YELLOWSTONE NATIONAL PARK

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Yellowstone National Park Transit Feasibility Study

for the Old Faithful-Madison Corridor and the Canyon Area

Yellowstone National Park Transit Feasibility Study

Old Faithful–Madison Corridor and Canyon Area

Prepared for the National Park Service

Prepared by VHB in association with Otak, Fehr & Peers,
and Dornbusch Associates

FINAL REPORT
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Executive Summary

Background and Purpose

Yellowstone National Park (Yellowstone) is a large, heavily visited, and iconic Western park with many road segments that facilitate park visitation and act as cogs in the wider regional transportation system. Focal park attractions are concentrated along these road segments. These focal attractions include hydrothermal features, scenic overlooks, roadside wildlife viewing, hiking opportunities, and developed areas providing visitor services.

Increasing visitation and changing patterns in visitor use have resulted in interrelated challenges related to protecting natural and cultural resources, preserving a high-quality visitor experience, maintaining public safety, and park facilities and operations.

Localized forms of alternative transportation, such as shuttle systems in focal park corridors, are consistently pointed to by park visitors and employees, the public and key stakeholder groups, and have been minimally explored in previous studies as possible ways to address park challenges. This study aims to assess whether transit services for the Old Faithful-Madison corridor and Canyon Village areas are feasible, and whether transit would significantly reduce traffic congestion, improve visitor mobility, and address key park concerns.

The National Park Service (NPS) retained the VHB team, consisting of VHB, Otak, Fehr & Peers, and Dornbusch Associates, to conduct a study that analyzes existing conditions, opportunities, risks, and constraints to assess whether transit is feasible for selected locations in Yellowstone National Park.

This feasibility assessment is limited to two study areas of the park:

- The Old Faithful-Madison Corridor, and
- The Canyon Area.

Project Process

This study took place from the spring of 2021 to the winter of 2022. The team initially conducted data analysis and forecasting to identify opportunities, risks, and gaps that could affect the design of transit system. This included an evaluation of the ridership market and reviewing the regional labor and housing market for transit staff. An existing conditions report was generated to document general field

conditions, including roadway infrastructure and operations, accommodating transit stops at key park destinations, and potential locations for transit maintenance facilities.[1]

To guide the development of transit concepts, the team conducted a transit feasibility workshop with key park members of the park to develop feasibility criteria and create a framework for the concepts. Based on the input from park staff, feasibility criteria were finalized, and the team developed seven initial transit concepts (four for the Canyon Area and three for the Old Faithful-Madison Corridor).

These initial transit concepts were presented to the park during a workshop session, in which feedback was given to guide refinement of those concepts. One initial transit concept was dropped from further consideration and others were adjusted to improve performance, reduce costs, and better address feasibility criteria. Additional details, analysis, and cost estimates were developed for all transit concepts.

The refined transit concepts were presented in a briefing to park staff and the comments and feedback from the briefing were incorporated into the final transit concepts presented in this report.

Transit Concepts

Canyon Area Transit Concepts

Concept 1: Transit/Bike/Hike Only on North Rim Drive and Transit and Managed Access on South Rim Drive. Key features include:

- Prioritization of multi-modal mobility on North Rim Drive.
- Two-way shuttle service, enhanced trail connections, and new bike infrastructure for visitors on North Rim Drive.
- No private vehicle access on North Rim Drive.
- Shuttle service and managed access on South Rim Drive.

Concept 2: Transit and Managed Access on North Rim Drive. Key features include:

- Shuttle service and managed access on North Rim Drive.
- Reversed direction of travel on North Rim Drive to support transit.

Concept 3: Transit and Managed Access for both North Rim Drive and South Rim Drive. Key features include:

- Shuttle service and managed access on both North Rim Drive and South Rim Drive.
- Reversed direction of travel on North Rim Drive to support transit.

[1] *Task 2 and 3 Technical Report: Data Analysis, Forecasting, and Existing Conditions Review*, January 2022.

Old Faithful-Madison Corridor (Geyser Basin) Transit Concepts

Concept 1: Express Route – Old Faithful to Midway Geyser Basin. Key features include:

- Direct shuttle service to Midway Geyser Basin from Old Faithful.
- Assumes managed access of the Midway Geyser Basin parking area.
- Park and ride location at Old Faithful.

Concept 2: Old Faithful to Fountain Paint Pot. Key features include:

- Shuttle service to Black Sand Basin, Biscuit Basin, Fairy Falls, Midway Geyser Basin, and Fountain Paint Pot.
- No managed access programs are assumed.
- Park and ride location at Old Faithful.

Concept 3: Old Faithful to Madison Junction. Key features include:

- Shuttle service to Black Sand Basin, Biscuit Basin, Fairy Falls, Midway Geyser Basin, and Fountain Paint Pot, and Madison Junction.
- No managed access programs are assumed.
- Park and ride locations at Old Faithful and Madison Junction.

Service Summary

The following table lists a summary of service characteristics and impacts for each concept.

Service Summary for Each Transit Concept

	Canyon Area Concept 1 Hike/Bike/ Transit Only on North Rim. and Transit & Managed Access on South Rim	**Canyon Area Concept 2** Transit and Managed Access on North Rim	**Canyon Area Concept 3** Transit and Managed Access on Both North Rim and South Rim	**Geyser Basin Concept 1** Old Faithful to Midway Geyser Basin Express	**Geyser Basin Concept 2** Old Faithful to Fountain Paint Pot	**Geyser Basin Concept 3** Old Faithful to Madison Junction
Potential Ridership	950,000 boardings	475,000 boardings	925,000 boardings	740,000 boardings	126,000 boardings	228,000 boardings
Annual Operating Cost	$2.2 million	$1.0 million	$2.1 million	$2.3 million	$1.1 million	$2.3 million
Cost per Boarding	$2.28	$2.06	$2.29	$3.03	$8.41	$9.96
Boarding per Hour per Bus	119	148	116	82	32	25
Capital Cost – Fleet	$13.7 million	$5.8 million	$13.7 million	$13.6million	$6.3 million	$13.6 million
Capital Cost - Infrastructure	$20.0 million	$10.2 million	$17.0 million	$18.0 million	$11.2 million	$17.6 million

Service Summary for Each Transit Concept (continued)

	Canyon Area Concept 1 Hike/Bike/ Transit Only on North Rim. and Transit & Managed Access on South Rim	**Canyon Area Concept 2** Transit and Managed Access on North Rim	**Canyon Area Concept 3** Transit and Managed Access on Both North Rim and South Rim	**Geyser Basin Concept 1** Old Faithful to Midway Geyser Basin Express	**Geyser Basin Concept 2** Old Faithful to Fountain Paint Pot	**Geyser Basin Concept 3** Old Faithful to Madison Junction
Parking Congestion Impact	100% reduction (North Rim) 20% reduction (South Rim)	30-40% reduction (North Rim)	35-40% reduction (North Rim) 20% reduction (South Rim)	100 spaces at Midway Geyser Basin (30-35%)	Negligible	Negligible
No. of Park & Ride Spaces	275-375 285 could be shared at Canyon Lodge. Requires up to 90 new parking spaces.	150-200 All could be shared at Canyon Lodge. No new parking spaces required.	250-350 285 could be shared at Canyon Lodge. Requires up to 65 new parking spaces.	200-230 spaces at Old Faithful	40-50 spaces at Old Faithful	40-50 spaces at Old Faithful 55-75 at Madison
Fleet	12 buses	5 buses	12 buses	11 buses	5 buses	11 buses
No. of Transit Staff	33	17	30	29	16	30
No. of Housing Units Needed	18 units	10 units	16 units	16 units	9 units	16 units
Maintenance Facility Footprint	5,100-square foot building 1.2-acre site	3,900-square foot building 0.7-acre site	5,100-square foot building 1.2-acre site	5,100-square foot building 1.1-acre site	3,900-square foot building 0.7-acre site	5,100-square foot building 1.1-acre site
Other Infrastructure Investments Required	New Trail, Widening of North Rim Drive, Parking at Canyon Village		Parking at Canyon Village	Parking at Old Faithful	Parking at Old Faithful	Parking at Old Faithful, Parking at Madison
Operational Requirements	Managed access for North Rim and South Rim. Parking management plan.	Managed access for North Rim. Parking management plan.	Managed access for North Rim and South Rim. Parking management plan.	Managed parking at Midway Geyser Basin		Parking attendants at Madison

Note: A breakdown of cost estimate elements for each transit concept are provided in Chapters 3 and 4. Information on the cost estimate assumptions is provided in the Cost Estimate Methodology appendix.

Criteria Findings

The assessment of each transit concept included consideration of the degree to which each could achieve the feasibility criteria set forth by the park. The matrix below presents an overview of how well each concept achieved the feasibility criteria defined by the park.

Feasibility Criteria Addressed for Each Transit Concept

	Canyon Area Concept 1 Hike/ Bike/ Transit Only on North Rim and Transit & Managed Access on South Rim	**Canyon Area Concept 2** Transit & Managed Access on North Rim	**Canyon Area Concept 3** Transit & Managed Access on Both North Rim and South Rim	**Geyser Basin Concept 1** Old Faithful to Midway Geyser Basin Express. Managed Parking at Midway Geyser Basin	**Geyser Basin Concept 2** Old Faithful to Fountain Paint Pot	**Geyser Basin Concept 2** Old Faithful to Madison Junction
Enhance Visitor Experience & Mobility	**Fully Met**	**Fully Met**	**Fully Met**	**Fully Met**	**Fully Met**	**Fully Met**
Maximizes Cost Efficiency and Productivity	**Fully Met**	**Fully Met**	**Fully Met**	**Fully Met**	**Partially Met**	**Minimally Met**
Reduce Parking Congestion	**Partially Met**	**Minimally Met**	**Minimally Met**	**Partially Met**	**Not Met**	**Not Met**
Reduce Roadway Congestion	**Partially Met**	**Minimally Met**	**Partially Met**	**Not Met**	**Not Met**	**Not Met**
Minimize Impacts to NPS Staff and Park Operations	**Not Met**	**Not Met**	**Not Met**	**Not Met**	**Not Met**	**Not Met**
Enhance Safety	**Partially Met**	**Minimally Met**	**Partially Met**	**Partially Met**	**Minimally Met**	**Minimally Met**
Minimize Infrastructure and Costs	**Not Met**	**Not Met**	**Not Met**	**Not Met**	**Not Met**	**Not Met**
Minimize Impacts to Resources	**Not Met**	**Minimally Met**	**Not Met**	**Not Met**	**Not Met**	**Not Met**

Following are some general findings about how well the transit concepts met the criteria.

- **All the transit concepts provided enhanced visitor mobility and experience.** Every transit concept had in common benefits such as providing an alternative means of access to popular destinations, access to destinations with limited parking availability and which a visitor might otherwise have to bypass, the potential for interpretive opportunities, and facilitating active transportation by creating ride/hike options.
- **Cost efficiency and productivity are maximized when transit concepts are paired with managed access.** All Canyon Area concepts and the Geyser Basin concept of an express route serving Midway Geyser Basin are paired with managed access. The potential ridership for those concepts would be very high. On the other hand, the Geyser Basin routes between Old Faithful and Fountain Paint Pot and Old Faithful and Madison were not, in large part, cost efficient because they carried relatively few people over very long routes.
- **Significant reductions in roadway congestion were more related to managed access than transit.** For example, the Canyon Area concepts included both transit service and managed access of North Rim Drive or South Rim Drive and while all those concepts would help reduce congestion on those roadways, congestion could be also controlled by just managed access, regardless of whether there was transit service.
- **Significant reductions in parking congestion were more related to managed access than transit.** Like roadway congestion, reductions in overflow parking and other parking congestion could not be achieved by transit alone and the reductions were primarily outcomes of managed access. Transit service could, however, supplement managed access programs by providing alternative access for visitors.
- **All transit concepts have broad impacts on NPS staff and park operations.** Transit is a complex operation at a park. And even small transit operations can involve a lot of park staff.
- **All transit concepts have substantial infrastructure needs and costs.** All transit operations require a park and ride location, housing for staff, and a place to garage, fuel, and maintain the bus fleet. Parking is a significant tradeoff since the size of the park and ride area needed by a transit service is at least double that of the number of spaces for which demand is reduced at a congested location.
- **The transit concepts often only minimally meet the criteria for minimizing impacts to park resources.** Transit can support a reduction in overflow parking and related impacts like social trails but have no significant reduction in vehicle miles traveled. All concepts require extensive infrastructure, most of which would be on developed area but nonetheless would have to be constructed.
- **Safety is improved, albeit sometime modestly. And the largest safety enhancements are related to managed access.** Transit does provide a good opportunity to reinforce safety issues with visitors, but it was typically the managing access to a busy parking lot or road that reduced traffic volumes and congestion.

1

Introduction

The National Park Service (NPS) retained the VHB team, consisting of VHB, Otak, Fehr & Peers, and Dornbusch Associates, to conduct a study that analyzes existing conditions, opportunities, risks, and constraints to assess whether transit is feasible for selected locations in Yellowstone National Park.

The transit feasibility assessment covers two high-visitation areas of the park: the Old Faithful-Madison Corridor and the Canyon Area. The evaluations are done separately for each study area since they are in distinct areas of the park and conditions and experiences a transit service might serve could differ for each study area.

This feasibility study explores the cost, benefits, and tradeoffs of several transit service options for each study area and those findings are assessed against following feasibility criteria, developed during pre-study park planning efforts and over the course of this study.

- Enhance Visitor Experience and Mobility
- Maximize Cost Efficiency and Productivity
- Reduce Roadway Congestion
- Reduce Parking Congestion
- Enhance Safety
- Minimize Impacts to NPS Staff and Park Operations
- Minimize Infrastructure and Costs
- Minimize Impacts to Park Resources

This is a feasibility study, not a plan, proposal, or decision-making process. Potential concepts would need to go through further planning, NEPA compliance, Section 106, design process and other steps.

1.1 Project Process

This study took place from the spring of 2021 to the winter of 2022. The team initially conducted data analysis and forecasting to identify opportunities, risks, and gaps that could affect the design of transit system. This included an evaluation of the ridership market and reviewing the regional labor and housing market for transit staff. An existing conditions report was generated to document general field conditions, including roadway infrastructure and operations, the ability to accommodate transit stops at key park destinations, and potential locations for transit maintenance facilities.[2]

To guide the development of transit concepts, the team conducted a transit feasibility workshop with park staff to develop feasibility criteria and create a framework for the concepts. Based on the input from park staff, feasibility criteria were finalized, and the team developed seven initial transit concepts (four for the Canyon Area and three for the Old Faithful-Madison Corridor).

A high-level evaluation of each concept was conducted to identify what would be required to implement a transit service in the two study areas, as well as to explore which concepts or concept elements may be particularly successful, what concepts or concept elements simply wouldn't be feasible, and what concepts might merit refining in more detail. These initial concepts were presented in a technical report[3] and to the park during a workshop session, in which feedback was given to guide refinement of the concepts.

One initial transit concept was dropped from further consideration and others were adjusted to improve performance, reduce costs, and better address feasibility criteria. Additional details, analysis, and cost estimates were developed for all transit concepts.

The refined transit concepts were presented in a briefing to park staff and the comments and feedback from the briefing were incorporated into the final transit concepts presented in this report.

Project Process Summary:

- Data Analysis, Forecasting, and Existing Conditions Review (July-September 2021)
- Evaluation Criteria Workshop Sessions (September 2021)
- Initial Concepts Development (September-November 2021)
- Concepts Review Workshop Sessions (November 2021)
- Decision Whether to Move Forward with Refinement of Concepts (January 2022)
- Concepts Refinement and Cost Estimates (June-November 2022)
- Project Briefing (December 2022)

[2] *Task 2 and 3 Technical Report: Data Analysis, Forecasting, and Existing Conditions Review*, January 2022.

[3] Task 4 *Technical Report: Initial Transit Concepts,* April 2022

2

Development of Transit Concepts

2.1 Canyon Area Transit Concepts

Figure 2-1 shows the study area for the Canyon Area transit concepts. Existing conditions, detailed in the first technical report for this study,[4] highlight congestion problems at the following locations.

