust, 2017).

A visitor spending analysis published by the NPS in May 2019, reported that 4.1 million visitors to Yellowstone in 2018 spent $512.6 million in communities near the park. That spending supported 7,089 jobs in the local area and had a cumulative benefit to the local economy of $647.1 million.

"These numbers once again show the enormous positive impacts our national parks have on our local economies," said Yellowstone National Park Superintendent Cam Sholly. "*Our national parks are one of the very best taxpayer investments in this country. For many reasons, well beyond economics, it's essential that we invest aggressively to protect these incredible places in the future.*"

The report shows $20.2 billion of direct spending by more than 318 million park visitors in communities within 60 miles of the park. This spending supported 329,000 jobs nationally; 268,000 of those jobs are found in these gateway communities.

The cumulative benefit to the U.S. economy was $40.1 billion. Lodging expenses account for the largest share of visitor spending, about $6.8 billion in 2018. Food expenses are the second largest spending area and visitors spent $4 billion in restaurants and bars and another $1.4 billion at grocery

Snowmobiling is a popular activity in the West Yellowstone area in the Winter and the park offers guided snowmobile and snow coach tours to Old Faithful, which helps to boost the local economy in the off season.

(Source: pjworldtour/Alamy stock photo, 2017)

and convenience stores. Visitor spending on lodging supported more than 58,000 jobs and more than 61,000 jobs in restaurants. Visitor spending in the recreation industries supported more than 28,000 jobs and spending in retail supported more than 20,000 jobs (NPS, 2019b).

Existing Transportation and Visitor Facilities in the Study Area

A portion of the work on this project involved field work and analysis of existing transportation and visitor facilities in the study area, primarily to understand how additional multimodal options could potentially fit into the context. In addition to the types of attractions and visitor experiences offered in the study area described previously, the following visitor transportation infrastructure, including roadway and parking and facilities currently exist.

West Entrance Road from West Yellowstone to Madison Junction

—Primarily a two-lane highway (one lane in each direction) extending from the West Gate to the park to Madison Junction, the West Entrance Road provides various pull-off areas and access to multiple sites and trailheads along the Madison River. The design of the roadway is consistent with typical rural highway standards, with lane widths that can accommodate trucks and large vehicles, as well as shoulder space of varying width on both sides of the roadway.

Grand Loop Road from Madison Junction to Old Faithful

—Similar to the highway from West Yellowstone to Madison Junction, the Grand Loop Road is also a two-lane highway (one lane in each direction) that provides access to multiple attraction sites, trailheads, and waysides in the park. The highway is channelized upon approach to several intersections and turn-offs with left turn lanes. Shoulder widths vary and there are several pull off areas along the route (both sides of the roadway).

Parking Facilities in the Study Area

—Delineated parking lots are available at several of the most popular attraction sites in the study area. There are also locations that provide more informal, overflow parking areas. In some cases, these may be graveled, unpaved parking areas, and in other locations they may be paved but not striped or delineated. This analysis focuses on the improved and delineated parking areas found at key attraction sites in the study area. Table 5.3 lists parking capacity at popular locations in the study area.

According to a GIS database maintained by the park, there are roughly 16,680 parking stalls in 254 parking lots and pullouts throughout the entire park. 4,470 of those parking stalls are typical striped passenger car stalls, 254 are striped accessible parking stalls, 261 are striped oversized stalls (for RV's and buses), and 210 are striped administrative stalls. The rest of the stalls are all non-striped stalls. Several of the parking areas and pull-offs in the geyser basin areas are not striped or delineated. This creates confusion and leads to inefficient parking patterns (NPS, 2017b).

Understanding Traffic Congestion in the Study Corridor

As visitation to Yellowstone increases over time, concerns intensify regarding how to provide public access while maintaining a

Table 5.3 Parking Capacity at Popular Locations in the Study Area

Location	Number of Spaces
Madison Information Station/Restroom	40 to 50 + 5 Bus/RV
Firehole Canyon Road-Firehole Falls	15
Firehole Canyon Road-Swimming Area	20
Nez Perce Creek Picnic Area	20
Fountain Flat Drive at Trailhead at Turn-around	50 + Additional Pull-Off Areas
Mary Mountain West Trailhead	6
Fountain Paint Pot Trail	60 + 6 Bus/RV
Firehole Lake Drive at Firehole Lake	20
Firehole Lake Drive at White Dome	8
Firehole Lake Drive at Great Fountain	20
Firehole Lake Drive at Surprise Pool	8
Firehole Lake Drive at Firehole Spring	8
Midway GB/Grand Prismatic Spring	62 + 8 Bus/RV
Flood Geyser Overlook	40
Fairy Falls Trailhead Parking Lot (Fairy Falls Overflow Parking is No Longer in Service)	50
Mallard Creek Trailhead	7
Biscuit Basin	62
Black Sand Basin	25
Old Faithful Complex	1,003

positive visitor experience and preserving Yellowstone's iconic natural and cultural resources. Understanding traffic congestion patterns and how these may increase and create problems is critical to being able to effectively manage visitor use and access over time.

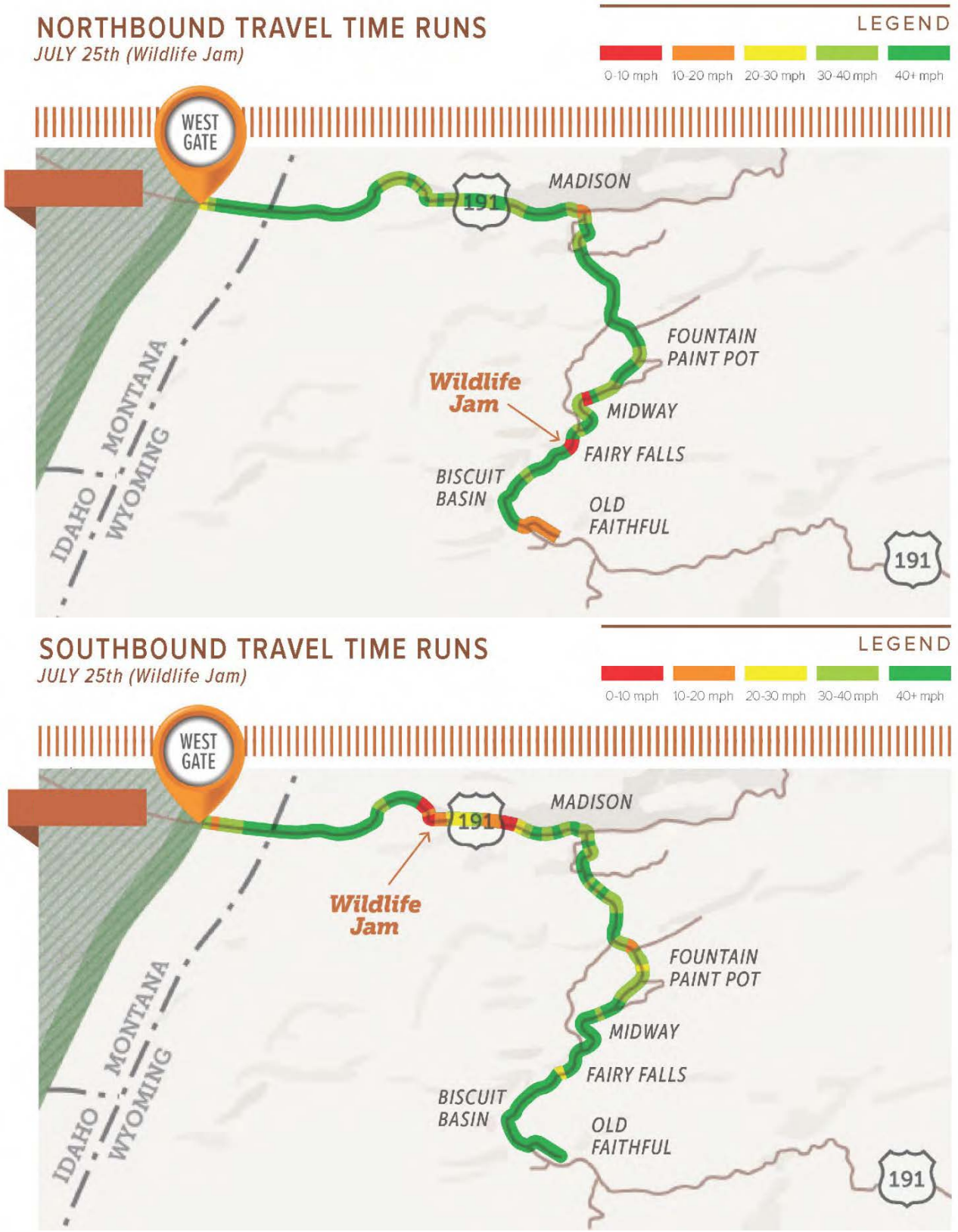
Recent Transportation Studies—To better understand the vehicular capacity of the park, the NPS commissioned a series of studies of traffic and parking conditions beginning in the summer of 2016, which was Phase 1, and Phase 2, extending to the summer of 2017 (NPS, 2017b, and NPS, 2018c). The study efforts led by Otak and Fehr & Peers were completed to:

1. Document how people move through the park.
2. Evaluate conditions at key intersections, roads, parking areas, and entrances.
3. Analyze congestion problems at several key locations.
4. Understand the vehicular capacity of the park.
5. Provide recommendations for next steps.

Speed Limits and Travel Times—According to the 2017 phase of study (published in 2018), the typical speed limit along the West Entrance and Grand Loop Roads is 45 mph, lowering to 35 mph upon approach to intersections.

Actual travel speeds in the corridor can vary depending upon conditions such as traffic levels and the presence of wildlife (animal jams). A recent review of Google Map travel times show the actual average speed of travel throughout the corridor at 31 mph.

The 2017 study documented actual travel times in the corridor during a series of peak summer days (July 23-25, 2017), for northbound and southbound, with and without slow downs due to traffic congestion and wildlife jams. The analysis showed that the average travel time between the West Entrance and Old Faithful on average during this



Figures 5.22— and 5.23—Travel Times with Traffic Congestion and Wildlife Jams

Source: NPS, 2017b; Otak/Fehr & Peers, Transportation and Vehicle Mobility Study, Phase 2, July, 2018

time was 41 minutes, 19 seconds northbound and 49 minutes, 53 seconds southbound. During a time of high traffic congestion with documented wildlife jams in the corridor, the travel time was 43 minutes, 3 seconds northbound and 69 minutes, 35 seconds southbound. Figures 5.22 and 5.23 shows speeds of travel northbound and southbound in the corridor, as documented through field conducted travel time runs in the 2017 study. A common location for wildlife jams as mentioned previously is in the Harlequin Lake Area, about two miles west of the Madison Junction.

Most Congested Areas in the Park—The 2016-2017 studies (published in 2017 and 2018) documented the most congested areas in the park, including roadways and parking areas, and these are represented in Figure 5.24. The congestion analysis was determined through data was collected over a three-day period from August 14 to 16, 2016 using a variety of traffic counters, video recorders, and direct observation by members of the study team. This data was coupled with year-round gate and traffic counter data collected by the NPS to inform the results of this study.

The 2017 study continued to assess vehicle flow, parking, and intersection conditions in the corridor between the West Gate and Old Faithful, but to a finer grain level. This analysis focused on visitor use conditions along the corridor between the West Gate and Old Faithful, analyzes the relationship between vehicle numbers in the park and parking lot capacities, and assesses how often Madison Junction and other intersections are over capacity.

The most congested roadways and parking areas at Yellowstone extend from West Yellowstone to Madison Junction and then

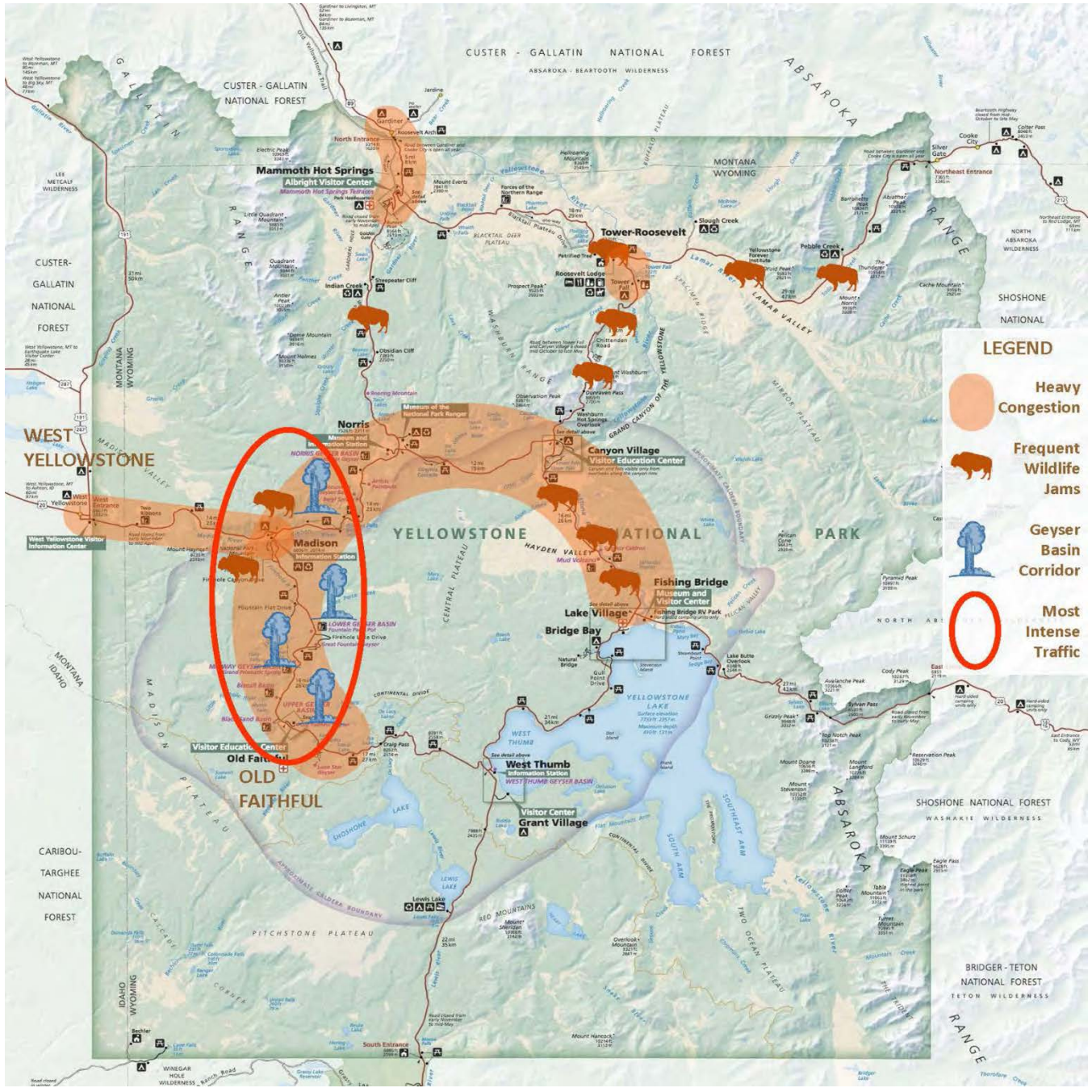


Figure 5.24—Most Congested Areas in the Park
(Source: author, 2018)

According to the 2016-2017 Transportation and Vehicle Mobility Studies by Otak and Fehr & Peers, the roadways and parking areas in the geyser basin corridor and other congested areas of the park are approximately 29% over capacity ona regular basis during the peak summer visitation period.

south and southeast to Old Faithful, as well as to north and northeast reaching the Canyon Area, following the Grand Loop roadway corridor, as shown in Figure 5.24. The orange shading highlights travel corridors and areas that are most congested

The most commonly traveled routes include:

- Trips entering and exiting through the West Entrance that included a stop at Old Faithful.
- Trips between the West and South Entrances that included a stop at Old Faithful.

In heavily-used corridors like the West Entrance, mid-summer traffic volume is roughly 29 percent higher than roads and parking lots can comfortably and safely handle. During July, vehicles travel in tight groups following closely behind one another nearly 60 percent to 80 percent of the time. Traffic volumes repeatedly approached levels where road performance begins to decrease rapidly with additional vehicle volume.

During much of the summer in this area, demand for parking exceeds capacity from late morning through late afternoon at the park's most heavily visited attractions, especially the geyser basins and overlooks. at the Grand Canyon of the Yellowstone.

If visitation continues to increase in the coming years, even at a moderate pace, vehicular demand for roads and parking in the geyser basin areas of the park would be expected to regularly exceed capacity sometime within the next ten years.

Hot Spots—the geyser basin area, extending from the Lower Geyser Basin through the Midway Geyser Basin and to the Upper Geyser Basin and Old Faithful, is the most congested area of the park on an ongoing basis, primarily due to the high concentration of hydrothermal features and popular attractions such as the Grand Prismatic Spring and Old Faithful Historic District.

The 2016 study found that during much of the summer, demand for parking exceeds capacity from late morning through late afternoon at the park's most heavily visited attractions, especially in the geyser basin corridor and overlooks at the Grand Canyon of the Yellowstone.

Based on the roadway and parking capacity analysis of the study, vehicular demand for roads and parking in Yellowstone are already over capacity during peak periods, and this will be expected to become more of a constant problem by the mid 2020s.

The 2017 phase of the study evaluated the corridor between the West Entrance and Old Faithful in more detail and found that the total number of vehicles entering the park before geyser basin parking lots reach capacity is about 9,300 vehicles. This second phase of study also found that the Madison Junction intersection was over capacity for 13 percent of the day during 5 percent of season, but by 2025, the junction would be projected to be over capacity 73 percent of the day for 49 percent of season if visitation continues to grow.

According to visitation data collected by the NPS, a total of 602,145 vehicles passed through the park's west entrance in 2019 over the entire year (NPS, 2021). The 2016 traffic mobility and parking capacity study found that of the total number of vehicles entering through the west gate, 20 percent of this traffic goes to Old Faithful and returns back through the West Entrance.

For 2019, that would have been 120,176 vehicles. People trying to find parking in the attraction parking areas and trailheads may circle or stall in place, causing traffic back-ups behind them, particularly in the Midway Geyser Basin. Parking traffic flows become clogged and people desperate to find a place to park may park along the roadside or parking edges damaging vegetation and soil crust conditions.

Another 29 percent of the vehicles traveling through the west entrance were found to continue south via West Thumb to the south entrance toward Jackson Hole.

The 2016 study also evaluated specific parking capacity and utilization in the Old Faithful complex throughout a typical summer day. The study found that the highest volumes of traffic going to and leaving Old Faithful occur between the hours of 11:00 a.m. and 5:00 p.m. According to the 2016 study, the east parking lot at Old Faithful often exceeded capacity during peak visitation times, while the west and center parking lots still had over 20 percent of the parking stalls available during the same time.

Transportation planners and traffic engineers use a rule of thumb that parking areas should be considered as reaching optimal capacity at 85 to 90 percent full (P. Stinger, personal communication, October 2016). Collectively, the parking lots at the Old Faithful complex were approaching 80 to 85 percent full during peak periods in the 2016 study, and this would be expected to continue to increase as visitation grows in the future according to the 2016 study.

Park entrances also can be hot spots for congestion. However, the park has implemented a number of actions recently to improve flow through at the West Gate and traffic congestion has been greatly reduced at that location, including additional signage and lane designations.

Vehicle Types and Proportions Moving through the West Gate—the 2017 study also evaluated the various types of vehicles move through the West Entrance to Yellowstone and the percentage of each type. Table 5.4 shows the results. This is important to understand when considering shuttle options, because shuttling could become an alternative form of transportation for those traveling in passenger cars, SUVs, vans, and pick-up trucks, but less like for those traveling in RVs, campers, tour buses, and heavy trucks.

Quantity of Vehicles Moving through the West Gate and Corridor Traffic Volumes—the NPS tracks volumes of vehicles entering all entrances to the park. The average numbers of vehicles entering the West Gate per day for the months of May, June, July, August and September in 2018 and 2019 (more typical visitation years than 2020) are shown in Table 5.5. The numbers of visitors entering the West Gate during these same months are also shown in Table 5.5.

Table 5.5 Average Numbers of Vehicles and Visitors PER DAY Entering through the West Gate, May through September (2018-2019 Average)

	MAY	JUNE	JULY	AUGUST	SEPTEMBER
VEHICLES	2,164	3,839	4,525	3,842	3,228
VISITORS	6,870.5	11,641.5	12,963	11,049	9,703

(Source: NPS , 2021)

As previously noted, 55 percent of all single day visitors to Yellowstone come in and back out of the West Gate, and 54 percent of all visitors (including overnight) enter and exit the West Gate. The average daily traffic volume on the roads in the study area is documented by the park and the state highway department. Average daily traffic volumes are calculated by the total volume of traffic on a corridor divided by the number of days that corridor is open to use and is used as a measure to understand traffic flow and operations. Average daily traffic includes all trips in both directions of flow.

The West Entrance Road from West Yellowstone to Madison Junction carries 10,190 vehicles per day on average, and the Grand Loop Road between Madison Junction and Old Faithful carries 9,420 vehicles on average per day.

For purposes of transit and shuttle ridership, the NPs uses a ratio of 2.6 people per vehicle, which is used in the system operational and capacity analysis summarized in Chapter 6.

Table 5.4 Vehicle Type Distribution at the West Gate

Vehicle Type	Percentage
Motorcycles	4.3%
Passenger Cars (Including Light Trailers	56.8%
SUVs, Vans, Pick Up Trucks	26.5%
Buses (Tour Buses)	1.3%
Light Trucks (2-3 Axles)	5.9%
RVs and Campers	3.4%
Heavy Trucks (4 or More Axles)	1.8%

(Source: Otak and Fehr & Peers, study conducted 2017; published 2018)

Examples of two types of traffic jams at Yellowstone National Park—a back up at one of the entrance stations and a "bison jam," which can be a common occurrence on park roads.

(Sources: Peaco, 2017–top photo; Ian Rutherford/Alamy stock photo, 2017—bottom photo)

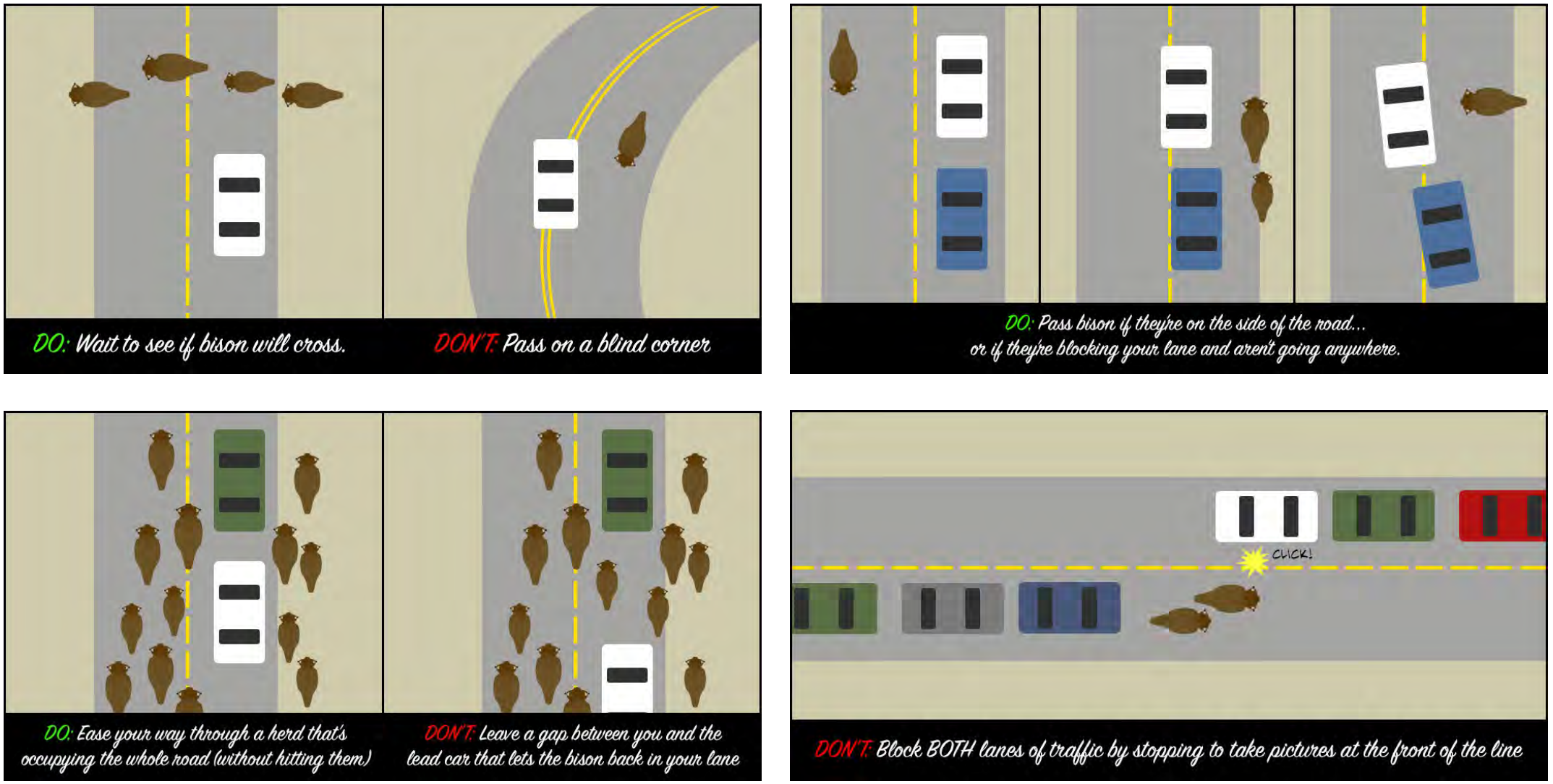


Figure 5.25—How to Navigate a Bison Jam (Illustrations posted by a photographer who frequents Yellowstone, Max Waugh)
(Source: Waugh, 2017)

YELLOWSTONE NATIONAL PARK

Mt. Washburn

Grand Canyon

Yellowstone

CREST OF ABSAROKA

NATIONAL

East Entrance

→ TO CODY

FOREST

YELLOWSTONE LAKE

Old Faithful

CONTINENTAL DIVIDE

River

IDAHO WYOMING Boundary Cr.

Bechler R.

Snake River

Fall R.

Big Game Ridge

Two Ocean Pass

Bobcat Ridge

Huckleberry Mtn.

TETON NATIONAL FOREST

Enos Lake

Fork

6 Planning a Shuttle System at Yellowstone

Visitors on the boardwalk at Grand Prismatic Spring, Midway Geyser Basin

(Source: Berzina/Shutterstock.com, n.d.)

Chapter 6—Planning a Shuttle System at Yellowstone

The Draw of the Geyser Basin Corridor and Related Challenges

The concentration of hydrothermal features in the geyser basins and other park attractions accessible from the Madison Junction to Old Faithful is clearly a major reason for visitors to come to Yellowstone. Destinations such as Old Faithful and the Grand Prismatic Spring are some the park's most iconic features, and these places plus many other features on the west side of the park draw millions of visitors each year.

As described in Chapter 5, multiple studies in recent years have documented visitor use and vehicle congestion in this portion of the park, and the findings of this work by others can help to inform the need for potential solutions (NPS, 2017b and NPS, 2018c).

As shown in Figure 6.1, travel within the geyser basin corridor and the journey to and from Old Faithful are the most common trips taken in the park. As such, the most traveled routes are:

- Trips entering and exiting through the West Entrance that included a stop at Old Faithful; and
- Trips between the West and South entrances that included a stop at Old Faithful.

As such, this chapter focuses on analyzing the potential for shuttle service scenarios in the geyser basin corridor and providing service between West Yellowstone and Old Faithful, with a sub-option of service solely between Madison Junction and Old Faithful.

There are multiple concerns and problems related to increasing traffic congestion and visitation levels at popular sites in the park, such as:

- ***Impacts to visitor experience***—Congestion and overcrowding at entrances, roads, parking areas, trailheads, trails, attraction sites, visitor centers, restrooms, and other facilities.
- ***Environmental***—Air pollution, noise pollution, light pollution, wildlife impacts, damage to resources, including critical natural and cultural features, especially the iconic hydrothermal features.
- ***Park operations***—The more that park staff have to manage traffic jams and congested parking areas, the less time they have to spend on providing other critical services—such as helping and guiding visitors and protecting resources.

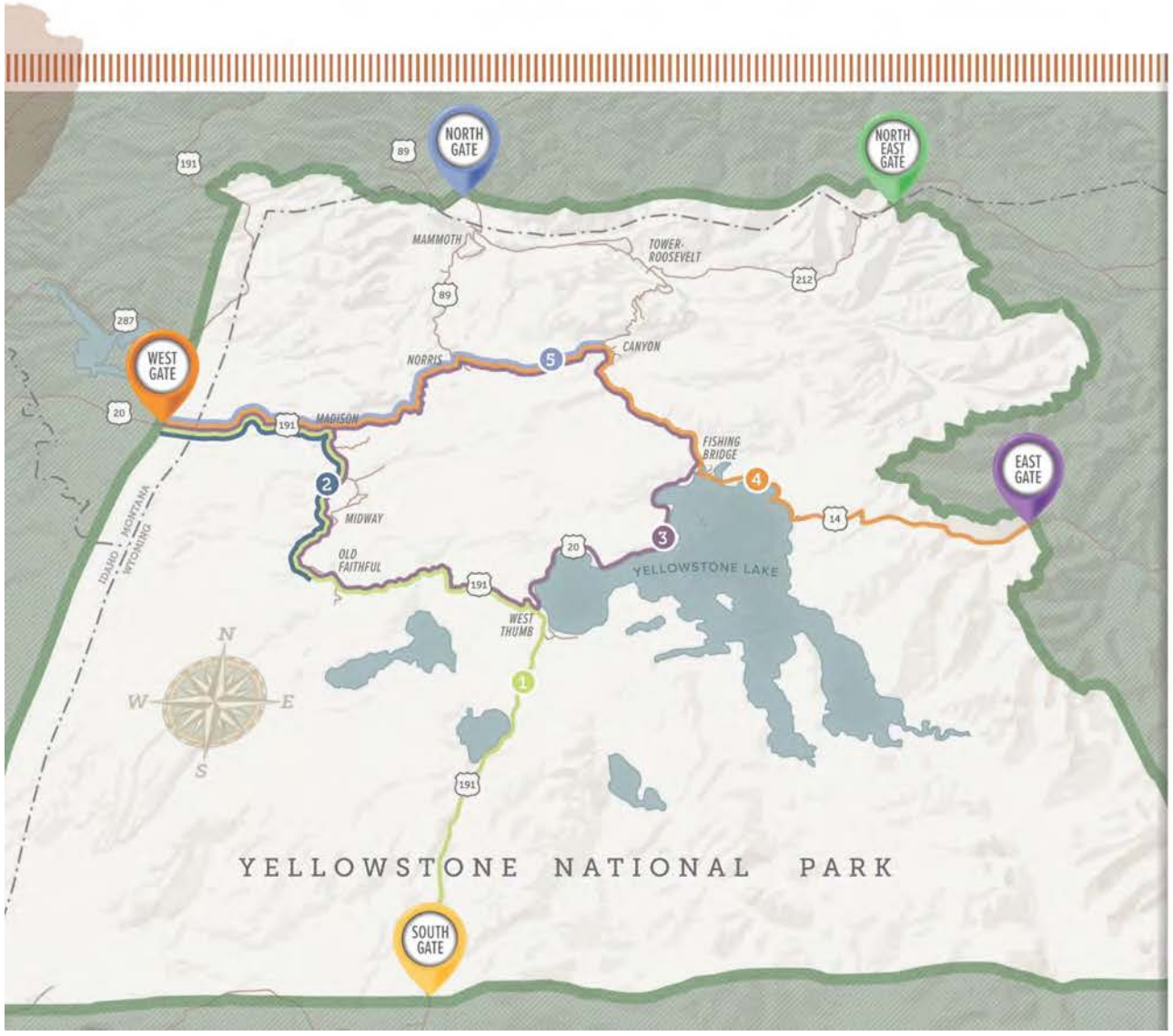
Managing Visitors in the Geyser Basin Corridor

As the most congested area of the park, the roads and parking areas in the geyser basins between Madison Junction and Old Faithful are frequently congested with traffic circulating or stalled in parking areas as visitors wait for others to leave to obtain a space. Overflow parking along parking lot entrance roads and along the main Grand Loop road occurs on a regular basis, creating constant management challenges. Because this part of the park is closed to standard vehicle traffic during the winter (with the exception of snow coach tours that take visitors to Old Faithful), most visitors are only able to enjoy the amazing concentration of hydrothermal features from approximately late April through early November. While interactions with the hydrothermal features in the park represent one of the most important visitor experiences offered at Yellowstone, such interactions can be a challenge to manage year after year.

Over the decades, the NPS has introduced new facilities and interpretive information intended to educate visitors and promote conservation of these resources. Yet overcrowding creates conflicts that give rise to undesirable visitor behavior. As described earlier, the 2017 study of summer visitor use patterns at major attractions in Yellowstone identified several hot spots of undesirable visitor behavior (D'Antonio & Siddler, 2018; Mills and Bramblett, 2017).

Behaviors observed by the research team included parking outside of designated areas, creation of social trails, trash in geothermal pools and terraces, people stepping off boardwalks, and destruction of fragile geologic resources. There were high concentrations of unwanted behavior around parking areas, trails and boardwalks at Old Faithful and Midway Geyser Basin, including the Grand Prismatic Spring and Fairy Falls. It is apparent that the high concentration of visitors creates an environment that can easily give rise to these unwanted behaviors. The Mills and Bramblett study also identified problems affecting the otherwise pristine streams and rivers that are prime habitat for rare species such as the Yellowstone cutthroat trout.

Active visitor use management in this corridor is essential for visitor safety and to maintain a high-quality experience. Existing data provided by the NPS and others suggests that careful consideration of the level of visitation combined with design interventions at specific locations could go a long way to reduce the negative impacts of the high levels of congestion experienced in summer months.



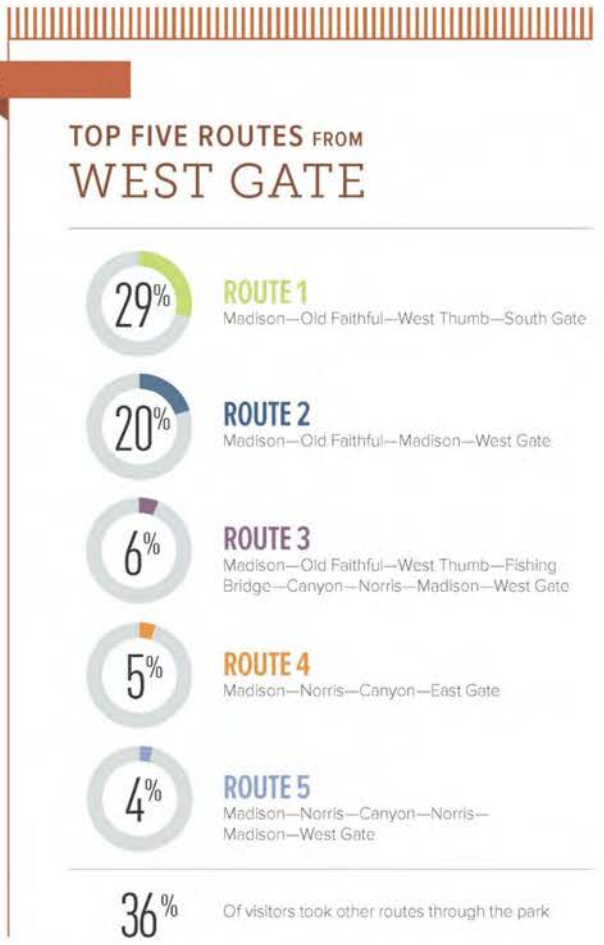


Figure 6.1—Travel Patterns at Yellowstone, Most Traveled Routes from the West Entrance
(Source: Otak; Fehr & Peers, 2017)

Implementing a Shuttle Program as a Visitor Use Management Tool

Public transportation is often referred to as a shuttle, transit, or bus system, but it may also take the form of vans, trams, or other vehicles that move people from one place to another. Public transportation is recognized by the NPS as a viable tool for managing congestion and is listed in the agency's Congestion Management Toolkit (NPS, 2021c), which can be found here: https://www.nps.gov/orgs/1548/upload/Congestion_Management_2021-508.pdf

Public transportation can serve as an effective management tool to address congestion and desired visitor use patterns in various ways:

- Transferring multiple carloads of people into a shuttle vehicle will reduce traffic levels on park roads and in parking areas, but to ensure that a manageable level of access is achieved (and that the cumulative number of vehicle and visitor don't increase beyond desired levels), the overall amount of traffic and vehicles must be managed in tandem with the shuttle service;
- Shuttle vehicles have a set capacity and can be operated on a set schedule that delivers a pre-calculated number of visitors to resource areas and certain locations within a defined timeframe (assuming that visitors are only

able to access the same areas by shuttle OR as noted in the first point above, the overall level of visitor access delivered to that geography can be managed to a pre-determined level.