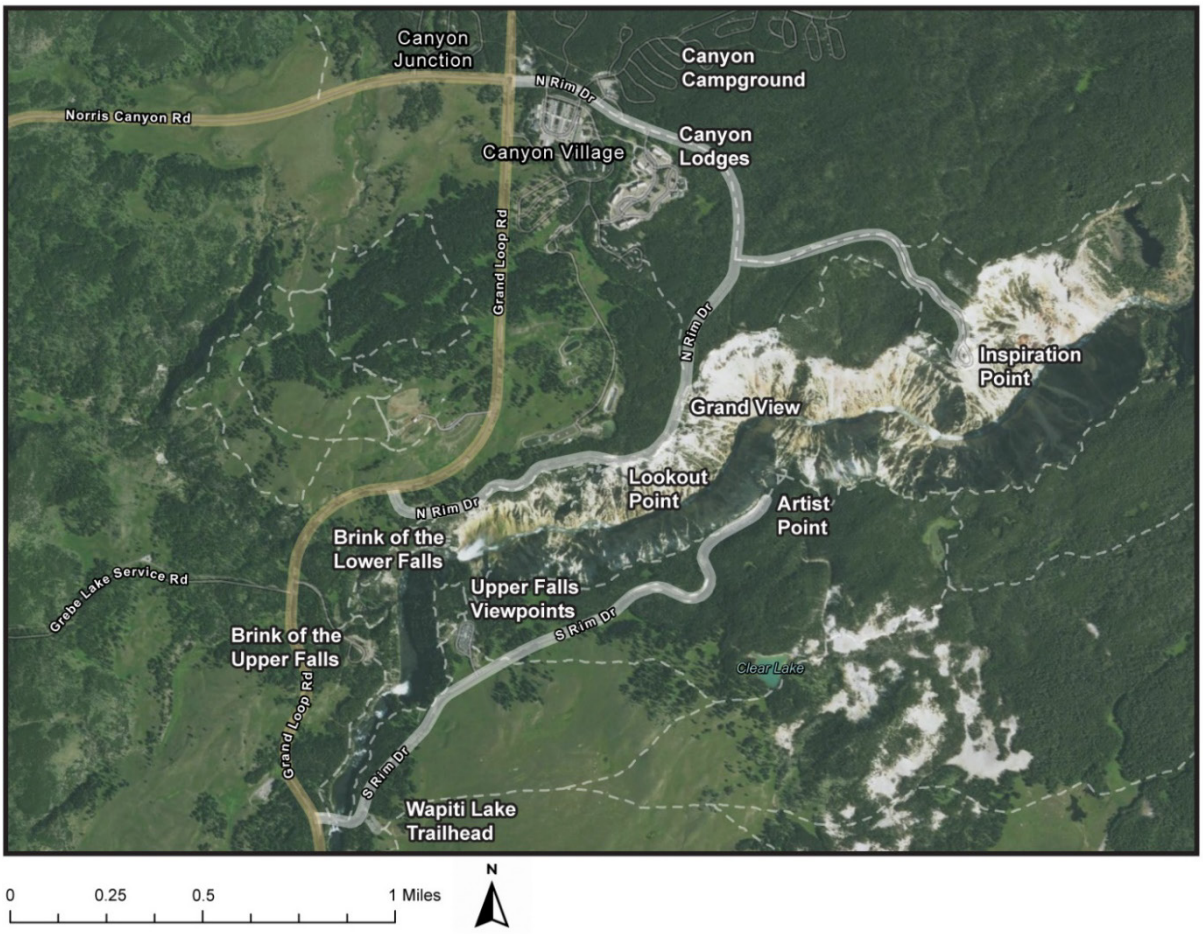
- Roadway congestion most frequently occurs at the Canyon Junction intersection, on Grand Loop Road at the entrance to North Rim Drive, and along North Rim Drive.
- Parking congestion is most common in Canyon Village and along North Rim Drive. Also, the Artist Point and Brink of the Upper Falls parking lots are heavily used and sometimes congested.

Four initial transit concepts were developed for the Canyon Area to explore how they might reduce congestion, improve visitor mobility, and address key park concerns.

A. North Rim Drive with transit service added to existing conditions
B. North Rim Drive with transit and managed access
C. North Rim Drive with transit and managed access and South Rim Drive with transit and managed access
D. North Rim Drive with transit with North Rim Drive closed to cars and South Rim Drive with transit and managed access

[4] *Task 2 and 3 Technical Report: Data Analysis, Forecasting, and Existing Conditions Review*, January 2022.

Figure 2-1: Canyon Area Context Map



A key finding from the evaluation of the initial transit concepts for the Canyon Area was that providing transit service without combining it with managed access would not be effective. Visits to the canyon rim viewpoints tend to be relatively short (previous studies indicate that the average time spent along the entirety of North Rim Drive is about 30 minutes) and transit does not compete well with the convenience of personal car use for such short trips. Because of this finding, initial Canyon Area Concept A was eliminated from further consideration.

Initial Concepts B and C were retained for further refinement. One refinement made to the concepts was to exclude access to Brink of the Upper Falls on South Rim transit routes. If Brink of the Upper Falls were included in a South Rim transit route it would require an additional bus operated on the route. The costs for operating an additional bus would be approximately $170,000 annually and initial capital investments would be about $1.7 million for the bus and housing for drivers.

Initial Concept D was retained for further refinement, with enhanced multi-modal options for the North Rim. The enhancements include a new trail connection between Canyon Lodge and the North Rim Trail and a redesign of the roadway to support bicycling. As with Concepts B and C, a stop at Upper Falls was excluded from the South Rim route.

The final transit concepts for the Canyon Area are presented in Chapter 3.

2.2 Geyser Basin Transit Concepts

Figure 2-2 shows the study area for the Geyser Basin transit concepts. Existing conditions, detailed in the first technical report for this study,[5] highlight congestion problems along the corridor as follows.

- The roadways and most parking areas of the Geyser Basin are over capacity on a regular basis. A mobility study[6] modeled roadway and parking conditions and found mid-summer traffic volumes were roughly 30% higher than roads and parking lots can comfortably handle.
- Overflow roadside parking routinely occurs near Fountain Paint Pot, Midway Geyser Basin, and Fairy Falls. There are frequently backups of cars waiting to enter the Midway Geyser Basin parking lot and NPS staff is often needed to direct traffic.
- The section of Grand Loop Road between Madison Junction and Old Faithful is subject to wildlife jams, particularly on the northern segment nearest Madison Junction, as well as localized delays and jams due to queuing of cars waiting to enter parking areas and the parking/unparking of cars along roadways.
- At Old Faithful there is often severe congestion on the approach to and within the parking lots approximately 30 minutes before and after eruptions of the Old Faithful geyser.

Three initial transit concepts were developed for the Geyser Basin study area. All three were retained for further refinement.

A. Old Faithful to Midway Geyser Basin Express, with managed parking at Midway Geyser Basin
B. Old Faithful to Madison, all stops
C. Old Faithful to Fountain Paint Pot, all stops

Geyser Basin Initial Transit Concept A was developed to test the outcomes of offsetting the need for approximately 100 parking spaces at Midway Geyser Basin. Congestion management at Midway Geyser Basin is an ongoing effort at the park and a managed access pilot is being considered.

Geyer Basin Initial Transit Concept B was developed to evaluate the use of Madison as an intercept park and ride location for those arriving to the corridor from the north and west. Old Faithful would also be a park and ride location.

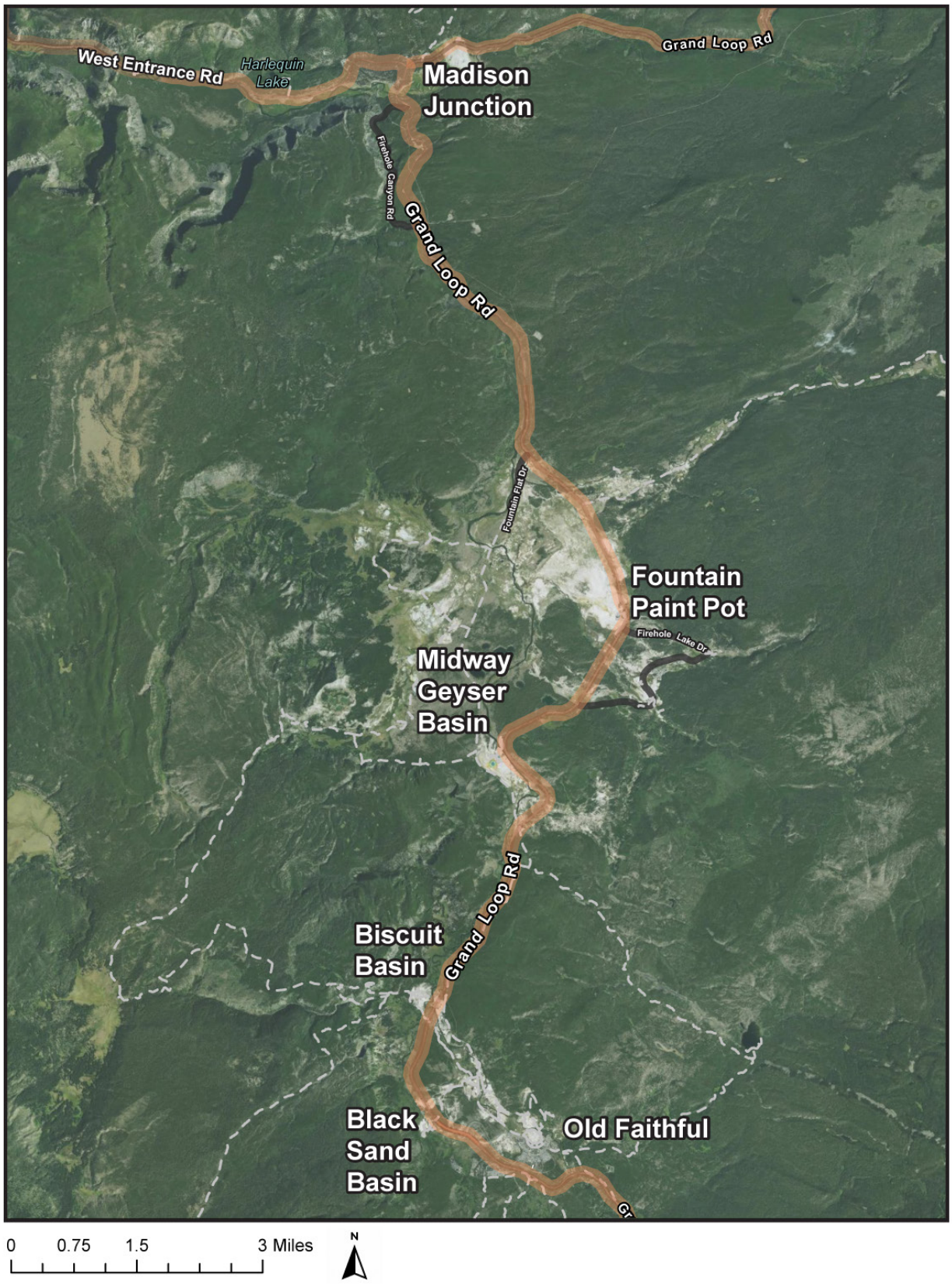
Geyser Basin Initial Transit Concept C was developed to assess options for providing transit connections between Old Faithful and high-visitation destinations along the corridor.

The final transit concepts for the Geyser Basin are presented in Chapter 4.

[5] *Task 2 and 3 Technical Report: Data Analysis, Forecasting, and Existing Conditions Review*, January 2022.

[6] *Transportation and Vehicle Mobility Study, Data Collection and Analysis*, June 2017

Figure 2-2: Geyser Basin Area Context Map



2.3 Ridership

A supporting technical report[7] for this study describes the approach to estimating the potential market for transit in the two study areas. The approach uses traffic volume data and travel pattern data from earlier transportation studies.[8] Traffic volume data are adjusted to 2021 visitation levels and only passenger car trips are considered.

The travel pattern data provides information about the origin and destination of visitor trips. This enables identification of trip patterns conducive to transit by eliminating pass-through and overshoot (trips passing in and out of a corridor) trips. The assumption is that people passing through would not take a shuttle just to later get back in their car and drive the same route again.

Other adjustments for ridership estimates include use of the park's standard vehicle occupancy rate of 2.7 persons per vehicle and consideration of the assumed operating hours for each transit concept. As the ridership estimates are for 2021 visitation levels, the estimates would be lower if visitation stabilizes to a level less than in 2021.

In this report ridership is presented as "boardings", as is typical for transit studies. Boardings are counts of each time a person boards a bus, not the number of unique riders of the bus. Each rider would make multiple boardings per day. For example, someone riding from Old Faithful to Midway Geyser Basin and back would be counted twice – once boarding at Old Faithful and once boarding at Midway Geyser Basin. Someone visiting two destinations along a bus route would be counted at least three times.

The potential ridership for the transit concepts evaluated in this study ranges from 126,000 to 950,000. For comparison, Table 2-1 lists the NPS bus transit systems that have more than 100,000 boardings annually. The data is shown for 2019, as ridership for 2020 and 2021 were generally less due to responses to the pandemic.

Table 2-1: Top NPS Bus/Shuttle/Tram System Ridership (2019)

Park	System Name	2019 Boardings
GRCA	South Rim Shuttle Service	7,644,331
ZION	Zion Canyon Shuttle	6,777,100
NAMA	DC Circulator	5,565,092
YOSE	Yosemite Valley Shuttle	3,161,758
SEKI	Giant Forest Shuttle	940,164
BRCA	Bryce Canyon Shuttle & Rainbow Point Shuttle	774,010
ROMO	Bear Lake and Moraine Park Shuttle	764,423
ACAD	Island Explorer	647,098
YOSE	Mariposa Grove Transportation Service	640,686
PERL	Ford Island Tour	580,054
DINO	Tram transit	504,000
HAFE	HAFE Shuttle transport	380,425

Source: NPS National Transit Inventory and Performance Report, 2019

[7] *Task 2 and 3 Technical Report: Data Analysis, Forecasting, and Existing Conditions Review*, January 2022.

[8] *Transportation and Vehicle Mobility Study, Data Collection and Analysis*, June 2017, and traffic counts on North and South Rims from 2021

2.4 Common Assumptions for Transit Concepts

For each transit concept, there are some assumptions and service planning elements that are common among transit concepts.

- **Service Characteristics:** Transit service would run from Memorial Day to Labor Day in both locations. Old Faithful-Madison Corridor transit service would run for 10 hours per day and 8 hours per day at the Canyon Area.
- **Bus Fleet:** The bus fleet would consist of battery electric buses.
- **Maintenance Facilities:** A separate maintenance facility would be developed for each study area (Old Faithful-Madison Corridor and Canyon Area). Buses would be parked outdoors, and solar canopies would not be provided.
- **Housing:** Housing would be constructed for staff required to support the transit system.
- **New Development:** New development related to the transit system (maintenance facilities, staff housing, and parking) would be located in existing developed areas to reduce the impact on natural resources.

2.5 Limitations of the Study

This transit feasibility study has limitations and does not address the following issues:

- **Desired Conditions:** This study does not propose desired conditions at any of the park focal locations. Transit concepts respond to existing management strategies at the park.
- **Funding:** This study does not identify potential funding strategies for initial capital projects or fleet acquisition.
- **Transit Business Planning:** This study does not include an analysis of transportation fees or other revenue required to support annual transit operations and maintenance.
- **Managed Access:** Analysis related to managed access strategies was excluded from this study, and staffing information and cost estimates related to managed access are not included in this report.

3

Canyon Area Transit Concepts

This chapter presents the evaluation of transit concepts serving the Canyon Area. Three transit concepts are explored.

- Concept 1: Transit/Bike/Hike Only on North Rim Drive and Transit and Managed Access on South Rim Drive
- Concept 2: Transit and Managed Access on North Rim Drive
- Concept 3: Transit and Managed Access for both North Rim Drive and South Rim Drive

3.1 Canyon Area Study Assumptions

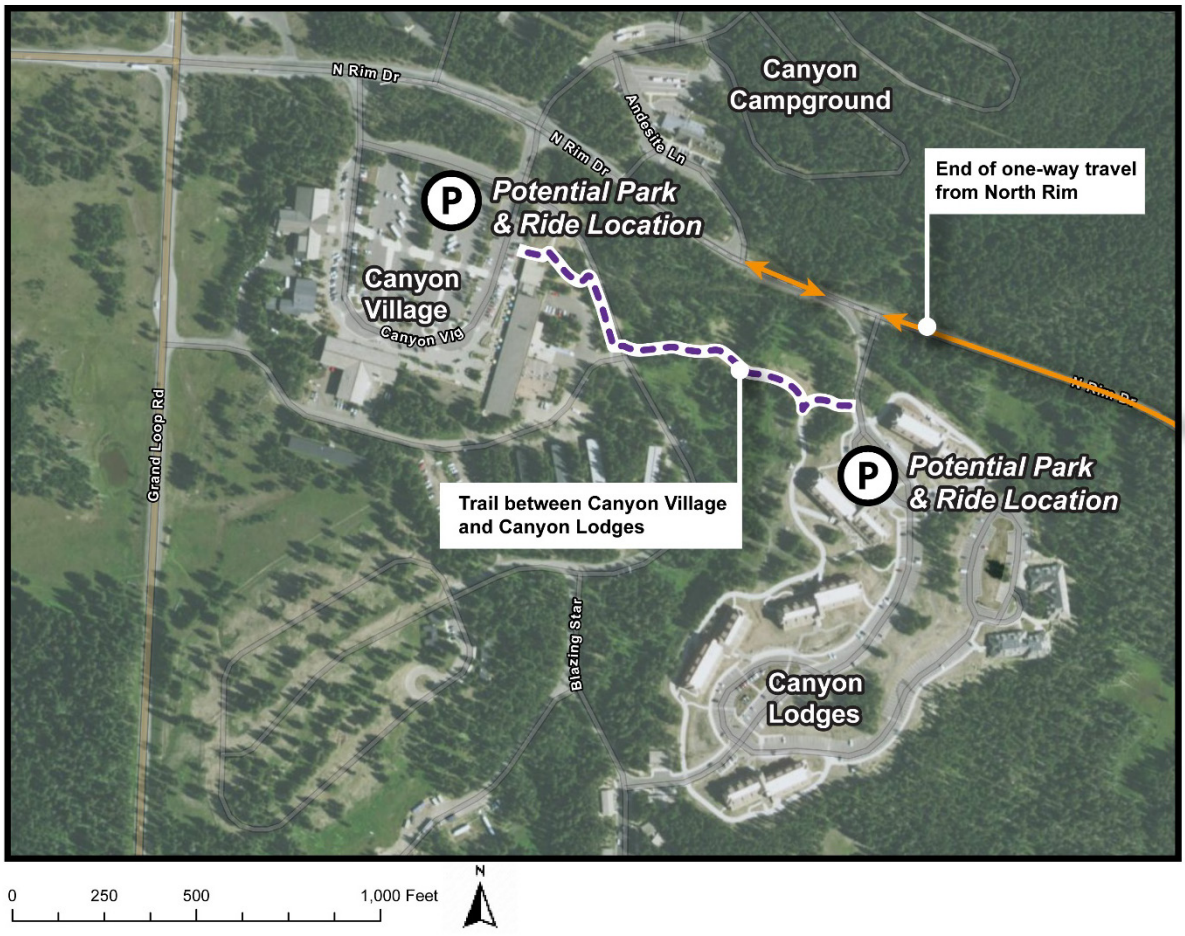
There are several transit service planning elements that are common among Canyon Area transit concepts.

- **Service Schedule:** Transit service is assumed to operate from Memorial Day to Labor Day. In the Canyon Area transit service is assumed to operate from approximately 9:00 am to 5:00 pm. These hours consider peak activity levels along the canyon rim roads identified in prior transportation studies.
- **Managed Access:** The transit concepts consider the possibility of actively managing vehicle access along North Rim Drive and South Rim Drive. No specific managed access method or desired conditions are defined. Rather, this assessment of transit concepts only assumes that there would be some sort of managed access that results in eliminating overflow parking and that transit provides an alternative means of access for those visitors.[9]

[9] Managed access is out of scope of this feasibility study. If desired, a separate study would be needed to evaluate costs and impacts to visitors, resources, stakeholders, and park operations.

- **Park and Ride Locations:** Designated park and ride locations are assumed to be at Canyon Village and/or the Canyon Lodge. See Figure 3-1.
- Transit parking at Canyon Lodge would be shared with the guest parking. The lodge area has 429 parking spaces, and most are empty during the day. For the purposes of this study, it is assumed that sharing of two-thirds of the parking, or 285 spaces, is the practical limit to ensure parking availability for lodge guests throughout the day.
- Parking at the Canyon Village complex would be more difficult to share as parking demand at Canyon Village peaks midday, the same time as transit parking demand would peak.

Figure 3-1: Potential Canyon Area Park and Ride Locations



- **Reversal of Travel Direction on North Rim Drive:** North Rim Drive is currently one-way from Grand Loop Road to the entrance to Canyon Lodge & Cabins. Two of the transit concepts consider the potential of reversing the direction of travel along North Rim Drive although both transit concepts could also operate with the current direction of travel. An objective of reversing the travel direction would be to eliminate the possibility of back-ups onto Grand Loop Road caused by drivers entering North Rim Drive. A discussion of other benefits and tradeoffs for reversing the direction of travel is provided in the Task 4 report.

3.2 Summary of Canyon Area Transit Concepts

All three Canyon Area transit concepts enhance visitor experiences and mobility by providing an alternative means to access popular destinations, access to destinations with limited parking availability and which a visitor might otherwise have to bypass, the potential for interpretive opportunities, and facilitating active transportation by creating ride/hike options. The concept that is best at enhancing visitor mobility and experience is Concept 1, which prioritizes multi-modal mobility along North Rim Drive in addition to providing transit access to South Rim Drive.

All three Canyon Area transit concepts are paired with managed access programs and as a result they have good performance metrics due to strong ridership potential. See Table 3-1.

The cost per boarding would be less than $3.00 for each concept, whereas national averages for public transit systems are $3.35 to $5.24.[10] Passenger boardings on the two concepts with transit serving both North Rim Drive and South Rim Drive could exceed 900,000 per season. That amount of boardings would exceed those reported in 2019 (pre-pandemic) for transit systems at Bryce Canyon National Park and Rocky Mountain National Park.[11]

The criteria of reducing parking and traffic congestion are only partially or minimally met by the concepts. The concepts that reduce parking congestion along both North Rim Drive and South Rim Drive require large park and ride operations. Concept 2, with service only on North Rim Drive, does reduce congestion along North Rim Drive but has potential to shift traffic and parking to South Rim Drive. Reductions in traffic congestion at some locations are offset by increased left-turn delays at Canyon Junction attributable to some traffic shifting from the canyon rim roads to Canyon Village and the park and ride locations.

All three concepts fail to meet the criteria of minimizing infrastructure and costs and minimize impacts on park staff and park operations. At best, the criteria of minimizing impacts to resources is minimally met.

[10] Based on data from the National Transit Database for 2019 (pre-pandemic) for Bus Rapid Transit systems and fixed route bus systems, respectively.

[11] NPS National Transit Inventory and Performance Report, 2019.

Table 3-1: Canyon Area Concepts: Service Summary

	Canyon Area Concept 1 Hike/Bike/ Transit Only on North Rim Drive. and Transit & Managed Access on South Rim Drive	**Canyon Area Concept 2** Transit and Managed Access on North Rim Drive	**Canyon Area Concept 3** Transit and Managed Access on Both North Rim Drive and South Rim Drive
Potential Ridership	3,800 people per day 950,000 boardings per year [1]	1,900 people per day 475,000 boardings per year [1]	3,700 people per day 925,000 boardings per year [1]
Annual Operating Cost	$2.2 million	$1.0 million	$2.1 million
Cost per Boarding	$2.28	$2.06	$2.29
Boarding per Hour per Bus	119	148	116
Capital Cost – Fleet	$13.7 million	$5.8 million	$13.7 million
Capital Cost - Infrastructure	$20.0 million	$10.2 million	$17.0 million
Parking Congestion Impact	100% reduction (North Rim) 20% reduction (South Rim)	30-40% reduction (North Rim)	35-40% reduction (North Rim) 20% reduction (South Rim)
No. of Park & Ride Spaces (estimated 285 available at Canyon Lodge)	275-375 285 could be shared at Canyon Lodge. Requires up to 90 new parking spaces.	150-200 All could be shared at Canyon Lodge. No new parking spaces required.	250-350 285 could be shared at Canyon Lodge. Requires up to 65 new parking spaces.
Fleet	12 buses	5 buses	12 buses
No. of Transit Staff	33	17	30
No. of Housing Units Needed	18 units	10 units	16 units
Maintenance Facility Footprint	5,100-square foot building 1.2-acre site	3,900-square foot building 0.7-acre site	5,100-square foot building 1.2-acre site
Other Infrastructure Investments Required	New Trail, Widening of North Rim Drive, Parking at Canyon Village		Parking at Canyon Village
Operational Requirements	Managed access for North Rim and South Rim. Parking management plan.	Managed access for North Rim. Parking management plan.	Managed access for North Rim and South Rim. Parking management plan.

1 Assumes each person boards bus an average of 2.5 times per day.

3.3 Canyon Area Concept 1: Transit/Bike/Hike Only on North Rim Drive and Transit/Managed Access on South Rim Drive

Canyon Area Concept 1 addresses input from park staff during 2021 workshop sessions. This revised approach prioritizes multi-modal mobility along North Rim Drive in addition to providing transit access to South Rim Drive. Enhanced opportunities for hikers, walkers, and bicyclists to experience the North Rim are provided through a combination of shuttle opportunities, trail improvements, and managed access.

The South Rim Drive transit route supplements managed access to provide an alternative mode of access to the South Rim and support active recreation with hike/ride opportunities.

The North Rim elements of Concept 1 are shown in Figure 3-3. North Rim Drive would be closed to private vehicle traffic from Canyon Lodge to the Brink of the Lower Falls parking area. North Rim Drive from Brink of the Lower Falls to Lookout Point would be designated as a pedestrian and bicycle area only. Improved and new trail connections between the Canyon Lodge area and the North Rim Trail provide enhanced options for hikers to reach and experience the North Rim.

North Rim Drive would have two-way circulation for bicyclists and transit vehicles. The width of much of North Rim Drive would need to be widened to enable two-way travel. To minimize the amount of widening and to enhance bicycling, North Rim Drive would be configured with a single, two-way lane for transit vehicles and "advisory shoulders" (also known as "advisory bike lanes") on for bicyclists. Roadway designs with advisory bike lanes are used when there are low traffic volumes and low vehicle speeds to provide designated areas for bicyclists while minimizing the width of roadways.

With the roadway configuration shown in Figure 3-3 transit vehicles would use a single lane for travel in both directions and use the advisory shoulders when passing approaching transit vehicles. The transit vehicles would yield to cyclists and pass each other when the shoulders are clear. The concept shown in Figure 3-4 has one-way bicycle lanes on each side of the transit vehicle lane. An alternative configuration that could be considered is locating both bicycle lanes along the south side of the road, to take advantage of the scenic vistas.

3.3.1 Service Characteristics

Frequency, Travel time and Reliability: Both transit routes would operate on a 7-to-8-minute frequency. Round trip travel time would be 30 minutes for North Rim Drive and 45 minutes for South Rim Drive. The travel time for each trip includes "recovery time" of a few minutes of scheduled layover time at the end of the trip to account for occasional unplanned delays.

Reliability for the North Rim Drive transit route is projected to be excellent since the transit vehicles remain on North Rim Drive and there are no other motor vehicles.

Reliability for the South Rim Drive transit route can be achieved with the appropriate recovery time built in for each loop to ensure that headways are consistent. Delays are most likely to be experienced at Canyon Junction after leaving Canyon Village and turning left onto Grand Loop Road.

Figure 3-2: Transit/Bike/Hike Only on North Rim Drive and Transit and Managed Access on South Rim Drive

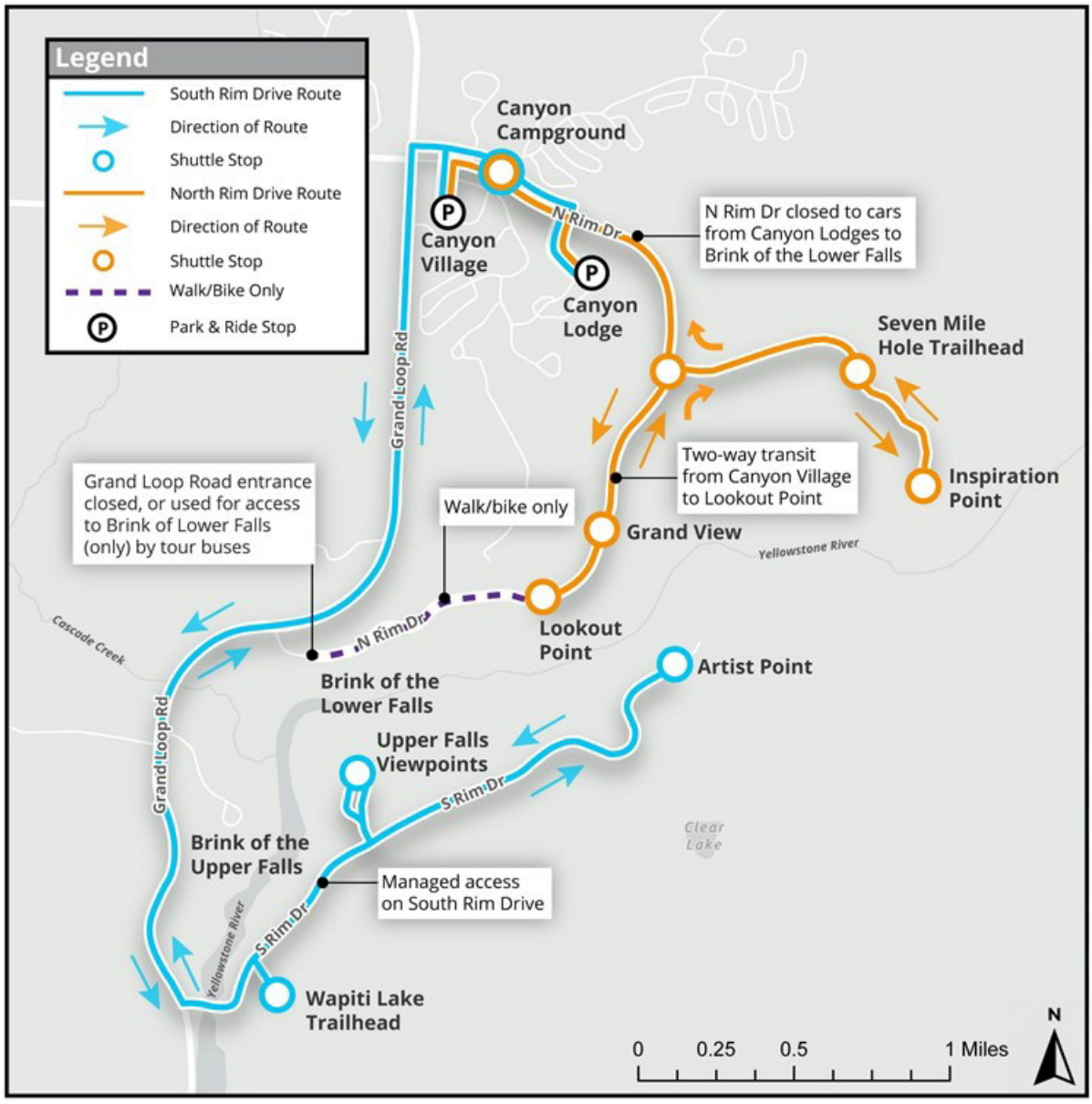


Figure 3-3: North Rim Drive Shuttle Route and Multi-Modal Opportunities

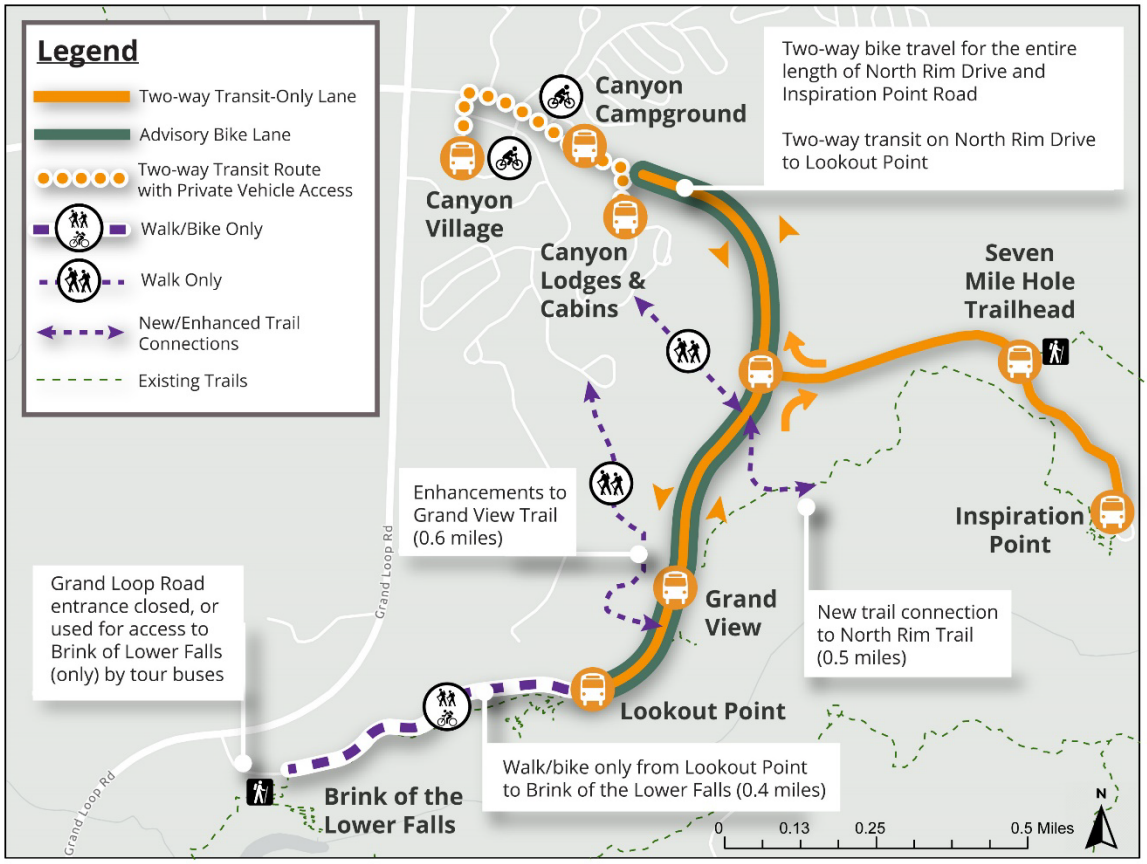
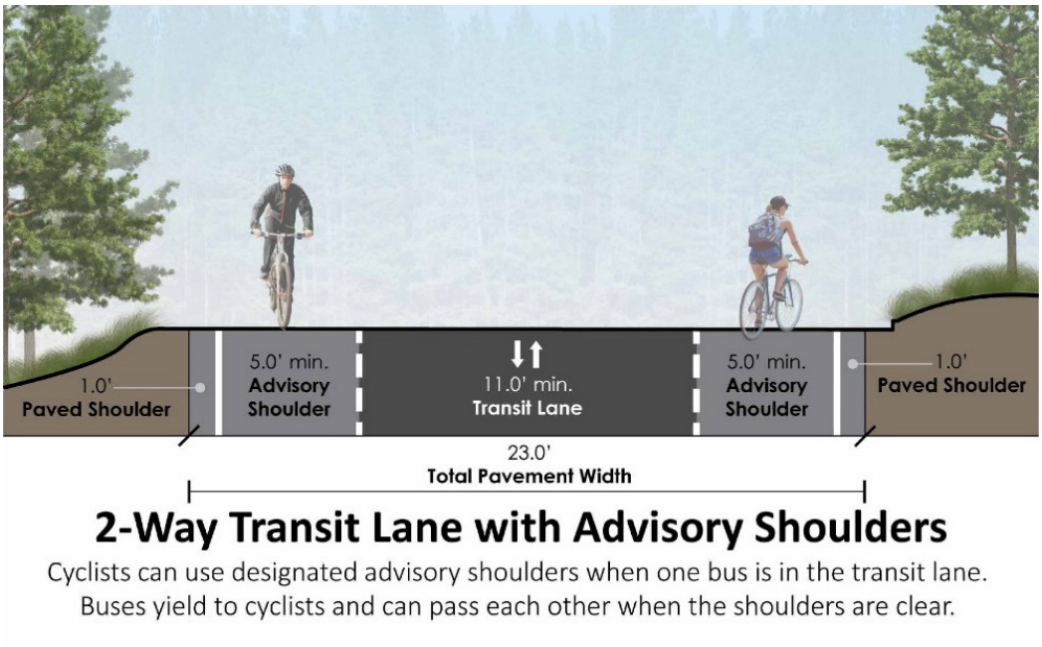


Figure 3-4: Conceptual Cross Section of North Rim Drive



Fleet: A minimum of 12 full-size buses with about a 35-seat capacity would be appropriate for the anticipated passenger loads. Ten buses would be in service at peak times (4 on North Rim Drive and 6 on South Rim Drive), with two spares.