- Shuttles can be guided by knowledgeable staff and/or include interpretive and information programs that constantly and consistently deliver key messages to visitors that in turn may help to encourage stewardship and desirable visitor behaviors (such as avoiding crowding on trails and boardwalks; maintaining distance from hydrothermal features and wildlife; and protecting sensitive vegetation and soil crust areas).

While public transportation can bring benefits in managing large volumes of visitors, shuttle systems are costly to implement, operate, and maintain. Also, if not planned and implemented with consideration to visitor use management, shuttle service can bring unintended consequences such as pulsing of visitors at drop off locations, as occurred when the Zion Canyon shuttle was first implemented and has since been addressed through improvements to the shuttle stop areas (see Chapter 4).

This chapter examines several potential shuttle service scenarios and related considerations related to routing between the town of West Yellowstone and the Old Faithful visitor complex, and a sub-option of service operating only between Madison Junction and Old Faithful. It is recognized that the park may be interested in phasing a shuttle system in over time, and as such the segment of the corridor that would have the highest destination-driven demand for shuttle service would be from Madison Junction to Old Faithful. That said, because many visitors who stay in West Yellowstone show a strong interest in traveling to Old Faithful (Otak and Fehr & Peers, 2016), a shuttle connection to/from West Yellowstone could be important in serving that demand.

Shuttle Routing Scenarios and Stop Locations Tailored to Visitor Use Patterns and Enhancing Visitor Experiences

Understanding visitor use patterns and desired visitor experiences is a critical aspect in developing a shuttle system to serve national parks. The quality of the visitor experience that a shuttle system can provide should be fully considered, particularly as compared to the diminished experience that is common during the summer months when overcrowding can lead to long wait times, extreme traffic conditions, and inability to park and/or access popular features.

With the understanding that the most congested area of the park is between Madison Junction to Old Faithful and that the most used entrance to the park is the West Entrance to get to this area, this study explores the potential for shuttling scenarios from West Yellowstone to Old Faithful corridor and the potential for connecting hiking and bicycling loops within the corridor. The study addresses several key questions:

- *What are the best locations for shuttle stops in the corridor based on known visitor use patterns?*
- *What visitor experiences are offered at these locations and how could these be enhanced?*
- *What are the best timeframes and scheduling for shuttle operations?*
- *What would be the optimal size and passenger capacity of a shuttle vehicle in the corridor?*
- *Given various scheduling scenarios and vehicle capacity calculations, how many visitors could be delivered by a shuttle system?*
- *Would the level of visitors delivered by shuttle system make a noticeable difference in traffic congestion in the corridor?*

To answer these questions, a range of shuttle routing scenarios was explored and analyzed, each with a differing set of stops and related timetables for service. Potential trip itineraries related to each scenario were defined, along with operating hours and travel distances. Identified stop locations considered existing visitor use patterns and popularity of certain features, as well as access to trailheads and other recreational opportunities.

Information from the case studies was used to understand operational considerations, such as vehicle types and capacity, typical route times including stops and layovers at destinations, facilities and amenities needed at stops, location options for personal vehicle parking prior to boarding the shuttle, and communication of timetables and route options.

One of the principal lessons from the earlier stages of implementing the Zion Canyon shuttle system was that the system must operate on a frequent enough timetable that visitors can catch the shuttle with minimal wait times. At the same time, the delivery of visitors needs to avoid pulsing too many people at one time at the shuttle stops (beyond what the design and surrounding resource areas can handle). Over the years, the Zion shuttle has gotten more and more popular. The system managers have reduced headways by increasing the number of buses, and at present, the system is operating about the maximum capacity possible.

Additional facilities such as comfortable stops, wayfinding information at stops, and interpretive information provided both along the route and at stops heighten the overall experience.

Based on these and other lessons from the case studies, a range of scenarios was developed to evaluate potential to provide convenient access to destinations throughout the geyser basin corridor, as well as an improved visitor experience. The operational and capacity analysis of this project focuses on three service options between West Yellowstone and Old Faithful. These service options could operate singularly or on a synchronized timetable traveling the same route (recognizing that operating multiple service options at once will increase the number of shuttle vehicles needed to provide that level of service). The benefit of operating multiple service scenarios at once is it would maximize opportunities visitors would have in the geyser basin to access different locations at different time intervals. Visitors would be able to transfer between the different service lines while in the midst of their visit.

Service options studied included:

- Old Faithful Express—direct service back and forth to Old Faithful;
- Geyser Basin Explorer—service to and from Old Faithful with intermediate stops at key sites in the geyser basin corridor; and
- Westside Trekker—service to and from Old Faithful with a greater number of intermediate stops than Explorer and with the intent for this to function as primarily a hiker shuttle that could also have flag stop service.

The fastest and most direct option, the Old Faithful Express, would provide non-stop service from the west entrance at West Yellowstone (or Madison Junction the sub-option terminus) to the Old Faithful area, including the Old Faithful Geyser, the Historic District, Visitor Center, and Education Center.

The second option, the Geyser Basin Explorer, provides opportunities to stop at many of the most frequently visited destinations in the geyser basin corridor. This service option is intended for visitors who want to spend some time at the features, perhaps take short hikes, or picnic and relax for a few hours, but spend about a half a day overall.

The third option, the Westside Trekker, is intended for visitors who want to spend a longer time in the geyser basin corridor and/or along the Madison River segment (although this area would not be accessed with the sub-option service of Madison Junction to Old Faithful). This option could accommodate bicyclists and backpackers interested in accessing trails and lower volume roads, and who may be staying for multiple days. It also could accommodate visitors wishing to spend a long day visiting the hydrothermal features.

Operating these services in tandem would maximize visitor use and access opportunities. For example, if they wanted to visit two or three locations and then head back to West Yellowstone or other route terminus, they could first travel on the Geyser Basin Explorer and then transfer to the Old Faithful Express.

Table 6.1 lists the three shuttle scenarios analyzed and the anticipated experiences and overall length of time estimated for the scenario, and the stops associated with each scenario. Figure 6.2 provides a map showing the context of the shuttle service study area within the park. Figures 6.3 shows the routing and stops for each service scenario and. Combined. Figures 6.4 through 6.6 more detailed maps of the three shuttle service scenarios and stops for each.

Table 6.2 evaluates shuttling scenarios for each of these three options if the service initiated at Madison Junction (not in West Yellowstone). Figure 6.7 shows the service scenarios and stop locations for the Madison Junction to Old Faithful sub-option. Table 6.3 lists and describes potential shuttle stops, flag stops, and other places, as well as miles and distances in between, from West Yellowstone to Old Faithful. Table 6.4 list stops and miles and distances in between for the Madison to Old Faithful sub-option.

Madison Junction to Old Faithful Sub-Option

In evaluating the potential for shuttle service between Madison Junction and Old Faithful, compared to service between West Yellowstone and Old Faithful, it is interesting to consider how removing the 14.4-mile journey as a shuttle ride may change the visitor experience and service opportunities. Several observations come to light:

- Shuttle operations would be less costly due to the reduction in vehicle miles traveled per day; less vehicles would be needed.
- Visitors may be able to spend more time in this area of the park via shuttle access within a single day. However, visitors would still be traveling from their lodging location to access the shuttle system at Madison Junction or Old Faithful.
- The difference between the Geyser Basin Explorer and Westside Trekker scenarios becomes less distinctive from each other without any service along the Madison River corridor.
- A greater volume of park and ride capacity would need to be developed *inside* the park—at Madison Junction and Old Faithful, rather than development of a West Yellowstone in-town shuttle loop and park and ride lot.

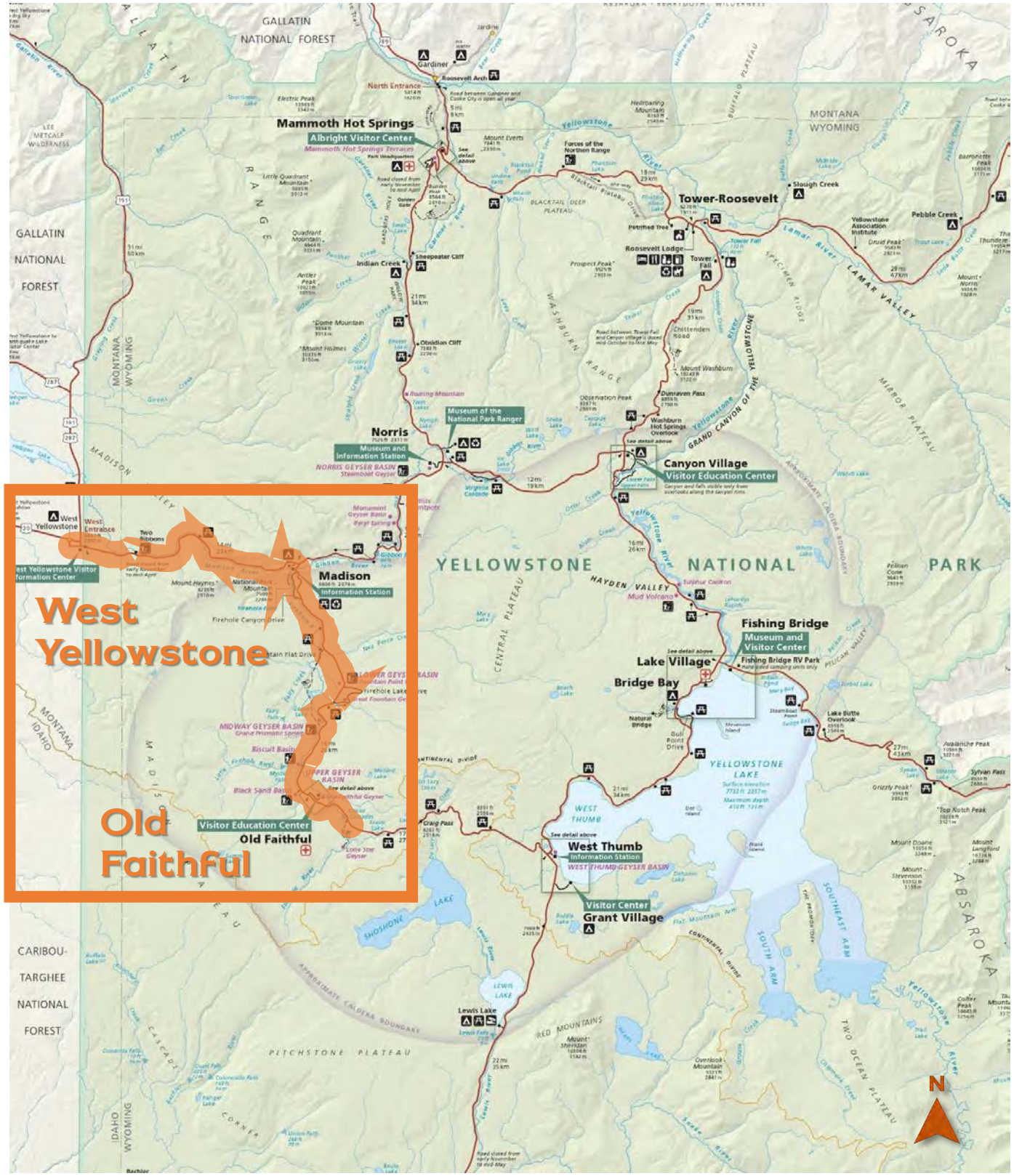


Figure 6.2—Shuttle Scenarios Route in the Context of the Park
(Base map source: NPS, 2017)

- Bus maintenance/operations (bus garage with fueling, cleaning, maintenance, and bus storage functions) would need to be developed *inside* the park rather than an in-town location.
- There could be less inclination to ride the shuttle if people are driving from town (where they are lodging) and into the park. Would they be likely to shift modes? More proactive and aggressive marketing and outreach may be needed to promote the shuttle experience. And, during peak visitation, the shuttle may need to be mandatory with management/metering of private vehicle access in the corridor to be effective in reducing congestion.

Selecting Stop Locations

Recommended shuttle stops related to each service scenario and related visitor experiences are described and diagrammed in this chapter. The stop locations selected for each scenario are primarily driven by the visitor experiences available at those locations, as well as the desired level of service and timetable for each scenario studied.

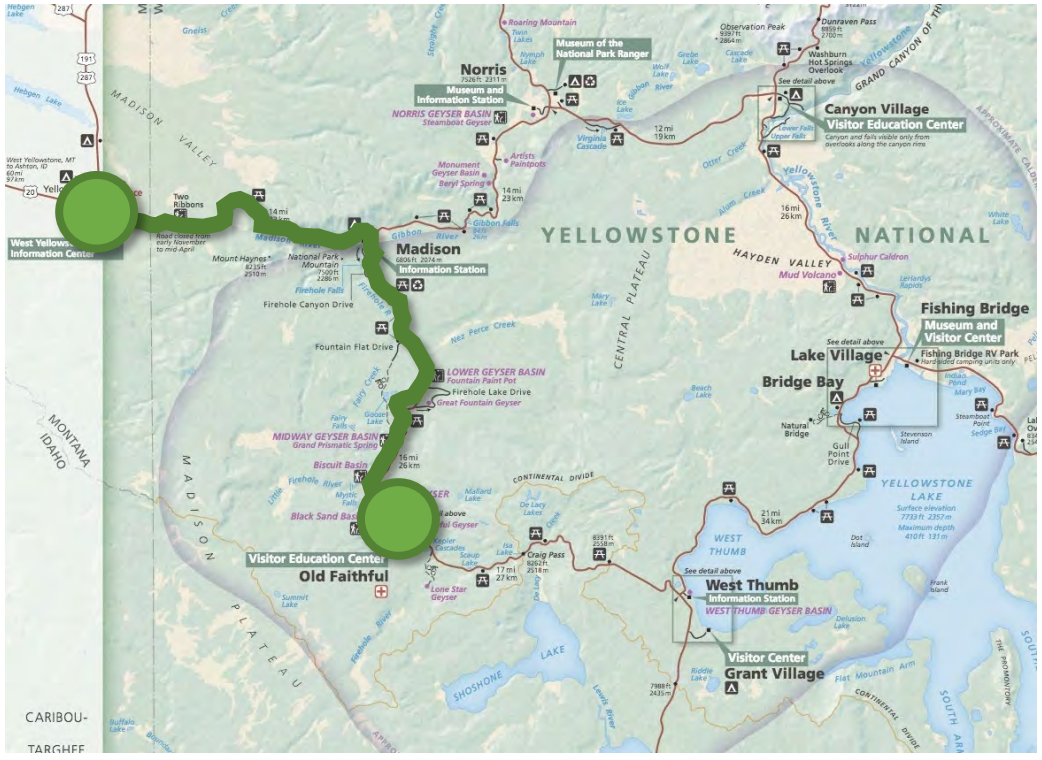
When planning transit service in urban areas, the spacing and minimum distance between stops often becomes a decision factor due to the need to maximize efficiency of service. In national parks, this is typically less of a concern because shuttling is often intended to function more as an enhancement of the visitor experience and a visitor use management tool and less as an efficient form of transportation.

That said, national park visitors like to have options, and they like the convenience of frequent service even if they may not in as much of a hurry to get from place to place. Again, if two or three services operated in tandem, this would maximize these options for visitors.

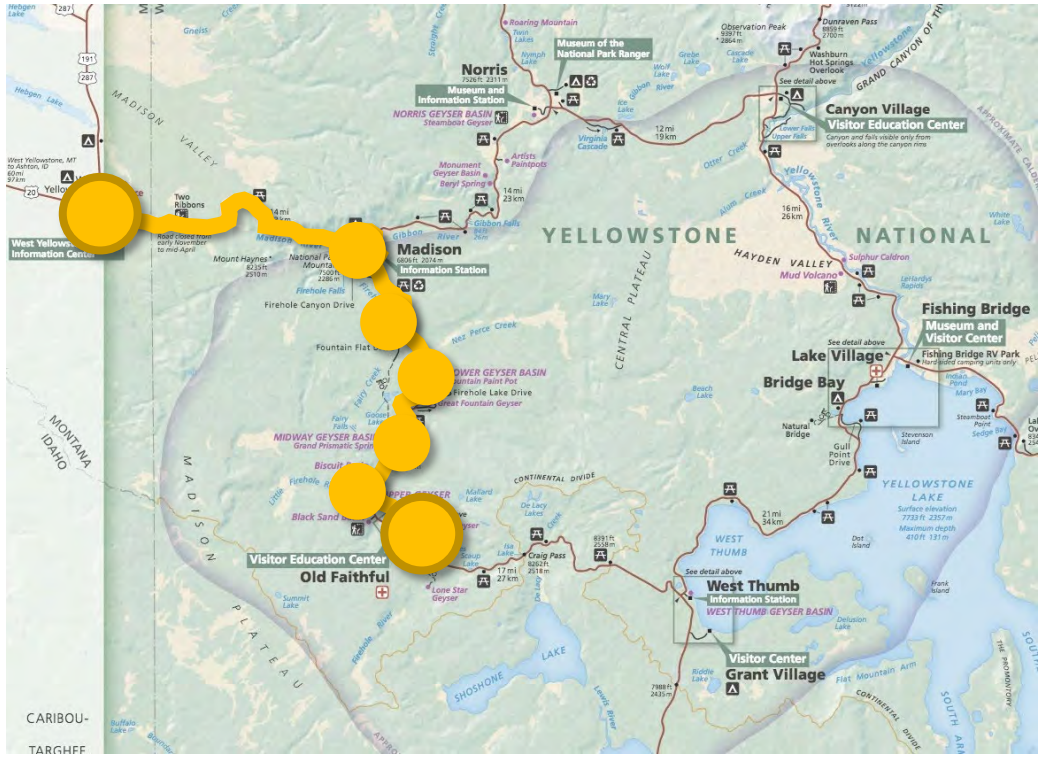
Table 6.1 Shuttle Service Scenarios Studied—West Yellowstone to Old Faithful

Old Faithful Express	Geyser Basin Explorer	Westside Trekker
Visitor Experience: Round-trip from West Yellowstone to Old Faithful in the quickest possible time, with some wildlife watching and sight-seeing from the shuttle vehicle (perhaps enhanced through an audio program). The primary experience would be quality time at the Old Faithful area, watching Old Faithful and visiting Old Faithful Inn, Historic District/Visitor Centers. Visitors could take time to do some hiking in the Upper Geyser Basin area, which also provide the opportunity to loop back to other shuttle stops that are part of the Geyser Basin Explorer service.	**Visitor Experience:** Sight-seeing, wildlife watching, and photography in the geyser basin corridor with opportunities to stop at multiple sites. Walking trail loops/boardwalks. Picnicking /day use. Likely less time in the Old Faithful area and Upper Geyser Basin if planning a half day to three quarters of a day outing. Visitors could hike or bike from one stop to another as part of the experience. Opportunity to focus on themes in interpretation and narration on buses and at stops around hydrothermal features.	**Visitor Experience:** Sight-seeing, wildlife watching, and photography in the geyser basin corridor with opportunities to stop at multiple sites; even more sites than the Geyser Basin Explorer service. Walking trail loops/boardwalks. Picnicking /day use. Fishing (multiple rivers/streams). Likely less time in the Old Faithful area and Upper Geyser Basin if planning a half day to three quarters of a day outing. Visitors could hike or bike from one stop to another (between sites and features) as part of the experience with even more opportunities to experience more of the park via shuttle. Bike loops on low-speed roads and trails; this service could incorporate a bicycle carrying trailer on certain bus runs.
3 – 4+ Hours / Half Day	4 – 6+ Hours / Partial Day Longer	8 – 10+ Hours / Full Day
2 Stops: West Yellowstone, Old Faithful	7 Stops: West Yellowstone, Madison Junction, Fountain Flat Drive, Fountain Paint Pot/Firehole Lake North, Midway Geyser Basin(Grand Prismatic and Fairy Falls), Biscuit Basin, and Old Faithful	10+* Stops: West Yellowstone, Madison River Two Ribbons Trailhead or Harlequin Lake, Madison Junction, Firehole Canyon Drive, Fountain Flat Drive, Fountain Paint Pot/Firehole Lake North, Firehole Lake South, Midway Geyser Basin (Grand Prismatic and Fairy Falls), Biscuit Basin, and Old Faithful *Could be more with flag stops

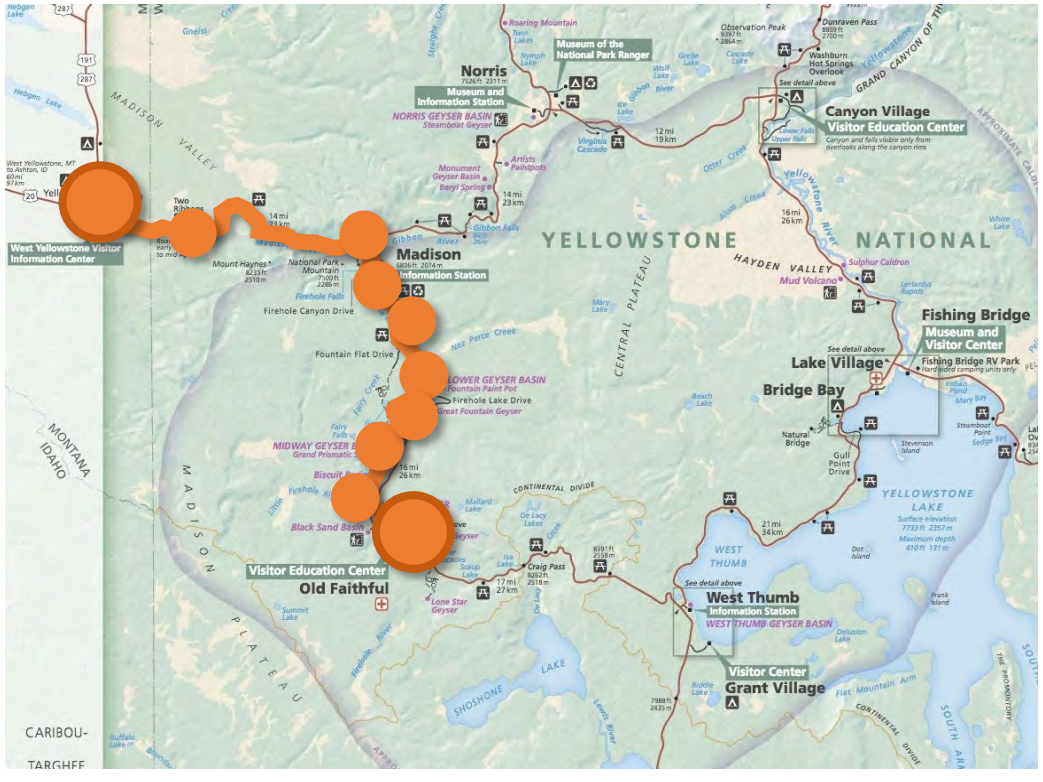
Old Faithful Express Termini and Stops



Geyser Basin Explorer Termini and Stops



Westside Trekker Termini and Stops



Combined Services Termini and Stops

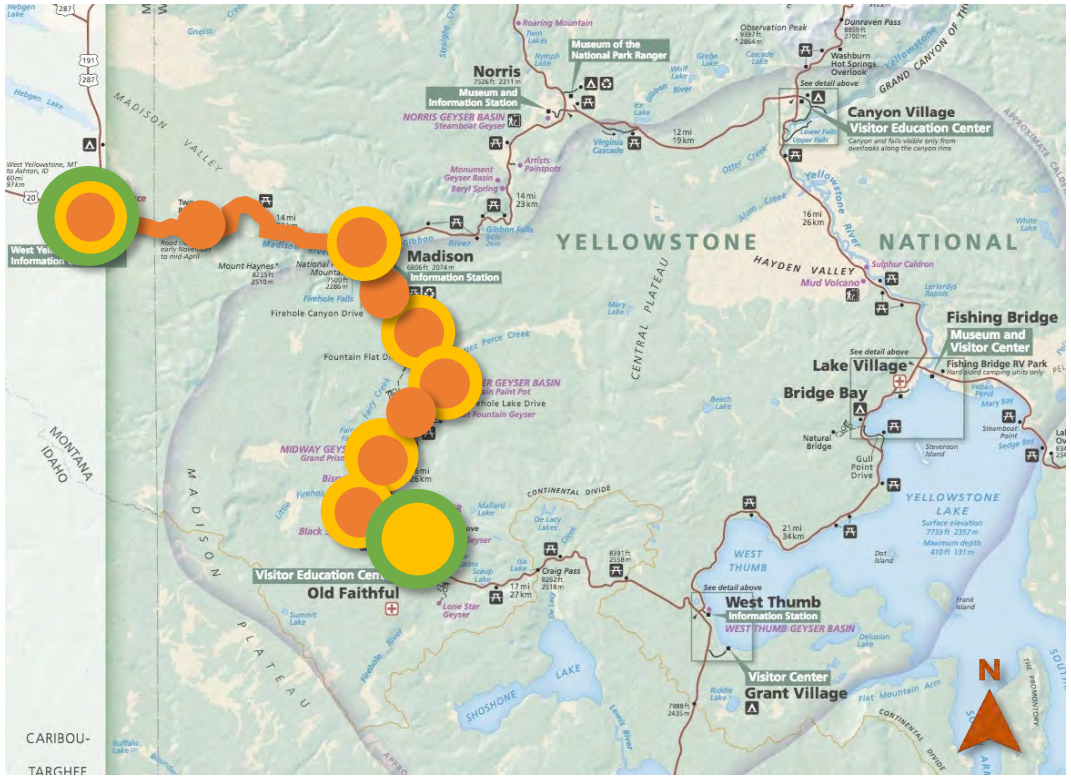


Figure 6.3—Shuttle Service Scenarios and Stops Studied—West Yellowstone to Old Faithful

(Base map source for all maps: NPS, 2017)

(Base map source: NPS, 2017)

Figure 6.4—More Detailed Map of Old Faithful Express Stops

(Base map source: NPS, 2017)

Figure 6.5—More Detailed Map of Geyser Basin Explorer Stops

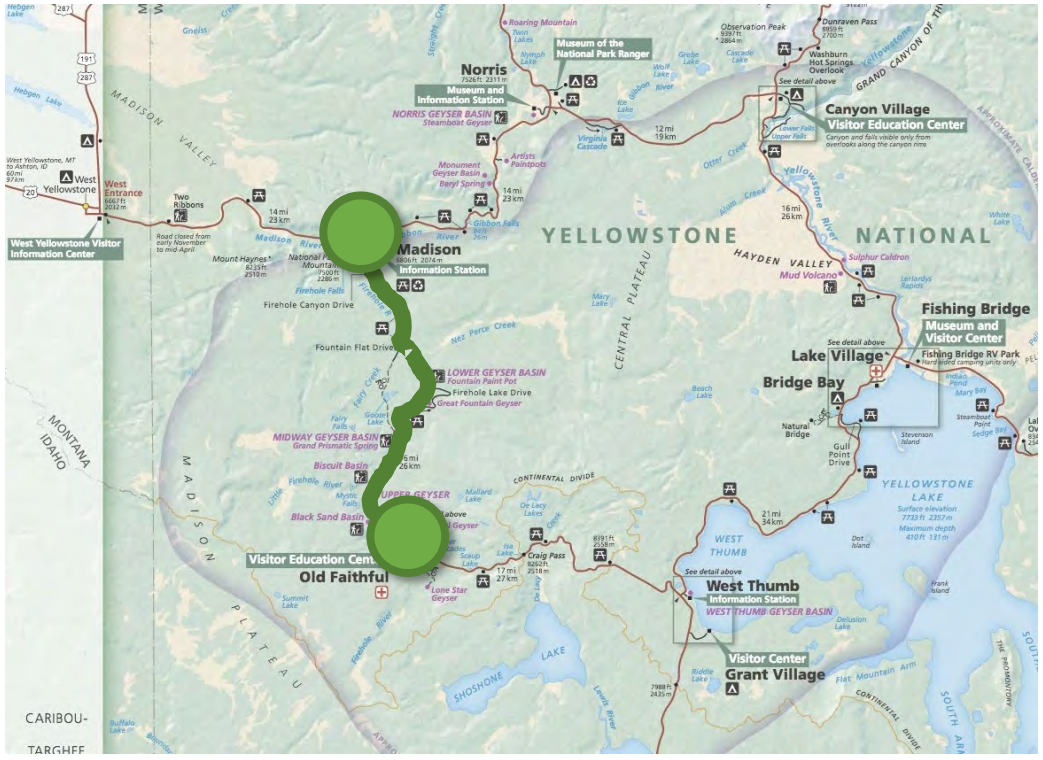
(Base map source: NPS, 2017)

Figure 6.6—More Detailed Map of Westside Trekker Stops

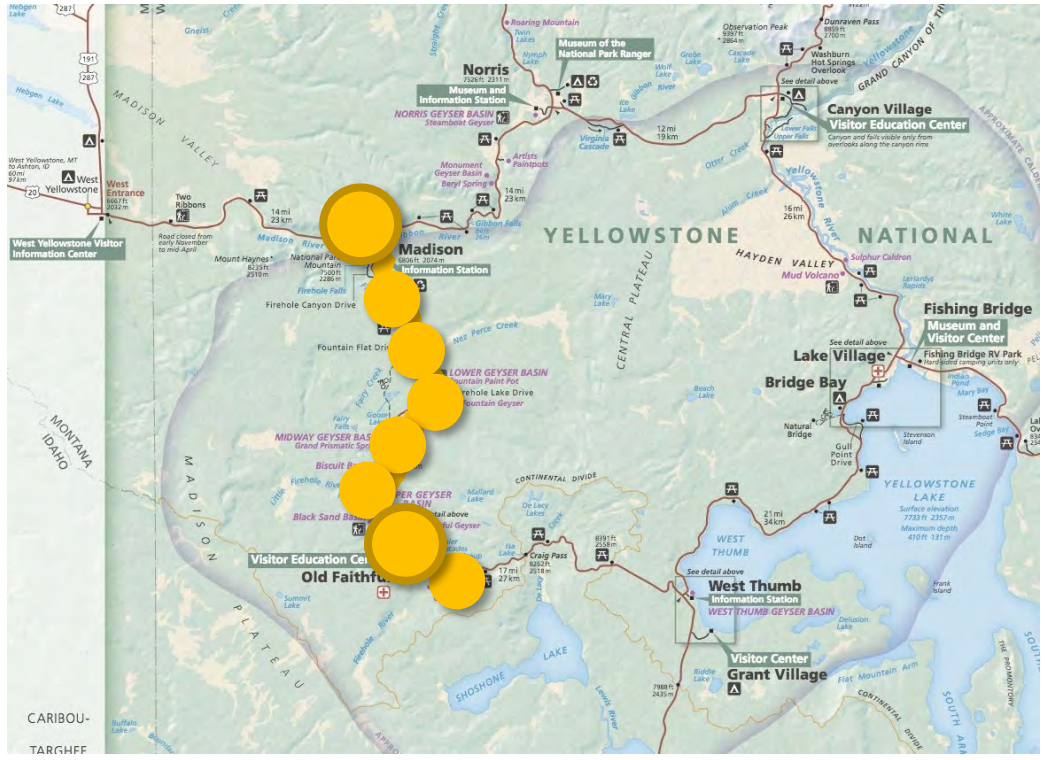
Table 6.2 Shuttle Service Scenarios Studied—Madison Junction to Old Faithful

Old Faithful Express	Geyser Basin Explorer	Westside Trekker
Visitor Experience: Round-trip from Madison Junction to Old Faithful in the quickest possible time, with some wildlife watching and sight-seeing from the shuttle vehicle (perhaps enhanced through an audio program). The primary experience would be quality time at the Old Faithful area, watching Old Faithful and visiting Old Faithful Inn, Historic District/Visitor Centers. Visitors could take time to do some hiking in the Upper Geyser Basin area, which also provide the opportunity to loop back to other shuttle stops that are part of the Geyser Basin Explorer service.	**Visitor Experience:** Sight-seeing, wildlife watching, and photography in the geyser basin corridor with opportunities to stop at multiple sites. Walking trail loops/boardwalks. Picnicking /day use. Old Faithful area experiences. Visitors could hike or bike from one stop to another as part of the experience. Opportunity to focus on themes in interpretation and narration on buses and at stops around hydrothermal features.	**Visitor Experience:** Sight-seeing, wildlife watching, and photography in the geyser basin corridor with opportunities to stop at multiple sites; even more sites than the Geyser Basin Explorer service. Walking trail loops/boardwalks. Picnicking /day use. Fishing (multiple rivers/streams). Old Faithful area experiences. Visitors could hike or bike from one stop to another (between sites and features) as part of the experience with even more opportunities to experience more of the park via shuttle. Bike loops on low-speed roads and trails (but less opportunities without Madison River segment); this service could incorporate a bicycle carrying trailer on certain bus runs.
2+ Hours Approx.	3-4+ Hours / Half Day or Longer	6-8+ Hours / Full Day
2 Stops: Madison, Old Faithful	8 Stops: Madison Junction, Firehole Canyon Drive, Fountain Flat Drive, Fountain Paint Pot/Firehole Lake North, Midway Geyser Basin(Grand Prismatic and Fairy Falls), Biscuit Basin, Old Faithful, Lone Star Geyser	10+* Stops: Madison Junction, Firehole Canyon Drive, Fountain Flat Drive, Fountain Paint Pot/Firehole Lake North, Firehole Lake South, Midway Geyser Basin (Grand Prismatic and Fairy Falls), Biscuit Basin, Black Sand Basin, Old Faithful, Lone Star Geyser, and potential flag stops at other trailheads *Could be more with flag stops

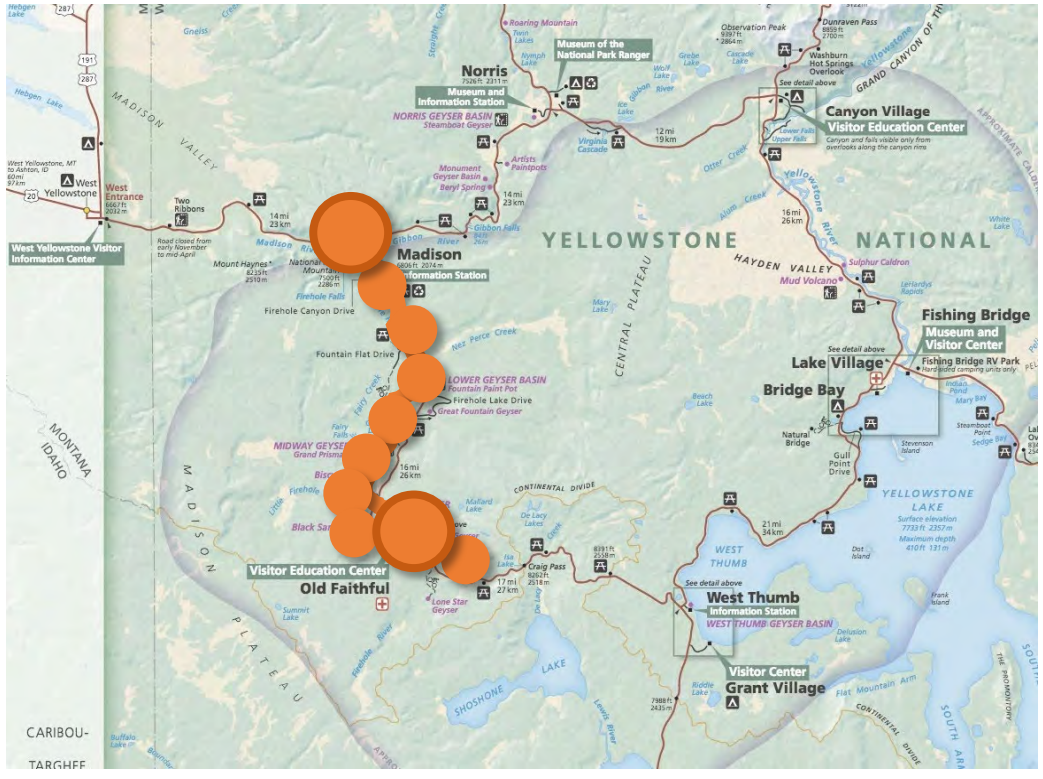
Old Faithful Express Termini and Stops



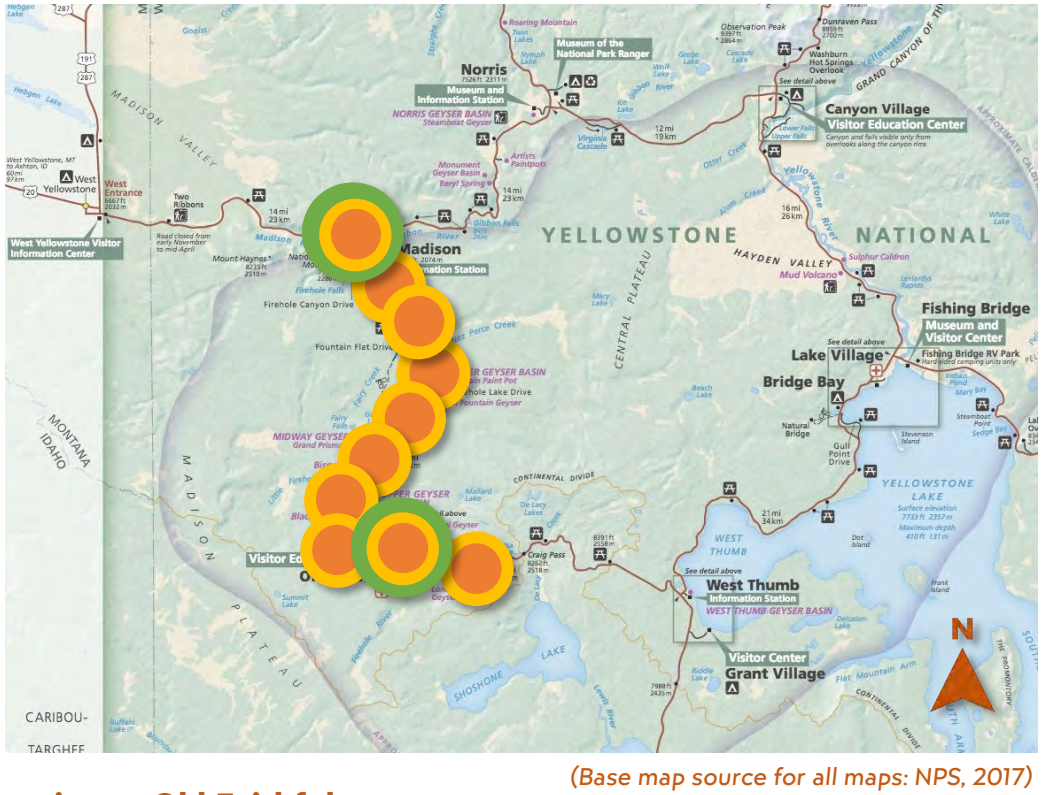
Geyser Basin Explorer Termini and Stops



Westside Trekker Termini and Stops



Combined Services Termini and Stops



(Base map source for all maps: NPS, 2017)