Maximum daily mileage for each bus would be about 110 miles, within the range of full-size and mid-size battery electric buses currently available.

In addition, the operation would need at least two light vehicles—a maintenance truck and a car for the supervisor.

Ridership: The potential market for transit users would be approximately 3,800 people per day. Assuming an average of 2.5 boarding per person (half make multiple stops), ridership is estimated at 9,500 boardings per day and 950,000 annually.

It is important to note that the current level of visitation along North Rim Drive cannot be met by Concept 1's transit operation. Concept 1 would have North Rim Drive closed to all private vehicle whereas other North Rim Drive transit concepts assume that they accommodate only the overflow parking along North Rim Drive. The proposed transit service can only accommodate roughly 55% of the current visitation, based on 2021 data. As 2021 represented a peak in visitation, it may be that the proposed transit service could accommodate more than 55% of visitation if visitation stabilizes to a level lower than 2021. In addition, there would be enhanced opportunities for walkers, hikers, and bicyclists that could replace some unmet levels of current visitation.

3.3.2 Field Operations

Parking Management for the Park and Ride Operations: The transit service would need 275 to 375 park and ride spaces. Up to 285 could be shared among Canyon Lodge guest parking but the remaining amount may need to be accommodated by expanding the Canyon Village parking, perhaps by as many as 90 spaces. Staff would be needed to manage the shared Canyon Lodge and Canyon Village parking. A parking management plan would help to ensure that the needs of Canyon Lodge guests, those visiting the Canyon Village Education Center, and patrons of the Canyon Village stores and restaurants are addressed.

Bicycle Rentals: This concept includes the availability of bicycle rentals at Canyon Village, Canyon Campground, and Canyon Lodge. This would require staff to provide bike rentals and education on bicycling and bear safety.

3.3.3 Infrastructure Needs

Bus Stops: There would be bus stops at 11 locations. See Table B in the cost estimate methodology appendix for a summary of the level of investment for each.

Roadway Improvements: North Rim Drive would need to be widened to allow two-way travel by transit vehicles. From Lookout Point to Canyon Lodge, the paved roadway would need to be expanded throughout the corridor (approximately 5,700 feet) by an average about four feet (from approximately 19' to 23'), with some segments requiring slightly more or less width. This would allow for a shared two-way transit lane, two designated advisory shoulders for bicyclists, and shoulders. See Figure 3-4. In addition, a section of the Lookout Point parking area would need to be widened to accommodate a turnaround point for transit vehicles.

Parking: The operation would need 275 to 375 park and ride spaces. Up to 285 could be shared among Canyon Lodge guest parking but as many as 90 would be new.

Hiking Trails: A new trail would connect the Canyon Lodge area to North Rim Drive and North Rim Trail. The new trail would be an 8-foot-wide crushed rock path that extends 4,400 linear feet The existing trail from the Canyon Lodge to Grand View would be widened to 8 feet and resurfaced to better accommodate hikers.

Bicycle Facilities: Bicycle rental locations would be at Canyon Village, Canyon Campground, and Canyon Lodge. The rentals at Canyon Campground and Canyon Lodge would be targeted towards guests and may not need a dedicated facility. The rental location at Canyon Village may require a dedicated facility.

Maintenance Facility: A maintenance facility with at least two service bays would be required for the 12-bus fleet. The footprint of the facility would be about 1.2 acres.

Housing: Housing would be required for 33 transit staff. The transit staff would include 3 mechanics, a manager, an administrative assistant, parking attendants, staff for the bike rental, drivers, dispatchers, and cleaners. Housing units to accommodate transit staff are not currently available within the park or within an hour's drive in a gateway community.

Signage: New static signage and changes to existing static signage would be needed. No permanent electronic signage would be required.

- Signage would be needed to direct visitors to the park and ride areas.
- Areawide directional signage would need to be changed due to the restricted access of North Rim Drive and the managed access program for South Rim Drive.

3.3.4 Potential to Pilot Transit Concept

The concept relies on managed access and transit operations to accommodate a high level of visitation. Piloting of the transit operations along with a pilot of a managed access program would require substantial capital investments in fleet, maintenance facilities, and other infrastructure. Piloting is not likely to be practical.

The hiking trail projects proposed as part of this concept could be done at any time but are not suitable as pilots. Piloting of the bicycle rental is not recommended if North Rim Drive remains one-way and the current level of motor vehicle traffic remains.

3.3.6 Cost Estimates

The capital costs for Canyon Area Concept 1 are summarized in Table 3-2. Details of the cost methodology are provided in the appendix.

Table 3-2: Canyon Area Concept 1 – Capital Costs

Item	Number	Unit Cost	Cost
Fleet – Buses	12	$1,000,000	$12,000,000
Fleet – Chargers	12	$125,000	$1,500,000
Fleet – SUV and Pickup	2	$75,000	$150,000
Subtotal			**$13,650,000**
Maintenance Facility – Building	5,100 square feet	$800	$4,080,000
Maintenance Facility – Site	1.2 acres	$1,500,000	$1,800,000
Maintenance Facility – Utilities Connection		Lump Sum	$900,000
Subtotal			**$5,880,000**
Housing –Modular	2 people	$450,000	$900,000
Housing – Dorm Style	31 people	$250,000	$7,750,000
Subtotal			**$8,650,000**
Transit Stops (Low)	5	$100,000	$500,000
Transit Stops (Medium)	4	$200,000	$800,000
Transit Stops (Medium-High)	2	$300,000	$600,000
Subtotal			**$1,900,000**
Parking at Canyon Village	90 spaces	$16,000	**$1,440,000**
Road widening (North Rim Drive)	5,700 linear feet	$300	**$1,710,000**
Turnaround (Lookout Point)		Lump Sum	**$200,000**
Trails	7,300 linear feet	$65	**$475,000**
Other		Lump Sum	**$100,000**
TOTAL			**$34,005,000**

Notes: Amounts shown as current (2022) dollars.
Continuation of extraordinary cost increases attributable to supply chain disruptions and labor shortages arising from the pandemic would result in higher costs.

The annual operation and maintenance (O&M) costs for the Canyon Area Concept 1 are summarized in Table 3-3. The cost estimate covers 8,000 in-service hours per season (10 buses, 8 hours per day, 100 days per year), and the cost of extra staff for parking attendants and bike rental. Additional details of the cost methodology are provided in the appendix.

Table 3-3: Canyon Area Concept 1 – Annual O&M Costs

Item	Cost
Labor – Base Operating Cost	$1,600,000
Labor – Parking and Bike Rental	$120,000
Labor – Pre- and Post-Season	$90,000
Subtotal	**$1,810,000**
Facilities – Maintenance	$80,000
Facilities – Housing	$120,000
Bus Stops	$30,000
Lease of Off-Season Bus Storage	$130,000
Subtotal	**$360,000**
TOTAL	**$2,170,000**

3.3.7 Benefits, Tradeoffs, and Impacts

Benefits, tradeoffs, and impacts of Canyon Area Concept 1 are summarized in Table 3-4.

Canyon Area Concept 1 would be strongest in enhancing visitor mobility and access and in overall cost efficiency and productivity. It also provides some reductions of traffic congestion and parking congestion.

A significant tradeoff would be that this concept would have considerably more infrastructure needs, and resource impacts, than any of the other transit concepts. There would be new trails, North Rim Drive would be widened, and additional parking may be needed at Canyon Village, in addition to the bus stops, maintenance facility and other infrastructure needed to support any transit system.

Table 3-4: Canyon Area Concept 1: Benefits, Tradeoffs, Impacts

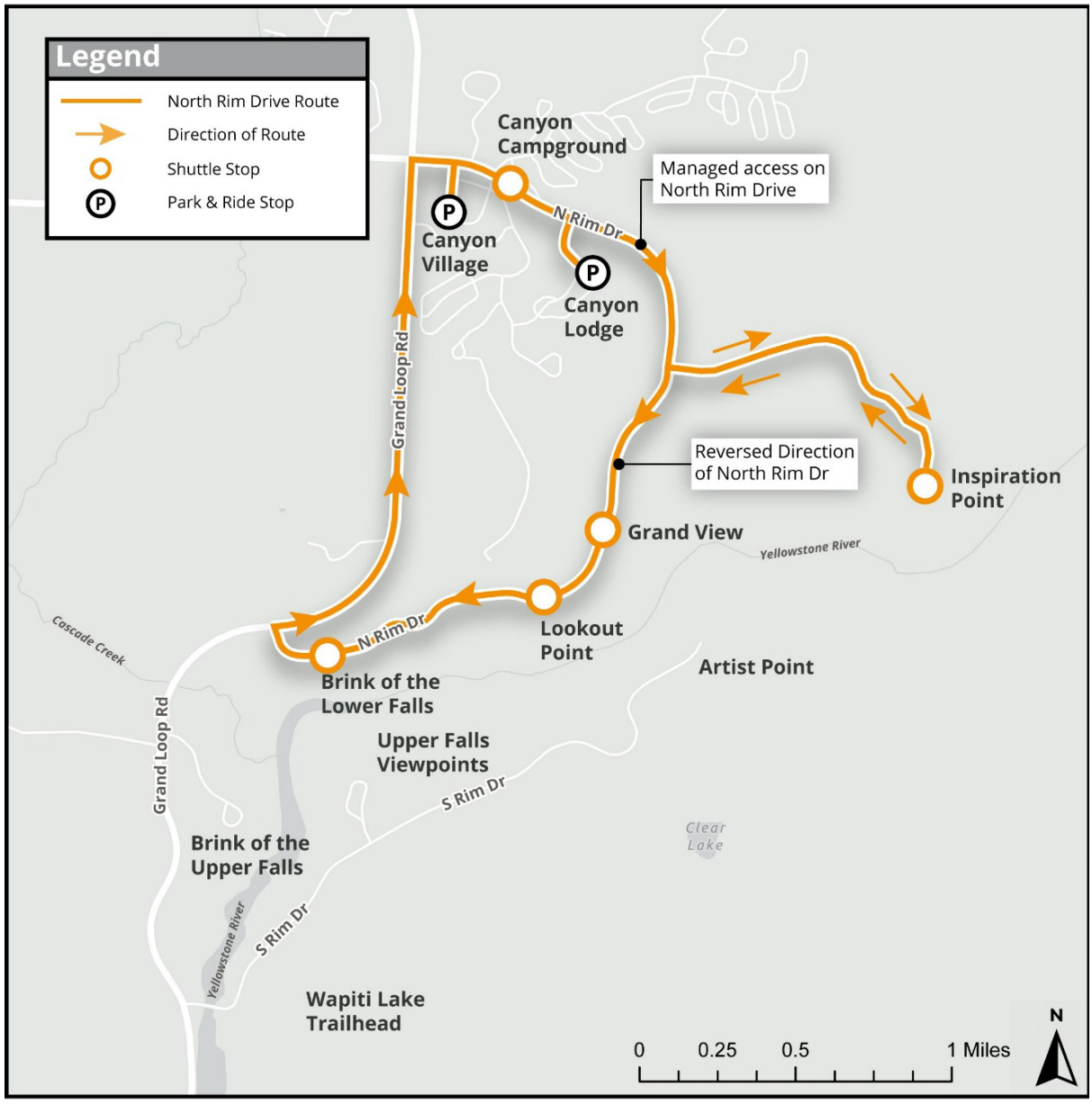
	Criteria	Benefits/Tradeoffs/Impacts
Fully Met	Enhance Visitor Experience & Mobility	› Multi-modal access to multiple popular destinations along the canyon rim › Access to viewpoints without the constraint of parking availability › Supports active recreation with new hiking and cycling opportunities › Car-free experience along North Rim Drive between Lookout Point and Brink of Upper Falls › New trail connection from Canyon Lodge to North Rim Trail › Supports hike/ride opportunities on both North and South Rim › Interpretation opportunities
Fully Met	Maximizes Cost Efficiency and Productivity	› Ridership: 950,000 boardings per year › Annual operating costs: $2.2 million › Performance metrics:[1] 119 boardings/hour/bus, $2.28 per boarding
Partially Met	Reduce Parking Congestion	› All private vehicles removed from North Rim Drive › Eliminates overflow parking along South Rim › 275-375 park and ride demand at Canyon Village and Canyon Lodge
Partially Met	Reduce Roadway Congestion	› 100% reduction in traffic on North Rim Drive › Eliminates backups from North Rim Drive onto Grand Loop Road › 20-40% reduction in traffic on South Rim Drive › 12% reduction in time spent following another vehicle on Grand Loop Road south of Canyon Village › Level of service for left turn at Canyon Junction drops from LOS C to D
Not Met	Minimize Impacts to NPS Staff and Park Operations	› Heavy involvement with system launch › Person required to continually coordinate with transit business partner › Ongoing facility maintenance › Managed access also impacts staff and operations
Partially Met	Enhance Safety	› Reduce conflicts between pedestrians, cyclists, and vehicles by removing private vehicle access on North Rim Drive › Eliminates backups from North Rim Drive onto Grand Loop Road › Reduced congestion in South Rim Drive parking lots › Shuttle system provides a safety education opportunity
Not Met	Minimize Infrastructure and Costs	› Up to 90 new parking spaces at Canyon Village › Road widening along North Rim Drive and turnaround at Lookout Point › New trail from Canyon Lodge to North Rim Drive and North Rim Trail › Bike rental facility at Canyon Village › 12 35-passenger buses, 10 bus stops › 5,100-square foot/1.2-acre maintenance facility, Housing for 33 employees › Infrastructure also needed for managed access
Not Met	Minimize Impacts to Resources	› Eliminates parking along North Rim Drive › Housing and maintenance facilities in developed areas › Requires widening North Rim Drive from Lookout Point to Canyon Lodge › Potential for 90 new parking spaces for park and ride

1 Per the Federal Transit Administration's National Transit Database (2019, pre-pandemic) national averages for fixed route buses were 27 boardings per hour and $5.24 per boarding. For Bus Rapid Transit the averages were 53 boardings and $3.25 per boarding.

3.4 Canyon Area Concept 2: Transit and Managed Access on North Rim Drive

This concept provides shuttle service between Canyon Village and North Rim Drive. See Figure 3-5. The transit service would be paired with a managed access program for motor vehicles using North Rim Drive. In addition, the direction of travel along North Rim Drive would be reversed. Transit riders would park at Canyon Lodge.

Figure 3-5: Transit and Managed Access on North Rim Drive



3.4.1 Service Characteristics

Frequency, Travel time, and Reliability: The transit service would operate on a 7-to-8-minute frequency to meet the full potential demand and enable convenient hop on and hop off service. The round-trip route would be 5.5 miles in length and travel time would be 30 minutes, including recovery time. Reliability can be achieved with the appropriate recovery time built in for each loop to ensure that headways are consistent.

As with any transit concept that involves reversing the direction of travel on North Rim Drive, the first viewpoint encountered would be Inspiration Point and the roadway to Inspiration Point could become congested and delay transit operations.

Fleet: Full-size buses with about a 35-seat capacity would be appropriate for the anticipated passenger loads. The minimum fleet size would be five shuttles. Four would be in service at peak times, with one spare. Daily mileage for each bus would be about 110 miles, well within the range of full-size electric buses currently available.

In addition, the operation would require at least two light vehicles—a maintenance truck and a car for the supervisor.

Ridership: All riders would board the bus at least twice, once traveling to North Rim Drive and once returning. Some would get on and off at multiple locations along North Rim Drive. Assuming an average of 2.5 boarding per person (half make multiple stops), ridership is estimated at 4,750 boardings per day and 475,000 annually.

3.4.2 Field Operations

Parking Management for the Park and Ride Operations: The transit service would require 100 to 150 park and ride spaces and they would be shared among the Canyon Lodge guest parking. This would be about 25 to 35% of the capacity of the Canyon Lodge parking and would be below the estimated practical limit of 285 shared spaces. The operation would require detailed planning to ensure it was convenient for both transit riders and Canyon Lodge guests.

3.4.3 Infrastructure Needs

Bus Stops: The transit operation would have bus stops at 8 locations. See Table B in the cost estimate methodology appendix for a summary of the level of investment for each.

Roadway Improvements: No changes to roadways and intersections would be required to accommodate maneuvering of the large buses.

Parking: The operation would require 150 to 200 park and ride spaces. This parking could be accommodated at Canyon Lodge and no new parking would need to be constructed.

Maintenance Facility: Maintenance and administrative facilities would be required for the 5-bus fleet. The footprint of the facility would less than an acre.

Housing: Housing would be required for 17 transit staff.

Signage: New static signage and changes to existing static signage would be needed. No permanent electronic signage would be required.

- Signage would be needed to direct visitors to the park and ride area.
- Areawide directional signage would need to be changed due to the reversal of direction of North Rim Drive and the managed access program.
- Changes to signage, striping, and markings would be required along North Rim Drive due to the change of travel direction.

3.4.4 Potential to Pilot Transit Concept

This North Rim transit service could be piloted as a smaller transit operation targeted towards those staying overnight in the Canyon Area. This would allow for the use of fewer and smaller buses. The pilot could use readily available (gas/diesel/hybrid) small shuttles that could be fueled and maintained at YPSS facilities. Targeting those staying overnight in the Canyon Area would avoid the need to manage a park and ride location.

3.4.5 Cost Estimates

The capital costs for Canyon Area Concept 2 are summarized in Table 3-5. Details of the cost methodology are provided in the appendix.

Table 3-5: Canyon Area Concept 2 – Capital Costs

Item	Number	Unit Cost	Cost
Fleet – Buses	5	$1,000,000	$5,000,000
Fleet – Chargers	5	$125,000	$625,000
Fleet – SUV and Pickup	2	$75,000	$150,000
Subtotal			**$5,775,000**
Maintenance Facility – Building	3,900 square feet	$800	$3,120,000
Maintenance Facility – Site	0.7 acres	$1,500,000	$1,050,000
Maintenance Facility – Utilities Connection		Lump Sum	$900,000
Subtotal			**$4,170,000**
Housing – Modular	2 people	$450,000	$900,000
Housing – Dorm Style	15 people	$250,000	$3,750,000
Subtotal			**$4,650,000**
Transit Stops (Low)	3	$100,000	$300,000
Transit Stops (Medium)	2	$200,000	$400,000
Transit Stops (Medium-High)	2	$300,000	$600,000
Subtotal			**$1,300,000**
Other		Lump Sum	**$75,000**
TOTAL			**$15,970,000**

Notes: Amounts shown as current (2022) dollars.
Continuation of extraordinary cost increases attributable to supply chain disruptions and labor shortages arising from the pandemic would result in higher costs.

The annual operation and maintenance costs for the Canyon Area Concept 2 is summarized in Table 3-6. The cost estimate covers 3,200 in-service hours per season (4 buses, 8 hours per day, 100

days per year), and the cost of extra staff for parking attendants. Additional details of the cost methodology are provided in the appendix.

Table 3-6: Canyon Area Concept 2 – Annual O&M Costs

Item	Cost
Labor – Base Operating Cost	$640,000
Labor – Parking attendants	$80,000
Labor – Pre- and Post-Season	$50,000
Subtotal	**$770,000**
Facilities – Maintenance	$60,000
Facilities – Housing	$70,000
Bus Stops	$20,000
Lease of Off-Season Bus Storage	$60,000
Subtotal	**$210,000**
TOTAL	**$980,000**

3.4.6 Benefits, Tradeoffs, and Impacts

Benefits, tradeoffs, and impacts of Canyon Area Concept 2 are summarized in Table 3-7.

Canyon Area Concept 2 would be strongest in enhancing visitor mobility and access and in overall cost efficiency and productivity. It only marginally meets criteria for reducing traffic congestion, parking congestion, and impacts on resources.

Most of the tradeoffs are those of any transit operation – the need for new infrastructure and the demands on NPS staff and park operations. The most substantial tradeoff would be if traffic and parking congestion were diverted from North Rim Drive to South Rim Drive.

Table 3-7: Canyon Area Concept 2: Benefits, Tradeoffs, Impacts

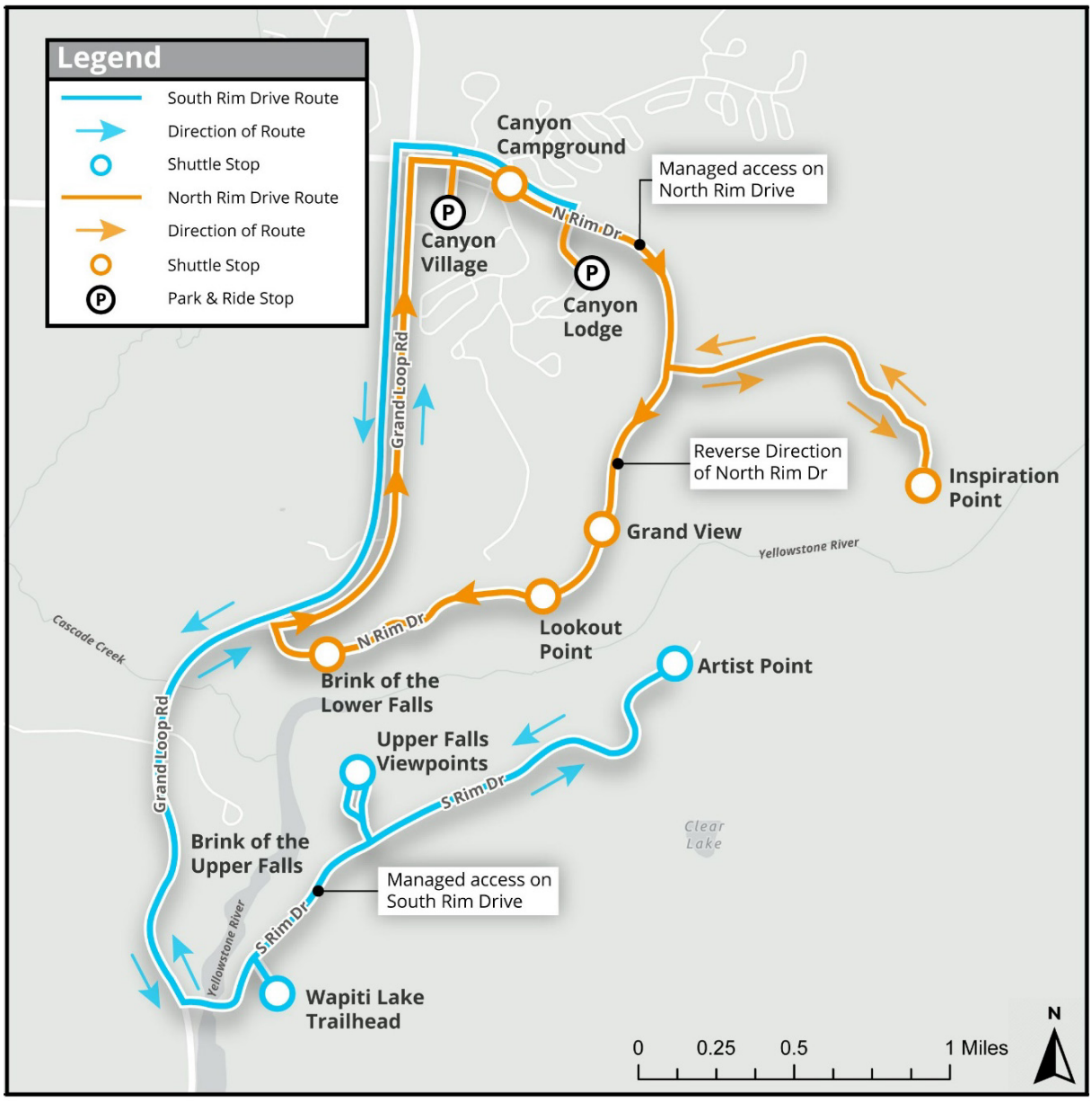
	Criteria	Benefits/Tradeoffs/Impacts
Fully Met	Enhance Visitor Experience & Mobility	› Access to viewpoints without the constraint of parking availability › Interpretation opportunities › Supports active recreation with trail connections (Hike/Ride) › Very convenient for guests at Canyon Lodge
Fully Met	Maximizes Cost Efficiency and Productivity	› Ridership: 475,000 boardings per year › Annual operating costs: $1.0 million › Performance metrics:[1] 148 boardings/hour/bus, $2.06 per boarding
Minimally Met	Reduce Parking Congestion	› Eliminates overflow parking along North Rim › Shares 35-45% of Canyon Lodge parking › Potential to shift some parking demand to South Rim
Minimally Met	Reduce Roadway Congestion	› 20-40% reduction in traffic on North Rim Drive › Eliminates backups from North Rim Drive onto Grand Loop Road onto › 3% reduction in time spent following another vehicle on Grand Loop Road south of Canyon Village › Level of service for left turn at Canyon Junction goes from LOS C to E › Potential to shift some traffic demand to South Rim
Not Met	Minimize Impacts to NPS Staff and Park Operations	› Heavy involvement with system launch › Person required to continually coordinate with transit business partner › Ongoing facility maintenance › Managed access also impacts staff and operations
Minimally Met	Enhance Safety	› Reduced parking and traffic congestion along North Rim Drive › Eliminates backups from North Rim Drive onto Grand Loop Road › Safety education opportunity with transit riders › Potential to shift traffic/parking to South Rim
Not Met	Minimize Infrastructure and Costs	› No new parking, shared with Canyon Lodge › 5 35-passenger buses, 8 bus stops › 3,900-square foot/0.75-acre maintenance facility, Housing for 18 employees › Infrastructure also needed for managed access
Minimally Met	Minimize Impacts to Resources	› Eliminates overflow parking along North Rim Drive › Housing and maintenance facilities in developed areas

1 Per the Federal Transit Administration's National Transit Database (2019, pre-pandemic) national averages for fixed route buses were 27 boardings per hour and $5.24 per boarding. For Bus Rapid Transit the averages were 53 boardings and $3.25 per boarding.

3.5 Canyon Area Concept 3: Transit and Managed Access for both North Rim Drive and South Rim Drive

This concept provides shuttle service along two routes—one between Canyon Village and North Rim Drive and one between Canyon Village and South Rim Drive. Both North Rim Drive and South Rim Drive would have managed access of private vehicles. In addition, the direction of travel along North Rim Drive would be reversed. Transit riders would park at Canyon Lodge and Canyon Village.

Figure 3-6: Transit and Managed Access for both North Rim Drive and South Rim Drive



3.5.1 Service Characteristics

Frequency, Travel time and Reliability: Both transit routes would operate on a 7-to-8-minute frequency. Round trip travel time would be 30 minutes for North Rim Drive and 45 minutes for South Rim Drive. Reliability for both routes can be achieved with the appropriate recovery time built in for each loop to ensure that headways are consistent. Delays are most likely to be experienced at Canyon Junction while waiting to turn left onto Grand Loop Road after leaving Canyon Village.

As with any North Rim transit concept that involves reversing the direction of travel on North Rim Drive, the first viewpoint encountered would be Inspiration Point and the roadway to Inspiration Point could become congested and delay transit operations.

Fleet: Full size buses of about 35-seat capacity would be appropriate for the anticipated passenger loads. The minimum fleet size would be 12 buses, with 10 in service at peak times and 2 spares. Daily mileage for each bus would be about 110 miles, well within the range of full-size electric buses currently available.

In addition, the operation would require at least two light vehicles—a maintenance truck and a car for the supervisor.

Ridership: The potential market for transit users would be approximately 3,700 people per day. Assuming an average of 2.5 boardings per person, ridership is estimated at 9,250 boardings per day, and 925,000 annually. Approximately 55% of the ridership would be on the North Rim route.

3.5.2 Field Operations

Parking Management for the Park and Ride Operations: The transit service would require 250 to 350 park and ride spaces. The high estimate exceeds the practical capacity (a maximum of 285 spaces) of any shared parking operation at Canyon Lodge. To accommodate the full potential parking demand, as many as 65 additional parking spaces would be required. This amount of parking would occupy slightly more than one-half acre, which is equivalent to the amount of space currently designated for RVs in the Canyon Village parking lot.

3.5.3 Infrastructure Needs

Bus Stops: The transit operation would have bus stops at 10 locations. See Table B in the cost estimate methodology appendix for a summary of the level of investment for each.

Roadway Improvements: No changes to roadways and intersections would be required to accommodate maneuvering of the large buses. In the Artist Point lot, most cars circulate past what would be the transit stop and it may be desirable to construct a cross aisle immediately before the transit stop to separate the transit area from the parking lot circulation.

Parking: The operation would require 250 to 350 park and ride spaces. Most could be shared among Canyon Lodge parking but at least 65 additional parking space would be required.

Maintenance Facility: A maintenance facility would be needed for the 12-bus fleet. The footprint of the facility would be about 1.2 acres.

Housing: Housing would be required for 30 transit staff.

Signage: New static signage and changes to existing static signage would be needed. No permanent electronic signage would be required.

- Signage would be needed to direct visitors to the park and ride locations.
- Areawide directional signage would need to be changed due to the reversal of direction of North Rim Drive and the managed access program.
- Changes to signage, striping, and markings would be required along North Rim Drive due to the change of travel direction.

3.5.4 Potential to Pilot Transit Concept

The concept relies on managed access and transit operations to accommodate a high level of visitation. Piloting of the transit operations along with a pilot of a managed access program would require substantial capital investments in fleet, maintenance facilities, and other infrastructure. Piloting is not likely to be practical.

3.5.5 Cost Estimates

The capital costs for Canyon Area Concept 3 are summarized in Table 3-8. Details of the cost methodology are provided in the appendix.

Table 3-8: Canyon Area Concept 3 – Capital Costs

Item	Number	Unit Cost	Cost
Fleet – Buses	12	$1,000,000	$12,000,000
Fleet – Chargers	12	$125,000	$1,500,000
Fleet – SUV and Pickup	2	$75,000	$150,000
Subtotal			**$13,650,000**
Maintenance Facility – Building	5,100 square feet	$800	$4,080,000
Maintenance Facility – Site	1.2 acres	$1,500,000	$1,800,000
Maintenance Facility – Utilities Connection		Lump Sum	$900,000
Subtotal			**$5,880,000**
Housing – Modular	2 people	$450,000	$900,000
Housing – Dorm Style	28 people	$250,000	$7,000,000
Subtotal			**$7,900,000**
Transit Stops (Low)	4	$100,000	$400,000
Transit Stops (Medium)	4	$200,000	$800,000
Transit Stops (Medium-High)	2	$300,000	$600,000
Subtotal			**$1,800,000**
Other		Lump Sum	**$75,000**
TOTAL			**$30,345,000**

Notes: Amounts shown as current (2022) dollars.
Continuation of extraordinary cost increases attributable to supply chain disruptions and labor shortages arising from the pandemic would result in higher costs.

The annual operation and maintenance costs for the Canyon Area Concept 3 is summarized in Table 3-9. The cost estimate covers 8,000 in-service hours per season (10 buses, 8 hours per day, 100 days per year), and the cost of extra staff for parking attendants. Additional details of the cost methodology are provided in the appendix.

Table 3-9: Canyon Area Concept 3 – Annual O&M Costs

Item	Cost
Labor – Base Operating Cost	$1,600,000
Labor – Parking attendants	$80,000
Labor – Pre- and Post-Season	$90,000
Subtotal	**$1,770,000**
Facilities – Maintenance	$80,000
Facilities – Housing	$110,000
Bus Stops	$30,000
Lease of Off-Season Bus Storage	$130,000
Subtotal	**$350,000**
TOTAL	**$2,120,000**

3.5.6 Benefits, Tradeoffs, and Impacts

Benefits, tradeoffs, and impacts of Canyon Area Concept 3 are summarized in Table 3-10.

Canyon Area Concept 3 fully meets criteria for enhancing visitor experience and mobility and for maximizing cost efficiency and productivity. It also provides some benefits in reducing traffic and parking congestion.

The most significant tradeoff would be the size of the transit operation. It would require substantial infrastructure to implement the service and large fleet and staff size to maintain the service.

Table 3-10: Canyon Area Concept 3: Benefits, Tradeoffs, Impacts

	Criteria	Benefits/Tradeoffs/Impacts
Fully Met	Enhance Visitor Experience & Mobility	› Alternative access to multiple popular destinations along the canyon rim › Access to viewpoints without the constraint of parking availability › Supports active recreation with hike/ride opportunities on North and South Rim › Interpretation opportunities
Fully Met	Maximizes Cost Efficiency and Productivity	› Ridership: 925,000 boardings/year › Annual operating costs: $2.1 million › Performance metrics:[1] 116 boardings/hour/bus, $2.29 per boarding
Minimally Met	Reduce Parking Congestion	› Reduced congestion in all canyon rim parking areas › Eliminates overflow parking along North Rim › 250-350 park and ride spaces at Canyon Villages and Canyon Lodge
Partially Met	Reduce Roadway Congestion	› 20-40% reduction in traffic on North Rim Drive › 20-40% reduction in traffic on South Rim Drive › Eliminates backups from North Rim Drive onto Grand Loop Road › 6% reduction in time spent following another vehicle on Grand Loop Road south of Canyon Village › Level of service for left turn at Canyon Junction goes from LOS C to D
Not Met	Minimize Impacts to NPS Staff and Park Operations	› Heavy involvement with system launch › Person required to continually coordinate with transit business partner › Ongoing facility maintenance
Partially Met	Enhance Safety	› Reduced parking and traffic congestion along North Rim Drive › Eliminates backups from Grand Loop Road onto North Rim Drive › Reduced congestion in South Rim Drive parking lots › Shuttle system provides a safety education opportunity
Not Met	Minimize Infrastructure and Costs	› Potential for 65 new parking spaces for park and ride › 12 35-passenger buses, 10 bus stops › 5,100-square foot/1.2-acre maintenance facility, Housing for 30 employees › Infrastructure also needed for managed access
Not Met	Minimize Impacts to Resources	› Eliminates overflow parking along North Rim Drive › Potential for 65 new parking spaces for park and ride › Housing and maintenance facilities in developed areas

1 Per the Federal Transit Administration's National Transit Database (2019, pre-pandemic) national averages for fixed route buses were 27 boardings per hour and $5.24 per boarding. For Bus Rapid Transit the averages were 53 boardings and $3.25 per boarding.