Figure 6.7—Shuttle Service Scenarios and Stops Studied—Madison Junction to Old Faithful

Table 6.3 Potential Shuttle Stops, Flag Stops, and Other Places along the Route with Mileage and Distances

PLACES ALONG ROUTE/ POTENTIAL STOPS	Mileposts from West Gate	Adjusted Travel Time (Minutes) at Peak*	Distance from Last Place	DESCRIPTION OF EXPERIENCES, FACILITIES, AND SERVICES	Park Roadway Location
WEST YELLOWSTONE	0			West Yellowstone Visitor Information Center, Grizzly and Wolf Discovery Center, Museum of the Yellowstone, Yellowstone Giant Screen Theatre, wide variety of lodging and dining, services/fuel, emergency medical.	West Entrance Road
TWO RIBBONS TRAILHEAD	3.6	9.5	3.6	Trailhead, overlook to Madison River, picnicking, possible bicycling route along river in this vicinity. See Figure 6.23.	West Entrance Road
SEVEN MILE BRIDGE/ MADISON RIVER PICNIC	8.1	20	4.5	Seven Mile Bridge Trailhead, Madison River overlook and picnicking, Madison Range overlook.	West Entrance Road
HARLEQUIN LAKE TRAILHEAD	12.8	31	4.7	Harlequin Lake Trailhead, picnicking, wildlife watching, bison sometimes congregate in this vicinity creating "animal jams" on the road that back up from Madison Junction.	West Entrance Road
MADISON JUNCTION	14.4	35	1.6	Campground, Amphitheater, Visitor Center/Info Station/Bookstore, Purple Mountain Trailhead, Terrace Springs Trailhead, Tuff Cliffs Picnic, Firehole River Bridge/Firehole Canyon Road N, National Park Mountain, Three Brothers Mountains.	West Entrance Road/Grand Loop Road
FIREHOLE CANYON DRIVE NORTH	15	36	0.6	One way (north to south) side drive along Firehole River, visitors can view Firehole Falls, The Cascades, and the Cascades of the Firehole, narrow road gets congested in summer with overflow parking, could potentially be a bike and hike only at peak with shuttle service.	Grand Loop Road
FIREHOLE CANYON DRIVE SOUTH	16.8	40	1.8	See above; southern exit is in proximity to the Cascades of the Firehole/swimming area; potential shuttle stop at either end of drive.	Grand Loop Road
FOUNTAIN FLAT DRIVE/NEZ PERCE PICNIC AREA	20.1	48	3.3	Fountain Flat Drive provides fishing access to the Firehole River, Nez Perce picnic area with restrooms, trailhead to Fairy Falls Trail, Goose Lake area; hydrothermal features include Hygeia Spring, Maiden's Grave Spring, Firehole Spring, Buffalo Spring, Ojo Caliente Spring; trail connects to Sentinel Meadows Trail/Imperial Meadows Trail and Upper Fairy Falls Trail, Fairy Creek Trail which loops back to Biscuit Basin (opportunity for loop trail hike - visitors can start here and pick up shuttle at Biscuit Basin at end of hike).	Grand Loop Road
MARY MOUNTAIN-NEZ PERCE TRAIL	20.9	51	0.8	Trailhead - potential flag stop for hikers (Trekker route); trail connects back to Grand Loop Road northeast of here.	Grand Loop Road
LOWER GEYSER BASIN, FOUNTAIN PAINT POT, AND FIREHOLE LAKE DRIVE NORTH	22.6	54	1.7	Parking and trailhead, interpretive loop (accessible): various hydrothermal features include Twig Geyser, Leather Pool, Silex Spring, and others; the exit point for Firehole Lake Drive is located across Grand Loop Road from Fountain Paint Pot parking, Firehole Lake Drive is one way (south to north) with access to several interesting hydrothermal features that could be a shared shuttle stop with Fountain Paint Pot and Firehole Lake Drive, but would need improvements for safe visitor crossing of the Grand Loop Road.	Grand Loop Road

Table 6.3, Continued, Potential Shuttle Stops, Flag Stops, and Other Places along the Route with Mileage and Distances

PLACES ALONG ROUTE/ POTENTIAL STOPS	Mileposts from West Gate	Adjusted Travel Time (Minutes) at Peak*	Distance from Last Place	DESCRIPTION OF EXPERIENCES, FACILITIES, AND SERVICES	Park Roadway Location
FIREHOLE LAKE DRIVE SOUTH/GREAT FOUNTAIN GEYSER	23.6	57	1	See above; southern entry point is in proximity to the Great Fountain Geyser, potential shuttle stop at either end of drive; south to north various hydrothermal features include springs such as Broken Egg, Firehole, Botryoidal, Surprise, and Black Warrior; geysers such as White Dome, Dilemma, and Bead; and Mushroom Pool.	Grand Loop Road
WHISKEY FLATS PICNIC AREA	24.2	58	0.6	Picnic area; could be potential flag stop with various springs and hydrothermal features nearby, but not a destination trailhead and very close to Midway GB stop.	Grand Loop Road
MIDWAY GEYSER BASIN, GRAND PRISMATIC SPRING, FAIRY FALLS TRAIL	24.6	59	0.4	Parking and trailhead connecting to Grand Prismatic Spring, Fairy Falls Trail and other trails from here connect to Biscuit Basin and the Upper Geyser Basin trails north of Old Faithful; hydrothermal features include the magnificent Grand Prismatic Spring, Opal Pool, Turquoise Pool, Excelsior Geyser Crater, and others.	Grand Loop Road
FAIRY FALLS TRAILHEAD PARKING LOT	26	63	1.4	Separate Fairy Falls Trailhead parking area to the south; this location could potentially be converted to shuttle only as an alternative to developing a new shuttle stop (or in addition to) the one conceptualized at Midway Geyser Basin; hydrothermal features in this area include the Steel Bridge Pool and others.	Grand Loop Road
MALLARD CREEK TRAILHEAD	26.5	64	0.5	Trailhead with parking for 7 cars accessible across the Grand Loop Road and located across from Midway Geyser area, could be a flag stop on Trekker route as the Mallard Creek Trail connects to Mallard Lake; loops back to Old Faithful).	Grand Loop Road
BISCUIT BASIN	28.4	68	1.9	Trails along hydrothermal features and the Fairy Creek Trail connects back to here from the Fountain Flat Drive to the Fairy Falls Trail north of here; Mystic Falls Trail and a high concentration of hydrothermal features here include Sapphire Pool, Black Pearl Geyser, Black Opal Pool, Cauliflower Geyser, Biscuit Basin Geyser, Broken Cone Geyser, Aftershock Geyser, Pulcher Springs, Sprite Pool, the Artemisia Geyser (via Artemisia Trail), and others.	Grand Loop Road
BLACK SAND BASIN	29.9	72	1.5	Parking and trailhead; only accessible southbound from the Grand Loop Road (due to separated highway at access to Old Faithful there is no northbound access); trails across the highway loop back to Old Faithful; hydrothermal features include Opalescent, Handkerchief, and Emerald Pools, Driveway Spring, and Whistle Geyser.	Grand Loop Road
OLD FAITHFUL AREA	31.8	77	1.9	In addition to the Old Faithful Geyser, there are trails all throughout the Upper Geyser Basin that allow viewing of many hydrothermal feature including Morning Glory Pool, Spiteful Geyser, Intermittent Spring, Grotto Geyser, Oblong Geyser, Chromatic Pool, Grand Geyser, Castle Geyser, Twilight Spring, Beehive Geyser, Sulphide Spring, Silver Spring, Blue Star Spring, Topaz Spring, and many other pools, springs, and geysers. The Continental Divide Trail traverses this area as well. The Old Faithful complex is also the location of lodging facilities, dining groceries, fuel, multiple visitor centers, Old Faithful Inn, Old Faithful Lodge, Snow Lodge.	Old Faithful Road System/Off Grand Loop Road
LONE STAR TRAILHEAD	32.9	79	1.1	Accessible from the Grand Loop Road, but also by trail from Old Faithful, Lone Star Trail provides access to Lone Star Geyser as well as connecting trails such as Shoshone Lake Trail, which leads to Shoshone Lake, and another trail from there that leads to Lewis Lake; there is a pull-off/overlook area at the Kepler Cascades on the Firehole River and also the trailhead parking area for the trail to Lonestar Geyser in this vicinity.	Grand Loop Road

Table 6.4 Madison Junction to Old Faithful Route Sub-Option—Potential Stops, Flag Stops, and Other Places, Miles/Distances

PLACES ALONG ROUTE/ POTENTIAL STOPS	Mileposts from West Gate	Adjusted with Start at Madison Junction	Adjusted Travel Time (Minutes) at Peak*	Distance from Last Place
MADISON JUNCTION	14.4	0		
FIREHOLE CANYON DRIVE NORTH	15	0.6	4	0.6
FIREHOLE CANYON DRIVE SOUTH	16.8	2.4	6	1.8
FOUNTAIN FLAT DRIVE/NEZ PERCE PICNIC AREA	20.1	5.7	14	3.3
MARY MOUNTAIN-NEZ PERCE TRAIL	20.9	6.5	16	0.8
LOWER GEYSER BASIN, FOUNTAIN PAINT POT, AND FIREHOLE LAKE DRIVE NORTH	22.6	8.2	20	1.7
FIREHOLE LAKE DRIVE SOUTH/GREAT FOUNTAIN GEYSER	23.6	9.2	22	1
WHISKEY FLATS PICNIC AREA	24.2	9.8	24	0.6
MIDWAY GEYSER BASIN, GRAND PRISMATIC SPRING, FAIRY FALLS TRAIL	24.6	10.2	25	0.4
FAIRY FALLS TRAILHEAD PARKING LOT	26	11.6	28	1.4
MALLARD CREEK TRAILHEAD	26.5	12.1	29	0.5
BISCUIT BASIN	28.4	14.0	34	1.9
BLACK SAND BASIN	29.9	15.5	37	1.5
OLD FAITHFUL AREA	31.8	17.4	42	1.9
LONE STAR TRAILHEAD	32.9	18.5	45	1.1

Shuttle Service Scenarios and Related Stops and Visitor Experiences

Potential shuttle stop locations are described in the following text, along with visitor experiences available at these locations for each of the three shuttle scenarios studied:

- Old Faithful Express
- Geyser Basin Explorer
- Westside Trekker

Old Faithful Express Service Scenario—The Old Faithful Express shuttle scenario would include two major stops, which would also serve as the route termini—West Yellowstone and Old Faithful. For the sub-option route studied of Madison Junction to Old Faithful the northern route terminal would be in the vicinity of Madison Junction. Refer to Tables 6.1 through 6.5 for information about proposed stop locations.

The shuttle routing alternatives studied evaluate 10- and 20-minute headways (the time between bus service at each stop/termini). Shuttles would travel back and forth multiple times through the corridor to achieve these headways. Half hour layover timeframes were assumed on either end of the route at the two shuttle terminals.

This scenario would provide visitors with the quickest access to and from seeing the Old Faithful Geyser and other activities in the Upper Geyser Basin and Old Faithful Historic District. The Old Faithful area is the most popular attraction in the park and many Yellowstone visitors only visit Old Faithful. The shuttle would provide an option for those wishing to access the Old Faithful area but ready to leave the hassles of driving in traffic and finding parking behind.

Riding the shuttle would result in a time advantage for visitors to Old Faithful because of the convenience of the proposed drop off point, as described later in this chapter. Visitors would not have to circulate to find parking in the large Old Faithful parking complex. Following are considerations and visitor experiences related to the West Yellowstone and Old Faithful stops.

West Yellowstone: Shuttle service in West Yellowstone eventually could be comprised of a separate town loop system that connects to the shuttle system in the park, or it could be part of the same system. Multiple stops also could be provided as part of routing the shuttle through town.

Shuttle stop locations should be easily accessible (within walking distance) from most hotels and accommodations. A primary transit center could be designed at a central location in town or along the street in a curbside location (perhaps along Yellowstone Avenue near the Museum of the Yellowstone or in the vicinity of the West Yellowstone Visitor Center, see Figure 6.8). The Yellowstone Avenue right-of-way is wide enough that it appears this could be accommodated.

Another possibility is that a park and ride facility could be developed to capture not only visitors in town, but also those driving in from areas via Highways 20, 87, and 287 from Idaho and Highway 191 from Montana destinations to the north (Bozeman, etc.) to West Yellowstone and wanting to visit the park.

According to study completed by Fehr & Peers in 2020, the *West Yellowstone Gateway Study*, stakeholders expressed interest during the planning process in developing a shuttle system to reduce congestion in town and at the west entrance to the park. (Fehr & Peers, 2020).

Such a shuttle could have the dual benefits of reducing congestion within the town by providing connections between lodging and attractions, dining, and shopping in the town center, while also taking automobiles off the west entrance and certain roads within Yellowstone National Park by providing visitors with shuttle access to the most popular and parking-constrained destinations.

Fehr & Peers recommended that a transit feasibility study be completed as a next step in further developing this concept an determining to what level congestion could be reduced as a result, and suggested that such a study be conducted collaboratively between NPS and Town staff and stakeholders, and consider factors such as:

- Alignment and stops in town
- Frequency and span of service
- Suitable locations for park and ride facilities
- Potential bypass or transit priority lanes to avoid congestion, and which destinations within the park to serve.

Fehr & Peers also noted that the existing visitor center parking lot would be a strong candidate location for a shuttle park and ride area, but that this needs to be further reviewed to determine if it would provide adequate capacity for parking and transit operations. In the longer-term future, a parking structure could potentially provide more capacity, if constructed here or another location. This would be similar to the example in Estes Park, the gateway community to

Photos showing congested conditions at the West Entrance to Yellowstone National Park

(Sources: Google Earth, 2021 , top, and Billings Gazette, n.d., bottom)

Rocky Mountain National Park, where a parking structure for purposes of park and ride for access to the shuttle system has been constructed adjacent to the visitor center in town.

The west gate to Yellowstone National Park is heavily-used and experiences high congestion during specific times. Fehr & Peers recommended that context-appropriate lane signage and striping be added to guide visitors in and out of the park. Additionally, this signage can be used to create “flexible lanes” that can be changed to accommodate the traffic demand, and as such, ***a lane eventually could be dedicated for shuttle access, giving transit into the park a time advantage, helping to incentivize ridership.***

West Yellowstone is a true gateway community to the park with lodging, dining, services, and a variety of facilities available for visitors and residents, including:

- West Yellowstone Visitor Information Center, operated year-round and staffed by the West Yellowstone Chamber of Commerce with a desk staffed by NPS rangers in summer and winter seasons; provides information about the park and areas to visit nearby; restrooms are available to the public
- Grizzly & Wolf Discovery Center—nonprofit wildlife educational and research park
- Yellowstone Giant Screen Theater—the movie *Yellowstone* can be viewed on a six-story-high screen
- Museum of the Yellowstone located in the historic Union Pacific Depot
- Wild West Yellowstone Rodeo, held multiple days a week in the summer
- Various guides, outfitters, and commercial tour services are available and originate from West Yellowstone

- Yellowstone Aerial Adventures Zipline
- Bicycle Rentals
- All Terrain Excursions and ATV Rentals
- Various guest ranches where visitors can interact with cowboys and ranchers, ride haywagons, and enjoy outdoor cookouts
- A diversity of restaurants and cafes for all meals—breakfast, lunch, and dinner
- A variety of overnight accommodations—hotels motels, upscale lodging, RV parks, and campgrounds
- A hub for enjoying nature and wildlife watching inside and outside park (Hebgen Lake, 20 miles west of West Yellowstone, Earthquake Lake Visitor Center, or Henry's Lake, and other locations along the Highway 191 Scenic Drive)

Old Faithful Complex: As a destination in high demand, the Express service would give visitors the option to get as quickly to Old Faithful as possible without having to worry about traffic congestion and finding parking. The most efficient stop location for dropping off and picking up visitors in the Old Faithful area would be in the parking area just to the northwest of the Old Faithful Inn (see Figure 6.9 and conceptual designs in Chapter 7).

This parking area likely could be retrofitted and there is sufficient space for multiple shuttle vehicles to line up at once as passengers are being dropped off and picked up and drivers are laying over for breaks.

The suggested shuttle stop area is directly adjacent to the main path to the Old Faithful Geyser, so visitors wishing to ride the shuttle to see the geyser can easily access the boardwalk and viewing area and then find their way back to the shuttle stop area to catch the next available shuttle. This location is in an already developed and disturbed area and is currently a large open gravel and dirt covered space.

The key consideration will be the requirement to design the shuttle terminal and facilities in compliance with Secretary of the Interior standards relevant to the Old Faithful Historic District and Old Faithful Inn. With contextual design best practices, this should be feasible.

There is ample space at this location for multiple buses, so if the three service scenarios (Express, Explorer, and Trekker) are operating concurrently, visitors also could have the opportunity to catch one of the other shuttles to see other places in the geyser basin corridor rather than returning immediately to West Yellowstone (or Madison Junction under the sub-option).

Numerous activities and attractions are available to visitors at the Old Faithful complex, including:

- Old Faithful Geyser
- Historic Old Faithful Inn (restaurant, ice cream, exhibits, etc.) and Old Faithful Historic District Walking Tour
- Old Faithful Visitor Education Center
- Old Faithful Lodge and Cabins and Old Faithful Snow Lodge accommodations
- Backcountry Office, Ranger Station, and Clinic
- Various eateries, general stores, gift shops, restrooms
- Haynes Photo Shop
- An extensive trails network and hydrothermal features throughout the Upper Geyser Basin that provides viewing access (Geyser Hill viewpoint and points north); walking, hiking, and bicycling trails;

Photos of the suggested location for a shuttle terminal and layover near Old Faithful Inn and the main path to the Old Faithful Geyser

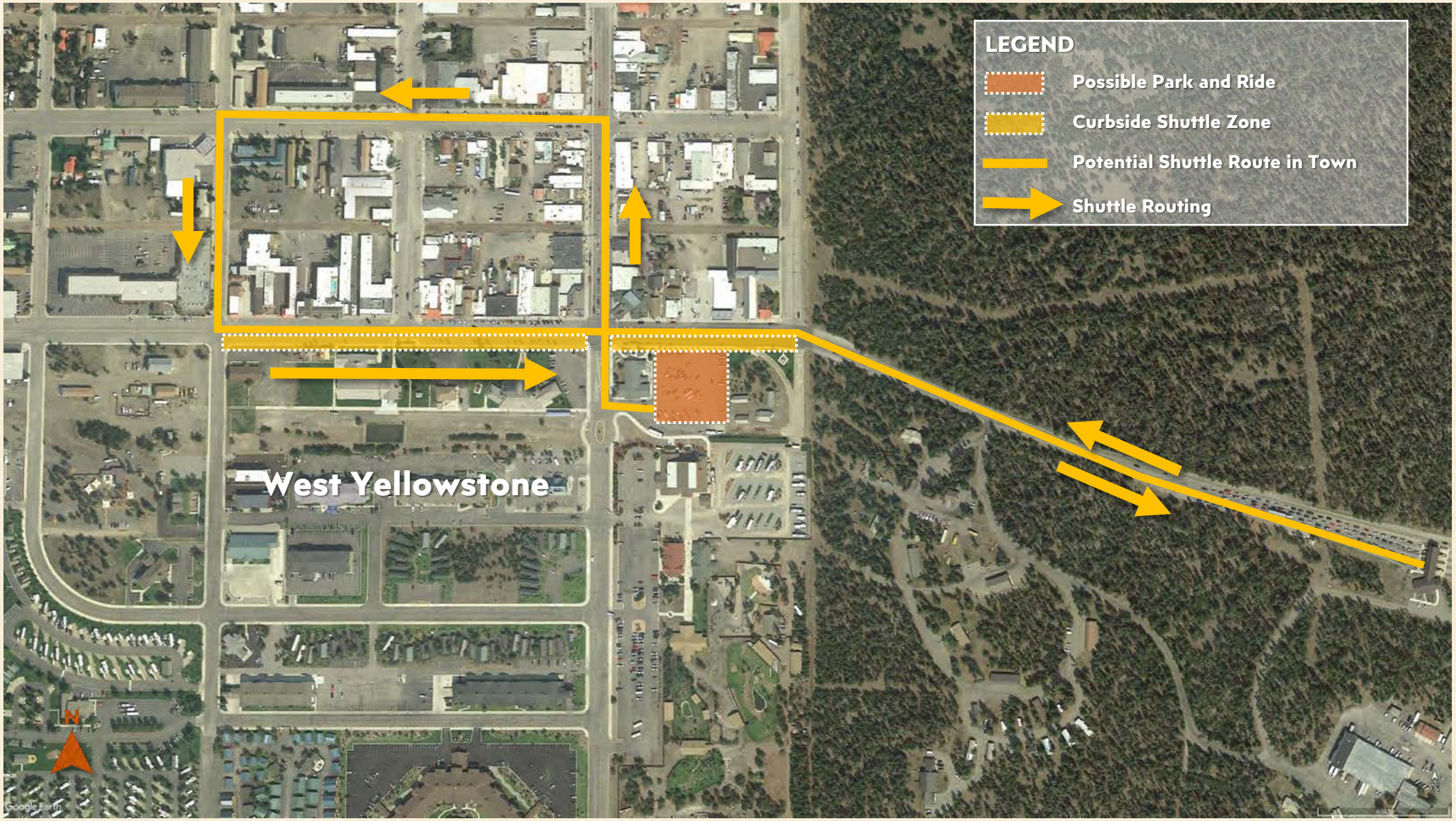


Figure 6.8—Conceptual Diagram for Shuttle Routing, Curbside Pick Up/Drop Off, and Park and Ride in West Yellowstone

(Base map source: Google Earth, 2021)

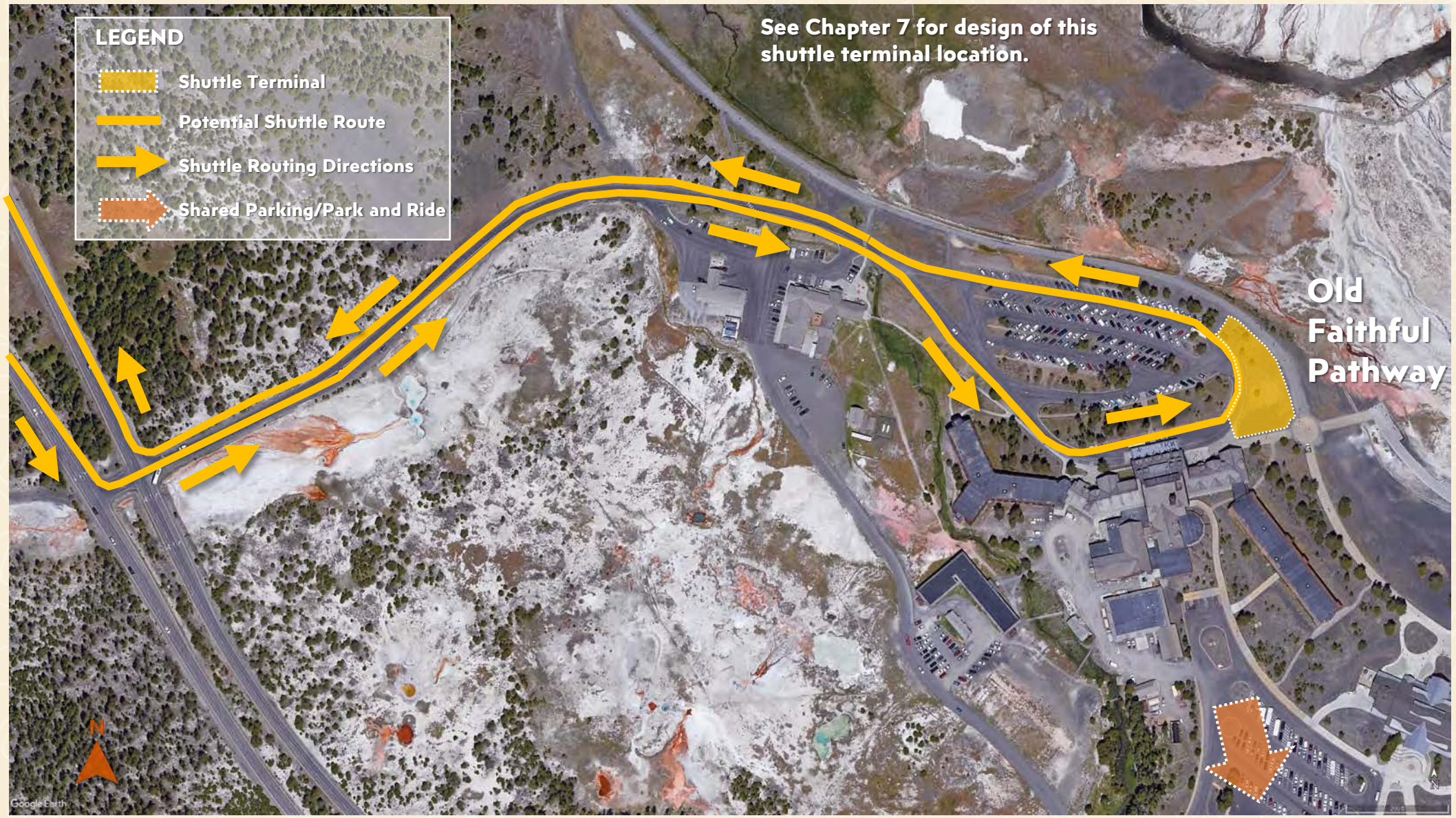


Figure 6.9—Conceptual Diagram for the Fastest and Most Convenient Shuttle Routing at Old Faithful

(Base map source: Google Earth, 2021)

- Old Faithful area trails extend to the Black Sand Basin (and Opalescent Pool and Rainbow Pool), Biscuit Basin (loop trail and the Mystic Falls Trail), and for those interested in journeying further, the Fairy Falls Trailhead, as well as the trail connections to Mallard Lake and Lone Star Geyser.

Geyser Basin Explorer Shuttle Service Scenario–The Geyser Basin Explorer shuttle scenario is conceptualized and analyzed to include seven stops for the West Yellowstone to Old Faithful route and eight stops for the Madison Junction to Old Faithful route sub-option. Refer to Tables 6.1 through 6.5 for information about proposed stop locations.

As with the Old Faithful Express scenario 10- and 20-minute headways were evaluated and ten-minute dwell timeframes at each intermediate stops and half hour layover timeframes at the two termini were assumed.

For the West Yellowstone to Old Faithful route, the five intermediate stops would occur at Madison Junction, Fountain Flat Drive, Fountain Paint Pot/Firehole Lake North, Midway Geyser Basin (which provides access to the Grand Prismatic Spring and the Fairy Falls Trailhead/Trail), and Biscuit Basin.

For the sub-option route, there could be six intermediate stops between Madison Junction and Old Faithful because the route is shorter. The analysis assumed these would be Firehole Canyon Drive, Fountain Flat Drive, Fountain Paint Pot/Firehole Lake North, Midway Geyser Basin, Biscuit Basin, and Lone Star Geyser (the shuttle would stay on the main road to serve the Lone Star stop, turnaround there and head to the Old Faithful terminal).

Experiences available in West Yellowstone and the Old Faithful area were described previously under the "Old Faithful Express" shuttle scenario. Following is a summary of activities and experiences available at the stops for the Geyser Basin Explorer service scenario. Refer to the description of "Other Unique Experiences" later in this chapter for potential shuttle options that provide access to Firehole Canyon Road, Firehole Lake Drive North and South/Loop Trail, and potential flag stops (such as the Mary Mountain West Trailhead, Whiskey Flats, and Mallard Creek Trailhead).

Madison Junction: The best location for a centralized stop in the Madison Junction area appears to be in the parking area near the amphitheater. There is ample space to retrofit the parking area in the already developed area and to provide shuttle stop space that could accommodate multiple vehicles at one time. Conceptual ideas for this shuttle stop location are shown in Figure 6.10..

Campers at the campground could reach this area via existing trails. Other features in this area include:

- Madison Information Station with park information and restrooms
- Yellowstone Forever Park Store
- Outdoor amphitheater with summer programs on topics such as astronomy, wildlife, and history; ranger-led programs such as photography workshops, Harlequin Lake Walk, and other activities; and Artist-In-Residence programs Trails from this area also provide access to the Madison River, but hikers must cross the river along the busy Grand Loop road to get to trails leading to Firehole Canyon Drive (for more about the Firehole Canyon Drive stop, refer to the West Trekker experience).

Firehole Canyon Drive: As described in Chapter 5, Firehole Canyon Drive is a unique loop drive experience via a two-mile, one-way road off the Grand Loop, just south of Madison Junction The narrow road follows the Firehole River canyon and provides access to Firehole Falls and a popular swimming area in the river. Firehole Falls drops 40 feet over the canyon walls, creating picturesque scenery. There is a small parking area near the falls and several small pull offs along the narrow road, but the area can get very congested on busy summer days. The swimming hole is extremely popular and also becomes crowded, with cars parked all along the sides of the road.

The shuttle could stop at a newly developed pull off area near the Firehole Canyon Drive intersection with the Grand Loop and drop visitors interested in hiking or bicycling the drive. It is possible that the Madison Junction to Old Faithful route sub-option could build in stops at both the north and south Firehole Canyon Drive access points, and then drop passengers off and pick them up at either end. See conceptual ideas for this location in Figures 6.11 and 6.12.

Fountain Flat Drive: Fountain Flat Drive is located about five and a half miles miles south of Madison Junction, in the vicinity of the confluence of Nez Perce Creek and the Firehole River, which is situated at the northern edge of the Lower Geyser Basin.

A great route for bicycling and hiking, Fountain Flat Drive is an old service road that remains open to cars for about a mile and then only to hiking and bicycling from that point south to where it connects with the Midway Geyser Basin area and the Fairy Falls trails network.

There are multiple options for shuttle service at this location as shown in Figures 6.13 and

6.14 The shuttle could come in and turn around at the existing turn-round ff the main road, which would have to be reconfigured to a circular turn-around (Option 1). Another option would be to retrofit nearby roadside pull-offs for transit use and connect these areas by trail with an enhanced pedestrian crossing of the Grand Loop Road (Option 2). A third option the shuttle could travel on Fountain Flat Drive all the way to the end of the road to the trailhead at the end. There is a turn-around at that area that the shuttle could use to return to the Grand Loop Road. Figures 6.14 for conceptual ideas for shuttle access here.

Activities in Fountain Flat Drive area include:

- Fishing in the Firehole River and nearby creeks is very popular here
- Picnicking at the Chief Joseph/Nez Perce picnic ground/wayside (circular turn around)
- Wildlife watching (bison roam the area, as well as other wild animals
- Ojo Caliente Hot Spring, Hygeia Spring, Maiden's Grave Spring, and other hydrothermal features along Firehole River and Nez Perce Creek
- Hiking and bicycling via the trail (old service road) that connects south to Midway GB/Fairy Falls

Fountain Paint Pot: The Fountain Paint Pot parking area has an entrance and exit, making it ideally suited as a shuttle stop. The shuttle could route through the parking area, but the best approach would be to reconfigure the parking area so there is an exclusive lane for transit, so buses won't get stuck behind other traffic and people circling to find parking. Conceptual ideas for this shuttle stop location are shown in Figure 6.15.

Experiences available in this area include:

- Accessible boardwalk trail to Lower Geyser Basin
- hydrothermal features (colorful mudpots, fumaroles, hot springs, and geysers in this area), bacterial and thermophile mats, Silex Spring, various pool
- Dead trees with white silicified bases ("bobby socks") that have become homes for tree swallows
- North exit point of Firehole Lake Drive is located across the Grand Loop Road from the Fountain Paint Pot parking area

Tree swallow in the Fountain Paint Pot Area
(Source: Frank, J.W., Wikipedia Commons, 2017)

Midway Geyser Basin/Grand Prismatic Spring/Fairy Falls Trail: The Midway Geyser Basin is one of the most heavily visited locations in the park as a result of the astounding beauty of the Grand Prismatic Spring and the Fairy Falls Trail access.

For this location, the existing parking area is a loop and dead ends, resulting in vehicles circulating looking for parking. This is not an optimal configuration for the shuttle to use as buses will get stuck behind circling traffic. A potential option that has been carefully studied in this project would be construction of an elongated "jug handle" shuttle pull off area (off the Grand Loop Road). See Figures 6.17 and 6.18 and a design diagrams and concepts in Chapter 7.

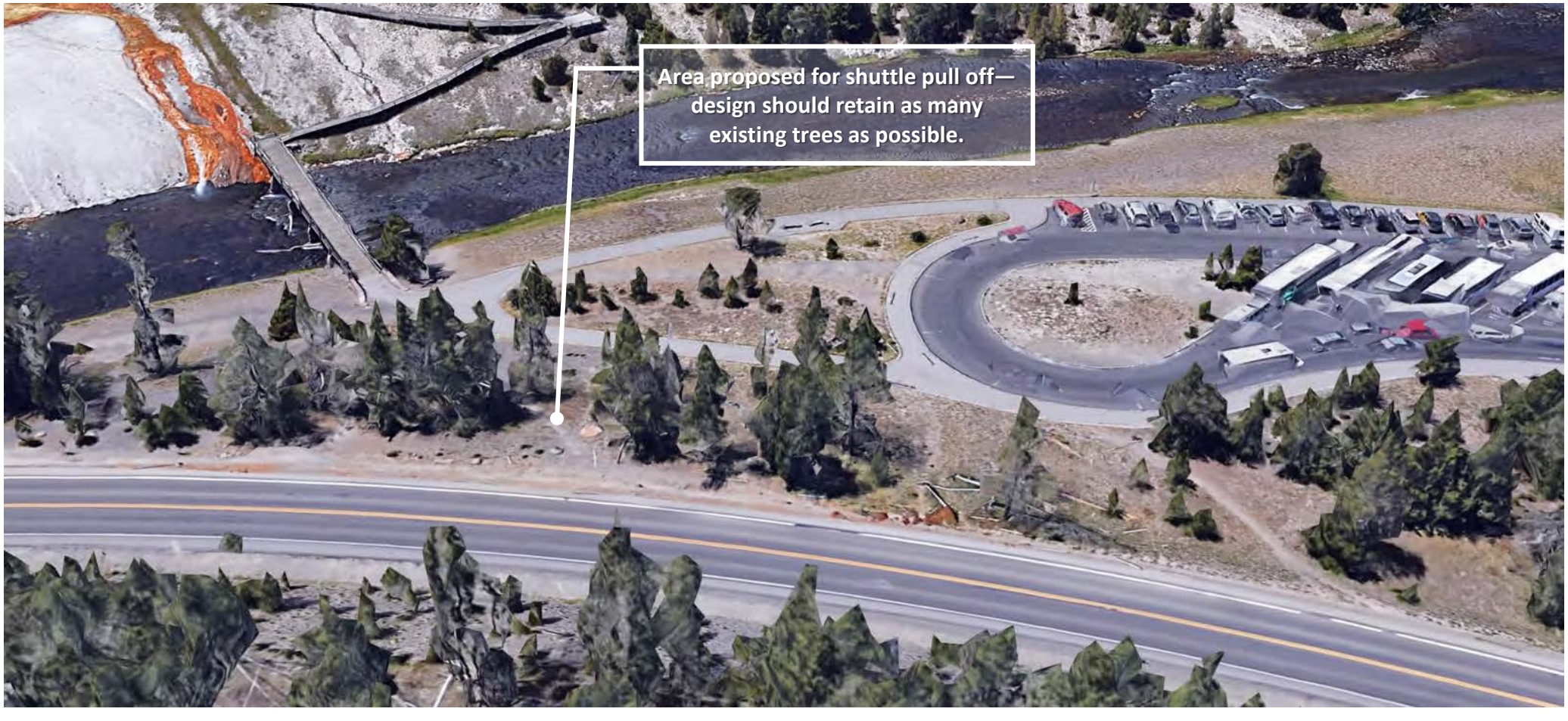
This new transit stop area would provide the advantage to shuttle riders of direct, convenient access to the Grand Prismatic trail/boardwalk system. Shuttles would be able to drop off and pick up passengers efficiently, without getting caught in the intense congestion in that area.