4

Old Faithful-Madison Corridor Transit Concepts

This chapter presents the evaluation of transit concepts serving the Old Faithful-Madison Corridor (Geyser Basin). Three transit concepts are explored.

- Concept 1: Express Route – Old Faithful to Midway Geyser Basin
- Concept 2: Old Faithful to Fountain Paint Pot
- Concept 3: Old Faithful to Madison

4.1 Geyser Basin Study Assumptions

There are some transit service planning elements that are common among Geyser Basin transit concepts.

- **Service Schedule:** Transit service is assumed to operate from Memorial Day to Labor Day. In the Geyser Basin Area, transit service is assumed to operate 10 hours per day.
- **Park and Ride at Old Faithful:** All Geyser Basin transit concepts use Old Faithful as a park and ride location. The transit-related parking would not need to be in a designated location. To avoid congestion entering and within the parking lots, it is assumed that transit routes would arrive via the northerly entrance and travel on the service road past the Laurel Employee Residence to a bus stop at the rear of the Old Faithful Inn.

4.2 Summary of Geyser Basin Transit Concepts

The Geyser Basin transit concepts include one that is integrated with a managed access program for a single destination and two others that provide access throughout the corridor but are not supported by a managed access program. The service summary for the Geyser Basin transit concepts is presented in Table 4-1.

Table 4-1: Geyser Basin Concepts: Service Summary

	Concept 1 Old Faithful to Midway Geyser Basin Express	**Concept 2** Old Faithful to Fountain Paint Pot	**Concept 2** Old Faithful - Madison
Potential Ridership	3,700 people per day 740,000 boardings per year [1]	420 people per day 126,000 boardings per year [2]	760 people per day 228,000 boardings per year [2]
Annual Operating Cost	$2.3 million	$1.1 million	$2.3 million
Cost per Boarding	$3.03	$8.41	$9.96
Boarding per Hour per Bus	82	32	25
Capital Cost – Fleet	$13.6 million	$6.3 million	$13.6 million
Capital Cost - Infrastructure	$18.0 million	$11.2 million	$17.6 million
Parking Congestion Impact	100 spaces at Midway Geyser Basin (30-35%)	Negligible	Negligible
No. of Park & Ride Spaces	200-230 spaces at Old Faithful	40-50 spaces at Old Faithful	40-50 spaces at Old Faithful 55-75 at Madison
Fleet	11 buses	5 buses	11 buses
No. of Transit Staff	29	16	30
No. of Housing Units Needed	16 units	9 units	16 units
Maintenance Facility Footprint	5,100-square foot building 1.1-acre site	3,900-square foot building 0.7-acre site	5,100-square foot building 1.1-acre site
Other Infrastructure Investments Required	Parking at Old Faithful	Parking at Old Faithful	Parking at Old Faithful, Parking at Madison
Operational Requirements	Managed parking at Midway Geyser Basin		Parking attendants at Madison

1 Each person boards bus twice, once riding to Midway Geyser Basin and once returning to Old Faithful
2 Assumes each person boards bus an average of 2.5 times per day.

Concept 1, an express route to Midway Geyser Basin, is effective at supporting a managed access program and succeeds in the test to see if transit access could replace on-site parking of 100 cars. But a tradeoff is that the on-site parking is moved elsewhere and more of it is needed. Concept 1 would need some 200 to 230 new parking spaces at Old Faithful.

Concept 2 would provide enhanced visitor experience and mobility for those who may use the service, but ridership is anticipated to be relatively low. It would be convenient for those staying overnight at the Old Faithful lodging but not for most day-trippers. The predominant direction of travel for visitors

arriving at Old Faithful is from the north and few of those visitors are likely to bypass destinations along the way to Old Faithful and then choose to use the transit service to return to those destinations.

Concept 3 would provide a park and ride intercept location at Madison in addition to providing benefits similar to those of Concept 2. However, Concept 3 would have dramatically higher costs without a substantial increase in ridership.

4.3 Geyser Basin Concept 1: Old Faithful to Midway Geyser Basin Express, Managed Access at Midway Geyser Basin

Geyser Basin Concept 1 provides direct service to Midway Geyser Basin from a park and ride location at Old Faithful. There is assumed to be managed access of the Midway Geyser Basin parking.

This transit concept was developed to test the outcomes of offsetting the need for approximately 100 parking spaces at Midway Geyser Basin. This concept is only an example of how transit service might be integrated into a managed access program for Midway Geyser Basin. If there was a managed access program, its objectives would be based on visitor use management analyses of resource protection and visitor experiences and the allocations of visitors accessing by private vehicle and by transit would differ from the 100-space assumption used in this initial assessment.

4.3.1 Service Characteristics

Frequency, Travel time, and Reliability: Due to high demand, the transit service would need to operate with trips every five minutes. This 5-minute frequency is the practical operational limit for a long transit route in such a busy location. The route is 14 miles round trip and travel time would be 45 minutes, including recovery time for each loop. In part because it is an express route to a single destination, reliability is anticipated to be very good, although this assumes managed access of the Midway Geyser Basin parking eliminates delays for buses entering the parking lot.

Fleet: Full size buses of about 35-seat capacity would be required for the anticipated passenger loads. The minimum fleet size would be 11 buses. Nine would be in service at peak times, with two spares. Daily mileage for each bus would average 230 miles. This is beyond the practical battery capacity of most standard batteries offered in battery electric buses. A bus with an extended range battery pack would be required. The operation would also require at least two light vehicles—a maintenance truck and a car for the supervisor.

Ridership: The potential market for transit users is approximately 3,700 people per day. With each person boarding the bus twice, once traveling to Midway Geyser Basin and once returning, there would be 7,400 boardings per day and 740,000 annually.

4.3.2 Field Operations

Given the high level of potential ridership, At least one transit "ambassador" could be needed to assist riders at the Old Faithful transit stop. At Midway Geyser Basin it is critical to reliable transit operations that buses not be delayed by congestion. If there was managed access at the lot, a bypass lane at the control point may be needed.

Figure 4-1: Express Route – Old Faithful to Midway Geyser Basin

4.3.3 Infrastructure Needs

Bus Stops: Transit stops would be required at Old Faithful and Midway Geyser Basin. Both would need to be relatively large due the anticipated ridership.

Roadway Improvements: No changes to roadways and intersections would be required to accommodate maneuvering of the large buses.

Parking: The parking demand at Old Faithful for those parking there and riding to Midway Geyser Basin is approximately 200 to 230 spaces. Essentially all of this would need to be new parking as there is little to no excess parking at Old Faithful much of the time during busy days.

Maintenance Facility: A maintenance and administration facility would be needed for the 11-bus fleet. The footprint of the facility would be a minimum of 1.1 acres.

Housing: Housing would be needed for 29 transit staff. This includes 3 mechanics, a manager, an administrative assistant, a transit ambassador, drivers, dispatchers, and cleaners.

Signage: Signage would be needed in the Old Faithful parking area to direct drivers to the Old Faithful bus stop.

4.3.4 Potential to Pilot Concept

Geyser Basin Concept 1 could not be done as a pilot without managed access being in place. If there was managed access the transit service could then be tested using smaller vehicles and limiting the service to overnight guests among the Old Faithful lodging.

4.3.5 Cost Estimates

The capital costs for Geyser Basin Concept 1 are summarized in Table 4-2. Details of the cost methodology are provided in the appendix.

The annual operation and maintenance costs for Geyser Basin Concept 1 are summarized in Table 4-3. The cost estimate covers 9,000 in-service hours per season (9 buses, 10 hours per day, 100 days per year), and the cost of extra staff for parking attendants. Additional details of the O&M cost methodology are provided in the appendix.

Table 4-2: Geyser Basin Concept 1 – Capital Costs

Item	Number	Unit Cost	Cost
Fleet – Buses	11	$1,100,000	$12,100,000
Fleet – Chargers	11	$125,000	$1,375,000
Fleet – SUV and Pickup	2	$75,000	$150,000
Subtotal			**$13,625,000**
Maintenance Facility – Building	5,100 square feet	$800	$4,080,000
Maintenance Facility – Site	1.2 acres	$1,500,000	$1,800,000
Maintenance Facility – Utilities Connection		Lump Sum	$900,000
Subtotal			**$5,880,000**
Housing – Modular	2 people	$450,000	$900,000
Housing – Dorm Style	27 people	$250,000	$6,750,000
Subtotal			**$7,650,000**
Transit Stops (Medium-High)	1	$300,000	$300,000
Transit Stops (Medium-High)	1	$400,000	$600,000
Subtotal			**$700,000**
Parking at Old Faithful	230 spaces	$16,000	**$3,680,000**
Other		Lump Sum	**$75,000**
TOTAL			**$31,610,000**

Notes: Amounts shown as current (2022) dollars.
Continuation of extraordinary cost increases attributable to supply chain disruptions and labor shortages arising from the pandemic would result in higher costs.

Table 4-3: Geyser Basin Concept 1 – Annual O&M Costs

Item	Cost
Labor – Base Operating Cost	$1,800,000
Labor – Transit ambassador	$30,000
Labor – Pre- and Post-Season	$90,000
Subtotal	**$1,920,000**
Facilities – Maintenance	$80,000
Facilities – Housing	$110,000
Bus Stops	$10,000
Lease of Off-Season Bus Storage	$120,000
Subtotal	**$320,000**
TOTAL	**$2,240,000**

4.3.7 Benefits, Tradeoffs, and Impacts

Benefits, tradeoffs, and impacts of Geyser Basin Concept 1 are summarized in Table 4-4.

This concept provides transit access to a key destination which many are unable to visit due to severe congestion and does so productively and cost efficiently. It succeeds on the test to see if transit access could replace on-site parking of 100 cars.

The tradeoffs are that the transit operation would require 200 to 230 new parking spaces at Old Faithful, would have a large infrastructure investment, and would increase impacts on NPS staff and park operations.

Table 4-4: Geyser Basin Concept 1: Benefits, Tradeoffs, Impacts

	Criteria	Benefits/Tradeoffs/Impacts
Fully Met	Enhance Visitor Experience & Mobility	› Access to a popular destination › Interpretation opportunities › Very convenient for guests at Old Faithful lodging
Fully Met	Maximizes Cost Efficiency and Productivity	› Ridership: 740,000 boardings per year › Annual operating costs: $2.3 million › Performance metrics: 82 boardings/hour/bus, $3.03 per boarding
Partially Met	Reduce Parking Congestion	› Reduces parking demand at Midway Geyser Basin by 100 spaces › Increases parking demand at Old Faithful by 200-230 spaces.
Not Met	Reduce Roadway Congestion	› No change in Level of Service, and negligible change in delay, at any parking lot entrance or intersection along the corridor › Eliminates traffic backups onto Grand Loop Road at Midway Geyser Basin
Not Met	Minimize Impacts to NPS Staff and Park Operations	› Heavy involvement with system launch › Person required to continually coordinate with transit business partner › Ongoing facility maintenance
Partially Met	Enhance Safety	› Reduced overflow parking near Midway Geyser Basin › Eliminates traffic backups onto Grand Loop Road at Midway Geyser Basin › Safety education opportunity with transit riders
Not Met	Minimize Infrastructure and Costs	› 200-230 new parking spaces at Old Faithful › 11 35-passenger buses, 2 bus stops › 5,100-square feet/1.1-acre maintenance facility, Housing for 29 employees
Not Met	Minimize Impacts to Resources	› Reduced overflow parking near Midway Geyser Basin › Housing and maintenance facilities in developed areas › 200-230 new parking spaces at Old Faithful

1 Per the Federal Transit Administration's National Transit Database (2019, pre-pandemic) national averages for fixed route buses were 27 boardings per hour and $5.24 per boarding. For Bus Rapid Transit the averages were 53 boardings and $3.25 per boarding.

4.4 Geyser Basin Concept 2: Old Faithful to Fountain Paint Pot

This transit concept uses Old Faithful as a park and ride location to access Black Sand Basin, Biscuit Basin, Fairy Falls, Midway Geyser Basin, and Fountain Paint Pot. See Figure 4-2. This transit concept does not include any managed access programs.

4.4.1 Service Characteristics

Frequency, Travel time and Reliability: The transit service would operate on a 15-minute frequency, identified as the minimum acceptable for meeting passenger service quality for any transit concept. One-way travel time between Old Faithful and Fountain Paint Pot would be 30 minutes. Possible travel time delays would be similar as for existing conditions since the vehicle would navigate existing congestion hotspots.

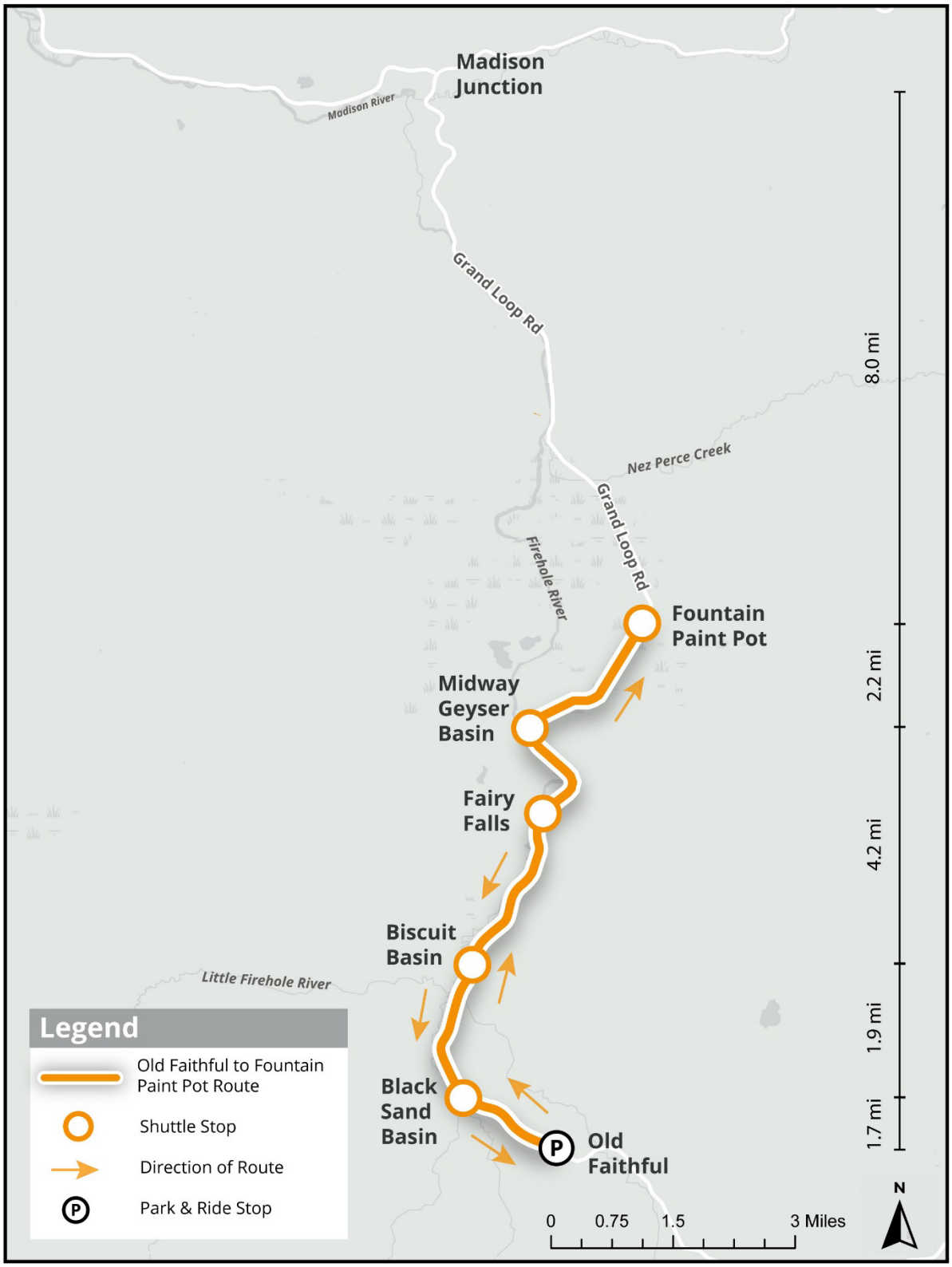
Fleet: The minimum fleet size would be five buses. Four would be in service at peak times, with one spare. Mid-size shuttles with about a 25-seat capacity would be appropriate for the anticipated passenger loads. However, for the purposes of this study, full-size buses, with extended range battery packs, are assumed since current models of battery electric mid-size shuttles do not have the necessary range.

Ridership: Ridership is anticipated to be low, with a maximum of 420 riders per day and annual boardings of 126,000. This forecast assumes that southbound traffic through the corridor would not use the transit service as those visitors would pass the destinations prior to reaching the parking at Old Faithful.

4.4.2 Field Operations

The key element for field operations for Concept 2 is to minimize any delays the transit vehicles may have navigating through congested parking lots. Where this cannot be done through physical changes (described in the next section), staff would be needed to control traffic at and within the lots. Such staff could be provided by the transit operator, NPS staff, or a combination of both.

Figure 4-2: Old Faithful to Fountain Paint Pot



4.4.3 Infrastructure Needs

Bus Stops: The operation would require construction of bus stops at Fountain Paint Pot, Midway Geyser Basin, Fairy Falls, Biscuit Basin, Black Sand Basin, and Old Faithful.