While the "jug handle' shuttle stop would be adding pavement to an area that is currently unpaved, the area is located in proximity to the development envelope of the Midway Geyser Basin parking area. Also with shuttle access, it is hoped that overflow parking could be reduced or eliminated along the Grand Loop Road, minimizing social trails in that vicinity. These areas could be revegetated and rehabilitated over time. The intent would be overall to achieve a net positive result, with reduced impacts to vegetation and soils. Existing trees in could be preserved within the island/buffer area of the jug handle pull off.

For more detail related to the jug handle shuttle stop design, see Chapter 7.

Experiences at the Midway Geyser Basin shuttle stop include the following:

- Grand Prismatic Spring—the world's third largest hydrothermal spring at more than 370 feet across and with vivid orange and red colors that melt into vibrant blues; a boardwalk encircles the spring and provides opportunities to view other features such as Turquoise Pool, Opal Pool, Indigo Spring, and Excelsior Geyser.



Bird's eye photo of the Midway Geyser Basin area and potential location of shuttle stop

(Source: Google Earth, 2021)

- Fairy Falls Trail/Fairy Creek Trail—provide paths to other geysers and water fall photo ops, as well as an elevated view from Midway Bluff of the Grand Prismatic
- Trails to points north (to Fountain Flat Drive) and south providing access to and visibility of other hydrothermal springs, geysers, and pools.

Fairy Falls Trailhead: The small circular parking lot here is carefully managed by the park because of its location in a sensitive hydrothermal area. One idea for this location would be to convert it to shuttle use only during the peak season (and then revert to visitor parking in other times).

Another possibility would be to remove all the current pavement and parking and build a nearby roadside pull off or jug handle shuttle stop with a connecting trail to the Fairy Falls Trail. This would reduce the amount of pavement the sensitive area, while still providing access to the high demand Fairy Falls Trail. See Figure 6.19 for these ideas.

Biscuit Basin: This area is accessible by trails from the Old Faithful area, and a shuttle stop located here (retrofitted into the existing parking area) would enable hikers and bicyclists to travel from the Old Faithful area to this location (about 2.5 miles from the Old Faithful visitor center) and get picked up by a southbound shuttle for a ride back to Old Faithful. This area is where the Firehole River meets the Little Firehole River and Iron Spring Creek. In addition to the features already mentioned, Black Opal Pool, Avoca Spring, Mustard Spring, Sapphire Pool, Shell Geyser, and Jewell Geyser can be viewed in this area. Conceptual ideas for this shuttle stop location are shown in Figure 6.20.

Lone Star Geyser: A cone type geyser located three miles southeast of Old Faithful Geyser and the Upper Geyser Basin. Visitors can follow a pleasant, partially paved trail along an old service road beside the Firehole River to the geyser. Lone Star Geyser erupts

Photo of suggested location for shuttle pull off at Midway Geyser Basin parking area

up to 45 feet from a 12-foot cone approximately every three hours. Multiple trailheads are available including one three and a half miles south of Old Faithful Overpass, and another just beyond Kepler Cascades Parking Lot. Visitors can access the Kepler Cascades Overlook from the Grand Loop Road in this vicinity. The Lone Star Geyser could be a shuttle stop integrated into any scenario, but the analysis of this study included it as a stop in the Madison Junction to Old Faithful route sub-option.

The best way to integrate this stop into the routing would be or the shuttles to continue on the Grand Loop Road past the Old Faithful off ramp a few miles southeast and then stop at the Kepler Cascades overlook parking and turn back northwest on the Grand Loop Road to the Old Faithful route described earlier. Old Faithful is the best terminal and layover location because of the facilities there.

Conceptual ideas for this shuttle stop location are shown in Figure 6.22.

Westside Trekker Service Scenario—The Westside Trekker shuttle scenario is envisioned as a hiker shuttle that could provide access to more sites than the Geyser Basin Explorer. Ten stops were assumed in the analysis, as well as the potential for flag stops. For the West Yellowstone to Old Faithful route, the additional three stops on this route include a Madison River wayside/trailhead location (could be Two Ribbons, Seven Mile Bridge, Harlequin Lake or others), Firehole Canyon Drive, Firehole Lake Drive (south access point).

For the Madison Junction to Old Faithful Trekker scenario, the additional stops include Firehole Canyon Drive, Firehole Lake Drive South, and Black Sand Basin.

The Trekker scenario not only would provide more access to hiking and fishing, it also would expand mountain biking and low speed side road bicycling access. These recreational opportunities could be especially nice for those who are visiting Yellowstone for longer durations.

Madison River Wayside/Trailhead:

There are a few different options where a shuttle could stop along the Madison River corridor after proceeding through the West Entrance to the park. Options include:

- Barns Hole Road—a graded road that can serve as a hiking or mountain biking path from the Grand Loop to the river and could be a good place for a shuttle flag stop.
- Two Ribbons Trailhead—connecting two pull off areas with access to and views of the Madison River, the Two Ribbons Trail is a short (0.6 mile) boardwalk loop interpretive trail. Various waterfowl, osprey, and bald eagles are commonly seen here. There are benches and places to sit and enjoy the scenery.
- Riverside Drive Access—a paved riverside access road that is enjoyable as a walking and bicycling path along the river. This path could potentially be extended along the river even further to enhance the hiking and bicycling experience (even if left unpaved). From review of conditions in the field, it appears the path could be extended all the way to Two Ribbons and maybe further.
- Other Madison River pull off areas—there are multiple existing pull off areas that have generous paved areas available that could function as shuttle pull offs. In a couple of locations where the river braids, there are excellent wildlife watching opportunities. The furthest east of these before Madison Junction is connected to the Harlequin Lake Trailhead, which provides a short hike (0.4 mile) to the lake at the foot of Purple Mountain. The peaceful trail is little used in an area of good habitat for birds, elk, beaver, and other wildlife.

Connected Walking and Bicycling Path along the Madison River: There are several existing pull offs, trails, and side loop drives off the West Entrance Road in the Madison River corridor. A longer-term idea would be to connect these up in the corridor to create a continuous walking and bicycling route that could extend from West Yellowstone to Madison Junction. Figure 6.23 diagrams this possibility.

While it is not known if this new visitor use activity would relieve any traffic pressure off the Geyer Basin Corridor, it would provide another form alternative transportation access into and out of the park's West Gate. Additionally, it would add an activity that could be enjoyed by everyone staying in West Yellowstone, including those staying for longer durations.

Firehole Lake Drive: A three-mile, one-way road (enter from south entrance) that can also be hiked or bicycled and provides access to many hydrothermal features: Great Fountain Geyser, the boardwalk around Firehole Lake, Firehole Spring, Surprise Pool, White Dome Geyser (erupts every 10 minutes), Pink Cone Geyser, Firehole Lake, Young Hopeful Geyser, Artesia Geyser, Steady Geyser, Black Warrior Lake, Hot Lake, and Hot Cascades.

The north exit point of the loop drive is located in close proximity to the Fountain Paint Pot parking area, and as such the shuttle stop could provide access to both sites. Improvements would be needed to enhance the safety of pedestrians crossing the Grand Loop Road here.

This drive presents a perfect opportunity to link with shuttle service and provide access to hikers and bicyclists interested in taking the loop drive through the landscape dotted with interesting geysers and hot springs. Further analysis and design is needed to determine if a shuttle stop/pull off area could be located near the south access intersection. If so, the shuttle could drop off hikers and bicyclists at the Fountain Paint Pot/north Firehole Lake Drive access point, and they could be picked up again at the south access area.

As noted above, this drive could be converted to hiking and bicycling (with no vehicle access), either during peak visitation or permanently. It is possible that the shuttle also could circulate the drive as an off Grand Loop Road shuttle experience. Further evaluations of timetables and routing could explore this. See Figure 6.16 for a conceptual diagram of this area.

From field work, it is clear that the pavement and improvements in this area are subject to extensive hydrothermal and geothermal expansion and contraction actions. The pavement is buckling and showing wear and tear in several locations. Perhaps by converting this to a narrower bicycling and hiking path, roadway maintenance efforts could be reduced in this vicinity.

Black Sand Basin: This access area includes trails that connect to other places in the Upper Geyser Basin, including the Old Faithful area. Stunning hydrothermal features are visible in this less-visited area of the geyser basin corridor (i.e. the parking lot is less utilized than other locations). The parking area could be converted to shuttle use as is, perhaps changing the loop area to one way only to create space for the shuttle while retaining visitor parking capacity. See Figure 6.21 for a conceptual diagram of this location.

Opalescent Pool at Black Sand Basin
(*Source: Salvagnin, Domenico., Wikipedia, 2008)*

Unique Experiences for Shuttle Riders and Supporting Services

In addition to the experiences at the shuttle stops described in this chapter, several opportunities that could be unique to shuttle riders are highlighted. These opportunities would further enhance visitors' experiences by offering activities not be readily available to other visitors. Having access to these opportunities likely would help to incentivize visitors to ride the shuttle, encouraging people to travel to the corridor via shuttle rather than by private vehicle. These opportunities could be promoted as part of the initiation stages of the shuttle service, including piloting to help encourage ridership.

Hiking and Bicycling Loops (Firehole Canyon Drive, Firehole Lake Drive, Madison River Corridor, and Other Locations)—As previously mentioned, tying in hiking and bicycling loops to shuttle stops could enhance visitor experience and encourage shuttle ridership. There are opportunities to connect sites in the geyser basins (such as from Old Faithful to Biscuit Basin and the Fairy Falls Trailhead). There may even be opportunities to create shuttle only access areas during summer—such as Firehole Canyon Drive and Firehole Lake Drive. These two one-way loop drives connect to the Grand Loop and become inundated with private automobiles during summer peak season. Visitor use management planning could evaluate the potential of closing these two drives to motor vehicle traffic during the summer and allowing only access by shuttle, hiking, and bicycling during that time. The shuttle could stop at either end of these drives to pick up visitors who've done the loop, or smaller shuttles could travel these loops and connect to the main shuttle.

Another example would be Riverside Drive and the longer-term idea of creating a connected pathway along the Madison River. These facilities could function as bicycling and hiking opportunities accessible to shuttle riders and other visitors. hiking loop connected by shuttle stops. There may even be opportunities to extend Riverside Drive as a trail along the river to further enhance this experience. Business opportunities for bicycle rentals in town would increase and there may be opportunities to tie in a bike sharing program in town with enhanced bicycling opportunities at key locations in Yellowstone.

People with disabilities who normally don't drive their own vehicle may have expanded opportunities at Yellowstone with shuttle linked accessible trail systems. For example, shuttles equipped with ramps for wheelchair users can pick up passengers in town and deliver them to sites that include accessible paths and trails (such as Old Faithful, Fountain Paint Pot and other locations.

One challenge for national park shuttle systems in gauging how much bicycle carrying capacity is needed and outfitting shuttle vehicles for sufficient carrying capacity. Some parks, such as Acadia and Zion, have created bicycle carrying trailers that the shuttles pull during peak bicycling periods of the summer. Corrals can be created with safe anchoring systems onboard shuttles to further expand bicycle carrying capacity.

Visitor Interpretation and Education as Part of the Transit/Shuttle Experience—Sight-seeing audio programs are a common experience on transit and shuttle systems in national parks. These presentations are often recordings that are offered between and upon approach to key destinations or sometimes even in-person talks given by an accompanying ranger on duty. These types of interpretive offerings clearly differentiate a national park shuttle or transit experience from that in a more urban area. Interpretive exhibits and educational information can also be displayed onboard the shuttle and at shuttle stops.

Interpretive programs offered only as part of the shuttle experience, exclusive to shuttle riders, could be another strategy for encouraging shuttle ridership. Programs could be themed for different routes and vehicles. For example, the Geyser Basin Explorer route could include extensive interpretation about hydrothermal features and the park's natural history. Or some buses could be themed to wildlife at the park and include special branding, illustrations, and interpretive exhibits about those species onboard.

At Yellowstone, integrating interpretation as part of the transit experience through recordings, illustrations, and other media conveyed to visitors would provide many benefits:

- Building awareness of precious and sensitive aspects of the Greater Yellowstone Ecosystem and inspiring a sense of the importance of stewardship and conservation with visitors;
- Providing the best education possible about avoiding negative impacts to wildlife and natural and cultural resources;

Interpretive wayside in the Roosevelt area of Yellowstone National Park
(Source: NPS, 2021)

- Helping to direct visitors to hiking and bicycling loops to further enhance their visit;
- Providing important information about shuttle operation timelines; and perhaps most importantly;
- Offering interpretation that aligns with the park's identified interpretive themes; and
- Offering educational messages to visitors that help to encourage distancing from hydrothermal features and wildlife and proper behavior on boardwalks and trails.

Interpretive themes are an organizational tool that reveal and clarify meaning, concepts, contexts, and values represented by park resources. Themes should accurately reflect current scholarship and science and encourage exploration of the context where natural processes occur and the effects of these processes.

Themes help to explain why the park's stories are relevant to humans and our world and help to enlighten visitors about connections they may have to an event, time, or place in the park.

An important objective across the national parks is the opportunity to build shared experiences and shared memories of places through interpretation. This is particularly important in a place like Yellowstone, where generations of visitors return time after time and adult visitors may remember a time they previously visited with their parents or grandparents

Information onboard shuttles and at shuttle stops provides another opportunity to reinforce key safety messages and rules for visiting, such as those in the box to the right. With the millions of visitors coming to the park each year, problems with visitors walking off Boardwalks trails, falling into hydrothermal pools, getting too close to wildlife, and even littering are unfortunately too common. Each year, some visitors have either been injured or have died as a result of not following these important rules. Repeating these messages in a respectful way is important, and this can be done as part of the audio program and displays onboard shuttles, as well as in tastefully designed displays at shuttle stops. Special programs conveyed onboard and through interpretation and information at shuttle stops could be focused on safe behavior around hydrothermal features and safe distancing while watching wildlife in the park.

SAFELY EXPLORING THERMAL BASINS

Boardwalks and trails protect you and delicate thermal formations. Water in hot springs can cause severe or fatal burns, and scalding water underlies most of the thin, breakable crust around hot springs.

- Always walk on boardwalks and designated trails. Keep children close and do not let them run on boardwalks.
- Do not touch thermal features or runoff.
- Swimming or soaking in hot springs is prohibited. More than 20 people have died from burns suffered after they entered or fell into Yellowstone's hot springs.
- Pets are prohibited in thermal areas.
- Do not throw objects into hot springs or other hydrothermal features.
- Toxic gases may accumulate to dangerous levels in some hydrothermal areas. If you begin to feel sick while exploring one of our geyser basins, leave the area immediately.

(Source: NPS, Yellowstone National Park, 2018-2021f)

Consideration for the large volume of non-English speaking, international visitors is important. Conveying the most important information in multiple languages and with illustrations and universally recognized icons will help to reach a broad audience. Audio programs provide the advantage of being able to convey messages in multiple languages more quickly through recordings. Recordings can be offered enroute, between sites and features, as well as when riders are preparing to disembark.

Audio programs onboard shuttles also offer the opportunity to point out historical facts, landmarks, geographic names, and other information in the conventions used and preferred by the NPS. People always wonder why certain features have been named the names called out in maps and signs. This information can be quickly conveyed as part of audio recordings, enriching visitors' experiences even more, because when they travel on their own, they may not have the benefit of understanding the particular history or geography of a certain place or landmark (such as Mount Haynes, Madison River, National Park Mountain, Nez Perce Creek, Chief Joseph Picnic Area, Mary Mountain, etc.).

Connecting and Special Use Shuttle Services, Bicycle Trailers, Flag Stops, and Final Evening Pick Up Runs

—Similarly to the service provided at Acadia National Park, a few smaller size shuttles (vans, cutaways or other vehicle types) could be included in the fleet for special purposes—either as part of the initial service or added in later years. These special use vehicles could serve on-demand needs, provide transport for research and special interest groups, operate for emergency pick-ups, and support other purposes. At Acadia, these vehicles also pull trailers of a large quantity of visitors' bicycles to key locations.

One challenge for national park shuttle systems in gauging how much bicycle carrying capacity is needed and outfitting shuttle vehicles for sufficient carrying capacity. For this reason, parks such as Acadia and Zion provide the bicycle carrying trailers to help serve the peak bicycling periods of the summer. Corrals can be created with safe anchoring systems onboard shuttles to further expand bicycle carrying capacity. Typically, for high-capacity shuttles running on set timetables, some parks avoid the carrying racks on the fronts (or sometimes backs) of buses because these take time to load and unload. For example, the Yosemite Valley shuttle buses do not have these racks.

Where urban transit systems are bound to efficiency and schedules, shuttle systems in national parks can often adopt more informal policies. These transit systems are there for the benefit of park riders—to enhance their visit and serve their needs. As such, sometimes national park shuttles will adopt a "flag stop" policy of picking up visitors and hikers when they are present from informal stops that are not part of their regular itinerary (at Yellowstone, this could include picking up hikers at various trailheads such as Mary Mountain West or fisherpersons along Fountain Flat Drive).

This policy can expand the usefulness of the shuttle system and further encourage ridership, and should be considered for the Yellowstone system, as long as the stops can be safely accessed with safe visitor boarding/alighting and the flag stop service doesn't create long delays in the shuttle schedule.

Visitor use management planning could evaluate the potential of closing these two drives to motor vehicle traffic during the summer and allowing only access by shuttle, hiking, and bicycling during that time. The shuttle could stop at either end of these drives to pick up visitors who've done the loop, or smaller shuttles could travel these loops and connect to the main shuttle.

Flag stops or on demand services could provide visitor access to specific locations in the park that are not on the main shuttle route(s). For example, if Madison to Old Faithful is selected as the first phase shuttle route, on demand service could take people to key locations from the one of the two shuttle terminals (Madison or Old Faithful) From Madison, an on demand service could take visitors so sites along the Madison River (such as for bicycling along Riverside Drive).

Business opportunities for bicycle rentals in town would increase and there may be opportunities to tie in a bike sharing program in town with enhanced bicycling opportunities at key locations in Yellowstone.

People with disabilities who normally don't drive their own vehicle may have expanded opportunities at Yellowstone with shuttle linked accessible trail systems. For example, shuttles equipped with ramps for wheelchair users can pick up passengers in town and deliver them to sites that include accessible paths and trails (such as Old Faithful, Fountain Paint Pot, and other locations.

Another concern at national parks is what happens if visitors miss the last bus out of the park for the day/evening? For this reason, national parks shuttle operators and dispatch can record details of visitors dropped off at key locations (such as hiking trails in remote areas) and track if visitors have not returned.

Another commonplace action is to run a final sweep (outside of the normal bus schedule) to check if any stragglers are waiting at shuttle

stops to be picked up. For example, if the last pick up was scheduled at 7:00 p.m., the park might run an 8:30 p.m. bus through the route to double check that no visitors are left behind. These last sweeps could even be handled by the smaller vehicles since there would be fewer passengers to pick up on these final runs.

Last runs sweeps also could support visitors who want to get reservations for dinner at Old Faithful, and then head back to the Madison campground later in the evening.

These special services, including on demand service could be incorporated into the shuttle contract or service agreement.

Visitors watching wildlife onboard the Denali National Park shuttle in Alaska

(Source: William Mullins/Alamy stock photo, 1987)

Visitors at Old Faithful

(Source: Vlad Turchenko/Shutterstock.com, n.d.)

A few smaller-size vans or cutaway shuttles could be added to the fleet to support special services and on demand needs in the park. These vehicles might serve transport for research or special interest groups, emergency pick-ups, hiker shuttles, and other types of programs.

Figure 6.10—Conceptual Diagram for a Shuttle Terminal in the Madison Area of the Park

(Base map source: Google Earth, 2021)

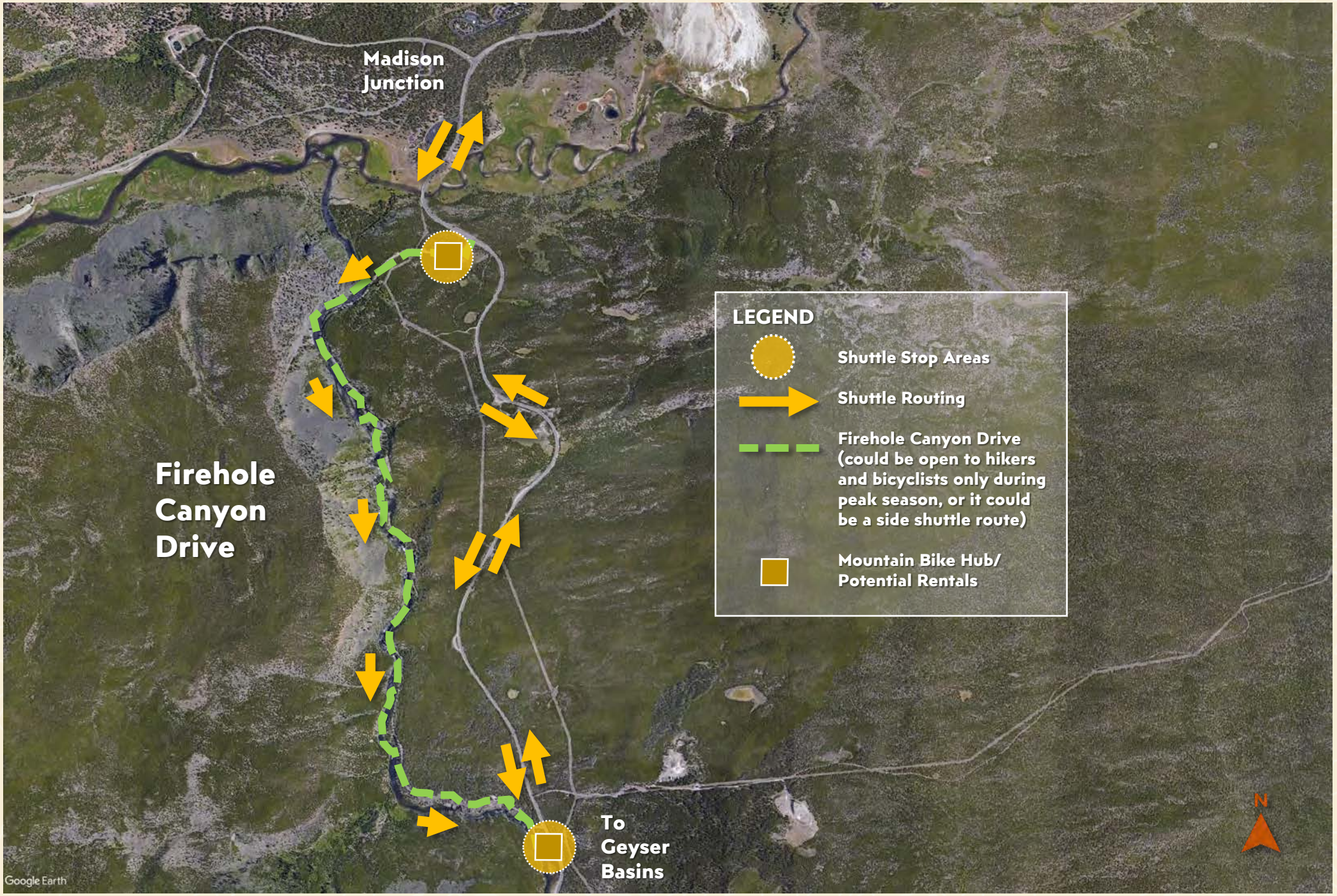


Figure 6.11—Conceptual Diagram for Firehole Canyon Drive

(Base map source: Google Earth, 2021)

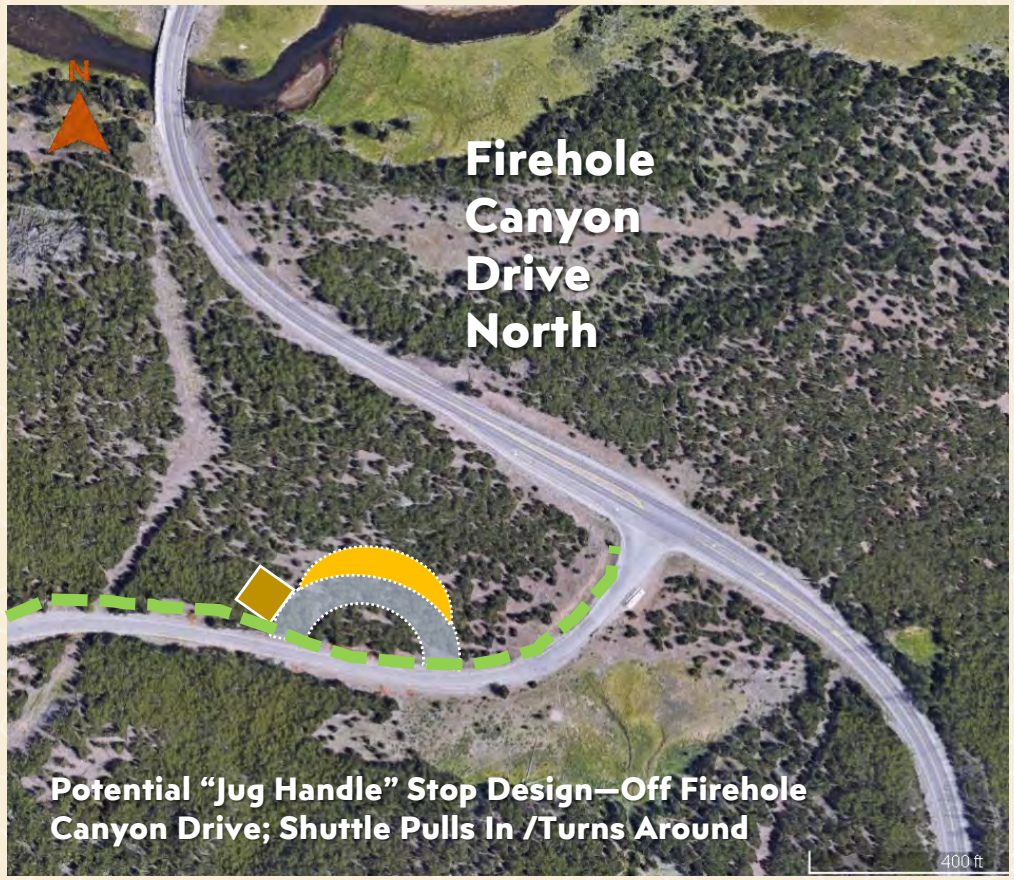


Figure 6.12—More Detailed Conceptual Diagrams for Firehole Canyon Drive North and South Access Areas

(Base map source: Google Earth, 2021)

Figure 6.13—Conceptual Diagram for the Fountain Flat Drive Access Area

(Base map source: Google Earth, 2021)

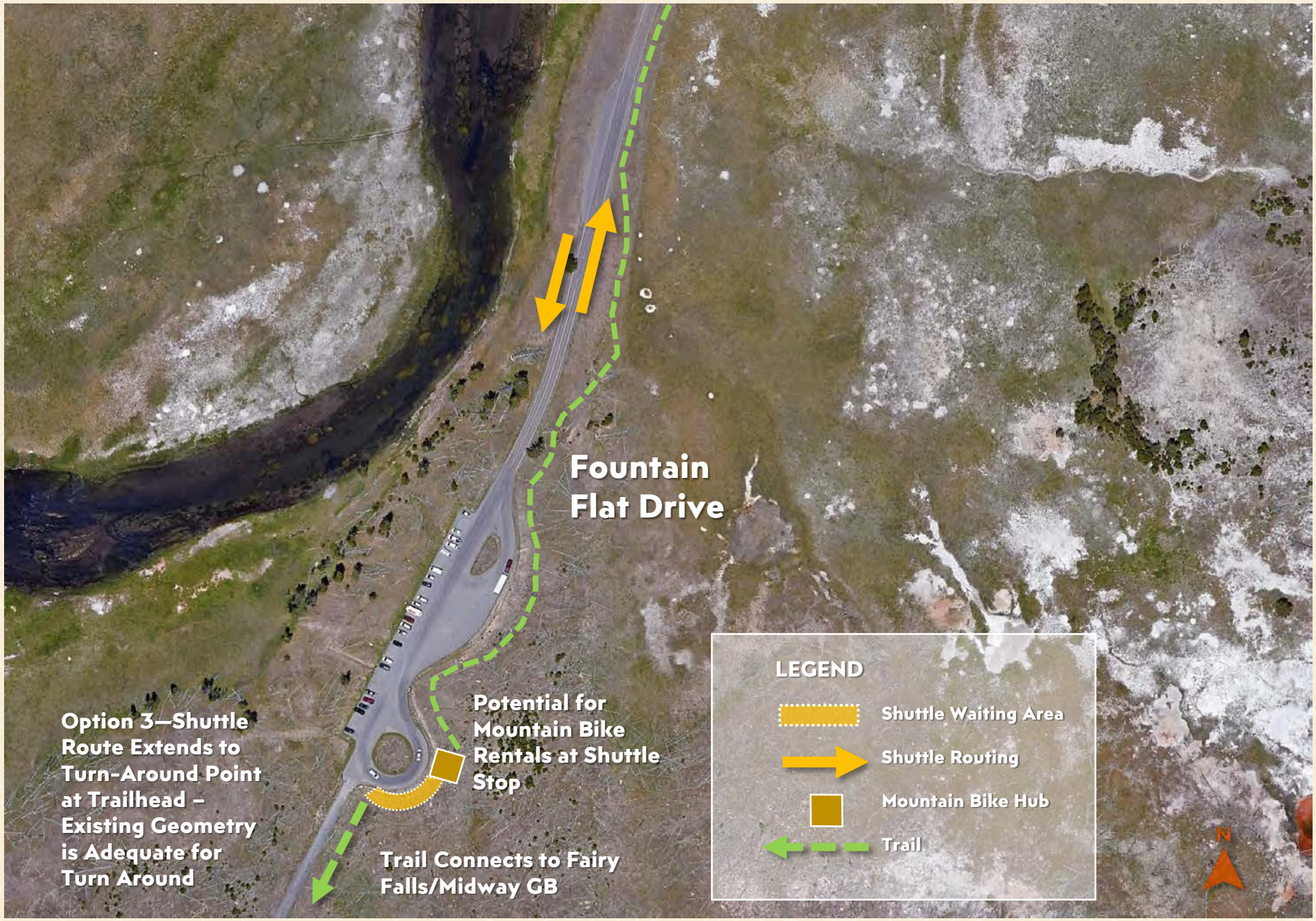


Figure 6.14—Conceptual Diagram for the End of Fountain Flat Drive/Trailhead Vicinity

(Base map source: Google Earth, 2021)

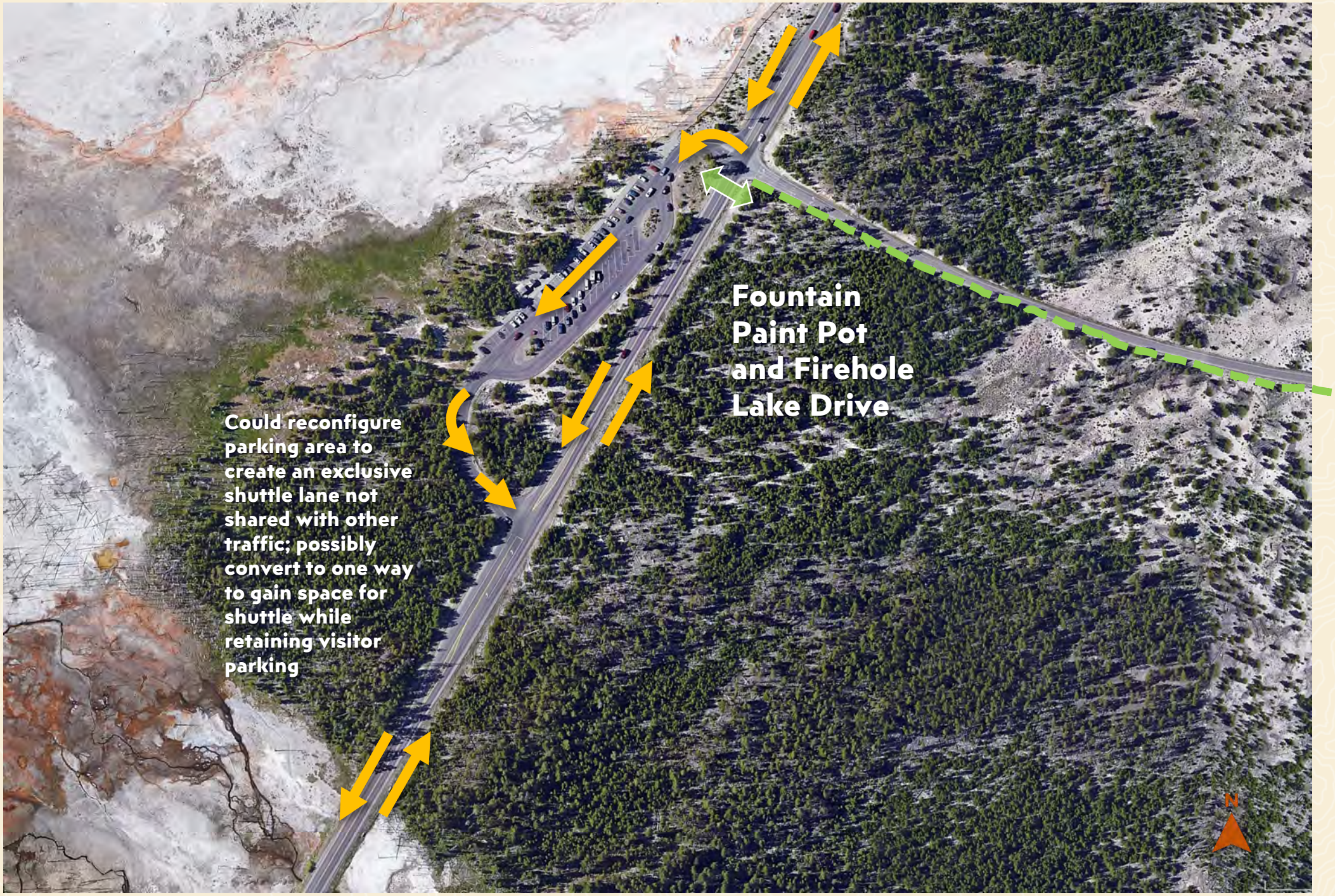


Figure 6.15—Conceptual Diagram for the Fountain Paint Pot and Firehole Lake Drive (North) Access Area

(Base map source: Google Earth, 2021)

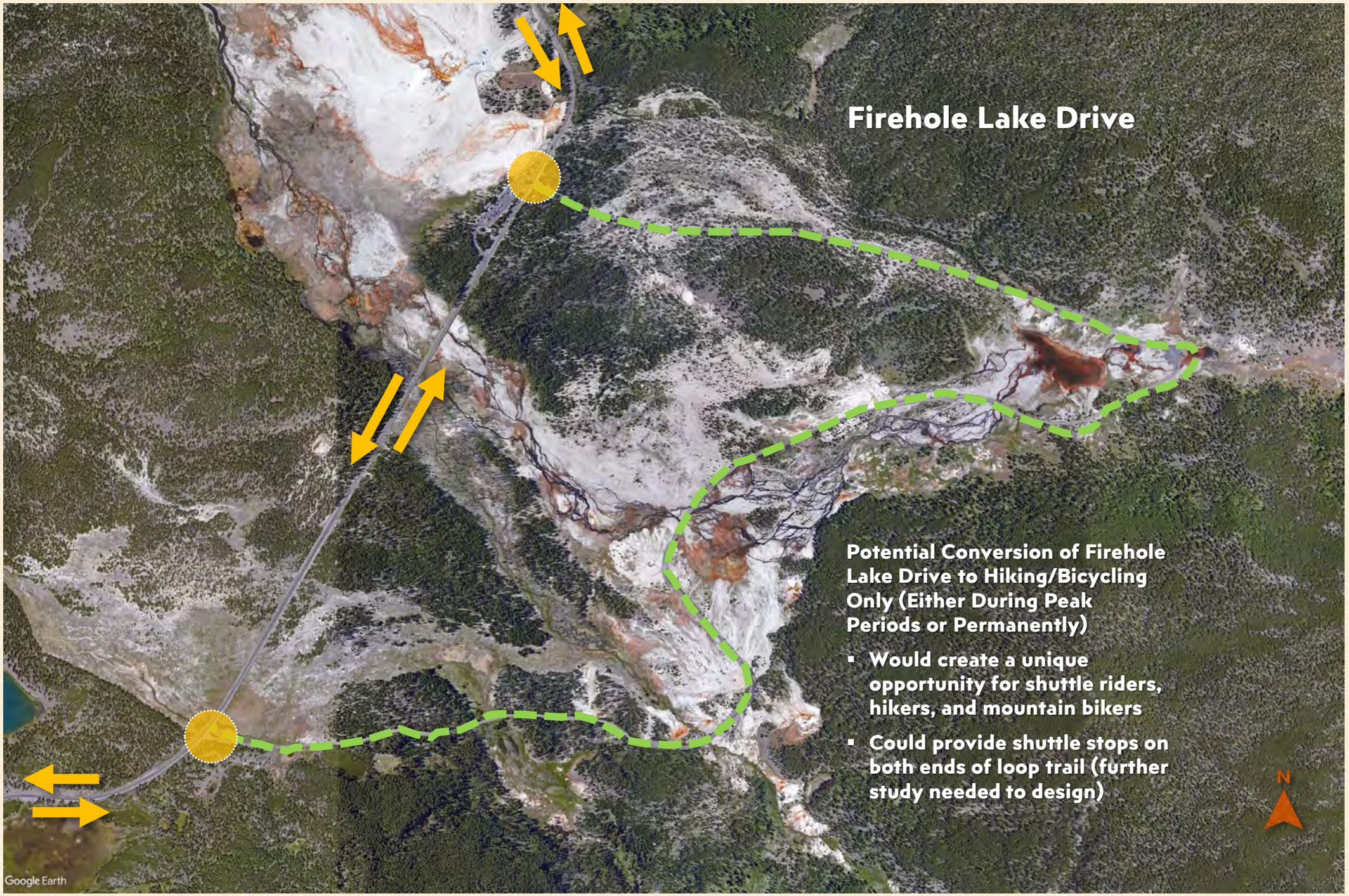


Figure 6.16—Conceptual Diagram for Firehole Lake Drive

(Base map source: Google Earth, 2021)

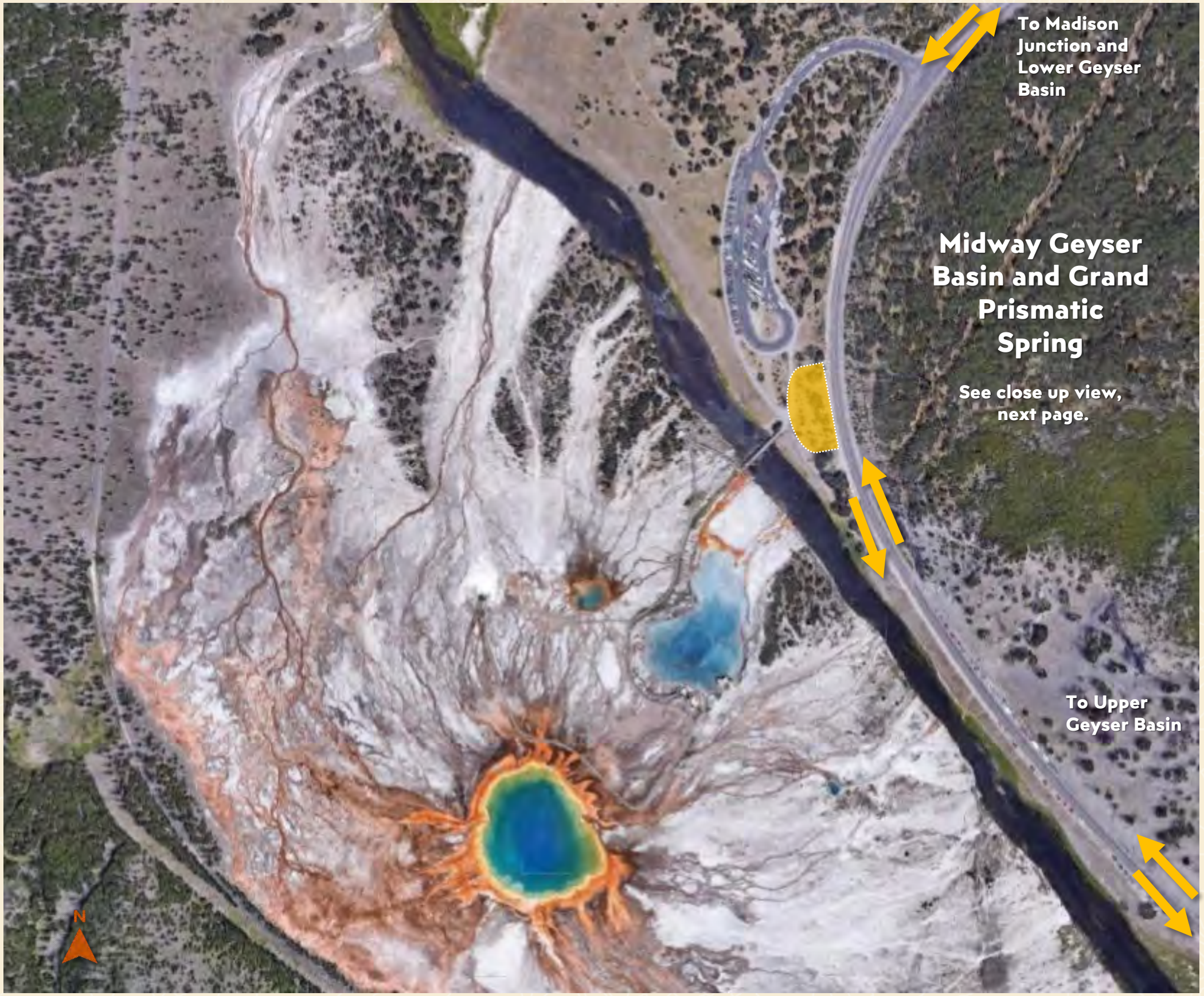


Figure 6.17—Midway Geyser and Grand Prismatic Spring Access Area, See Next Page for Detailed View *(Base map source: Google Earth, 2021)*

Figure 6.18—Conceptual Diagram for the Midway Geyser Basin/Grand Prismatic Spring Access Area

(Base map source: Google Earth, 2021)

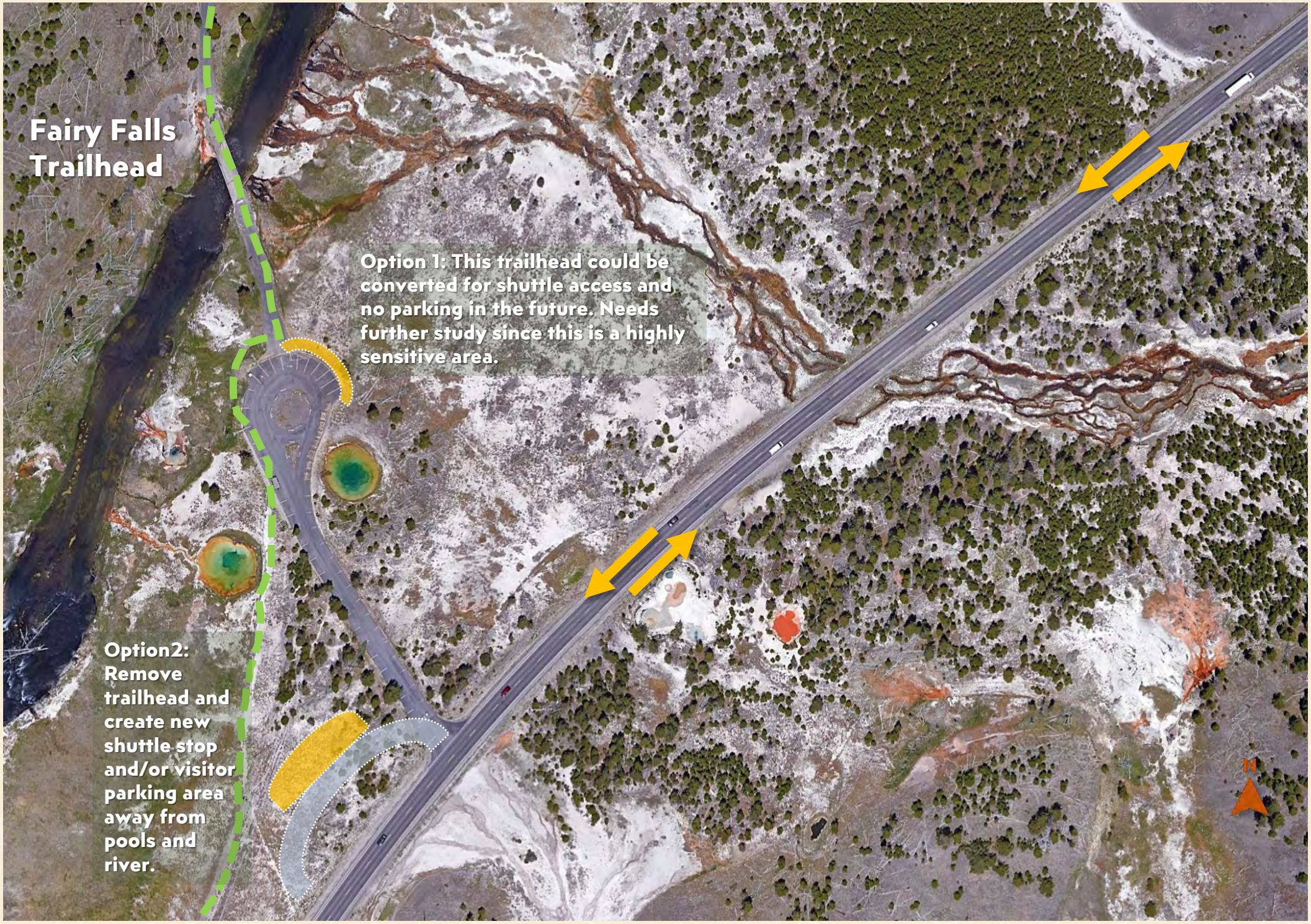


Figure 6.19—Conceptual Diagram for the Fairy Falls Trailhead Area

(Base map source: Google Earth, 2021)

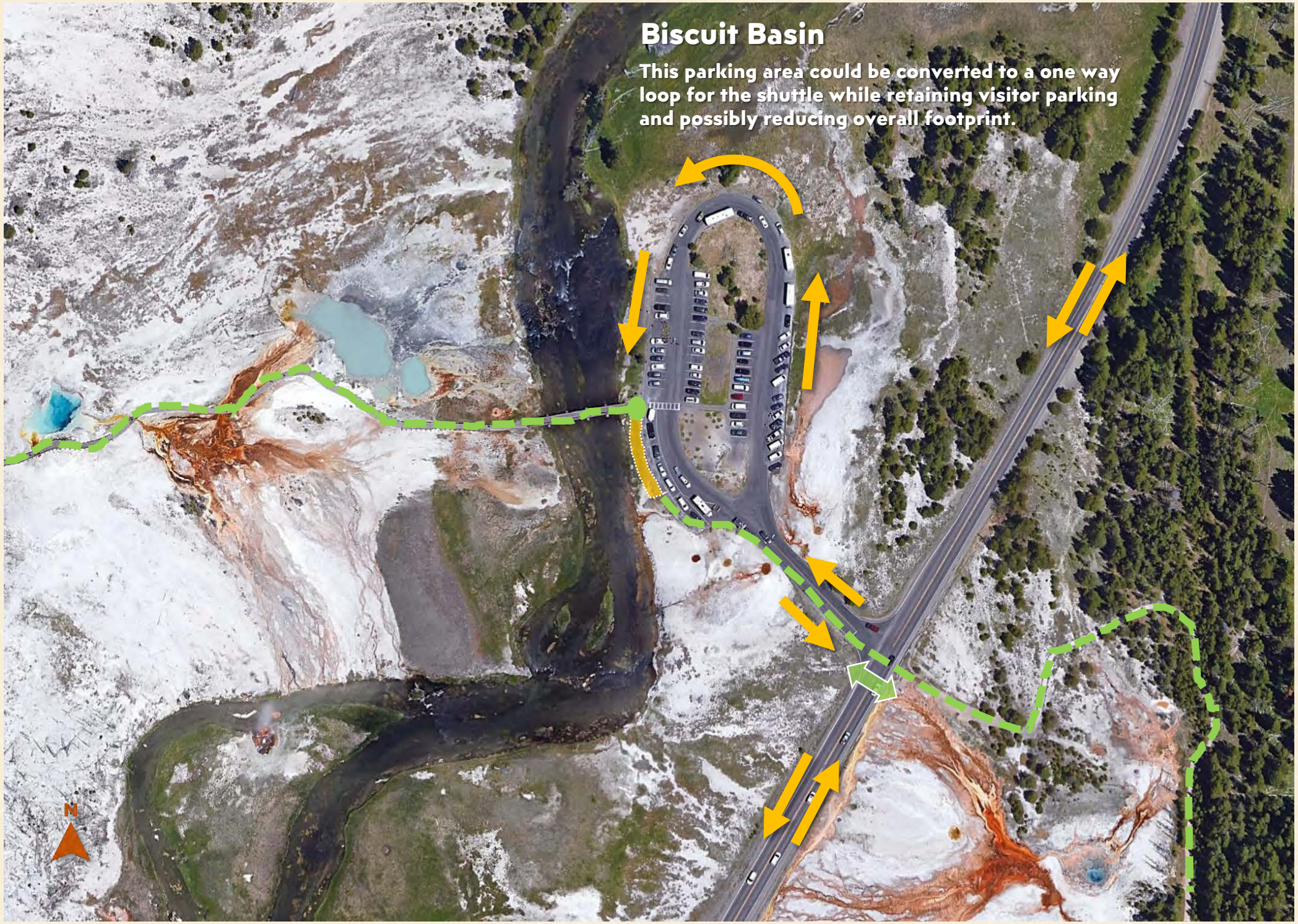


Figure 6.20—Conceptual Diagram for the Biscuit Basin Access Area

(Base map source: Google Earth, 2021)

Figure 6.21—Conceptual Diagram for the Black Sand Basin Access Area

(Base map source: Google Earth, 2021)

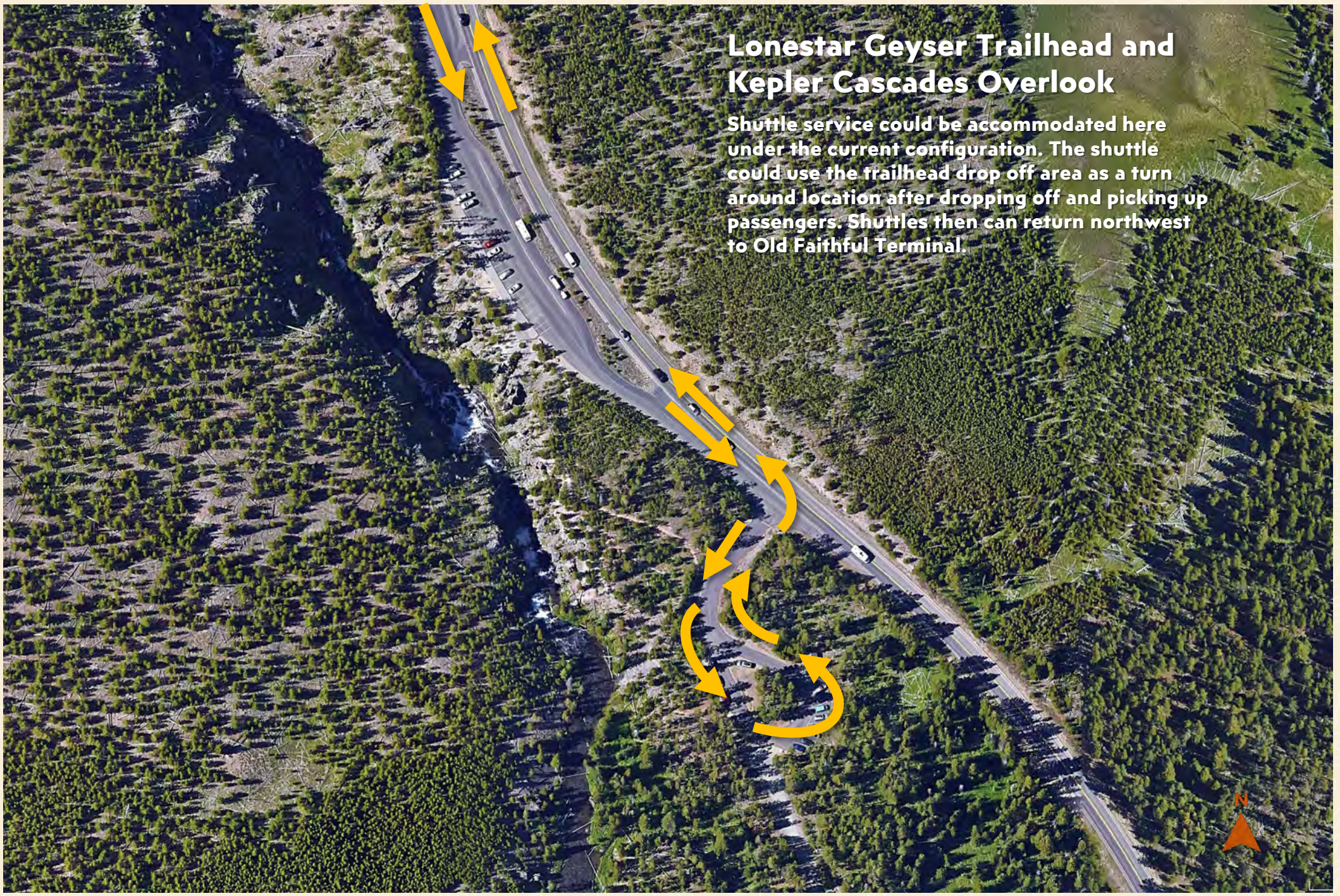


Figure 6.22—Conceptual Diagram for the Lone Star Geyser Trailhead/Kepler Cascades Overlook Area

(Base map source: Google Earth, 2021)

Figure 6.23—Conceptual Diagram for Creating a Connected Pathway Between the Overlooks and Drives in the Madison River Corridor

(Base map source: Google Earth, 2021)

Other Places in the Park Not Studied that Could be Served by Shuttle

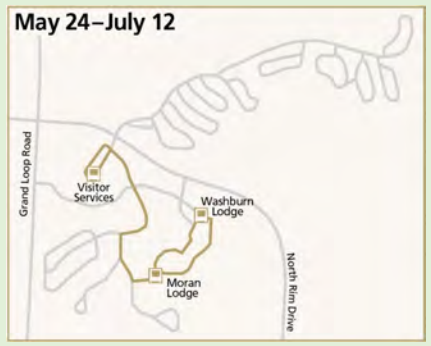
The shuttle routing studies of this project did not include some other heavily visited in the park that could be served by shuttle—either through a link to the scenarios studied in this project or through separate systems. As with the scenarios studied in these projects, these shuttle service opportunities would need to be further analyzed to determine feasibility for implementation. These include:

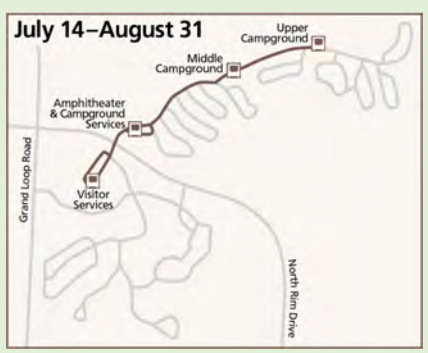
- ***Norris Geyser Basin*** —Just to the north of Madison Junction – this geyser basin could be connected to the shuttle corridor to the south through frequently running smaller buses, or this could be retained as a vehicle access only geyser area (no shuttle service).
- **Grand Canyon of the Yellowstone Area**—The park is interested in the potential for shuttle service in this area, which is a fairly compact visitor use area with a loop drive (North Rim Drive) that circles around to some of the viewpoints and overlooks along the canyon rim (Lookout Point, Grand View, Inspiration Point) and back to the lodging area and village. This creates an ideal dynamic for a looping shuttle system. The park is working with USDOT to pilot a small electric shuttle service in the Canyon area this summer (2021). See information at right.
- **Other Potential Shuttle Linkages**—There are a number of other potential places that could be linked by shuttle (whether hiker shuttles or general service). For example, service to West Thumb and Grant Village, west of Old Faithful could be provided, then linking with the Yellowstone area. These opportunities could be explored with further study or may arise once a first phase of the shuttle becomes operational.

Testing Driverless Electric Shuttles at the Grand Canyon Area of Yellowstone

As this master's project is being completed, Yellowstone National Park has announced an exciting new pilot program that will test autonomous electric shuttles in the Canyon area of the park. Nicknamed "T.E.D.D.Y"—The Electric Driverless Demonstration in Yellowstone will experiment with the emerging automated vehicle technology to learn about how this form of shuttling could potentially operate in the national park context. While the pilot program is intended for the purposes of testing this type of shuttle in national parks in general and not specifically for use in Yellowstone. the outcomes from this pilot will be informative to future analysis of shuttling options at the park (NPS, 2021).

The official launch of the pilot program is planned for May 24, 2021. The shuttle will extend through August, running on limited routes around Canyon Village and connecting lodging, campground, and visitor services areas. The shuttle will provide access to sites along the Canyon Rim Road (see maps below). The low-speed vehicles by Beep, Inc. can navigate on their own and stop for pedestrians, but during the pilot there will be an operator on board to monitor operations and take control if needed. Park representatives have stated that Yellowstone an the NPS are proactively engaging with emerging transportation technologies to test, pilot, and learn as a tool to reduce traffic and parking congestion while enhancing visitor experience. The pilot program is being implemented in consultation with the NPS Park Planning, Facilities, and Lands Directorate and the USDOT (NPS, 2021e).





The first two shuttles were recently delivered to the park, sporting graphic templates reflective of the Yellowstone context. Proposed routing plans are shown in the maps at left.

(Source: NPS, 2021e; photograph:my1035.com, 2021)

Avoiding Extra Costs to Visitors and Pricing and Discount Incentives

The NPS has explored different shuttle funding and payment options with varying levels of success. If visitors are required to pay an additional fee for the shuttle in addition to the park entrance fee, this can deter and discourage use of the shuttle. The most successful shuttle systems in national parks include the cost of the shuttle as part of the park entrance fee and not in addition to it. In this way, the shuttle service is perceived as one of the benefits of visiting the national park. Similarly, other parks have found that it is not advisable to charge a separate parking fee at park and ride locations, as this also deters shuttle use. It is best to package costs associated with the shuttle service into the structure of the entrance fee.

As an incentive to encourage use of the shuttle, which may be particularly helpful in the early period after the system is introduced to promote its use, the NPS could consider discounting the park entrance fee for shuttle riders only and evaluate financial structures to support this while still covering the operational costs of the system. Other types of discounts and incentives could be implemented in partnership with partners and business entities (Yellowstone Forever, Town of West Yellowstone, or others). For example, maybe shuttle riders could receive coupons for free or discounted meals in town or at Old Faithful or tickets to other adventures in town (Grizzly & Wolf Discovery Center, Giant Screen Theater, etc.). Or maybe shuttle riders get some free "swag" in the early days of the shuttle operations—such as water bottles or t-shirts, "I rode the Geyser Basin Explorer at Yellowstone." These products can serve double duty in promoting/advertising the shuttle system and incentivizing its use.

Shuttle Vehicles and Fuel System Options

A diversity of types of transit vehicles are operated in national parks, and a variety of possibilities were assessed for potential operation at Yellowstone as part of the case studies work of this project. Vehicle types also were evaluated related to ease of operations and maintenance and the opportunities they provide for visitors such as sight-seeing (seat and window orientation), quick access on and off, and carrying space for bicycles and gear. Finally, the overall size of the vehicle in scale with the park setting, roadways, and parking areas, as well as return on investment related to visitor carrying capacity per operational miles traveled and vehicle lifecycle also were considered (NPS, 2019).

Very large tour coaches (above 40 feet in length) were considered but dismissed because they would take up a lot of space in parking areas and at shuttle drop-off/pick-up zones. Even though these vehicles carry more passengers, they are not as easy for passengers to hop on and off, and they also require more space for staging and maintenance. In addition, they seem out of scale with the scenic qualities of the park—visually distracting from the surroundings.

As such, more of a typical transit bus, either heavy-duty shuttle buses, 40 feet in length, or medium duty shuttle buses, 35 feet or 30 feet in length, would be recommended for Yellowstone. For the operational and capacity modelling completed as part of this project, 40-foot-long buses with a capacity for 42 seated passengers were assumed.

Refer to Table 6.5 for the number of passengers typically carried by various types of shuttle vehicles, capital costs, and life span.

In addition to carrying seated passengers, shuttles also carry standing passengers (but only seated capacity was assumed in this project's analysis). Shuttles in national parks also can be equipped with special features to accommodate visitor needs, such as spaces for passengers in wheelchairs, gear storage, larger windows for sight seeing, open air tops for air circulation, and other features). Examples of where this has occurred in other national parks include Rocky Mountain, Acadia, Zion, and other locations.

Once a shuttle system is operational, with service facilities including a maintenance and operations base, stops, employee/driver pool, and other functions, it becomes more practical to add other types of service linked to the main shuttle service, and this may require the need for a variety of vehicle sizes as previously discussed in this chapter.

Several parks have piloted alternative propulsion vehicles, including Zion National Park, which looked at converting a portion of its fleet to fully electric-powered buses. Regarding fuel/propulsion assumptions, a review of transit systems in other national parks and the NPS transit inventory indicates that the agency has been modernizing its fleets in several parks. For example, at Yosemite, older diesel-only buses have been replaced by hybrid electric-diesel buses (built by the Gillig Corporation), making its fleet the first all-hybrid in the US.

The NPS estimated that with this replacement, particulate matter emissions were cut by 90 percent (along with a 60 percent reduction in nitrogen oxide emissions) and fuel efficiency increased anywhere from 20 to 55 percent depending on the route (Edmunds, 2021).

The hybrid electric-diesel buses also operate more quietly than the former diesel only buses and with no detectable diesel fumes. The buses

have a comfortable air suspension system adjustable to provide a lower entry point for riders, panoramic light-sensitive windows, and a GPS navigation system that lets passengers know exactly where they are. Through a regenerative braking system, the vehicles are able to recapture energy when coasting downhill or breaking and store it in the battery for use by the electric motor, adding even more fuel efficiency.

Hybrid electric-diesel buses currently operate in many national park settings and seem to be a preferred option for the benefits described in the Yosemite system, above. Given the relatively moderate terrain of the corridor studied at Yellowstone, hybrid electric-diesel buses should be able to operate efficiently. A full electric bus fleet likely would not be feasible given the length of the routes and anticipated service durations. The time intervals needed for recharging the buses would severely affect the efficiency and cost of service. That said, propulsion technology is constantly evolving and improving. As part of a future transit service feasibility study for Yellowstone, it is recommended that fuel and propulsion options be examined in more detail.

As shown in Table 6.5, the average life space for shuttles is The average life span for shuttles and buses is 15 to 18 years, but some agencies have been able to extend vehicle life through rigorous routine maintenance and indoor storage during the winter. Traditional diesel-powered buses have about the same life expectancy as hybrid diesel-electric buses.

While hybrid diesel-electric buses have an upfront higher capital cost, they achieve better fuel economy, which results in a lower overall life cycle cost of the vehicles. The Environmental Protection Agency (EPA) reports that traditional diesel-powered buses get about 3.6 miles to the gallon, while hybrid diesel-electric vehicles get about 5.1 miles to the gallon, with miles per gallon improving with each new generation of vehicles. This is about a 30 percent average less cost on an ongoing basis for fuel. Battery maintenance and replacement with Hybrid buses is another important consideration that adds cost to the life cycle. Hybrid buses also produce less pollutants and greenhouse gas emissions as addressed on the next page (EPA, 2021).

Table 6.5 Shuttle and Transit Vehicle Characteristics

VEHICLE TYPE	Typical Passenger Carrying Capacity (No. of People Seated)	Vehicle Capital Cost for Traditional Diesel Fuel Powered Buses (2021)	Vehicle Capital Cost for Hybrid Diesel-Elecric Powered Buses (2021)	Average Lifespan (Typical No. of Years Until Replacement Need)
PASSENGER VAN/LARGE SUV	8 to 15	$36,000	N/A	10
LIGHT-DUTY SHUTTLE (20-30 FEET LONG)	20-30	$116,000	$148,000	15
MEDIUM-DUTY SHUTTULE (30-35 FEET)	30-35	$150,000	$357,000	15
HEAVY DUTY SHUTTLE (40 FEET)	40-42	$160,000	$380,000	15
MEDIUM DUTY TRANSIT (40 FEET+)	40-42+	$300,000	$535,000	18
HEAVY DUTY TRANSIT (40-60 FEET; SOME ARTICULATED)	60+	$475,200	$653,000	18
SCHOOL BUSES	70-90	$137,000	N/A	18

(Source: NPS, 2019)

Fleet replacement is an ongoing concern that the NPS has begun to track more carefully in recent years given the high capital costs of replacing buses. Most parks with shuttle systems are on a rotating cycle for fleet replacement, with a cycle of replacing a lessor number of vehicles annually once the fleet begins to reach the end of its life. This reduces the capital cost of having to replace the entire fleet all at one time (NPS, 2019).

Agencies typically procure a “spare ratio” of buses in addition to those needed to serve routing and levels of service identified for these routes. The typical spare ratio in the industry calls for the purchasing of 10 to 15 percent additional vehicles in the fleet. This enables rotating of vehicle use and maintenance to reduce wear and tear on the fleet and having additional vehicles on hand in case on goes out of service.

Depending on the contracting mechanism the NPS would use for operating shuttle service at Yellowstone, the park can opt out of owning and maintaining the vehicles directly. Instead, the service contractor or concessionaire could bare the responsibility of fleet ownership and maintenance. This project does not address the various pros and cons related to contracting and operational frameworks for NPS shuttle systems,. This would need to be addressed in detail prior to any potential implementation of a system (see Chapter 8).

Greenhouse Gas Emissions

According to the 2019 National Transit Inventory and Performance Report commissioned by the NPS, transit buses carry more people per square foot of road space relieving congestion on park roads and reducing fuel-inefficient driving behaviors such as idling and stop and go, as well as circulating looking for open parking spots. Transit use reduces the overall volume of vehicle trips and vehicle miles traveled.

In the 2019 National Transit Inventory and Performance Report, NPS reported that transit use across the system resulted in a reduction of 266 metric tons of greenhouse gas (carbon dioxide/CO2) emissions than would have occurred if those trips were taken by private automobiles.

The propulsion technology selected for transit and shuttle vehicles also influences the level of greenhouse gas emissions produced. For example, traditional diesel buses emit far more greenhouse gas emissions than hybrid diesel-electric buses.

In order to better understand the advantages of shuttle service versus private automobile access related to reductions in greenhouse gas emissions, several sources were researched to support calculations of reductions that could be expected. While it is known that overall transit use as a transportation mode results in less greenhouse gas emissions per mile than private vehicle use, calculations were developed specifically for what could be expected for reductions in greenhouse gas emissions with operation of a shuttle at Yellowstone.

Calculations for the shuttle system operational and capacity analysis for this project indicate that the shuttle system could potentially displace 25 to 35 percent or more of the passenger vehicle traffic in the corridor. In addition, evaluation of traffic volumes and vehicle miles traveled in the geyser basin corridor, applying the metrics shown in Table 6.6, resulted in the following: shuttling would reduce the overall vehicle miles traveled in the corridor per year by 7,581,600 (assuming the six-month period when these roads are open).

Shuttling in traditional diesel-powered buses in the corridor would reduce CO2 emissions generated by 5,686,200 pounds, and shuttling in hybrid buses would reduce CO2 emissions generated by 6,004,627 pounds annually.

Table 6.6 Greenhouse Gas Emissions by Vehicle Type

VEHICLE TYPE	Pounds of CO2 Emissions per Mile
Private Passenger Vehicles, SUVs, Pick-Ups	0.89
Diesel Fueled Transit Bus	0.14
Hybrid Diesel-Electric Buses	0.098

(Source: NPS, 2019 and EPA, 2021)

Shuttle Branding and Identity Features

Some national park shuttle systems have implemented branding and identity graphics and elements as part of the program offered. For example, the shuttles at Rocky Mountain have colorful graphic wraps showing scenic mountain elements. Digital media technology has advanced to the point that creating appealing graphic wraps is a relatively cost-effective approach to branding, and wraps can be replaced easily after they fade.

At Yellowstone, such branding and graphics could include colors and elements emblematic of the park setting. Signature wildlife such as bison, grizzly bear, elk, Yellowstone cut-throat trout, or other elements could be prominently featured as shown in Figures 6.24 through 6.29. Photographs and names of geographic features and maps can be used as background elements to help visitors understand what route they are on and where the shuttles are traveling.

As Figures 6.24 through 6.29 show, graphic elements, colors, and images can help in branding the system. “If you are looking for the Old Faithful Express bus, look for the one that has an image of Old Faithful on it.” The different types of hydrothermal features in the park could be a source of inspiration for naming or branding different routes and/or buses of the shuttle system. Can you imagine shuttle names such as “Fumarole Fanny,” “Hot Springs Sally,” or “Mud Pot Annie?”. Branding could also be theme-based, representing interpretive or educational stories conveyed to visitors.

As shown in the shuttle illustrations, subtle themes and geographic references can be conveyed through wraps of topographic maps of the park. The same approach to branding, with colors, graphic enhancements, and signature elements could carry over to the design of shuttle stops and wind screens, as shown in Figures 6.30 through 6.32 (and see other design concepts in Chapter 7). Someone in West Yellowstone may want to get off at the Grand Prismatic stop, but how do they know which stop that is? “If you want that stop, look for the photograph of the Grand Prismatic Spring on the shelter there.”

These colors, illustrations, and graphic elements are not only visually attractive and beneficial in blending blend buses and stops into the context of the park, but they also serve as an extension of and enhancement to the setting. An important objective in all design (of shuttles and stops) should be a light touch on the landscape—context sensitive solutions that do not overshadow or distract from the beauty, grandeur, and wildness of the Yellowstone environment, but that rather blend with and enhance the setting.

Figures 6.24, 6.25, and 6.26—Bus Branding Concepts
(Source: Chargualaf, 2021)

Figures 6.26, 6.27, and 6.29—Bus Branding Concepts
(Source: Chargualaf, 2021)

Shuttle Stop Amenities

It is commonplace for shuttle stops in national parks to minimally appointed. This is often driven by the need for context sensitive design and having a light footprint on the landscape with improvements and development. That said, given the potential for inclement weather at Yellowstone throughout the year, having a system of contextually and cohesively designed shelters at shuttle stops would be beneficial to visitors (with rooftop coverage and wind screens to help protect visitor from rain and wind while they way).

Seating elements—integrated into the shelter structure and provided by separate seating walls and benches—can also be beneficial in adding comfort for visitors and providing places for visitors to rest and wait comfortably. At Zion Canyon shuttle stops and in other locations the seating wall serve the dual purpose of providing a comfortable place to rest for visitors, as well as funneling them toward pathways and trailheads and away from sensitive resources.

Trash and ash receptacles (Including recycling receptacles) may also be beneficial in keeping shuttle stop areas clean and free of litter, but these also add maintenance responsibilities to shuttle system operations.

Because public restrooms already exist at the termini stops (West Yellowstone or Madison Junction and Old Faithful) and at other intermediate stops in the geyser basin corridor, there likely would not be a need to build public restrooms at the shuttle stops. If the shuttle operates as envisioned, visitors should not have to wait longer than 10 to 20 minutes to catch the next bus and can be delivered at other stops with restrooms in

Figures 6.30, 6.31, and 6.32— Transit Stop Concept Showing Wind Screen Graphics

(Source: Roberts and Shelby, 2021)

relatively short timeframes. It would be unusual for shuttle buses to have restrooms or trash receptacles onboard, as these can deter from the visitor experience and also create the need for additional maintenance.

It is envisioned that the shuttles would lay over for half hour periods at either ends of the route. Use agreements may need to be implemented to ensure that shuttle drivers have access to certain restroom and breakroom facilities when they are laying over at either end of the route.

Bicycle racks should be provided in areas where visitors are likely to use them. At some shuttle stops, there may be an opportunity to introduces bicycle rental stations, particularly at either ends of longer distance bicycling routes.

Orientation to the park and the shuttle system is critical for success—and as such maps of the park and shuttle system, route maps showing shuttle stops and timetables, and other orientation information should be provided at each stop.

In summary shuttle stops should have the following amenities:

- Shelters
- Wind Screens
- Seating—integral to the shelter, as well as separate seating walls and benches
- Visitor information and orientation (maps/route info, etc.)
- Trash, recycling, and ash receptacles
- Bicycle racks and bicycle rental stations (some stops)
- Low level of dark sky compliant lighting (could be solar powered and automated)

Design guidelines for the elements at shuttle stops are presented in Chapter 7. As further discussed in Chapter 7, shuttle stops should be designed to be right-sized and contextually sensitive to the surroundings.

Shuttle System Operational and Capacity Analysis

The operational evaluation of the three shuttle service scenarios, Old Faithful Express, Geyser Basin Explorer, and Westside Trekker, was based on a model that assumed a 40- to 42-passenger vehicle capacity and that service would be provided over a 12-hour period daily from 7:00 a.m. to 7:00 p.m. in the corridor.