- The Fountain Paint Pot parking lot is frequently congested, and it would be impractical to have a bus stop within the lot under current conditions. Providing stops on the roadside are not recommended as this would involve constructing bus stops on both sides of Grand Loop Road and require transit passengers to cross the road and navigate through the congested traffic entering and/or within the lot. Ideally, the parking lot would be reconstructed such that one end of the lot is used by transit vehicles and the other by private vehicles, with each using one of the two driveways. See Figure A-2 in the Cost Estimate Methodology Appendix for an example.
- The Midway Geyser Basin parking lot frequently experiences extensive delays entering and circulating within the lot. Under current conditions, the parking lot is not feasible for a transit stop due to the likelihood of congestion-caused delays. If a new parking lot for private vehicles were constructed, a transit stop could be accommodated in the design or in the existing parking lot if part of it were retained for transit access only.

Parking: Some 40 to 50 spaces would be required at Old Faithful to accommodate transit riders. Given that the parking lots at Old Faithful frequently fill at times during the day, it is assumed that new parking capacity would need to be constructed.

Maintenance Facilities: A 3,900-square foot maintenance and administration facility would be needed for the 5-bus fleet. The footprint of the facility would be about 0.7 acres.

Housing: Housing would be needed for 16 transit staff. Transit staff would include two mechanics, a manager, an administrative assistant, and drivers, dispatchers, and cleaners.

4.4.4 Potential to Pilot Concept

This transit concept could be piloted at a lower service level with fewer shuttles to better understand demand. There would still be the need to establish bus stops at the focal destinations and the transit operation would have to contend with congestion in the Midway Geyser Basin and Fountain Paint Pot parking lots.

4.4.5 Cost Estimates

The capital costs for Geyser Basin Concept 2 are summarized in Table 4-5. Details of the cost methodology are provided in the appendix.

The annual operation and maintenance costs for Geyser Basin Concept 2 are summarized in Table 4-6. The cost estimate covers 4,000 in-service hours per season (4 buses, 10 hours per day, 100 days per year). Additional details of the O&M cost methodology are provided in the appendix.

Table 4-5: Geyser Basin Concept 2 – Capital Costs

Item	Number	Unit Cost	Cost
Fleet – Buses	5	$1,100,000	$5,500,000
Fleet – Chargers	5	$125,000	$625,000
Fleet – SUV and Pickup	2	$75,000	$150,000
Subtotal			**$6,275,000**
Maintenance Facility – Building	3,900 square feet	$800	$3,120,000
Maintenance Facility – Site	0.7 acres	$1,500,000	$1,050,000
Maintenance Facility – Utilities		Lump Sum	$900,000
Subtotal			**$4,470,000**
Housing –Modular	2 people	$450,000	$900,000
Housing – Dorm Style	14 people	$250,000	$3,500,000
Subtotal			**$4,400,000**
Transit Stops (Medium)	3	$200,000	$600,000
Transit Stops (Medium-High)	1	$300,000	$300,000
Transit Stops (High)	2	$400,000	$800,000
Subtotal			**$1,700,000**
Parking at Old Faithful	50 spaces	$16,000	**$800,000**
Other		Lump Sum	**$75,000**
TOTAL			**$17,420,000**

Notes: Amounts shown as current (2022) dollars.
Continuation of extraordinary cost increases attributable to supply chain disruptions and labor shortages arising from the pandemic would result in higher costs.

Table 4-6: Geyser Basin Concept 2 – Annual O&M Costs

Item	Cost
Labor – Base Operating Cost	$800,000
Labor – Pre- and Post-Season	$50,000
Subtotal	**$850,000**
Facilities – Maintenance	$60,000
Facilities – Housing	$70,000
Bus Stops	$20,000
Lease of Off-Season Bus Storage	$60,000
Subtotal	**$210,000**
TOTAL	**$1,060,000**

4.4.6 Benefits, Tradeoffs, and Impacts

Geyser Basin Concept 2 provides a high level of benefits for visitor experience and mobility. It provides access to the most popular destinations where parking is often constrained and is extremely convenient for those staying in the Old Faithful lodging. It supports active recreation by enabling ride/hike opportunities such as hiking through the Upper Geyser Basin to Black Sand Basin and riding back to Old Faithful. It also provides for interpretive opportunities.

A significant tradeoff would be the infrastructure required to support the transit service. Like all transit concepts, housing and a maintenance facility would need to be provided. In addition, Concept 2 would require additional parking at Old Faithful for those using transit and reconfiguration of the Midway Geyser Basin and Fountain Paint Pot parking lots to allow transit vehicles to avoid the congestion within those lots.

Table 4-7: Geyser Basin Concept 2: Benefits, Tradeoffs, Impacts

	Criteria	Benefits/Tradeoffs/Impacts
Fully Met	Enhance Visitor Experience & Mobility	› Access to multiple popular destinations › Convenient for OF lodging guests › Access to sites where/when no parking availability › Interpretation opportunities › Supports active recreation with trail connections (Hike/Ride)
Partially Met	Maximizes Cost Efficiency and Productivity	› Ridership: 126,000 boardings per season › Annual operating costs: $1.1 million › Performance metrics: 32 boardings/hour/bus, $8.41 per boarding
Not Met	Reduce Parking Congestion	› 40-50 park and ride spaces at Old Faithful › Parking demand along corridor reduced by 20 spaces › Bus stops would displace parking (5-10 spaces) at most destinations
Not Met	Reduce Roadway Congestion	› No change in Level of Service, and negligible change in delay, at any parking lot entrance or intersection along the corridor
Not Met	Minimize Impacts to NPS Staff and Park Operations	› Heavy involvement with system launch › Person required to continually coordinate with transit business partner › Ongoing facility maintenance
Minimally Met	Enhance Safety	› Safety education opportunity with transit riders
Not Met	Minimize Infrastructure and Costs	› 40-50 new parking spaces at Old Faithful › 5 25-passenger buses, 6 bus stops › 3,700 square foot/0.7-acre maintenance facility, Housing for 16 employees
Not Met	Minimize Impacts to Resources	› 40-50 new parking spaces at Old Faithful › Housing and maintenance facilities in developed areas › Mid-size battery electric buses do not have the range required for this route

1 Per the Federal Transit Administration's National Transit Database (2019, pre-pandemic) national averages for fixed route buses were 27 boardings per hour and $5.24 per boarding. For Bus Rapid Transit the averages were 53 boardings and $3.25 per boarding.

4.5 Geyser Basin Concept 3: Old Faithful to Madison

Geyser Basin Concept 3 provides intercept park and ride locations at both ends of the corridor and stops at primary geyser basin destinations. Park and ride locations are at Madison and Old Faithful. Additional stop locations are Fountain Paint Pot, Midway Geyser Basin, Fairy Falls, Biscuit Basin, and Black Sand Basin. This transit concept does not include any managed access programs.

4.5.1 Service Characteristics

Frequency, Travel time and Reliability: The transit service would operate on a 15-minute frequency, identified as the minimum acceptable for meeting passenger service quality for any transit concept. The route is 35 miles in length. Round trip travel time is 85 minutes, including recovery time for each loop. This route has a risk of poor reliability from the multiple destinations it serves, the need for it to navigate existing congestion hotspots, and wildlife-related delays along the northern segment of the route.

Fleet: The minimum fleet size would be 11 buses. Nine would be in service at peak times, with two spares. Mid-size shuttles with about a 25-seat capacity would be appropriate for the anticipated passenger loads. However, for the purposes of this study, full-size buses, with extended range battery packs, are assumed since battery electric mid-size shuttles do not have the necessary range.

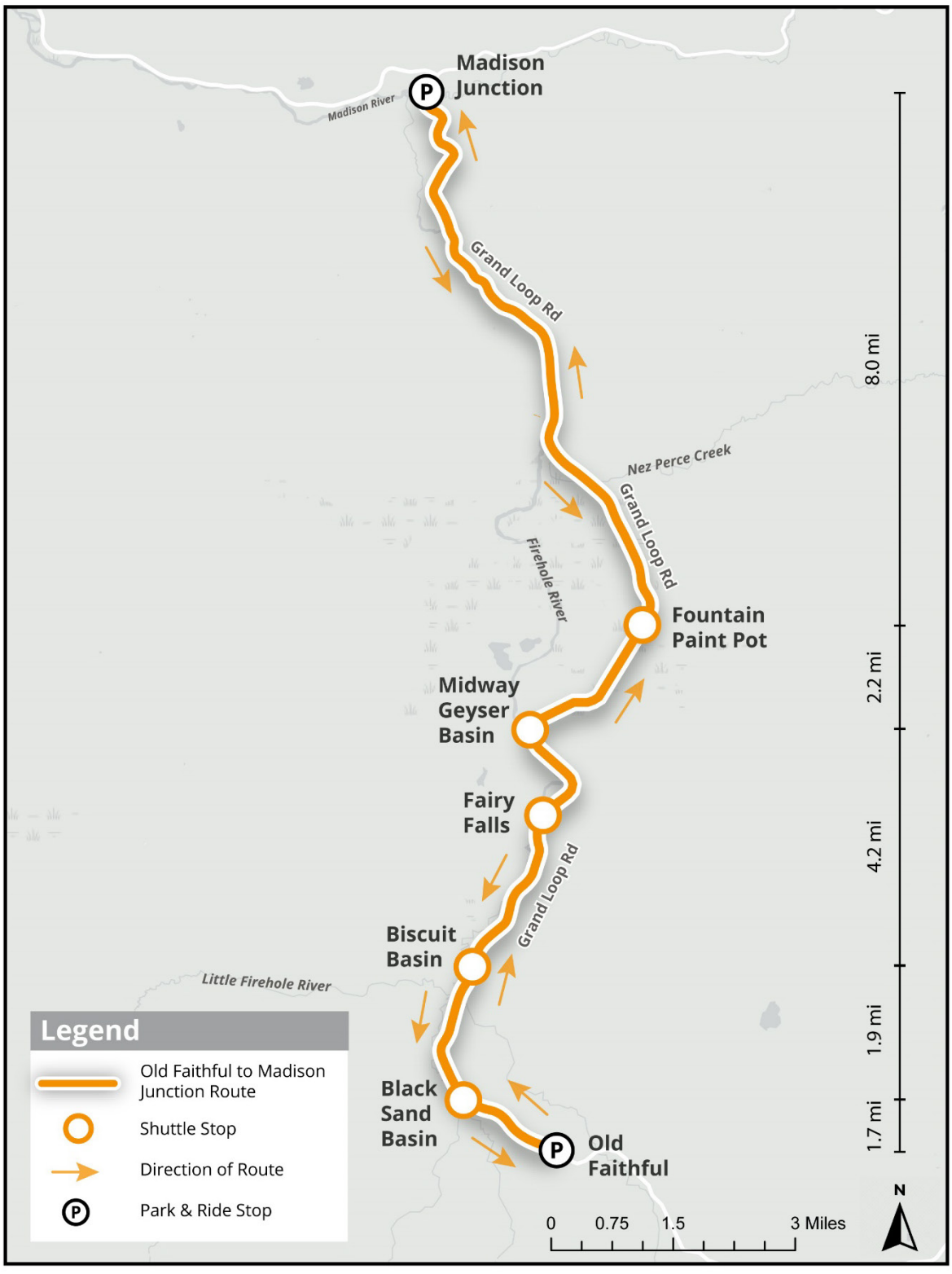
Ridership: Ridership is anticipated to be relatively low, with a maximum of 760 riders per day and annual boardings of 228,000.

4.5.2 Field Operations

Geyser Basin Concept 3 establishes a park and ride location at Madison. Parking attendants would be required to manage the parking to ensure that current users and transit riders are accommodated.

Like Concept 2, the key element for field operations for Concept 3 is to minimize any delays the transit vehicles may have navigating through congested parking lots. Where this cannot be done through physical changes, staff would be needed to control traffic at and within the lots. Such staff could be provided by the transit operator, NPS staff, or a combination of both.

Figure 4-3: Old Faithful to Madison



4.5.3 Infrastructure Needs

Bus Stops: Geyser Basin Concept 3 would require construction of bus stops at Madison, Fountain Paint Pot, Midway Geyser Basin, Fairy Falls, Biscuit Basin, Black Sand Basin, and Old Faithful. Similar to Geyser Basin Concept 2, improvements would be required at Midway Geyser Basin and Fountain Paint Pot to eliminate the frequent congestion and allow the transit service to operate on a reliable schedule.

Parking: Both Old Faithful and Madison would serve as park and ride locations.

- Some 40 to 50 spaces would be required at Old Faithful to accommodate transit riders. Given that the parking lots at Old Faithful frequently fill at times during the day, it is assumed that transit-related parking demand cannot be shared among the existing parking at Old Faithful and new parking capacity would need to be constructed.
- Some 55 to 75 new parking spaces would be required at Madison. This assumes that all existing car and RV parking capacity is retained.

Maintenance Facilities: A 5,100-square foot maintenance and administration facility would be needed for the 11-bus fleet. The footprint of the facility would be about 1.2 acres.

Housing: Housing would be needed for 30 transit staff. Transit staff would include three mechanics, a manager, an administrative assistant, drivers, dispatchers, cleaners, and two parking attendants.

4.5.4 Potential to Pilot Concept

This transit concept could be piloted at a lower service level with fewer shuttles to better understand demand. There would still be the need to establish bus stops at the Madison park and ride and focal destinations. The transit operation would have to contend with congestion in the Midway Geyser Basin and Fountain Paint Pot parking lots.

4.5.5 Cost Estimates

The capital costs for Geyser Basin Concept 3 are summarized in Table 4-8. Details of the cost methodology are provided in the appendix.

The annual operation and maintenance costs for the Geyser Basin Concept 3 are summarized in Table 4-9. The cost estimate covers 9,000 in-service hours per season (9 buses, 10 hours per day, 100 days per year). Additional details of the O&M cost methodology are provided in the appendix.

Table 4-8: Geyser Basin Concept 3 – Capital Costs

Item	Number	Unit Cost	Cost
Fleet – Buses	11	$1,100,000	$12,100,000
Fleet – Chargers	11	$125,000	$1,375,000
Fleet – SUV and Pickup	2	$75,000	$150,000
Subtotal			**$13,625,000**
Maintenance Facility – Building	5,100 square feet	$800	$4,080,000
Maintenance Facility – Site	1.2 acres	$1,500,000	$1,800,000
Maintenance Facility – Utilities Connection		Lump Sum	$900,000
Subtotal			**$5,880,000**
Housing – Modular	2 people	$450,000	$900,000
Housing – Dorm Style	28 people	$250,000	$7,000,000
Subtotal			**$7,900,000**
Transit Stops (Medium)	3	$200,000	$600,000
Transit Stops (Medium-High)	2	$300,000	$600,000
Transit Stops (High)	2	$400,000	$800,000
Subtotal			**$2,000,000**
Parking at Old Faithful	50 spaces	$16,000	**$800,000**
Parking at Madison	75 spaces	$12,000	**$900,000**
Other		Lump Sum	**$100,000**
TOTAL			**$31,205,000**

Notes: Amounts shown as current (2022) dollars.
Continuation of extraordinary cost increases attributable to supply chain disruptions and labor shortages arising from the pandemic would result in higher costs.

Table 4-9: Geyser Basin Concept 3 – Annual O&M Costs

Item	Cost
Labor – Base Operating Cost	$1,800,000
Labor – Parking attendants	$50,000
Labor – Pre- and Post-Season	$90,000
Subtotal	**$1,940,000**
Facilities – Maintenance	$80,000
Facilities – Housing	$110,000
Bus Stops	$20,000
Lease of Off-Season Bus Storage	$120,000
Subtotal	**$330,000**
TOTAL	**$2,270,000**

4.5.6 Benefits, Tradeoffs, and Impacts

Benefits, tradeoffs, and impacts of Geyser Basin Concept 3 are summarized in Table 4-10.

Concept 3 would provide enhanced visitor experience and mobility for those who may use the service, but ridership is anticipated to be relatively low. The park and ride location at Madison makes it convenient for those arriving from the north and east. However, compared to Geyser Basin Concept 2, Geyser Basin Concept 3 would have dramatically higher costs without a substantial increase in ridership.

Table 4-10: Geyser Basin Concept 3: Benefits, Tradeoffs, Impacts

	Criteria	Benefits/Tradeoffs/Impacts
Fully Met	Enhance Visitor Experience & Mobility	› Convenient transit access to those entering via West Yellowstone, arriving via Norris, and staying at the Madison Campground › Convenient transit access for OF lodging guests › Access to sites where/when no parking availability › Interpretation opportunities › Supports active recreation with trail connections (Hike/Ride) › Reliability of transit service may be impacted by animal jams
Partially Met	Maximizes Cost Efficiency and Productivity	› Ridership: 228,000 boardings per season › Annual operating costs: $2.3 million › Performance metrics: 25 boardings/hour/bus, $9.96 per boarding
Not Met	Reduce Parking Congestion	› 40-50 park and ride spaces at Old Faithful › 55-75 park and rides spaces at Madison › Parking demand along corridor reduced by 30-35 spaces › Bus stops would displace parking (5-10 spaces) at most destinations
Not Met	Reduce Roadway Congestion	› No change in Level of Service, and negligible change in delay, at any parking lot entrance or intersection along the corridor
Not Met	Minimize Impacts to NPS Staff and Park Operations	› Heavy involvement with system launch › Person required to continually coordinate with transit business partner › Ongoing facility maintenance
Minimally Met	Enhance Safety	› Safety education opportunity with transit riders › Slight reduction in traffic volumes through corridor
Not Met	Minimize Infrastructure and Costs	› 40-50 new parking spaces at Old Faithful › 55-75 new parking spaces at Madison › 11 buses, 7 bus stops › 5,100-square foot/1.1-acre maintenance facility, Housing for 30 employees
Not Met	Minimize Impacts to Resources	› 40-50 new parking spaces at Old Faithful › 55-75 new parking spaces at Madison › Housing and maintenance facilities in developed areas › Mid-size battery electric buses do not have the range required for this route

1 Per the Federal Transit Administration's National Transit Database (2019, pre-pandemic) national averages for fixed route buses were 27 boardings per hour and $5.24 per boarding. For Bus Rapid Transit the averages were 53 boardings and $3.25 per boarding.