Morning and evening timeframes are ideal for wildlife watching. Some visitors like to start their day early, while others enjoy visiting the Old Faithful area for dinner. Service that operates from 7:00 a.m. to 7:00 p.m. would accommodate these interests. If late diners need to get back to town, service could be extended with 8:00 p.m. and 9:00 p.m. with pick-ups at Old Faithful, integrated with restaurant hours during peak season.

The operational and capacity analysis looked at two frequencies of service: time intervals (headways) between shuttle stops of 10 minutes and time intervals/headways of 20 minutes (with shuttles leaving every 10 minutes/10-minute frequency of service at all stops or every 20 minutes/20-minute frequency of service at all stops). As learned from the Zion Canyon case study, providing convenient service frequencies of 10-minutes can encourage ridership and enhance visitor experience by extending the capacity of the system to accommodate waiting visitors.

The operational and capacity analysis was completed for the West Yellowstone to Old Faithful route scenarios, as well as the Madison Junction to Old Faithful sub-option route and is summarized in Tables 6.7 and 6.8.

Modelling assumptions are shown in the tables, including the timeframes of travel related to each of the three scenarios (Express, Explorer, Trekker) and number of stops (assuming 10-minute dwell time at each location and 30-minute lay over for driver breaks at each end of the route for West Yellowstone to Old Faithful and 20-minute lay over for Madison Junction to Old Faithful). This means there could be two to three shuttles present at the end of the route destinations at any given time requiring layover space at the termini.

The number of vehicles needed for operating and total fleet size vary depending upon the service coverage (miles traveled, locations served, and the overall duration of travel times) and whether 10-minute or 20-minute headways are assumed. Estimated operating fleet sizes and total fleet sizes are shown in the table. All three shuttle scenarios assumed a 12-hour daily service duration from 7:00 a.m. to 7:00 p.m., with last round sweeps in the corridor after that time frame and later round pick up services for dinner guests at Old Faithful.

The model assumed total annual service days of 180 from May through October and a carrying capacity of the buses at 80 percent full to calculate the number of passengers served and reduction in vehicles on the road. The Trekker service results in the highest number of passengers per day and annually, as well as the most private vehicles off the road due to the number of locations served.

Table 6.7 Shuttle Service Operational and Capacity Analysis – West Yellowstone to Old Faithful

	Shuttle Service Operational Analysis		
	Old Faithful Express	*Geyser Basin Explorer*	*Westside Trekker*
Number of Shuttle Stops	2	7	10+
Trip Duration	60 to 75 Minutes One Way*	130 Minutes One Way*	160 Minutes One Way*
Number of Shuttle Vehicles in Operation (Operating Fleet Size)	21 @ 10-Minute Headways 9 @ 20-Minute Headways	32 @ 10-Minute Headways 16 @ 20-Minute Headways	38 @ 10-Minute Headways 18 @ 20-Minute Headways
Estimated Full Fleet Size Needed**	24 @ 10-Minute Headways 14 @ 20-Minute Headways	35 @ 10-Minute Headways 18 @ 20-Minute Headways	42 @ 10-Minute Headways 20 @ 20-Minute Headways
Total Passengers Carried per Day at 80 Percent Capacity	2,420 @ 10-Minute Headways 1,243 @ 20-Minute Headways	2,420 @ 10-Minute Headways 1,243 @ 20-Minute Headways	3,058 @ 10-Minute Headways 1,512 @ 20-Minute Headways
Passengers Carried per Year (Assuming 180 Days of Service from May through October at 70 Percent Capacity	435,456 Passengers @ 10-Minute Headways 223,740 Passengers @ 20-Minute Headways	435,456 Passengers @ 10-Minute Headways 223,740 Passengers @ 20-Minute Headways	550,368 Passengers @ 10-Minute Headways 272,160 Passengers @ 20-Minute Headways
Estimated Percentage of Private Vehicles that Could be Replaced with Shuttle Use from May to October (80 Percent Capacity)	28 Percent @ 10 Minute Headways 15 Percent @ 20-Min Headways	28 Percent @ 10 Minute Headways 15 Percent @ 20-Min Headways	35 Percent @ 10 Minute Headways 18 Percent @ 20-Min Headways

NOTES:

* Travel times are conservative, taking into account the frequency of traffic and animal jams in the corridor. If actual durations of travel can be reduced with less traffic in the future, then carrying capacity of the transit system could be improved.

** Assumes 40-foot-long heavy-duty shuttle buses, with a preference for diesel-electric hybrid. Full fleet size assumes spare buses at a ratio of 10 to 15 percent of the necessary operating fleet size.

Table 6.8 Shuttle Service Operational and Capacity Analysis – Madison Junction to Old Faithful

	Shuttle Service Operational Analysis		
	Old Faithful Express	***Geyser Basin Explorer***	***Westside Trekker***
Number of Shuttle Stops	2	8	10+
Trip Duration	55 Minutes One Way*	96 Minutes One Way*	125 Minutes One Way*
Number of Shuttle Vehicles in Operation (Operating Fleet Size)	16 @ 10-Minute Headways 8 @ 20-Minute Headways	24 @ 10-Minute Headways 12 @ 20-Minute Headways	25 @ 10-Minute Headways 12 @ 20-Minute Headways
Estimated Full Fleet Size Needed**	18 @ 10-Minute Headways 10 @ 20-Minute Headways	28 @ 10-Minute Headways 14 @ 20-Minute Headways	29 @ 10-Minute Headways 14 @ 20-Minute Headways
Total Passengers Carried per Day at 80 Percent Capacity	2,083 @ 10-Minute Headways 1,243 @ 20-Minute Headways	2,083 @ 10-Minute Headways 1,243 @ 20-Minute Headways	2,789 @ 10-Minute Headways 1,411 @ 20-Minute Headways
Passengers Carried per Year (Assuming 180 Days of Service from May through October at 80 Percent Capacity	374,976 Passengers @ 10-Minute Headways 223,740 Passengers @ 20-Minute Headways	374,976 Passengers @ 10-Minute Headways 223,740 Passengers @ 20-Minute Headways	501,984 Passengers @ 10-Minute Headways 254,016 Passengers @ 20-Minute Headways
Estimated Percentage of Private Vehicles that Could be Replaced with Shuttle Use from May to October (80 Percent Capacity)	25 Percent @ 10 Minute Headways 15 Percent @ 20-Min Headways	25 Percent @ 10 Minute Headways 15 Percent @ 20-Min Headways	32 Percent @ 10 Minute Headways 16 Percent @ 20-Min Headways

NOTES:

* Travel times are conservative, taking into account the frequency of traffic and animal jams in the corridor. If actual durations of travel can be reduced with less traffic in the future, then carrying capacity of the transit system could be improved.

** Assumes 40-foot-long heavy-duty shuttle buses, with a preference for diesel-electric hybrid. Full fleet size assumes spare buses at a ratio of 10 to 15 percent of the necessary operating fleet size.

Considering destination-specific results in the analysis, the number of passengers within the corridor specifically bound for Old Faithful provides additional insight into the potential effectiveness of shuttle service. NPS statistics for Yellowstone indicate that the total number of visitors entering the West Entrance from May to October in 2019 was 1,668,800. Analysis of travel patterns in the park indicate that 20 percent of the visitors through the West Entrance go to Old Faithful and then return back to the West Entrance (and 54 percent of all visitors to all destinations in the park enter and return through the West Gate). The 20 percent bound for Old Faithful and back equates to 333,760 visitors.

At the 10-minute headways scenario, ***all*** of these visitors could be accommodated on the shuttle in any of the three scenarios and for either route (West Yellowstone to Old Faithful or Madison Junction to Old Faithful). And, there would be extra capacity to carry other visitors at the 10-minute headways.

Also, it is important to remember that this operational and capacity analysis assumes only one service scenario operates at once in the corridor. If multiple service scenarios are operated simultaneously (such as Express and Explorer), the carrying capacity would be the totals of the numbers shown for those scenarios in Tables 6.8 and 6.9.

Given this analysis, shuttle service could remove between 25 to 35 percent or more of all the traffic/vehicles in the corridor at 10-minute headways or between 15 to 18 percent of all the traffic/vehicles at 20-minute headways.

Given that the 2016 analysis by Otak and Fehr & Peers (published in 2017) found that the roadway and parking areas in the geyser basin were measured at 29 percent over capacity during peak periods, potentially ***all*** of this over capacity traffic could be accommodated in a shuttle system if designed and operated accordingly, and with the potential to carry more by adding to the system over time.

Other Important Considerations

Park and Ride Locations—Park and rides function as places where visitors park their personal automobiles and board shuttles. Lodging facilities also function as park and ride capacity, as well ride share, taxi, and tour bus drop off and transfer to shuttles. Park and ride locations could be developed outside the park and inside the park at key locations.

Outside the park, the Town of West Yellowstone is planning for growth and change in the community and as part of this could continue to evaluate the ideal location for a park and ride to support shuttle operations into the park. As discussed in Chapter 5, some capacity may be available along the Yellowstone Avenue corridor, and at the main park visitor information center in town.

Inside the park, there is a large volume of parking capacity at Old Faithful, but this is heavily utilized day to day. None the less, there is also a large volume of lodging related parking at the Old Faithful complex that could serve shuttle ridership, with people staying at Old Faithful and boarding the shuttles for excursions in the geyser basin corridor. With a more strategic look at the overall capacity and configuration of parking at Old Faithful, there

Shuttle bus terminal at Grand Canyon National Park
(Source: NPS/Alamy stock photo, 2011)

could be the potential to dedicate a certain number and area of parking for park and ride specific to the shuttle service.

At Madison Junction, there is a large already developed area for parking and tour bus staging and turn around. This overall space appears that it could be redesigned and reconfigured to support a large volume of park and ride capacity at that shuttle terminal. See Figure 6.10.

Shuttle Bus Maintenance and Storage Facility—National parks have taken different approaches in siting maintenance and storage facilities for park shuttle systems. At Zion, Rocky Mountain, Williamsburg, Harpers Ferry, and other locations, these facilities are located outside the concentration of visitor use, but on government-owned land. At Yosemite, the bus maintenance facility is located inside the park, in Yosemite Valley.

This is an important consideration that will need to be analyzed more closely in a shuttle system or alternative transportation feasibility study. Shuttle bus maintenance and storage facilities have the potential to need a large amount of space, as well as access to utilities and technology, and an employment base. Fueling stations and various maintenance bays and wash bays also need to be provided.

Potential locations inside the park (such as the termini locations of Old Faithful and/or Madison Junction), and outside the park if the West Yellowstone to Old Faithful route is implemented need to be further evaluated.

Managing Vehicle Access in the Shuttle Corridor during Peak Season

Managing congestion in the shuttle corridor and maintaining the level of traffic to within the capacity of roadways and parking areas in the geyser basin corridor of the park is a challenging issue. The shuttle system has the potential to carry a large volume of visitors entering through the West Entrance and as such, to remove their private vehicle traffic from the corridor.

However, the only way to truly maintain vehicle traffic to a set level would be to monitor, meter, and manage vehicle traffic in the corridor simultaneously with shuttle operations to the desired level of service and the calculated capacity of the infrastructure. This likely would only need to occur during peak visitation months of June, July, and August, and the rest of the time the roadways and parking areas could remain open to general traffic. ***Also, it is important to note that a large amount of vehicle traffic and parking could be accommodated in the corridor at the same time the shuttle system operates***– up to the capacities that existing parking areas can hold, while the overage in a capacity of visitor and vehicles could be accommodated on the shuttle system up to a desired level.

The NPS could determine the infrastructure capacity level to be managed for the corridor and monitor daily entrances and movements into the corridor. When the vehicle capacity is reached, a gate system could be activated. While the gate system could be automated, it might be most effective to be opened and closed by rangers at the appropriate time each day, and as such, it may even be advisable to install an entrance station at either end of the corridor for this purpose.

The gate could be automated and openable to shuttles by Opticom or other technology, and gates could be operated to allow visitors to depart from the corridor at either end. The gating system likely would need to be installed at two locations—south of the Madison Junction and east of Old Faithful on the Grand Loop road.

Such a system would enable the park (through digital/electronic control) to let a targeted number of vehicles into and out of the corridor that aligns with the infrastructure capacity of roadways and parking areas in that portion of the park. Calculated cumulatively with the shuttle system capacity and anticipated ridership, the park would be able to manage the area to a level of visitation that can be served by existing infrastructure and facilities. This approach is consistent with the NPS mission of protecting and preserving resources while enhancing visitor experience for future generations.

Implementing managed access to national parks and portions of national parks needs to be carefully considered. Many parks around the country have taken this approach to protect sensitive resources and maintain traffic to manageable levels. Some sensitive national park sites areas are only open to visitors by reservations and/or guided tours. The Zion Canyon area of Zion National Park is only open to shuttle riders, hikers, and bicyclists during the peak summer season (and not to private vehicles); although private vehicles can access the area throughout the rest of the year. Managed access is becoming a more prevalent visitor use management tool throughout the NPS as visitation continues to grow.

A widespread public notification and promotional program would be required to let people know that such a system is being implemented in the park and the benefits of implementing this system during peak season. Key messages to the public should include specifically address how the access management is benefitting park resources, visitor experience, the environment, and other important positive outcomes.

Elements such as website notices, signing, information in brochures and newsletters, visitor information kiosks, and other venues would need to be updated to let visitors know about the shuttle operations, routes serviced, and managed access if implemented during the peak summer months. People could be notified about the system through lodging reservation systems, at visitor information centers, and other locations.

If a managed access system could not be implemented in the shuttle corridor, levels of traffic would continue to rise with visitation growth over time. Even though the shuttle may have a near term effect of displacing private vehicle access and reducing congestion on the roadways and in parking areas, over the long-term future, traffic most certainly would rise to over-capacity levels again.

Voluntary vs. Mandatory Shuttle Service

As described, the shuttle service would be both voluntary and mandatory in a sense. People would have the option to choose to ride the shuttle or not up to the managed access level of the corridor. Then, once that threshold is reached on a daily basis, the only way to enter the geyser basin corridor would be aboard the shuttle system. This is really a hybrid approach, and is less restrictive than a fully mandatory system. Additionally, it is important to remember that visitors would have the option and choice to visit other areas of the park when the geyser basin corridor is full if they choose not to ride the shuttle. This is one of he benefits of implementing service from Madison Junction to Old Faithful (rather than from West Yellowstone to Old Faithful) in that the point of management and visitor access options can be simplified at the Madison Junction location. Visitors can still come in through the West Gate and then choose to either board shuttles at Madison or proceed northward on the Grand Loop Road when the geyser basin corridor is full.

With West Yellowstone to Old Faithful shuttle service, operations could still be managed effectively, but there could be more congestion at Madison and more wear and tear on the gating system with shuttles moving in and out of the geyser basin corridor. If Madison Junction is determined as the selected location for the shuttle terminal, it would be beneficial to create a point of access from the West Entrance Road to the park and ride area, so visitors could proceed to that location prior to the Madison Junction.

What about Animal Jams?

Traffic jams due to wildlife in the roadway or along side, with people slowing or stopping to view and photograph them is an almost daily occurrence at the park. This phenomenon can occur anywhere and at any time. Past studies tend to indicate that visitors are more likely to be tolerant of traffic congestion when they have the opportunity to view wildlife (NPS, 2018).

Animal jams would continue to affect general purpose traffic as well as buses and shuttling, causing slow downs in service. The operational and capacity analysis completed for this project assumed that shuttle travel times would periodically be affected by animal jams,

There could be the potential to wave shuttles through ahead of general-purpose traffic once the animal jam has cleared. However, often traffic in both directions tends to be chaotic during an animal jam, with some people parking their vehicles and getting out of them. A more systematic approach to managing and clearing animal jams could be studied and developed specifically for shuttle service. That said, all visitors—those in vehicles and those onboard shuttles likely will continue to experience travel delays related to the wildness of Yellowstone, and to many that is just part of a typical visit to the park that they are willing to accept (NPS, 2018).

How does a bear cross the road? Very carefully...and with help from rangers!

(Sources: top photo, Thurmer, 2014; bottom photo, Chiang, Flickr, 2010)

Potential Partnerships and Roles in Implementation

Given the limited and focused resources of the NPS, the most effective transportation solutions often rely on substantial support from partners, such as corporate entities, friends' groups, and other private or non-profit entities.

An example of an effective partnership was presented in *Partnering for Transportation Success at Acadia National Park—A Case Study of the Island Explorer Shuttle Bus System at Mount Desert Island and Acadia National Park* (NPS Alternative Transportation Program and the John A Volpe National Transportation Systems Center, 2003). The Island Explorer Shuttle Bus System, still in operation today and highlighted as a case study in Chapter 4, was implemented through a partnership of a diverse group of interests—the NPS, the US Department of Transportation, the Maine Department of Transportation, town governments, the Friends of Acadia, and other public and private organizations, including L.L. Bean, a major corporation based in Maine.

A diversity of funding sources financially support the ongoing operation of the shuttle system. According to the case study, the partnership:

- Illustrates the growing confidence in the strength and future of public transit on Mount Desert Island;
- May help to reduce financial vulnerability; and
- Fosters a widely shared sense of ownership that helps to make the system resilient based on the diversity of financial support.

LL Bean has been an ongoing financial partner and supporter of the Island Explorer shuttle system at Acadia National Park

(Source: Mount Desert Islander, 2016)

As America's first national park and with its ongoing stature as a premiere national park experience of the West, Yellowstone offers exceptional promotional value and cache to potential partners who may be interested in supporting a shuttling/hiking/bicycling program at the park. With corporate partners popular in the West (REI, Eddie Bauer, Cabela's, and others), there could be opportunities to fund and implement a system with private support that supplements public capital investments. Private donors can be recognized in tasteful ways without the need for distracting advertising and promotions.

There are also a wide variety of nonprofit organizations, friends' groups, and philanthropic entities who could be rallied to provide support to the system given the anticipated environmental benefits that could be realized. Town leaders and local businesses in West Yellowstone could also be approached to provide support to the system. This could be in the form of capital investment, land dedication, or simply cooperative agreements to support the use of public streets and public property for park and ride functions. Cooperation and support does not always need to be direct financial contributions.

Overall, the shuttle system with connecting hiking and bicycling opportunities would expand recreational use and rental equipment business opportunities in West Yellowstone and other gateway communities. The shuttle itself could be operated through a concession or service contract, creating a new business opportunity, managed in close cooperation with the park. Employment opportunities would be generated by the need for drivers and system staff needed for upkeep, fueling, and maintaining the vehicles. A new system like this, although seasonal, could help to add more stability to the local economy.

7 Design Concepts and Recommendations

Visitors on the Boardwalk in the Lower Geyser Basin

(Jim West/Alamy stock photo, 2015)

Chapter 7—Design Concepts and Recommendations

Context Driven Design, Sensitivity to Park Resources, and NPS Standards

Context Sensitive Design—Context sensitive solutions for transportation projects should be developed through a collaborative, interdisciplinary approach that involves all stakeholders. The process should carefully consider the physical setting; preservation of scenic, aesthetic, historic, and environmental resources; and function, safety, accessibility, and mobility. This approach also should consider the total context within which a transportation improvement project exists—so not just the immediate site, but the surroundings and connectivity to and from the site from these surroundings. Key principles are shown in the box in the far right column on this page and include the employment of early, continuous and meaningful involvement of the public and all stakeholders throughout the project development process (Federal Highway Administration, 2020).

Applying a context driven design process is important in any setting, but absolutely critical in a national park environment where sensitive natural and cultural resources are the defining features of the setting and the foundation of the visitor experience of the park. Context driven deign that is sensitive to protecting park resources and enhancing visitor experience is an inherent part of the NPS mission.

For the proposed shuttle system in the geyser basin corridor, there is not just one site, but many locations where the shuttle would stop, and for each there is the potential to either retrofit existing conditions to accommodate service, or to implement new improvements, while ensuring a light touch on the landscape. The corridor as a whole and each individual shuttle stop and terminal location will need to be carefully reviewed, applying a context sensitive design approach in all cases.

In many cases, the existing geometry of parking and turn around areas at the park are already designed to accommodate large tour buses, so designing shuttle stops may only require restructuring the use of the existing pavement. Only minimal adjustments (retrofitting) may be needed to provide unimpeded shuttle access to the visitor drop-off and pick-up zones. In other cases, a completely new shuttle pull off area may need to be designed and constructed.

The proposed shuttle terminal location at the Old Faithful, northeast of the Old Faithful Inn, is already functional related to circulation and the area is already developed and disturbed. The design as conceptualized later in this chapter would expand upon the pedestrian area and include shelters and amenities for a multi-stop facility at this location. See Figures 7.1, 7.2, 7.31 and 7.32.

The proposed shuttle stop location at the Midway Geyser Basin site would involve improving a new area just south of the existing parking area with a pull off in an elongated “jug handle” configuration (see Figure 7.13 and Figures 7.24 through 7.30). Even though new improvements would be required here, the design as conceptualized in this chapter would be carefully integrated into the existing context, retaining as many of the mature trees in that location as possible and providing direct access to the bridge that crosses the Firehole River to take visitors to the Grand Prismatic Spring boardwalk and Fairy Falls Trail.

CONTEXT SENSITIVE SOLUTIONS

Core Principles for the Decision-Making Process

- Strive towards a shared stakeholder vision to provide a basis for decisions.
- Demonstrate a comprehensive understanding of contexts.
- Foster continuing communication and collaboration to achieve consensus.
- Exercise flexibility and creativity to shape effective transportation solutions, while preserving and enhancing community and natural environments.

Core Principles for Design

- Safe for all users.
- Design process involves a shared stakeholder vision as a basis for decisions and for solving problems that may arise.
- Design outcomes meet or exceed the expectations of both designers and stakeholders, thereby adding lasting value to the community, the environment, and the transportation system.
- Demonstrate effective and efficient use of resources.

(Source: US Federal Highway Administration, 2020)

Sustainable Design—The NPS also is committed to sustainable design and ensuring that new transportation and parking facilities and improvements are designed to be as green as possible in addition to being designed to carefully within each park context. The NPS has implemented a program called Innovative and Sustainable Transportation Evaluation Process (INSTEP), which is in the beta phase. and represents the agency's commitment to encouraging innovations in sustainable transportation (NPS, 2017d).

After testing multiple green infrastructure rating systems for applicability to NPS transportation projects and systems and finding that none of the systems adequately addressed the agency's mission and sustainability needs, the NPS developed the INSTEP process to encourage, share, and track innovative sustainable actions, knowledge, and design techniques (NPS, 2017d). INSTEP synthesizes applicable elements of existing design and construction infrastructure rating systems, while also integrating NPS specific elements that are responsive to the natural and cultural resource and visitor experience objectives of the NPS.

All NPS Denver Service Center (DSC)-managed transportation projects are required to comply with federal sustainability requirements. The INSTEP program guidance provides a framework for how this can occur. (NPS, 2017d). Projects also must follow other applicable NPS design standards for each phase of project design and delivery—pre-design, schematic design, design development, construction documents, and construction (NPS, 2018-2021,b). The DSC publishes an INSTEP guide and maintains the INSTEP Checklist. A beta version of the spreadsheet checklist is available at: https://www.nps.gov/articles/transinstep.htm.

The checklist assists transportation project teams in complying with sustainability standards throughout design and construction. Table 7.1 provides a list of INSTEP measures for project evaluation from the checklist (NPS, 2017d).

Other applicable design requirements for NPS projects are available through the agency's Workflows program, also administered through the DSC: https://www.nps.gov/dscw/index.htm. The Workflows program provides a series of checklists for each phase of design and references to specific design standards and requirements that must be followed for all NPS projects (NPS, 2018-2021b).

Environmental Compliance—The NEPA compliance process is typically the primary regulatory process for implementing actions and making improvements in national parks. The NPS is required by the NPS Organic Act and NEPA to plan and make informed decisions that help preserve park resources and values. The NPS carries out this responsibility by preparing studies and involving the public before making decisions that will affect the environment. NEPA requires analysis of environmental, social-cultural, and economic conditions and of the relative impacts under a range of alternatives to the proposed action, including no action. The NPS NEPA Handbook (2015), and Director's Order 12 (2011) are two of the primary sources of guidance for NEPA compliance (NPS, 2021d). These and additional resources can be found here: https://www.nps.gov/subjects/nepa/policy.htm.

In national parks, given the requirement to preserve resources unimpaired, project improvements generally must avoid impacts to natural and cultural resources under NEPA. NEPA, as well as other applicable federal and state regulations, would require analysis and documentation related to the project's avoidance of impacts to cultural resources, rivers and streams, hydrothermal features, geologic conditions and soils (soil crusts), vegetation, habitat areas, fish and wildlife, and other elements. In addition, considerations related to visitor access, use, safety, and experience may also be analyzed as part of NEPA. Sensitive areas and resources must be protected and left unimpaired and visitor experience must be enhanced.

Context driven and context sensitive design is an important guiding principle to ensure compliance with these regulations. Design of facilities in national parks, as discussed previously in this chapter, must minimize the footprint of improvements to only that needed for function and form.

Evaluation of design precedents, such as shuttle systems in other national parks can provide insights into how to retrofit and right-size facilities into sensitive settings. For example, the shuttle stops at Zion Canyon were right-sized to each location, but not over designed—an excellent example of context sensitive design.

Applying a context driven design process is important in any setting, but absolutely critical in a national park environment with sensitive natural and cultural resources.

Table 7.1 NPS Innovative and Sustainable Transportation Evaluation Process (INSTEP) Factors—Beta Stage Sustainability Guidance for Transportation Projects

Project Planning Context

- Alignment and Site Selection
- Context-Sensitive Design
- Resiliency
- Financial Sustainability and Total Cost of Facility Operations (TCFO)
- Innovative and Customized Strategies

Natural Resources

- Fish and Wildlife
- Vegetation
- Soils and Geologic Resources
- Invasive Species
- Water Resources
- Soundscapes and Acoustic Resources
- Dark Sky Preservation
- Innovative and Customized Strategies

Cultural Resources

- Historic and Prehistoric Structures
- Archaeological Resources
- Cultural Landscapes
- Ethnographic Resources
- Innovative and Customized Strategies

Visitor Experience

- Safety
- Visual Resources
- Connectivity
- Accessibility
- Education and Outreach
- Local Economy
- Innovative and Customized Strategies

Energy and Climate Change

- Air Quality
- Recycling
- Heat Island
- Energy Consumption
- Innovative and Customized Strategies

Materials and Construction

- Material Selection
- Waste Management
- Construction Practices
- Quality Control
- Noise and Vibration
- Innovative and Customized Strategies

Innovation and Custom Strategies

- Project Specific Sustainable Practices
- Customized Design Solutions for Sustainability

(Source: NPS, 2017d)

Old Faithful Historic District

The shuttle stop at the Old Faithful complex would be located within the designated Old Faithful Historic District. New construction within the boundaries of historic properties, including the approach to site design, the scale of the facility, and location must respect the overall character of the site. According to the US Department of Interior Secretary of the Interior's Standards for the Treatment of Historic Properties (NPS, 2017f), new construction needs to be built in a manner that protects the integrity of the historic building(s) and the property's setting. The following standards would apply:

- Buildings, driveways, parking lots, landscape improvements and other new features must not alter the historic character of a property. A property's historic function must be evident even if there is a change of use.
- The location of new construction should be considered carefully in order to follow the setbacks of historic buildings and to avoid blocking their primary elevations. New construction should be placed away from or at the side or rear of historic buildings and must avoid obscuring, damaging, or destroying character-defining features of these buildings or the site.
- Protecting the historic setting and context of a property, including the degree of open space and building density, must always be considered when planning new construction on an historic site This entails identifying the formal or informal arrangements of buildings on the site, and whether they have a distinctive urban, suburban, or rural character.
- In properties with multiple historic buildings, the historic relationship between buildings must also be protected. Contributing buildings must not be isolated from one another by the insertion of new construction.

Some of the old yellow buses at the historic Old Faithful Inn; in the concept studied in this project, shuttle buses would circulate through this area, as shown with the red bus in the photo (passing along the west side of the Inn's porte cochere)

(Source: D. Hurst/Alamy stock photo, 2008)

- As with new additions, the massing, size, scale, and architectural features of new construction on the site of a historic building must be compatible with those of the historic building. When visible and in close proximity to historic buildings, the new construction must be subordinate to these buildings. New construction should also be distinct from the old and must not attempt to replicate historic buildings elsewhere on site and to avoid creating a false sense of historic development.
- The limitations on the size, scale, and design of new construction may be less critical the farther it is located from historic buildings.
- As with additions, maximizing the advantage of existing site conditions, such as wooded areas or drops in grade, that limit visibility is highly recommended.
- Historic landscapes and significant viewsheds must be preserved. Also, significant archeological resources should be taken into account when evaluating the placement of new construction, and, as appropriate, mitigation measures should be implemented if the archeological resources will be disturbed.

Shuttle Terminal Concept in the Old Faithful Historic District—This project conceptualizes a shuttle stop and plaza designed to support offloading and boarding capacities of multiple shuttles at once. The proposed location is in an open area near and to the northwest of the Old Faithful Inn. This would be an ideal shuttle stop location because of its location adjacent to the pedestrian path that leads directly to the Old Faithful Geyser viewing area. It is an already disturbed, paved area that would be well-suited for shuttle stop development. Shuttles could come in through the first entrance to Old Faithful, bring visitors into the loop drive that already exists and efficiently drop them off close to the Inn and Geyser. This location would bring important advantages in separating the shuttle from other general vehicle traffic in the Old Faithful area (shuttles would only be mixing with Inn guest traffic and tour buses here) and in close proximity to the premiere attracting that visitors want to see, the Old Faithful Geyser. See Figures 7.1, 7.2, and 7.3, as well as Figures 7.26 through 7.27 later in this chapter.

There are some trees and native landscaping adjacent to this area and an area that could be revegetated to help to screen the shuttle stop area from views. Also, there is a slight drop in grade that would clearly separate this area from the architectural presence of the Old Faithful Inn. The design of the shelters in this area could be unique from or similar to other shelters in the shuttle system. The most important guiding principle is that they should be compatible with, ***but subordinate to and distinctive from,*** the architecture of the nearby Old Faithful Inn. Per the Secretary of the Interior standards summarized above, *"When visible and in close proximity to historic buildings, the new construction must be subordinate to the historic buildings.* ***New construction should also be distinct from the old and must not attempt to replicate historic buildings elsewhere on site and to avoid creating a false sense of historic development."***

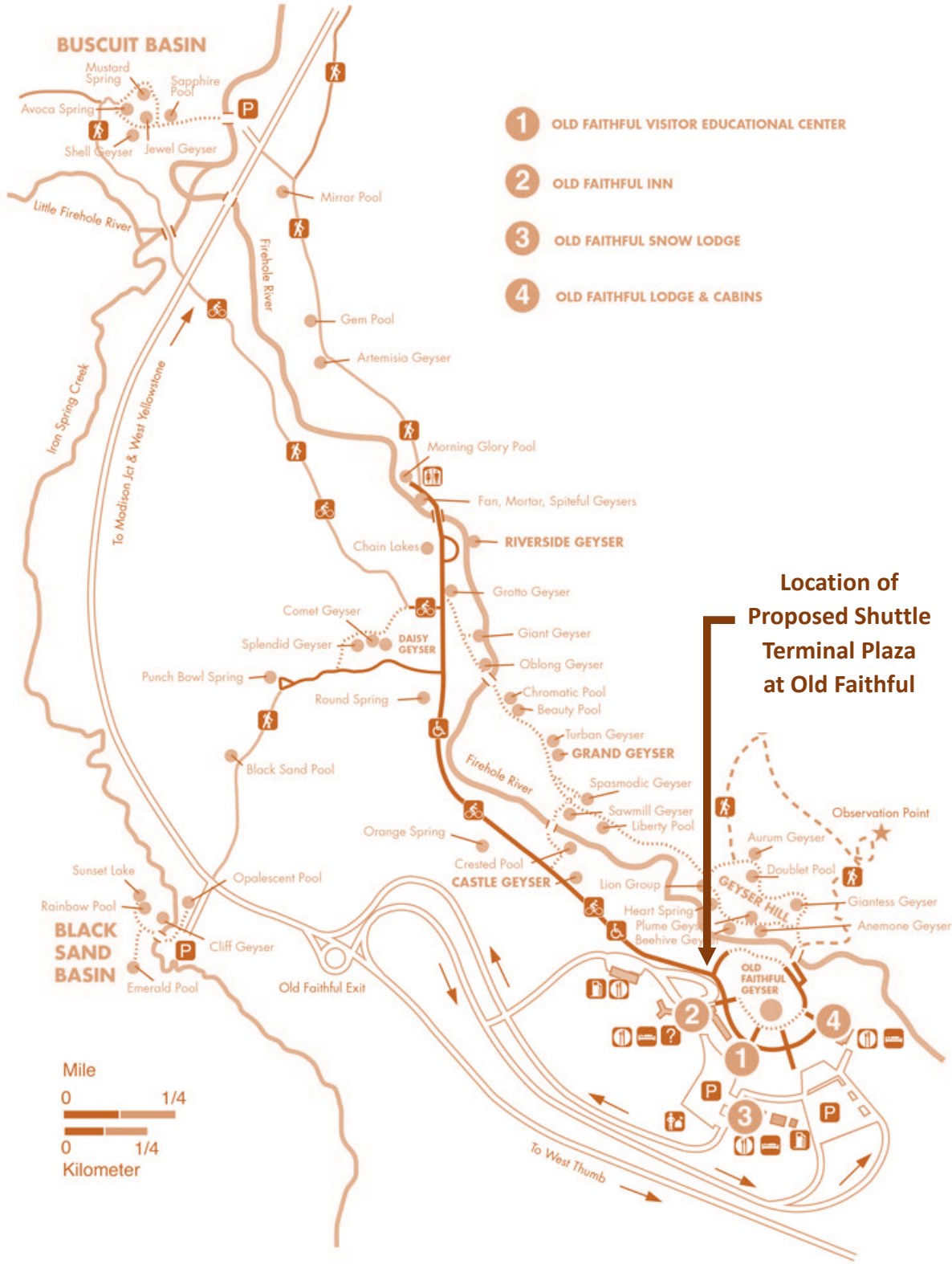


Figure 7.1—Vicinity Map of Old Faithful Complex and Proposed Location of Shuttle Terminal Plaza

(Source of base map: Earth Trekkers, accessed 2021, proposed location is a preliminary idea denoted by the author)

Aerial photograph of the proposed shuttle terminal location at Old Faithful

(Source: Google Earth, 2021)

Figure 7.3 –Concept for a Shuttle Terminal Plaza Near Old Faithful Inn

(Source: Roberts and Shelby, 2021)

Figure 7.2—Perspective View Concept for Shuttle Terminal at Old Faithful (also see renderings later in this chapter)

(Source: Roberts and Shelby, 2021)

Design Precedents from Shuttle Systems in Other National Parks

Prior to presenting additional design concepts for the shuttle system envisioned as part of this project, it is insightful to review some of the design precedents of the case studies of shuttle systems at other national parks. In considering potential design guidelines for the Yellowstone shuttle system with connecting hiking and bicycling trails, best practices in other national parks were researched as part of the case studies presented in Chapter 4.

Shuttle facilities at Zion National Park/Zion Canyon, Rocky Mountain National Park, and Yosemite National Park provide precedents that can help to inform future design at Yellowstone, as summarized in Table 7.2. Overall, in a review of multiple shuttle systems at national parks, the Zion Canyon shuttle system appeared to have the best design approach and aesthetic.

Some shuttle stops were redesigned and expanded after initial implementation of the system in order to provide more space for unloading passengers to get oriented and organized before moving forward on the trail systems at each stop. Today, there is ample space for waiting and queueing at the stops (although as visitation increases and ridership continues to grow, there may be a need to manage the maximum number of people in each stop area to the design capacity that now exists).

The program of shared parking where possible with businesses and public facilities in the gateway community has reduced the need for a large-scale parking structure, has helped to reduce visual intrusion into the context and character of Springdale. Whereas, the large, multi-story parking structure recently constructed at the entrance to Estes Park has introduced a significant visual change to the arrival experience into that community.

The Zion Canyon system was carefully designed and uses natural materials and design features that are repeated throughout the system—including in-park stops and in-town stops. This context-sensitive approach blends with the aesthetic of the surrounding natural landscape and geology while also creating a signature identity for the system recognizable to visitors all throughout its extent.

Like at the Zion Canyon shuttle stops, low rock walls (seat height) can be organizing and defining elements of shuttle stop areas along the geyser basin corridor shuttle route. These can all be constructed in the same cost-effective approach, with concrete or CMU base and rock faced veneer using natural rock available locally, similar to other masonry in the park. The low walls can be designed to fit the available space and needs of each stop location.

The Zion Canyon shuttle system also has an excellent system of signing and wayfinding, making it easier for visitors to navigate the system and know where they area. The signs are designed in earth tone colors that blend well with the setting but are still highly visible and eye catching.

Refer to Table 7.2 for a list of other design precedents related to national park shuttle systems, derived from the case studies analyses and other research.

Springdale (top) and Zion Canyon (bottom) shuttle stops; note low seating walls

(Sources: Top photo: pierre rochon/Alamy stock photo, 2015; Bottom photo: Kristi Blokhin/Shutterstock.com, n.d.)