5

Criteria Findings

The assessment of each transit concept included consideration of the degree to which each could achieve the feasibility criteria set forth by the park. Following are some general findings about how well the transit concepts met the criteria.

- **All the transit concepts provided enhanced visitor mobility and experience.** Every transit concept had in common benefits such as providing an alternative means of access to popular destinations, access to destinations with limited parking availability and which a visitor might otherwise have to bypass, the potential for interpretive opportunities, and facilitating active transportation by creating ride/hike options.
- **Cost efficiency and productivity are maximized when transit concepts are paired with managed access.** All Canyon Area concepts and the Geyser Basin concept of an express route serving Midway Geyser Basin are paired with managed access. The potential ridership for those concepts would be very high. On the other hand, the Geyser Basin routes between Old Faithful and Fountain Paint Pot and Old Faithful and Madison were not, in large part, cost efficient because they carried relatively few people over very long routes.
- **Significant reductions in roadway congestion were more related to managed access than transit.** For example, the Canyon Area concepts included both transit service and managed access of North Rim Drive or South Rim Drive and while all those concepts would help reduce congestion on those roadways, congestion could also be controlled by just managed access, regardless of whether there was transit service.
- **Significant reductions in parking congestion were more related to managed access than transit.** Like roadway congestion, reductions in overflow parking and other parking congestion could not be achieved by transit alone and the reductions were primarily outcomes of managed access. Transit service could, however, supplement managed access programs by providing alternative access for visitors.
- **All transit concepts have broad impacts on NPS staff and park operations.** Transit is a complex operation at a park. And even small transit operations can involve a lot of park staff. Table 5-1 illustrates the breadth to which any transit operation involves NPS staff.

Table 5-1: Park Tasks to Support Transit:

	Involvement with Start-up	Ongoing Involvement
Office of the Superintendent, Strategic Communications		
› Media Relations	●	●
› Social media and website	●	●
› Stakeholder communications	●	●
Administration		
› Communication technology support	●	●
Business & Commercial Services		
› Coordination with transit business partner	●	●
› Day-to-day issues, Service planning, Marketing		
› Quality Assurance, performance review	●	●
› NPS transit pro forma and fee adjustments	●	●
› Coordination with lodging concessioner	●	●
› Shared parking to support transit		
Facility Management and Operations		
› Design/Construction of transit infrastructure	●	
› Bus stops, Maintenance facility, Roadway/parking signage and markings, Utilities		
› Maintenance of transit infrastructure		●
› Bus stops, Maintenance facility, Roadway/parking signage and markings, Utilities		
Resource Education		
› Day-to-day visitor information		●
Visitor & Resource Protection		
› Emergency Services	●	●
› Congestion management	●	●
› In some parking lots to support transit vehicle circulation		
Yellowstone Center for Resources		
› Social science monitoring	●	●
› Resource monitoring		●

Notes: Identifying staffing to support managed access is out of scope.
Some services could be supported by transit contractor, e.g., bus stop cleaning, visitor information, parking lot congestion management.

› **All transit concepts have substantial infrastructure needs and costs.** All transit operations require a park and ride location, housing for staff, and a place to garage, fuel, and maintain the bus fleet. Parking is a significant tradeoff since the size of the park and ride area needed by a transit service is at least double that of the number of spaces for which demand is reduced at a congested location.

› **The transit concepts often only minimally meet the criteria for minimizing impacts to park resources.** Transit can support a reduction in overflow parking and related impacts like social trails but have no significant reduction in vehicle miles traveled. All concepts require extensive infrastructure, most of which would be on developed area but nonetheless would have to be constructed.

- **Safety is improved, albeit sometime modestly. And the largest safety enhancements are related to managed access.** Transit does provide a good opportunity to reinforce safety issues with visitors, but it was typically the managing access to a busy parking lot or road that reduced traffic volumes and congestion.

Appendices

A. Cost Estimate Methodology

B. Task 2 and 3 Technical Report: Data Analysis, Forecasting, and Existing Conditions Review, January 2022

C. Task 4 Technical Report: Initial Transit Concepts, April 2022

A. Cost Estimate Methodology

The cost estimates presented in this study are Rough Order of Magnitude (ROM) cost estimates for the evaluation of general feasibility. ROM cost estimates provide a preliminary, high-level view of potential project costs for an initial functional program based on experience and cost of similar projects. Additional details, NEPA, and Class C estimates would need to be created with a transit plan if the park were to decide to move forward.

The cost estimate values are presented in current (2022) dollars. Continuation of extraordinary cost increases attributable to supply chain disruptions and labor shortages arising from the pandemic would result in higher costs. Other methodology and key assumptions for cost categories are summarized below.

Capital Costs

Fleet

All buses are assumed to be battery electric vehicles. The transit concepts evaluated for the study use a range of mid-size to full-size buses. The pictures below show an example of a full-size and a mid-size battery electric bus (BEB).

New Flyer XE40 Battery Electric Bus, like those to be used at Zion National Park.

Example of Cutaway-style Battery Electric Bus

All manufacturers of full-size transit buses offer battery electric versions. Mid-size battery-electric buses are not as readily available but are becoming more so. Battery electric mid-size buses are frequently adaptions of cutaway-type shuttles that have a custom passenger body on a standard truck chassis such as a Ford 450. The companies making the cutaway buses now add electric powertrains using batteries provided by other vendors.

At the present time only 40-foot full-size transit buses are offered via GSA Fleet. Accordingly, the cost estimates for both concepts are based on those vehicles. The cost per bus in the Canyon Area transit concepts is assumed at $1,000,000. This is based on the cost of similar buses procured for Zion National Park. While the base cost of the buses is $800,000 to $900,000, the $1,000,000 cost covers some upgrades, accessory options, extended warranties, training, and spare parts. Buses on the Geyser Basin routes would require extended range batteries and the cost per bus for the Geyser Basin concepts is $1,100,000.

Should any transit services be piloted, the pilot may use non-BEB vehicles and fuel. The cost of these vehicles is typically less than for BEB vehicles, although identifying the specific costs is out of scope for the transit feasibility study.

Charging

Depot charging, primarily overnight, is assumed for the bus fleet. The cost estimates include $125,000 each for 60 kW chargers for each bus in the fleet. This is the size and cost of the equipment being used for the new bus fleet at Zion National Park. The $125,000 cost per unit includes conduit and associated infrastructure for installing the new chargers.

The cost estimates do not include upgrades to transformers or other electrical grid upgrades that may be necessary to accommodate not only a potential bus fleet, but other sustainability initiatives in the park. The number of in-service buses among the six transit concepts range from 4 to 10 and peak charging loads could range from 240 kWh and 600 kWh if there is not any energy management. A detailed analysis of charging loads, along with potential solar charging options, would need to be conducted with a transit plan if the park were to decide to move forward with a battery electric bus operation.

Other Fleet Vehicle

All transit concepts would require some service vehicles. For each it is assumed there is a pickup truck for use by maintenance and an SUV for use by operations. There are battery electric options for both are available from GSA Fleet. The combined cost for the two vehicles, including chargers, is estimated at $150,000.

Transit Maintenance Facilities

The transit maintenance facility buildings would include administrative and dispatch offices, a driver breakroom, maintenance bays, and parts and tire storage. Bus parking is assumed to occur outside, uncovered. The site would include parking for office and maintenance staff and for drivers.

Three factors that can significantly affect the sizing of the building are (1) the number of maintenance bays, (2) whether bus washing is done inside or outside, and (3) whether a driver training room is included. For this study, bus washing is assumed to occur outside and there would be no dedicated training room.

As shown in Table A, two sizes of transit facility buildings are assumed, dependent on fleet size. The administrative space is that same for both. For fleets with fewer than 10 buses, there would be a single maintenance bay. For larger fleets, there would be two maintenance bays and larger auxiliary areas for parts and tire storage.

Table A: Transit Maintenance Facility Sizing

	Fewer than 10 Buses in Fleet	10 or More Buses in Fleet
Administrative Area	1,800 GSF	1,800 GSF
Maintenance Area	2,100 GSF	3,300 GSF
Total	3,900 GSF	5,100 GSF

GSF = Gross Square Feet

The size of the entire site varies with the number of buses in the fleet and the amount of employee parking. The site is sized based on 400 square feet per employee parking space and 1,500 square feet per bus parking space, in addition to the building size and an allowance for circulation around the building. The site footprint for the transit concepts ranges from 0.7 acres to 1.2 acres. As a comparison, the Old Faithful Bus Garage, used by Xanterra, is approximately 4,000 square feet and the site is approximately 2.5 acres.

The cost estimate for the maintenance facility is comprised of three parts. The building cost is estimated at a project cost of $800 per square foot. Site work is estimated at $1,500,000 per acre. In addition, because the location of any facility is undefined, an allowance of $900,000 is added for the potential need to extend utilities to the site. Based on the study team's experience at other parks, the allowance is estimated to cover costs for extending utilities up to 1000 feet.

Transit Stops

The study estimated approximate cost categories for the transit stops that would be needed. Cost categories include "low" transit stops (approximately $100,000), "medium" transit stops (approximately $200,000), "medium-high" transit stops (approximately $300,000), and "high" transit stops (approximately $400,000). Table B and Table C list the categories for each potential bus stops in the two study areas. Examples showing the general magnitude of work follow.

Table B: Canyon Area Transit Stops – Estimated Level of Investment

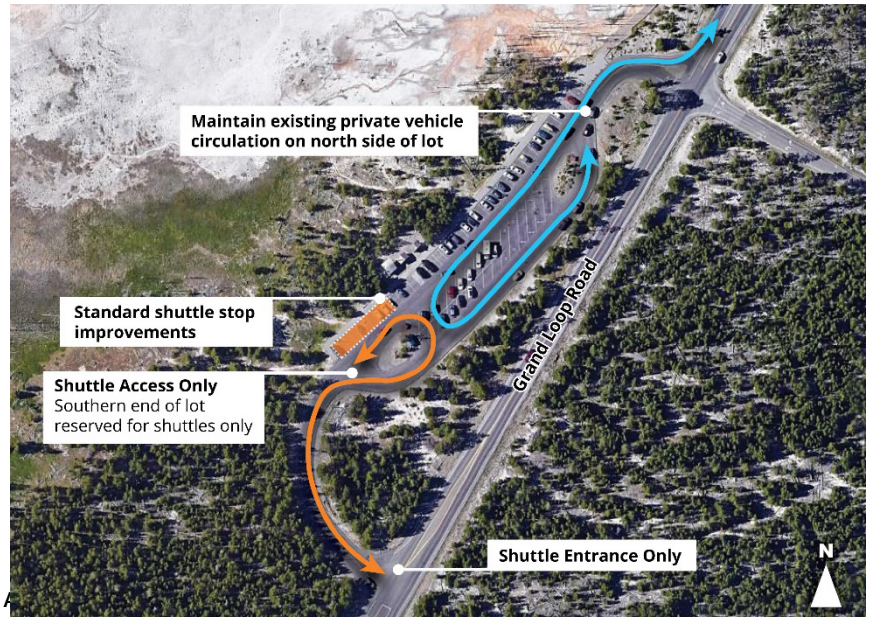
Location	Category	Notes
Canyon Village Visitor Center	Low	Displace parking in front of Education Center. No shelter.
Canyon Village Campgrounds	Low	Near campground office. No shelter.
Canyon Lodge and Cabins	Medium	New stop for park and ride operations. Shelters, access to rest rooms, and queuing areas for riders. Facilities for the staff managing the park and ride operations.
Lookout Point	Medium	New curb extension to create shuttle stop in existing parking area.
Grand View	Medium-High	Expand boarding area into the tree line on the west side of North Rim Drive. Connect shuttle stop to Grand View Trail.
Inspiration Point Road at North Rim Drive Intersection	Medium	New pullouts (2) along road. No shelter or seating.
Inspiration Point Road at Seven Mile Hole Trailhead	Medium	New pullouts (2) along road. No shelter or seating.
Inspiration Point	Low	Utilize existing parking area and sidewalk for shuttle boarding area. No shelter due to size constraints.
Brink of Lower Falls	Medium-High	On north side of road, away from rim. Large shelter.
Brink of Upper Falls	Low	Use existing pull up area and sidewalk near restroom for shuttle stop.
Wapiti Trailhead	Low	Use existing parking bay near sidewalk for shuttle boarding area. No shelter.
Upper Falls Viewpoints	Low	Use existing sidewalk and parking area as boarding area. Existing shelter could be used for the shuttle stop.
Artist Point	Medium	Use existing sidewalk and tour bus pull up area as boarding area. Large shelter and seating area. Develop new cross aisle for private vehicles to bypass bus top.

Table C: Geyser Basin Transit Stops – Estimated Level of Investment

Location	Category	Notes
Madison Junction	Medium-High	Park and ride location.
Fountain Paint Pot	High	Requires separation of buses and cars due to congestion. Large boarding area.
Midway Geyser Basin	High	Requires separation of buses and cars due to congestion. Large boarding area.
Fairy Falls	Medium	Large boarding area.
Biscuit Basin	Medium	Develop boarding area in existing parking bay.
Black Sand Basin	Medium	Develop boarding area in existing parking bay.
Old Faithful	Medium-High	Behind Old Faithful Inn, near Visitor Center. Large boarding area.

Figure A-1: Conceptual example of a 'medium' investment transit stop, at Black Sand Basin parking area

Figure A-2: Conceptual example of a 'high' investment transit stop, at Fountain Paint Pot



Housing

Cost estimates for housing are based on the staffing estimates. For all concepts it is assumed that two of the transit staff (such as the manager and the chief mechanic) would reside in private modular housing and the remainder would reside in shared dorm-style housing.

The cost estimates are independent of location and assume that utility connections are available and there are no extraordinary site costs. The cost for each modular housing unit is assumed to be $450,000. The per-person cost for those assumed to reside in dorm-style housing is $250,000.

Options other than stick-built housing for transit staff, if available, could have lower costs. For example, many of the transit staff at Grand Canyon National Park reside in RV sites.

Parking

Any park and ride spaces required at Madison, Old Faithful, or Canyon Village are assumed to require new construction. No specific locations for the new parking area are assumed and an estimate of $16,000 per parking space is used. This is a high-end range estimate that reflects the teams experience in other parks.

The exception is at Madison for which is assumed a cost of $12,000 per new parking space. Some of the existing paved footprint of the Madison lot could be used and so the amount of new pavement required would be less.

Trails

The cost estimates for trails (Canyon Area Concept 1) assumes a unit project cost of $65 per foot for an 8'-wide crushed rock pedestrian path. This is based on the team's experience designing trails at national parks and other recreation areas.

Roadways

The cost estimates for the widening of North Rim Drive for Canyon Area Concept 1 assumes a unit project cost of $300 per foot for a 4' widening. An allowance of $200,000 is included for widening a section of the parking area at Lookout Point to allow buses to turnaround. This is in addition to the allowance for bus stop improvements.

Other

All concepts include an allowance for other, smaller, capital investments, primarily signage. The allowance ranges from $75,000 to $100,000. The higher amount reflects conditions where there would be a dynamic sign (Geyser Basin Concept 3) or a bicycle rental operation (Canyon Concept 1).

Operating & Maintenance Costs

The operating and maintenance costs include labor, care of facilities, and off-season storage of the bus fleet.

Labor

The cost estimate for labor uses a base per-hour operating cost and add extra labor costs and the cost of facilities.

- The base operating cost is $200 per in-service vehicle hour. This metric is typical in the transit industry and covers expenses incurred during day-to-day operations. This includes vehicle operations, vehicle maintenance, non-vehicle maintenance, and general administration.

  The Federal Transit Administration provides an annual report of costs and other metrics for public transit agencies throughout the country.[12] For 2021, the average operating cost per in-service vehicle hour was $157.92 for fixed-route buses and $202.36 for bus rapid transit vehicles.

  Comparable costs for National Park Service bus operations are not readily available due to the unique characteristics of many of the NPS transit systems and the variety of business models for operating those systems. One example that could be comparable is at Bryce Canyon National Park. That system utilizes a contractor to provide both vehicle and personnel at a base cost (FY2023) of approximately $168 per hour.
- Because most hourly costs of in-service vehicle hours are based on year-round operations and fixed costs are averaged for the entire year, the labor cost estimates for the transit concepts include supplemental costs for transit staff to work an additional two weeks beyond the 100-day season assumed for all transit concepts.
- Some transit concepts would include additional personnel as parking attendants or for a bicycle rental operation. The cost estimates for these positions assume a (loaded) hourly rate of $25.00 per hour. This is comparable to hourly costs for parking attendants at Grand Canyon National Park.

Other O&M Costs

Operation and maintenance costs for the employee housing and the maintenance facility assume $8.00 per square foot annually to cover utilities and routine maintenance. The size of housing assumed 1,200 square feet for modular units and 400 square feet per person for dorm-style housing.

An allowance of $2,500 is assumed for routine maintenance of each bus stop.

The cost for winter storage of buses is estimated assuming leased space of 650 square feet per bus and an annual cost of $16.00 per square foot, including utilities. It is assumed that the storage facility would be leased year-round to ensure year-to-year availability.

[12] National Transit Database, 2021 Report Year. Federal Transit Agency, U.S. DOT, Office of Budget and Policy, September 2022.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YELLOWSTONE NATIONAL PARK