Table 7.2 Design Precents from Case Studies and Other Research of Shuttle Systems and Shuttle Stop Designs

Zion Canyon Shuttle at Zion National Park	Rocky Mountain National Park Shuttle	Yosemite Valley Shuttle at Yosemite National Park
▪ Natural materials of stone and timber in construction of shelters with similar design aesthetic throughout ▪ Context appropriate shelter designs ▪ Extensive visitor information and interpretive displays at shuttle stops ▪ Seating areas and trash receptacles ▪ Low rock-faced walls double as space-defining design features and additional seating areas ▪ Shuttle stops are separated from vehicle circulation areas; shuttle route is not open to vehicles during summer season ▪ Ample waiting/queuing space at shuttle stops and trailhead areas ▪ Park and ride activity is accommodated through surface parking lots and shared parking areas throughout the gateway community of Springdale and at the entrance to the park ▪ Extension of park shuttle aesthetic and design into gateway community shuttle character ▪ Bus maintenance facility and storage inside the park, tucked away and not visible from visitor areas	▪ Natural materials of stone and timber in construction of shelters with similar design aesthetic throughout ▪ Context appropriate design for shelters fits with Rocky Mountain context ▪ Visitor information and interpretive displays at shuttle stops ▪ Seating areas and trash receptacles ▪ Shuttle stops are not always separated from vehicle circulation areas ▪ Large new park and ride structure in the gateway community of Estes Park ▪ Additional park and ride internal to the park, near Glacier Basin Campground ▪ Bus maintenance facility and storage outside the park	▪ Natural materials of stone and timber in construction of shelters; but a variety of designs are in place depending on the context ▪ Visitor information and interpretive displays at some shuttle stops, but not as extensive as other parks ▪ More shade and shelter needed at several stops ▪ Seating areas are ample in some locations and limited in others ▪ Shuttle stops are not always separated from vehicle circulation areas ▪ Bus maintenance facility and storage inside the park

Photographs of Glacier Gorge shuttle stop, Rocky Mountain National Park

Photographs of shuttle stops along the Yosemite Valley Shuttle route; Curry Village on the left and Valley Visitor Center on the right

(Source for top photos: author, 2018; source for bottom photos: Wright, D., 2014)

Design Best Practices and Recommendations

Based on the review of other national park shuttle systems and other examples around the US, as well as knowledge of design requirements applicable to NPS facilities, the following design best practices are recommended for the Yellowstone shuttle system and connecting hiking and bicycling trails.

Analyze Each Site Environment, Protect Sensitive Areas, and Right-Size Footprints—A thorough site analysis should be completed as part of the design process at each location proposed for shuttle stop improvements, inside and outside the park. As previously mentioned, all NPS actions, including development of shuttle stops and related improvements, are subject to compliance with the National Environmental Policy Act (NEPA), NPS Director's Orders, and various other regulatory requirements. There would be additional permitting requirements under the jurisdiction of West Yellowstone for improvements in town.

When possible, shuttle stops should be located in areas near trees, which can help to screen the shuttle stop area, but also bring the added benefit of natural shade near the waiting area. Small signs , maps, and low-profile interpretive displays in shuttle stop areas can also help to orient visitors to the views they are seeing, including significant mountains and landmarks. Onboard audio programs can point out scenic elements and landmarks along the journey.

Context driven and context sensitive design is an important guiding principle related to designing facilities in national parks, as discussed previously in this chapter.

New facilities need to be designed to blend into setting and lay lightly on the land. As such, right-sizing the footprint of shuttle stop areas to provide only the space needed for shuttle vehicle and emergency vehicle operations and to accommodate the number of visitors unloaded and loaded at the stops will be important.

Site planning and engineering design should use tools such as "AutoTURN®" to confirm that turning radii are sufficient and to avoid broader expanses of pavement than needed. See Figures 7.5 and 7.6 for typical turning radii requirements for shuttle buses.

Design must minimize the footprint of improvements to only that needed for function and form. Overdesign, with too much pavement (more than needed to accommodate the design vehicles or the estimated people at one time in a space) is inconsistent with context sensitive design.

Create a System-Wide Context Driven Design Aesthetic—Similarly to the Zion Canyon shuttle system, using consistent design materials, colors, and styles throughout the entire shuttle system, in a context sensitive approach that fits in the park and in West Yellowstone (if shuttle facilities are located there), is highly recommended.

Take a simple design approach with tried and true durable and lasting materials and do not try to mimic particular architectural styles or create unique designs—the shelters should be simple and subordinate to the setting. Let the landscape of the park predominate. This approach will be easier and more cost effective to construct and maintain and will ensure that the design is a lasting legacy that will be consistent and attractive for the long term (avoiding new styles and colors popping up over time).

Using a consistent palette of materials, colors, and elements through the entire system, while also contextually designing the shelters and stops to blend with park setting, will reinforce the brand identity of the shuttle system so it is easily recognizable to visitors. The Zion Canyon system was designed exceptionally well in this manner.

Low Impact Development, Sustainable Materials, and Accessible Surfaces—Low impact development design is becoming more common in urban areas, but it has always been critical in national parks. Low impact development approaches include the use of sustainable and recycled materials, permeable pavements, green stormwater runoff infrastructure, natural revegetation, energy conserving features, and other elements should be required as part of the shuttle system project delivery.

Permeable pavers (interlocking for structural properties) bring the advantage of letting stormwater soak through, into the ground and they also are less susceptible to frost heaving and settlement if they are installed properly. Crushed fines with a binding agent for pedestrian paths are also commonly used in national parks for a low impact, but at highly used shuttle stops, it may be more advantageous to use concrete (colored to blend with the surrounding landscape) for pedestrian waiting areas and paths.

Regardless of the type of surface, all public pedestrian areas must be firm and stable and meet federal accessibility standards.

Protect, Enhance, and Frame Views and Viewscapes—At Yellowstone, it's all about the views and viewscapes—epic, broad, open views of an untouched landscape that stretch to the horizon in all directions. Shuttle locations must be designed with careful consideration of these views and to avoid interrupting the scenic experience for visitors. Each location must be carefully studied to understand the view dynamics.

Locating shuttle stops in areas near trees will help to screen and buffer them from view, and brings the added benefit of natural shade near the waiting area.

Small signs , maps, and low profile interpretive displays in shuttle stop areas can also help to orient visitors to the views they are seeing, including significant mountains and landmarks. Designers should consider setting a maximum height for signage so it is more aligned with human scale while still complying with applicable clearance requirements.

Onboard audio programs can point out scenic elements and landmarks along the journey.

Consider Soundscapes and Noise Mitigation—Preserving natural soundscapes and mitigating noise is always an important consideration in national parks. All shuttle stops would be located in already developed locations of roadway and parking activity, and as such, already subject to noise levels from traffic and visitors. Revegetation around the perimeter of shuttle stop areas as well as the low stone-faced walls as defining features would help to mitigate some shuttle stop related noise levels from surrounding areas. In addition, the use of hybrid electric-diesel buses would help to reduce noise levels compared to buses that are all diesel.

Support Wildlife Watching and Safe Visitor Interactions with Wildlife—Shuttling visitors through wildlife areas offers a variety of opportunities that are beneficial to the visitors, as well as to the wildlife:

- Visitor interactions with wildlife can be better managed onboard the shuttle and visitors can receive messages in multiple languages through onboard audio programs about the importance of distancing from wildlife when out in the park.
- Because visitors are on the shuttles and not in personal vehicles, they would not be prone to stopping or slowing to photograph wildlife, which causes animal jams on the park roads.
- Carrying a proportion of visitors in shuttles also can reduce roadway congestion and the level of intensity of animal jams when they occur.

Shuttle vehicles should be designed with floor to ceiling (or at least expansive) windows, so visitors can have extensive visual interaction with the Yellowstone landscape and wildlife that are part of the landscape.

Interpretive and educational audio programs and/or rangers on board shuttles can provide more information about the Yellowstone ecosystem, wildlife, and their characteristics, inspiring a culture of stewardship, preservation, and respect for wildlife with visitors.

Provide an Appropriate Level of Lighting and Protect Dark Skies—As a general rule, it is not recommended that shuttle stop locations in the park be equipped with lighting due to concerns about how it might affect natural night skies and wildlife. Since the shuttle would be in operation only during daylight hours, lighting at the stops in the park generally would be unnecessary.

However, lighting may be needed in park and ride areas, and if shuttle service is provided into October, there may be a need for morning and evening supplemental light. There may also be a need for emergency lighting at some locations. Shuttle riders may return late and need to be picked up on demand or in the final sweep of the evening when conditions are dark.

As such, designers should consider providing a very low level of lighting at shuttle stops that would be fully dark sky compliant. Such lighting could be powered by a solar voltaic battery system that stores energy and activates the lighting when needed. It would also be possible to activate this lighting during emergencies with a switch that is accessible to shuttle drivers, rangers, and possibly visitors.

Lighting that is subtly integrated into the shelter design, beneath benches, or low-level bollard lights could be designed to fit the setting without introducing intrusive pole lighting. All lighting would need to be designed to protect dark skies with shielded light levels.

Dark sky design resources are available from various sources including the International Dark Sky Association (IDA) and the Illuminating Engineering Society (IES), which has upgraded to a new framework for design and system ratings called BUG, which stands for Backlight, Uplight, and Glare. The BUG rating system is more comprehensive in controlling light pollution. Today, luminaires have a BUG rating that is comprised of the luminaire design, what direction(s) the light is aimed, and the initial luminaire lumen. The BUG system is designed so it is fast and easy to compare lights. The BUG system also includes the distance the

light is installed from a property line based on multiple of the mounting height.

Figure 7.4 shows the dark sky compliant approach for lighting, which would applicable to park and ride areas (International Dark Sky Association, 2020).

At the shuttle stop location adjacent to the Old Faithful Inn, lighting from the building and parking area may be sufficient to partially shed light toward the shuttle stop area. Again, shuttle riders would be using the system during daylight hours, so more intensive lighting would not be needed. If the park determines it would be helpful to visitors to provide a very low level of lighting along the path to the stops, low profile bollard lighting, shielded to prevent light pollution, could be considered. Electricity service could be extended from the system in the vicinity or operated through a solar battery system.

In West Yellowstone, streetlights would provide partial lighting over the shuttle stop locations, and again, because the system will be operating in daylight hours, specific lighting at the stops is not necessary or recommended due to dark sky considerations. If a park and ride surface parking area is constructed, there could be a need for lighting to support visitor use and security during early morning or evening hours.

In this case, dark-sky-compliant lighting fixtures should be used, in compliance with International Dark Sky Association (IDA). Shielding is the most effective means for controlling light pollution. Shielded light points downward and full cut-off shielding blocks upward light above 90 degrees. The following graphics depict what the light fixtures look like with shielding and how shielded sources can reduce glare and uplighting.

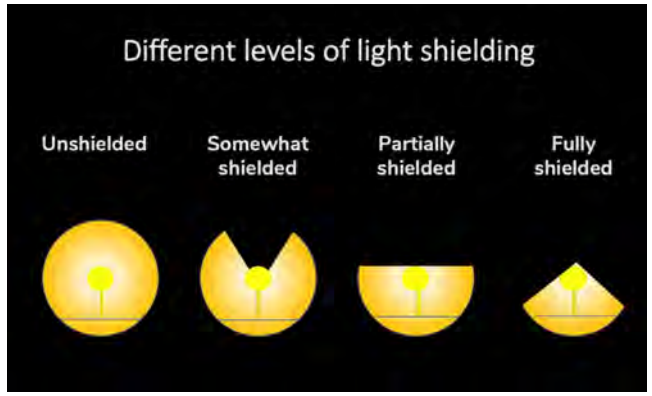


Figure 7.4—Different Levels of Light Shielding

(Source; Earth Law Center, 2021)

Provide Attractive Signing and Wayfinding Elements—Because of the importance of avoiding intrusions on the scenic experience of Yellowstone, it will be important to find the right balance for signing associated with shuttle stops—enough to help guide visitors, but not too much so as to create visual clutter.

A certain amount of signing is important to help visitors understand where they are waiting and where they are disembarking to. There is the potential to include signature architectural elements, such as a human scale vertical column or through the material and color used at the shuttle stops, and this will reinforce intuitive wayfinding and recognition of the shuttle system, "Oh, I see the shuttle stop over there…let's head in that direction."

Shuttle stop signs with colors and numbers can help to identify certain routes and keyed to maps can orient visitors in trip making and how to get to certain locations in the park. All signing must be designed in accordance with NPS standards.

Refer to the collection of images in Figure 7.20 as well as Figure 7.22 for suggested design concepts and options for identity signing .

Enrich Visitors' Experiences through Interpretive Programs and Displays—Interpretive displays can be included in the program of the shuttle stop improvement areas. This was done as part of the Zion Canyon system implementation, with more expensive interpretive and informational displays at the primary shuttle hubs and visitor center and just a few signs at individual stops inside the park. Refer to Chapter 6 for more information related to the benefits of providing interpretation at shuttle stops and onboard the vehicles.

Visitor enjoying scenic view and interpretive panel at Zion National Park

(Source: Flickr/Jared, 2019)

Shuttle stop at Grand Canyon National Park
(Source: BlueBell/Alamy stock photo, n.d.)

Shuttle Turning Geometry

Design geometry and turning radius dimensions for bus turn arounds are important to understand when retrofitting or creating new shuttle circulation and service areas. The diagrams shown in Figures 7.5, and 7.6 illustrate design standards for bus turn around areas, referencing the standards and guidelines of multiple transit agencies. For a 40-foot-long bus, as recommended for the Yellowstone shuttle system, the minimum inside turning radius is 28 feet and the minimum outside turning radius is 50 feet, as shown in Figure 7.5.

Concrete Pads for Bus Loading Areas

Shuttle loading areas in the roadway are subject to a high amount of use and wear and tear related to the weight of the buses and wheels turning. Most transit agencies recommend that these areas be paved in concrete, creating a "concrete pad" in the road next to the shuttle platform area (pedestrian waiting area). Concrete will withstand the wear and last longer than asphalt, resulting in less long-term costs for pavement rehabilitation. Figure 7.7 provides a typical cross section for a shuttle concrete pad.

	Radius (R1) of inner rear wheel	Radius (R2) of outer front corner
Minimum	28'	50'
Desirable	30'	55'

For 40' vehicles and articulated vehicles

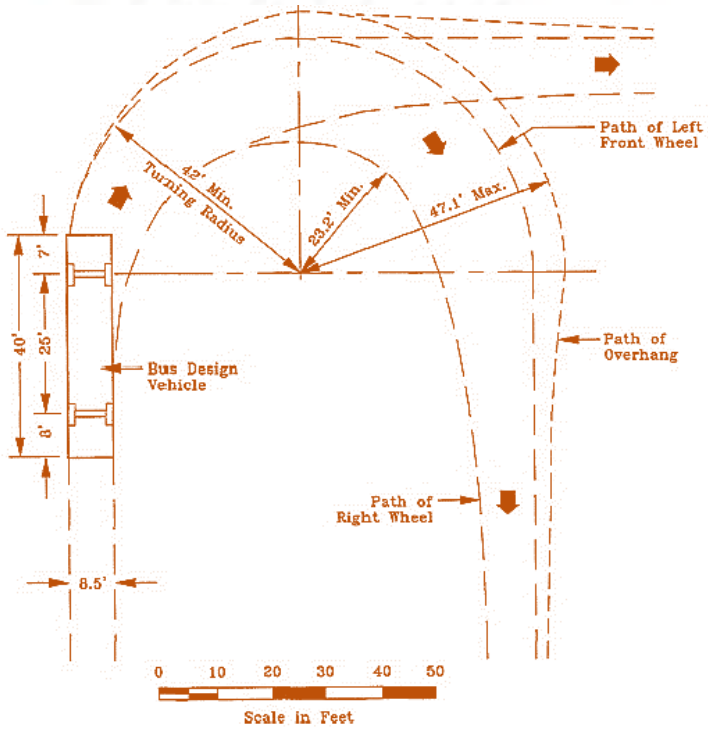


Figure 7.5—Bus Turning Radii for 40-Foot and Longer Buses

(Source: Transit Facilities Design Manual SunLine Transit Agency, 2006)

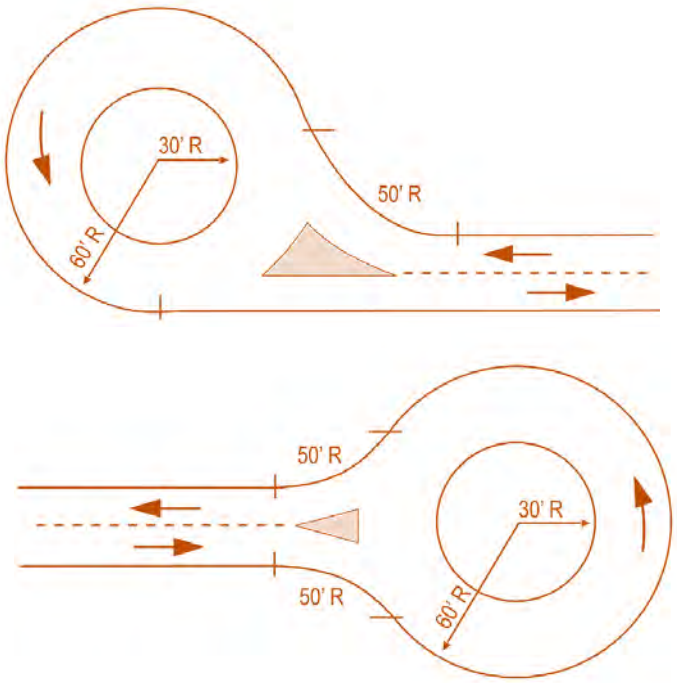


Figure 7.6—Design Dimensions for Cul-de-Sac and Loop Turn Arounds for 40-Foot and Longer Buses

(Source: Transit Facilities Design Manual, SunLine Transit Agency, 2006)

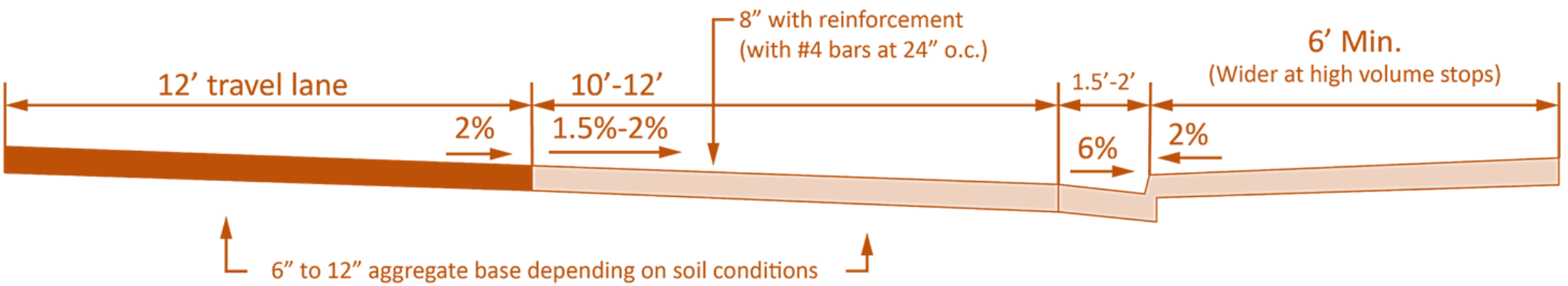


Figure 7.7—Concrete Bus Pad Cross Section and Dimensions

(Source: Bus Stop Design Guidelines from the Riverside Transit Agency, 2015)

Bus Platforms for Service by Multiple Shuttles

At a shuttle stop where several services may converge and where buses congregate (lay over), multiple bus bays or spaces are typically needed, along with areas where passengers boarding or alighting the bus can take refuge. Two typical options for design of these areas are parallel curb lines and sawtooth curb lines (Washington State Department of Transportation/ WSDOT, 2015).

Figure 7.8 shows typical parallel and sawtooth designs for parking 40-foot-long buses for passengers boarding and alighting at a platform. The sawtooth design does not require buses to arrive or depart in any order and provides more space-efficient berthing, while the parallel design shown may require that buses arrive and/or depart in order. In the design of parallel bus berths, additional roadway width is needed for swing-out maneuvers if shorter bus loading platforms are utilized.

The roadway width and the amount of lineal space required at the bus platform are directly related where designs allow departing buses to pull out from the platform around a standing bus. The shorter the berth length allowed, the wider the roadway. Designers should use turn simulation software (such as AutoTURN®) to verify the design.

Other benefits of the sawtooth design include:

- Well defined stopping space recognizable to drivers and passengers (particularly when the stopping edge is curved, but also when straight).
- Configuration allows buses to easily pull out and around other parked buses with better visibility than parallel arrangements (see Figure 7.9).

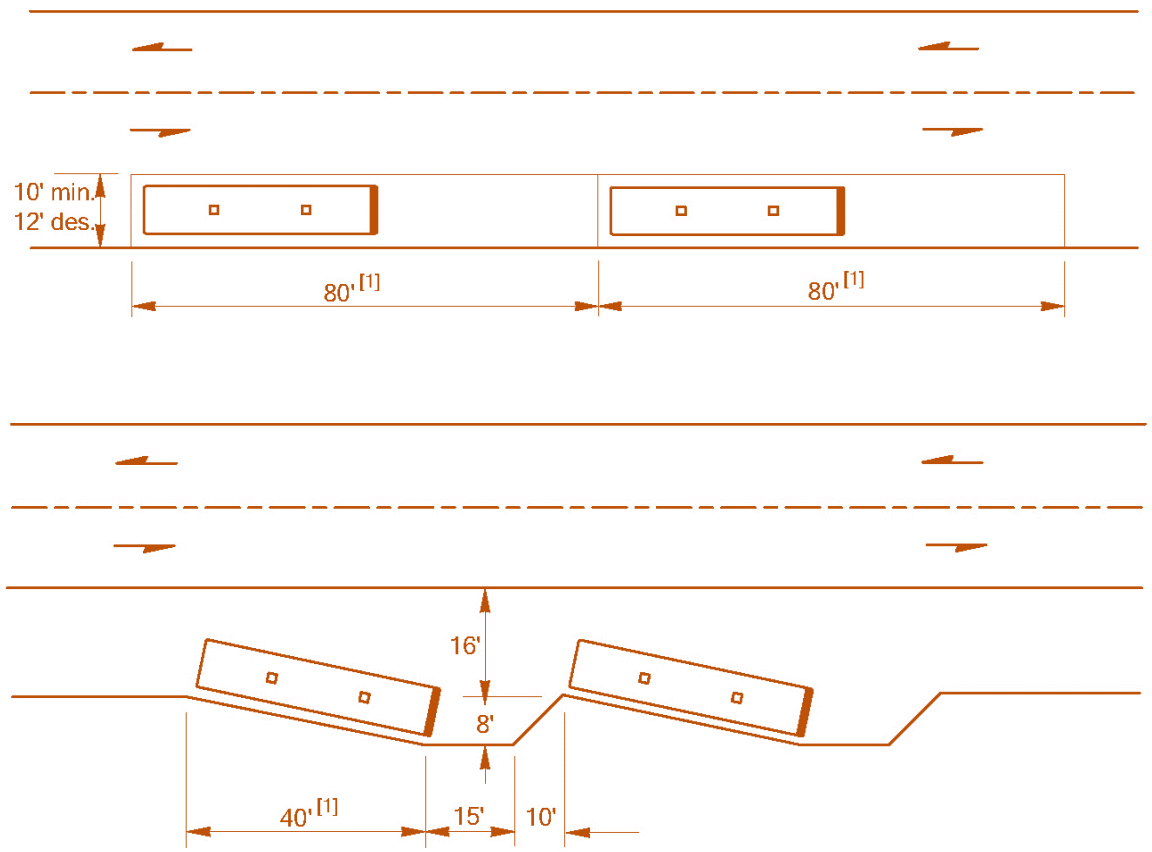


Figure 7.8—Parallel and Sawtooth Bus Platform Designs

(Source: WSDOT Transit Facilities Design Guidelines, 2015)

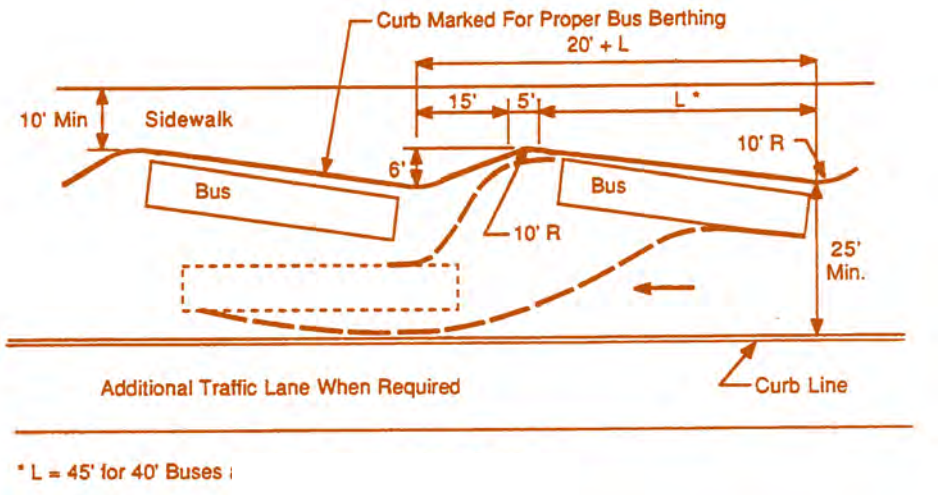


Figure 7.9—Bus Movements and Dimensions for Sawtooth Curb Line

(Source: Bus Stop Design Guidelines of the Riverside Transit Agency, 2015)

Figures 7.10 and 7.11 are examples of a platform design that has a combination of parallel and sawtooth bus berths at a platform that could serve multiple buses, such as for a shuttle terminal or transit center.

An important aspect in multiple bus stop locations is proper signing and marking for the bus bays for both operators and passengers. The route or service provided relevant to each bus bay should be clear. Separate layover bays needed for terminating bus routes also can be accommodated in these designs. Projects should consider future service plans and maximize flexibility in the design of transit center bays and circulation (WSDOT, 2015).

Jug Handle Shuttle Stops

"Jug handle" shuttle stop configurations are pull offs along the main road, designed with safe geometry for entering and exiting the roadway and with a center island/buffer area. Figures 7.12 and 7.13 on the next page show typical jug handle configurations—7.12 is for a single bus and 7.13, the elongated version could be designed at any length to accommodate multiple buses

A benefit of jug handle shuttle stops in national parks is that the island buffer space can be planted with native vegetation, which will help to screen the shuttle stop from view and provide a buffer from the main road. This configuration for pull off areas is commonly used throughout national parks, and there are already several pull offs in Yellowstone designed in this way. Some of these may even have the potential to be used as is or slightly reconfigured for shuttle stops.

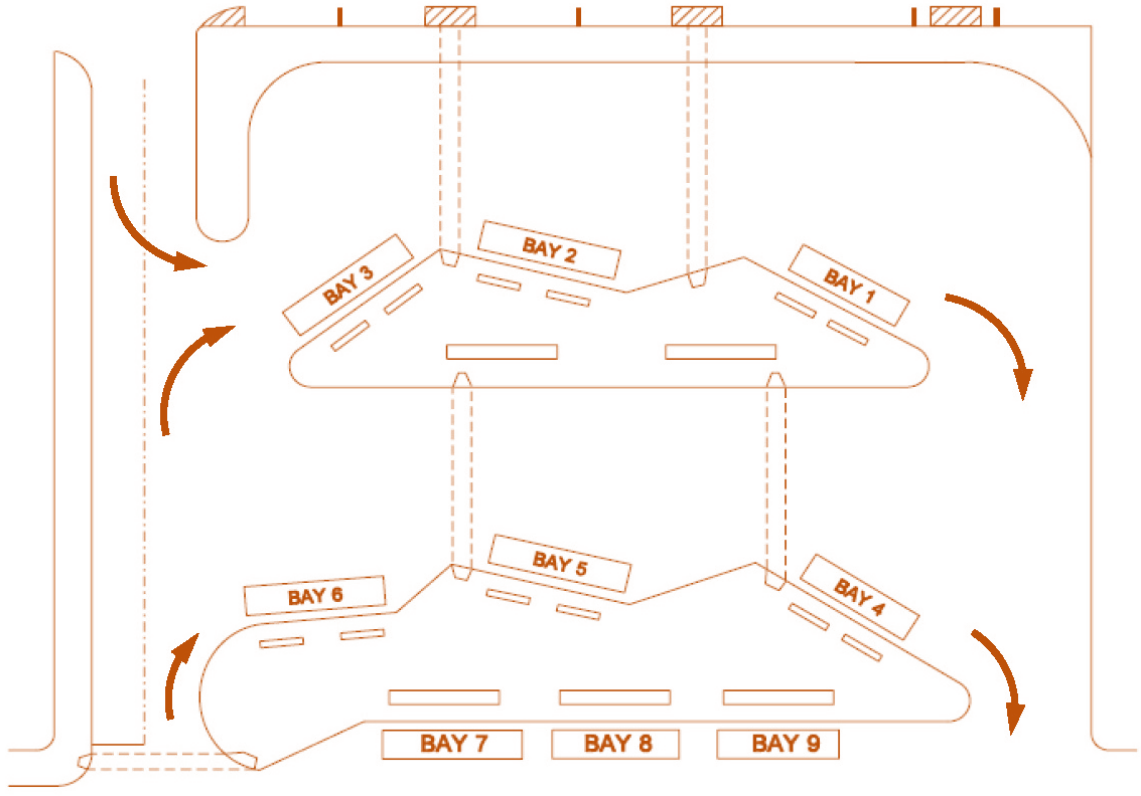


Figure 7.10—Combination Bus Bay Configurations at Shuttle Terminal or Transit Center

(Source: WSDOT Transit Facilities Design Guidelines, 2015)

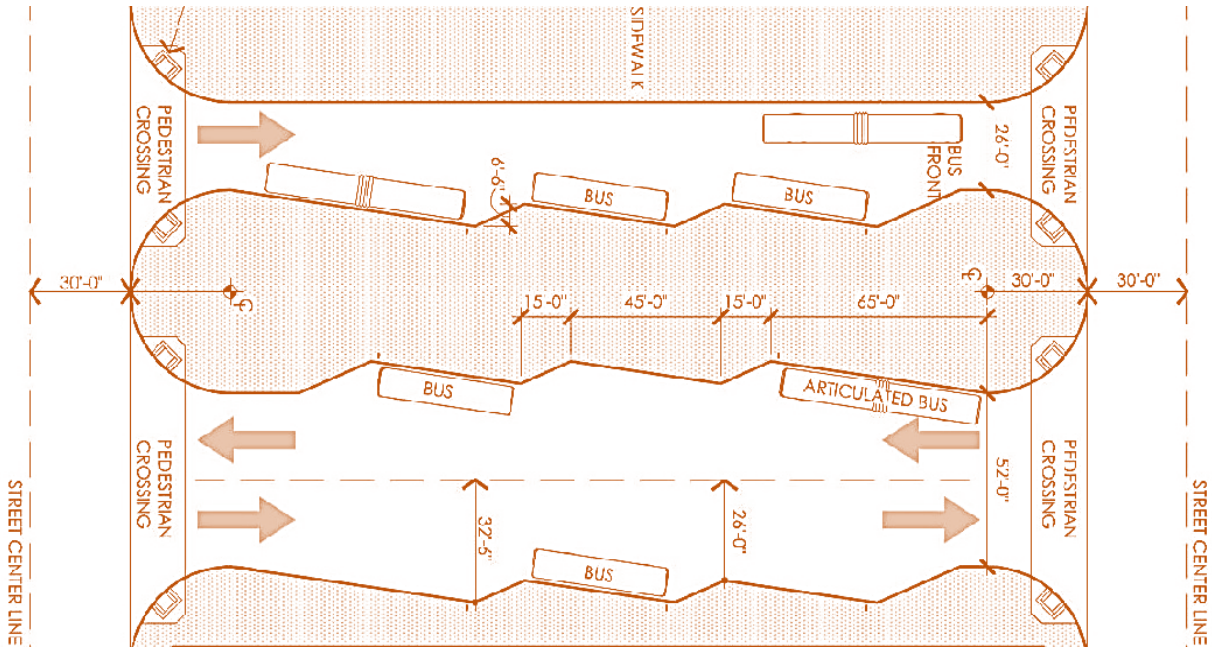


Figure 7.11—Multiple Bay Bus Platform Design Example

(Source: Bus Stop Design Guidelines of the Riverside Transit Agency, 2015)

Roadside Pull Off Areas

Roadside pull off areas (also called turnouts) require consideration of speed of travel, sight distance, and the capability for the bus to pull out of and back into the stream of travel with ease. Figure 7.14 shows several examples of roadside buss pull off designs.

Along the West Entrance Road and Grand Loop Road at Yellowstone there are already various pull off areas that provide space for vehicles to pull out of traffic. In some cases, these double as viewpoints. It may be possible to repurpose some of these existing pull off locations for shuttle use as long as a safe pedestrian pathway can be provided from the shuttle stop to the destination where visitors are heading.

On some roadways that are low volume, buses stop "in line" or "in lane" meaning that buses stop right in the traffic lane with out having to pull off. The advantage is that the buses do not need to pull back into traffic after dropping off and picking up passengers. Zion Canyon shuttle has some stops like this (see photo below). However,

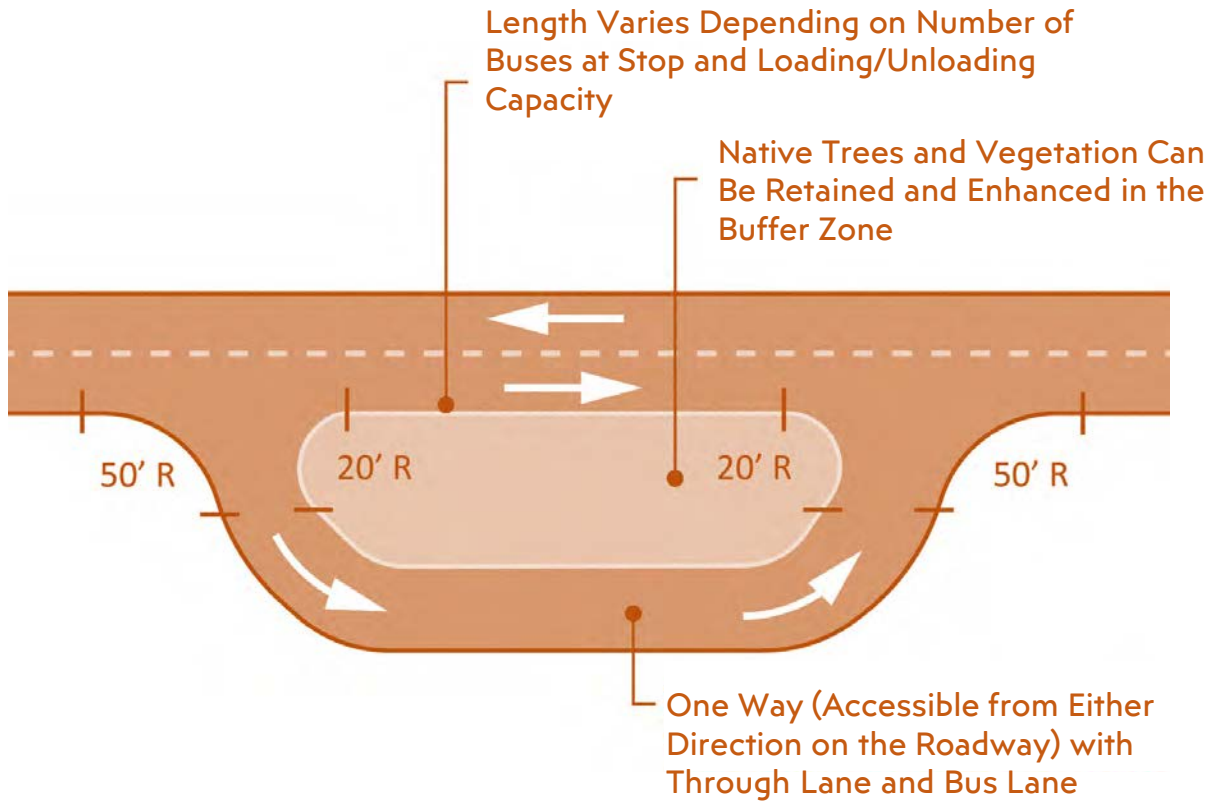


Figure 7.12—Elongated Jug Handle Bus Stop Design Configuration and Dimensions
(Source: Transit Facilities Design Manual, SunLine Transit Agency, 2006)

Zion Canyon Shuttle – example of in line stops
(Source: St. George News, 2009)

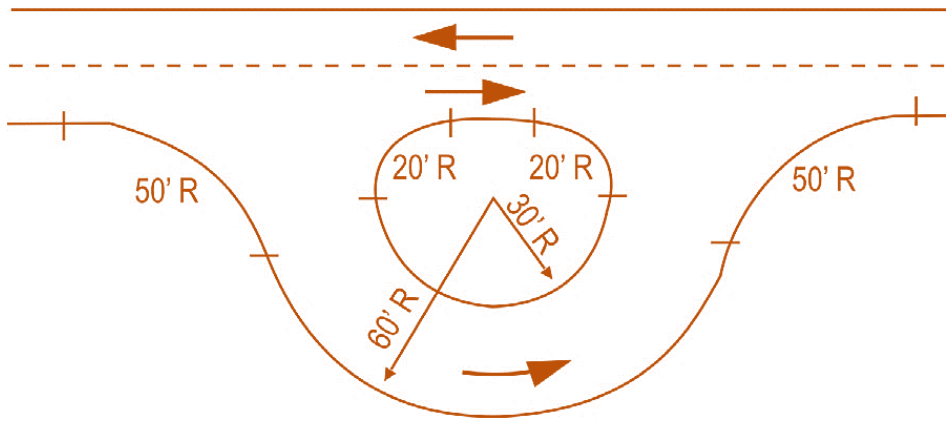


Figure 7.13—Jug Handle Bus Stop Design Configuration and Dimensions
(Source: Transit Facilities Design Manual, SunLine Transit Agency, 2006)

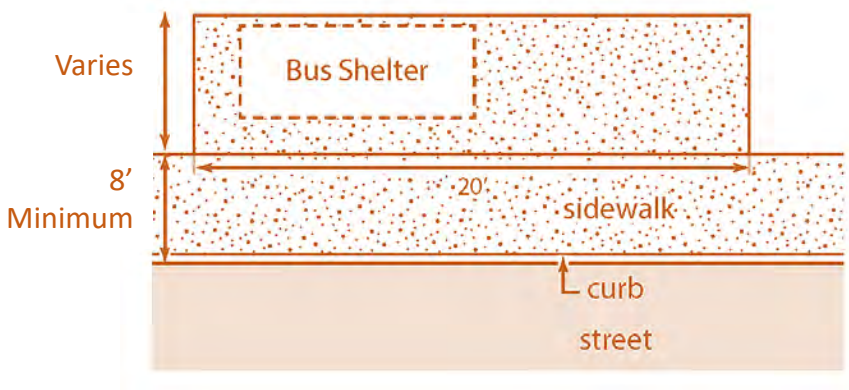
most likely any bus stops at Yellowstone would need to occur in safe pull off areas, jug handles, end loops of parking areas, and other wayside locations due to the heavy traffic on the main park roads.

Pedestrian Platforms Next to Stops

The pedestrian space where shuttles unload and load is called the platform. In most cases, this is designed to a height that buses can align with for unloading while also being accessible to surrounding sidewalks and pathways. Buses typically carry automated ramps that allow people in wheelchairs to seamlessly deboard the vehicle onto the adjacent sidewalk. See Figure 7.15.

Pedestrian waiting platforms and transit plazas can be designed in variety of configurations and sizes. Larger areas will serve multiple buses at once, such as at a shuttle terminal, while some stops may be designed to accommodate one bus at a time with a single shelter.

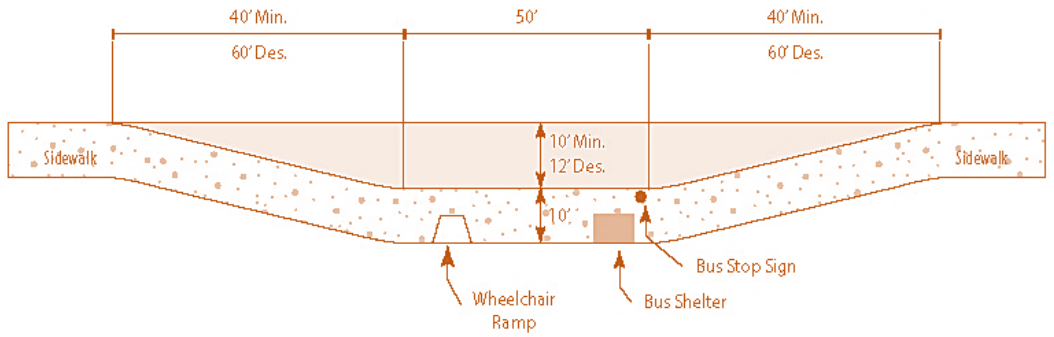
Portland cement concrete pavement is desirable for pedestrian platforms and spaces, for longevity and ease of cleaning. An additive integral color and sand blasting of the surface would help blend the pavement into the park surroundings.



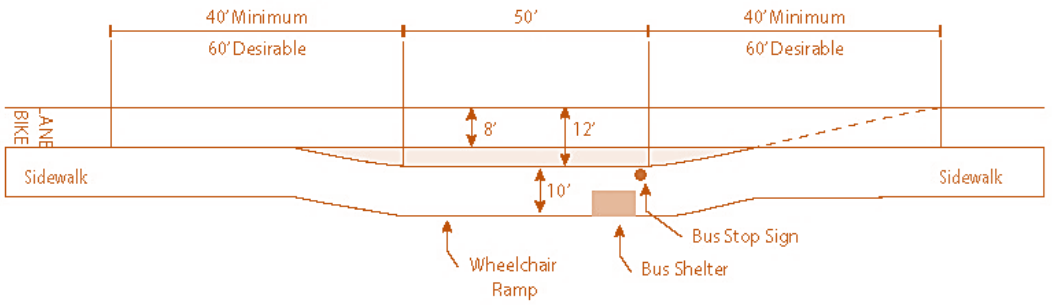
Figures 7.15—Pedestrian Area and Shelter Dimensions

(Source: Bus Stop Design Guidelines from the Riverside Transit Agency, 2015)

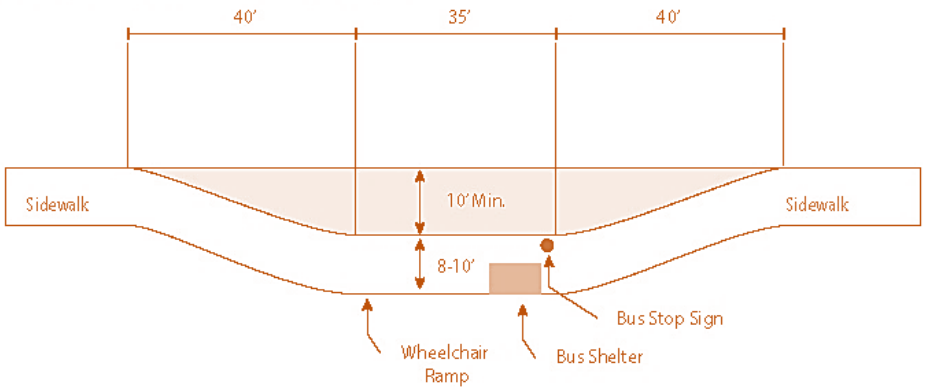
Design Parameters for Large Bus Turnout



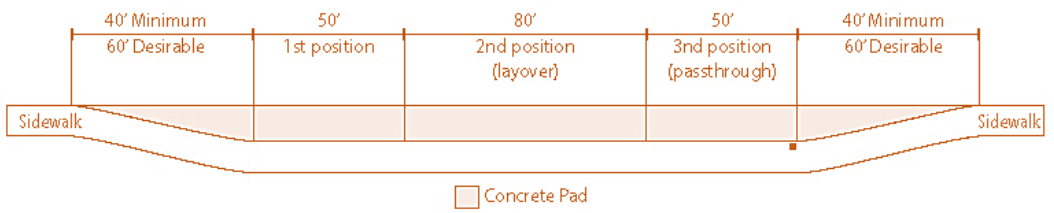
Design Parameters for Large Bus Turnout Adjacent to a Bike Lane



Design Parameters for Van Turnout



Design Parameters for Multiple Berth Bus Turnout



Figures 7.14—Typical Roadside Shuttle Bus Pull Off Areas

(Source: Bus Stop Design Guidelines from the Riverside Transit Agency, 2015)

A "Kit of Parts" Approach to Shelter and Stop Design

A design style that is simple, yet attractive can blend into any setting, and as such architectural design of the shuttle stop shelters should be simple in form, minimalistic, and of a style that will not take attention away from the epic scenery and viewsheds at Yellowstone. Clean lines, a shed roof, and a minimal number of columns will help the shelter appear more transparent and less dominating in the landscape.

Figure 7.16 shows the various elements that make up a "kit of parts" approach to shuttle stops. Using a "kit of parts" approach to the shelter design and other elements in the shuttle stop area will allow the design to adapt to available space at each location and accommodate varying levels of passenger queues. For example, the design can be expandable to provide one shelter or multiple shelters, depending upon the location (see Figure 7.18). The columns, seating, wind screens, and other elements can be designed to fit in different configurations depending upon the direction of wind and weather conditions specific to each site.

Another advantage of the kit of parts approach is that shelter and stop components can be easily replaced. Additional components can be ordered and stored for immediate replacement needs. This will help to reduce operating costs and ensure longevity and sustainability of the shuttle stop areas.

Figure 7.16—Kit of Parts for Shuttle Stops and Shelter Components

(Source: Roberts and Shelby, based on adapted transit shelter designs by Otak, 2021)

Each stop should be equipped with a shelter (or multiple shelters if multiple buses may be stopping at once, such as at shuttle terminals), seating, wayfinding/identity signs, wind screens, maps of the area and shuttle system/stops, and potentially bicycle racks and trash/recyclable receptacles.

Context sensitive design is a focus of the proposed concepts developed as part of this project. The use of weathered steel (typically a rust color) or powder coated painted steel (dark brown) for columns and support beams is envisioned. This coloring will help to blend shelters into the surrounding setting.

The roof could either be standing seam metal (painted in same color as columns) or could be designed to support shatter proof glass panels that also could include integrated photovoltaic solar panels to generate energy for low level lighting at the shuttle stop. The structural design of the shelter would be sufficient to support snow loads and would include a pitch in the shed roof that directs snow and rain toward the back of the shelter.

Concrete seat walls are integrated into the shelter design, and separate low height rock-faced seating walls in the stop area provide ample seating for visitors and help to guide them toward desired pathways to attractions. See Figures 7.19 and 7.20.

Trash and recycling receptacles, if provided, should be bear/wildlife proof.

Bicycle racks could be provided at some locations where people may be bicycling between sites. The shuttle stops could serve as mini transportation hubs for alternative modes (transit, hiking, and bicycling). At some locations, provision of bike rental stations could be considered. See Figure 21.

Transit shelter designed by Otak, Inc. for the Scottsdale Road Corridor in Scottsdale, Arizona using the Kit of Parts approach—note that the roof incorporates solar photovoltaic panels for to generate energy for lighting

(Source: author; Otak designed transit shelter, 2015)

Wind screens are typically provided as shatter proof glass sheets, which can be etched, stenciled, or appliqued with maps of the park (specific sites of the shuttle stops), photographs, and other designs. The NPS arrowhead can be integrated into the design. See Figures 7.17 and 7.18.

This project envisions that pedestrian area pavements would be Portland cement concrete with integral color with either a gritty sand finish or light broom finish for good traction. The design approach would incorporate Universal Design best practices—maximizing accessibility for everyone and would comply with all federal accessibility design requirements.

The conceptual design illustrations throughout this chapter show various ideas envisioned for the geyser basin corridor as part of the design work on this project. These are preliminary, and design development is needed to further evolve these concepts.

In addition, more input is needed from the NPS and Yellowstone National Park staff to help shape and further develop these concepts. The design process will benefit from input from an integrated team of landscape architects, engineers, architects, scientists and resource specialists, and other experts.

The best design outcomes are always collaborative and developed as a result of an integrated team working together.

Figure 7.17—Perspective Vignette of Shuttle Stop in the Geyser Basin Corridor
(Source: Roberts and Shelby, 2021)

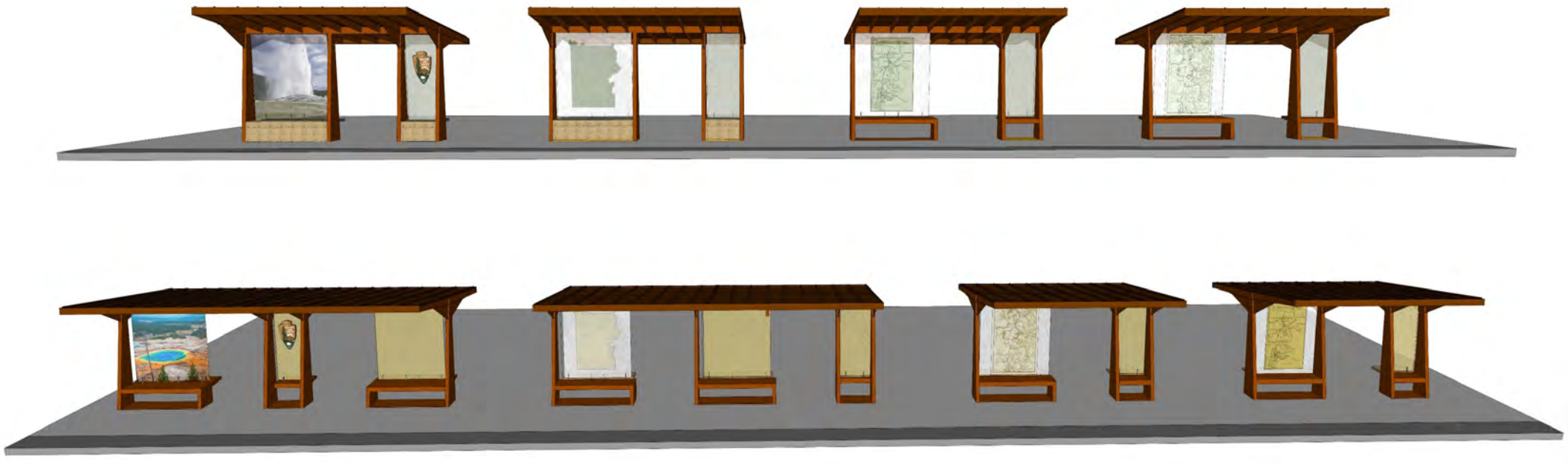
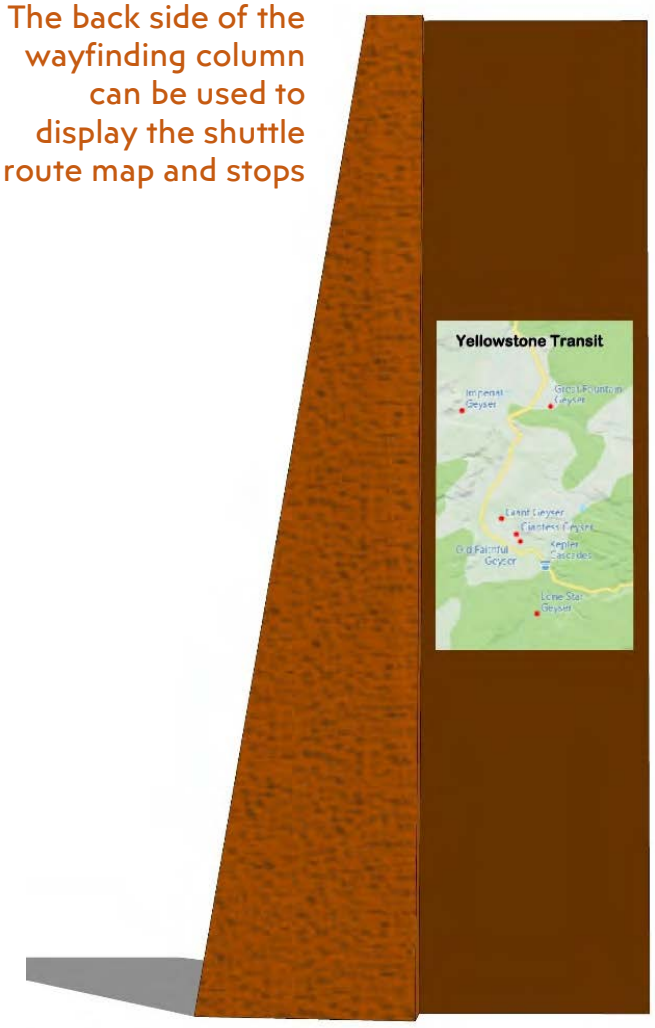


Figure 7.18—Kit of Parts Shelter Configurations—Shelters Can Be Expanded with Different Spatial Dimensions between Columns
(Source: Roberts and Shelby, 2021)

Figure 7.19—Seating Wall—Potential Construction in Different Lengths and Configurations in the Transit Stop Areas
(Source: Roberts and Shelby, 2021)

Design options for wayfinding signs at the shuttle stops (weathered steel or rock-faced concrete column to match seating walls)

The back side of the wayfinding column can be used to display the shuttle route map and stops



Various configurations for wayfinding signs; the overall size, dimensions, materials, and level of detail can vary depending on the location

NOT TO SCALE

Figure 7.20—Collection of Wayfinding Sign Options, Some Could be Integrated with Seating Walls; Backside Display of Route Map and Stop Locations

(Source: Roberts and Shelby, 2021)

Figure 7.21—Conceptual Design Vignette—Some Stops Could Include Bicycle Racks
(Source: Roberts and Shelby, 2021)

Figure 7.22—Conceptual Design Vignette—Example of Shuttle Stop Sign in Context
(Source: Roberts and Shelby, 2021)

Midway Geyser Basin and Old Faithful Shuttle Stop Concepts

The design illustrations on this page and the following pages, in Figures 7.23 through 7.27 illustration concepts for the shuttle stop at the Midway Geyser Basin (Grand Prismatic Spring/Fairy Falls Trail) and the Old Faithful shuttle terminal, respectively. The Midway Geyser Basin stop would deliver visitors immediately to the Firehole River Bridge and Grand Prismatic Spring boardwalk system.

Figure 7.23—Bird's Eye Perspective View of the Midway Geyser Basin Shuttle Stop; Note Tree Preservation in Island Buffer Area

(Source: Roberts Shelby, and Schneider, 2021)

Figure 7.24—Perspective Rendering of the Midway Geyser Basin Shuttle Stop, Looking Northwest
(Source: Roberts, Shelby, and Schneider, 2021)

Figure 7.25—Perspective Rendering of the Midway Geyser Basin Shuttle Stop, Looking Southwest
(Source: Roberts, Shelby, and Schneider, 2021)

Figure 7.26—Bird's Eye Perspective Rendering of the Old Faithful Shuttle Terminal, Note Sawtooth Bus Bay Configuration
(Source: Roberts, Shelby, and Schneider, 2021)

Figure 7.2—Perspective Rendering of the Old Faithful Shuttle Terminal (See Closer View, Next Page)
(Source: Roberts, Shelby, and Schneider, 2021)

(Source: Roberts, Shelby, and Schneider, 2021)

8 Conclusions

Bison along the Firehole River

(Source: YegoroV/Shutterstock.com, n.d.)

Chapter 8—Conclusions and Recommendations

Summary of the Anticipated Benefits of Further Study and Implementation

A shuttle system in the geyser basin corridor would offer many benefits. Implementation would have the potential to reduce private vehicle volumes on roadways and demand for parking in the corridor by up to 25 to 35 precent or more with service at ten-minute headways and with a fleet size comparable to other parks with transit service over similar route lengths.

Coupled with private automobile access management in the corridor during the peak summer period, this would help to alleviate problems that visitors regularly encounter related to bumper-to-bumper traffic on the road, waiting in traffic to enter parking areas, circulating to find parking spaces, crowding at sites, and other frustrating experiences.

Passengers on the inside of a Zion Canyon shuttles—large windows provide great views of the park's extraordinary scenery

(Source: Leon Werdinger/Alamy stock photo, 2016)

On the resource protection side, a shuttle system with access management would reduce the amount of pressure on natural and built resources in the park. Overflow parking along roadsides of the Grand Loop and at the edges of parking areas would be reduced and better contained, minimizing impacts to vegetation, soil crusts, hydrothermal features, and habitat areas.

Audio programs, interpretive displays, visitor information exhibits, and materials disseminated as part of the shuttle program would further enhance the visitor experience and knowledge about the park, helping to build lasting, positive memories of Yellowstone with visitors and instilling a sense of stewardship.

With linked and expanded hiking and bicycling connections between shuttle stops, loop experiences, and exclusive shuttle rider access during the peak season to interesting places (such as Firehole Canyon and Firehole Lake Drive), visitors' experiences could be even further enhanced and recreational opportunities expanded at the park for first time visitors as well as those staying longer durations. More visitors potentially could enjoy car-free visits to Yellowstone with linkages to other transportation options throughout the region.

In addition to enhancing visitors' experiences and protecting park resources, there are a variety of other benefits and positive outcomes that could potentially be realized through implementation of the sustainable transportation solutions, including a shuttle system with connecting hiking and bicycling trails at Yellowstone, such as:

- Less overall vehicle miles traveled in the park, and thus less greenhouse gas emissions, pollutants, and noise generated, resulting in mitigation of climate change and improved air quality and natural soundscapes;
- Less demand for roadway and parking infrastructure and as such, less pressure to expand built improvements in sensitive areas and where resources severely limit development;
- Potential for reduced wildlife/automobile collisions and jams and improved safety on the roadways and in parking areas;
- Better capability to manage visitor interactions with wildlife and to convey more messages about safe behaviors in the park setting; and
- Visitors will have the opportunity to enjoy the park in a different way—as more relaxed passengers rather than frustrated motorists trying to drive the busy roads and find parking on hot summer days. As shuttle passengers, they'll be able to sit back, enjoy the view, and learn more about one of the most interesting and still mostly wild places in the world—Yellowstone National Park.

Unique experiences could be offered to shuttle riders exclusively, such as access to Firehole Canyon Drive or Firehole Lake Drive.

Current Study Limitations

This study provides background and a foundation that could support a more detailed feasibility study of potential shuttle operations at Yellowstone. While the study provides a comprehensive look at existing conditions in the geyser basin corridor and addresses potential shuttling options with hiking and bicycling connections, as well as a variety of planning and design considerations, the study has not fully explored the following topics. These topics should be further evaluated and considered in future studies, planning, and design phases if the park pursues implementation of a shuttling program.

- Whether or not the shuttle system is mandatory or voluntary for all or a portion of the summer season—there are advantages in setting an ideal visitation level for the corridor, given that intensity of use will continue to increase, along with congestion and crowding over time. Setting an ideal visitation level and managing to that level through shuttle system capacities and scheduling related to private automobile access management in the corridor could be a sustainable path forward. A visitor use management planning process could further explore the ideal visitation level for the geyser basin corridor (and other heavily visited locations in the park). With this approach, shuttle use would be mandatory during the times that the park is managing access and visitation levels in the corridor and could be voluntary at other times.
- Considerations related to implementation of the shuttle, whether voluntary or mandatory and the timeframes for voluntary vs. mandatory use should be addressed in more detail in the feasibility study.

  Throughout the year, there likely could be times when visitor use could be monitored and managed in a way that could allow both voluntary shuttle use and private automobile access in the shuttle-served corridor. Metering visitor traffic in the shuttle service area would require a gating system that could be monitored and controlled electronically, as touched on in Chapter 6, but the technical capabilities of how to do this and analytical outcomes need to be addressed more fully as part of future visitor use management planning and/or the shuttle feasibility study.
- Various options for shuttle routing should be further studied. The analysis in this project assumes that a potential location for the shuttle operations and maintenance base would be in West Yellowstone, outside the park and connected to a visitor park and ride facility, as well as potentially a town loop system. However, space may potentially be available inside the park, such as in the vicinity of Madison Junction and park facilities there, and/or in the Old Faithful complex.

  Since the primary attractions in the geyser basin corridor are located between Madison Junction and Old Faithful, the shorter route studied in Chapter 6, could operate back and forth between hubs at Madison and Old Faithful. There also could be the potential for park and ride at Madison with some expansion of the existing parking area near the amphitheater. Since Old Faithful is one of the

Shuttle bus terminal for the Grand Canyon South Rim shuttle service

(Source: John Crowe/Alamy stock photo, 2016)

lodging hubs in the park, guests who are staying there could ride the shuttle and leave their cars behind. Similarly, there is a large campground at Madison and campers could also ride the shuttle without needing a separate park and ride lot (leaving their vehicles behind at the campground). Further study and analysis could help to determine ridership potential with this shorter route inside the park, as well as potential shuttle use that might occur if people are driving from other origins (Jackson Hole, WY) and might be interested in parking at Old Faithful and riding the shuttle from there.

Avoiding the 14-mile leg of the shuttle routing from Madison Junction to West Yellowstone would reduce the length in miles and durations of service, decreasing annual operational costs of the system. That said, the Town of West Yellowstone is an important gateway community to the park and a likely place where shuttle employees might choose to live during the summer service period. In addition, there is a large potential ridership pool in the town given the extent of lodging and camping facilities and visitor services there. If there is no connecting route to town, visitors staying in West Yellowstone would need to be willing or required to park and ride the shuttle from an in-park parking area. Whereas access to the system in West Yellowstone may naturally encourage a greater level of ridership and may offer partnership and private business opportunities that an in-park shuttle system may not. So, there are pros and cons to be further analyzed, and as such, the potential for a connecting shuttle route to and from West Yellowstone is something that should continue to be evaluated on an ongoing basis if shuttle service is implemented in the park. Even if shuttle operations and services are contained within the park, ongoing communication and coordination with Town representatives on inter-related park/town transportation issues will be important.

Visitors at the Brink of the Upper Falls in the "Grand Canyon of the Yellowstone" area, another location that the park intends to study to determine the potential feasibility of shuttle service

(Source: Craig Lovell/Eagle Visions Photography/Alamy stock photo, 2008)

- Other potential shuttle routes in the park should be considered, and the park has already begun to analyze the potential for a circulating/loop shuttle that would serve the Canyon area. With such a system, operations and routing likely would need to be separate from a geyser basin corridor system given the miles of distance between the two areas in the park and the associated operating costs and wear-and-tear on shuttles with traveling over that distance. That said, a short distance shuttle that would originate from Canyon Village and the lodging in that area (circulating in a loop providing access to popular North Rim Drive sites) could offer a unique experience for visitors while reducing levels of congestion, if private vehicle access and parking are managed concurrently with shuttle operations.

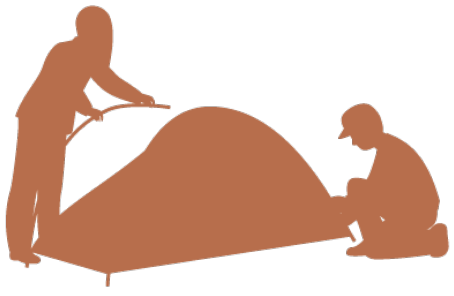
  With every shuttle routing scenario studied, the operating timetables and assumptions would vary, so it is recommended that a variety of scenarios (in addition to those evaluated in this project) be explored to determine the greatest advantages for operations and visitor experience. Ongoing analysis should examine various visitor itineraries and potential adjustments to the timetables to optimize service efficiencies.

- The maintenance and operations base for a park shuttle fleet will require careful planning and consideration. While briefly addressed in Chapter 7, more analysis is necessary to determine the appropriate location, sizing, and design of a base of operations for the shuttle system.

- Similarly, the potential for providing a large

park and ride area or multiple park and ride areas where visitors can leave their vehicles to access the shuttle should be further where there is extensive existing explored. Should this be located in West Yellowstone where there is the potential to capture a greater amount of shuttle riders near lodging and services? Or, should an in-park location be considered, such as at Madison Junction and/or Old Faithful (as mentioned earlier), where space and parking capacity may be available. What generators of ridership could help support a shuttle service terminating in these locations? Any of these locations could provide opportunities and advantages, as well as challenges, and as such these potential locations need to be further studied.

- How visitation patterns may change with provision of the shuttling system is an area of analysis that should be ongoing with further studies and potential implementation of the shuttle system over time. The Zion Canyon shuttle has become very popular and is an attractant to visitors in and of itself. Will this occur with a geyser basin corridor system, and how will the park manage the popularity of such a system that also would have limited capacity?



Campers at Madison would be able to easily hop on the shuttle to enjoy a car-free journey through the geyser basin corridor.

Yellowstone is a wild place—large animals roam free, and shuttle facilities in the park would need to be designed in a manner that does not change the habitat value for these creatures or the natural character of the park.

(Source: SED Travel Photography/Shutterstock.com, n.d.)

- Environmental impacts associated with implementing the shuttle system with hiking and bicycling connections—with implementation of any actions or improvements in a national park, projects are required to comply with the National Environmental Policy Act (NEPA). That process requires consideration and analysis of a reasonable range of alternatives and potential environmental effects associated with these alternatives, along with mitigation measures to ensure that environmental impacts are not significant and park resources remain unimpaired. The NEPA process and compliance with other applicable regulatory provisions would need to occur prior to implementation.
- Future planning and design should continue to explore and advance concepts for enhancing visitor experience and integrating improvements and amenities sensitively into the park's environment. Specific recommendations for repairing areas damaged by previous social trails activity associated with overflow parking and preventing future damage to resources from visitor crowding and congestion in the corridor should be addressed as part of future projects.
- Management of wildlife interactions—Yellowstone is a wild place. Predator species roam free, and while the geyser basin corridor is mostly inhabited by bison and elk, grizzly bears and wolves are known to roam

Rear-view mirror traffic jam at Yellowstone

(Source: Michael Vi/Shutterstock.com, n.d.)

through the area from time to time. This is an ongoing focus of management in the park and as discussed in Chapter 7, the shuttle may bring some advantages in better management of interactions with wildlife. Biological or social science studies with data-driven outcomes could evaluate the true potential of these advantages in the future.

And what about animal jams? Long back ups of traffic happen regularly at Yellowstone due to wildlife that are either in the road or roaming within view with visitors stopping to view and photograph them. These traffic jams occur intermittently and at unpredictable locations, which could affect shuttle schedules and efficiencies. This unavoidable occurrence in a place where wildlife roams free and its effect on shuttle system operations will need to be further reviewed. Although, it is important to note that visitor surveys have shown that Yellowstone visitors are willing to tolerate a certain amount of inconvenience to see wildlife (NPS, 2018).

- There may be opportunities that arise with the shuttle system, as well as unintended consequences, both positive and negative that will require adaptive management solutions. For example, will certain types of visitors prefer to ride the shuttle more than others? How will the shuttle work with families who have small children and may prefer to be near their personal vehicles? Will there be certain groups, such as wildlife watching enthusiasts, hikers, or sight-seers that fine more benefit in the shuttle system than others? These are questions that will need continue monitoring and evaluation.
- The selection of the type of shuttle vehicles and fueling/propulsion system will need further study and consideration. At a conceptual level, this study assumes that a 40-foot-long bus would be the predominant vehicle, carrying 42 passengers seated and potentially 18 more standing based on research of similar shuttles at Yosemite and other locations. Depending on the actual vehicle chosen, ridership modelling will need to confirm actual system carrying capacity. Fueling systems and access to fuel types should also be evaluated. The Yosemite buses are diesel-electric hybrid, which brings advantages related to reduced pollution and greenhouse gas emissions. Perhaps the same fueling system could work at Yellowstone, but this needs to be further analyzed.

  Characteristics of the vehicles are also important. The Zion Canyon shuttles have large side windows, which open up views of the extraordinary scenery of the park to passengers, and this would be a nice feature for a shuttle in Yellowstone as well. Places to carry/store gear while riding; whether or not the vehicles should carry bicycles; and whether a separate bicycle shuttle could operate and provide access to certain areas of the park—these also are topics that need to be further explored.
- This study does not fully address financial and operational feasibility, such as how the system would be contracted or operated, who would own and maintain the vehicles, and how the system would be funded. Capital and operating costs are not estimated in this study. While the study outlines potential options based on other national park models, additional analysis is needed to determine the best approach for Yellowstone and to identify potential partners who could support implementation.

  Evaluating a preferred operational and financial framework for the system will be important. This should be part of a feasibility study for shuttle services to/from and within the park, providing an in-depth understanding of capital investment and operating costs, potential concession and/or contracting mechanisms, partnership opportunities, and other factors. Is there a corporate partner or philanthropic organization that would be interesting in supporting a shuttle system at Yellowstone, similarly to LL Bean's support of the Island Explorer system at Acadia? These potential opportunities should be further explored.
- As addressed in Chapter 3 (page 23), there is a difference between urban and suburban transit systems and how these operate compared to in-park transit systems. Urban and suburban systems are typically designed to carry as many passengers as possible during the service period. In parks, the shuttle systems need to operate with scheduling and capacities that align with visitor use management objectives.

Will certain visitors be more likely to ride and enjoy the shuttle than others? Such as wildlife watchers, photographers, hikers, and sight seers?

There is a difference between the amount of visitors a shuttle system could accommodate and the amount of visitors that a system *should* accommodate given limitations on park resources, space, operations capacity, and other factors. This study does not address the desired visitor capacity of specific sites in the corridor. Analysis of the maximum number of people at one time that each site can accommodate is needed to determine how many visitors the shuttle system should deliver on an ongoing basis.

In spite of the many considerations related to a potential shuttle system that need further evaluation, this study has shown that there could be a variety of beneficial outcomes as a result of implementing shuttle service at Yellowstone, as summarized earlier in this chapter. To achieve the beneficial outcomes, visitor use management in the geyser basin corridor would be needed in parallel with shuttle service operations. This access management program could be focused on the geyser basin during peak periods of visitation, with monitoring, metering, and management of traffic to maintain the desired capacity of vehicles on the road and in parking areas, while also delivering visitors by shuttle.

This study has shown that there could be a variety of beneficial outcomes as a result of implementing shuttle service at Yellowstone.

Visitors along the Firehole River

(Source: Tami Freed/Shutterstock.com, 2014)

Next Steps

The NPS has already determined that it will proceed with a detailed transit feasibility analysis to evaluate potential shuttling options in the park. The NPS also has been exploring and testing a shuttle pilot program in the Canyon area.

A planned shuttle system feasibility analysis should address more fully the topics listed on this page and previous pages. As stated, this study has only been able to address many of the topics listed to a limited extent.

Typically, when a national park moves forward with planning an alternative transportation system, such as a shuttling program, a feasibility study explores how a range of issues would be addressed through system operations. Often, a pilot program to test the potential shuttling program occurs as part of the feasibility study process or directly following the study. This allows the opportunity to work through the initial orientation period, so visitors have time to become aware of the shuttle system and how it operates. Building visitor awareness of the system with promotion of the system and ridership incentives may be part of the pilot program. Piloting also provides time for working out any initial "bugs" that may occur in the first season or two of operations. Several previous shuttle feasibility studies for other parks have recommend that the pilot program extend for at least three years (NPS, 2014) in order to provide sufficient time for these purposes.

Conclusions

In summary, this project shows that implementing a shuttle program serving the geyser basin corridor could result in a variety of positive outcomes. However, more detailed analysis is needed to determine specific operational and financial models that might be feasible and how service could be implemented.

Overall, shuttle system operations could significantly reduce the number of vehicles and traffic congestion on roads and in parking areas. This also would result in less pollution, reduced greenhouse gas emissions, and less impacts to resources related to overflow parking.

The shuttle system would need to be designed with adequate facilities such as staging and layover areas, route termini, and a maintenance and storage headquarters area potentially in West Yellowstone or an in-park location. Attractive and convenient stops and facilities would need to be carefully designed to fit the context of the park setting.

Analysis completed for the *Sustainable Solutions for Visitor Access* project indicates that the shuttle system would provide a variety of beneficial outcomes. The three types of services—Express, Explorer, and Trekker—could operate singularly or in tandem, providing visitors with a variety of choices to access sites in the geyser basin corridor. Riding the shuttle would give visitors the opportunity to avoid the hassles of traffic congestion and overcrowded parking areas.

The shuttle system would reduce the number of private vehicles in the congested corridor by up to 25 to 35 percent or more assuming a 10-minute frequency of service and a fleet size comparable to other national parks operating shuttles on similar route lengths.

The shuttles could provide onboard visitor interpretation and be designed to deliver visitors to a variety of recreational experiences and sight-seeing attractions in the geyser basin corridor, including some areas that may not be accessible to private vehicles. Leveraging existing park trail and roadway systems, an interconnected network of hiking and bicycling routes could link with the shuttle system to further expand hike and ride and bike and ride opportunities.

Not only would the shuttle system enhance visitor experience, but parking areas would be able to operate at the capacities they were originally designed to accommodate. In addition, implementation could help to manage the number of people at one time at attractions, reducing crowding on boardwalks and trails, as well as undesirable off trail foot-traffic.

Yellowstone National Park has always been proactive in managing its resources and maintaining a high-quality visitor experiences over generations as part of achieving its mission as America's first national park—so that grandparents who take their grandchildren to the park can share the same experiences they once had as a child.

With the potential to offer a new, more sustainable way for visitors to access and enjoy the park through shuttling programs and linked hiking and bicycling loops, Yellowstone will be able to enhance visitors' experiences even more while also protecting the resources and wonders for which the park is world reknown.

Until we meet again...it won't be long.

(Source: Joshawa van Leeuwan/Shutterstock.com, n.d.)

Sapphire Pool in the Background, Biscuit Basin, Upper Geyser Basin

(Source: Jspannoff/Shutterstock.com, n.d.)

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One More Look at the Wonders of the Geyser Basin Corridor

(Source: AabHa Images/Shutterstock.com, n.d.)

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