Chapter 10: Air Quality

10.1 Introduction

This chapter describes the existing air quality in the air quality impact analysis area and the effects of the project alternatives on air quality. Air quality in a given area depends on several factors such as the area itself (size and topography), the prevailing weather patterns (meteorology and climate), and the pollutants released into the air. Air quality is described in terms of the concentrations of various pollutants in a given area of atmosphere (for example, parts per million or micrograms per cubic meter).

What is the air quality impact analysis area?

The air quality impact analysis area focuses on the area around S.R. 210 from its intersection with S.R. 190/Fort Union Boulevard in Cottonwood Heights to its terminus in the town of Alta, and includes the Alta Bypass Road. The impact analysis area also includes the area around the gravel pit and the existing UTA park-and-ride lot at 9400 South and Highland Drive.

Air Quality Impact Analysis Area. The air quality impact analysis area focuses on the area around State Route (S.R.) 210 from its intersection with S.R. 190/Fort Union Boulevard in Cottonwood Heights to its terminus in the town of Alta, and includes the Alta Bypass Road. The impact analysis area also includes the area around the gravel pit, the location of a proposed mobility hub, adjacent to Wasatch Boulevard north of Fort Union Boulevard and the existing Utah Transit Authority (UTA) park-and-ride lot at 9400 South and Highland Drive (see Figure 1.1-1, Transportation Needs Assessment Study Area, in Chapter 1, Purpose and Need).

10.2 Regulatory Setting

10.2.1 National Ambient Air Quality Standards (NAAQS)

The U.S. Environmental Protection Agency (EPA), under the authority of the Clean Air Act (42 United States Code [USC] Section 7401 and subsequent sections), established National Ambient Air Quality Standards (NAAQS) for ubiquitous pollutants considered harmful to public health and the environment (40 Code of Federal Regulations [CFR] Part 50). These standards include both primary and secondary standards. Primary standards protect public health, while secondary standards protect public welfare (such as protecting property and vegetation from the effects of air pollution). These standards have been adopted by the Utah Division of Air Quality as the official ambient air quality standards for Utah.

EPA has set NAAQS for six principal pollutants known as *criteria pollutants*. The current NAAQS are listed in Table 10.2-1. According to EPA, transportation sources currently contribute to four of the six criteria pollutants: carbon monoxide (CO), particulate matter (PM_{10} and $PM_{2.5}$), ozone (O_3), and nitrogen dioxide (NO_2).

If an area meets the NAAQS for a given air pollutant, the area is called an *attainment area* for that pollutant (because the NAAQS have been attained). If an area does not meet the NAAQS for a given air pollutant, the area is called a *nonattainment area*. A *maintenance area* is an area previously designated as a nonattainment area that has been redesignated as an attainment area and is required by Section 175A of the Clean Air Act, as amended, to have a maintenance plan for the 20 years following its redesignation to attainment or maintenance status.

Table 10.2-1. National and Utah Ambient Air Quality Standards for Criteria Pollutants and Attainment Status for Salt Lake County

Pollutant	Primary/Secondary Standard	Averaging Time	Level	Form	Attainment Status for Salt Lake County
Carbon monoxide (CO)	Primary	8 hours	9 ppm	Not be exceeded more than once per year	Partial attainment area[a]
		1 hour	35 ppm	Not be exceeded more than once per year	
Ozone (O_3)	Primary and secondary	8 hours	0.070 ppm	Annual fourth-highest daily maximum 8-hour concentration, averaged over 3 years	Marginal nonattainment area
Particulate matter ($PM_{2.5}$)	Primary	1 year	12.0 µg/m³	Annual mean, averaged over 3 years	Serious nonattainment area
	Secondary	1 year	15.0 µg/m³	Annual mean, averaged over 3 years	
	Primary and secondary	24 hours	35 µg/m³	98th percentile, averaged over 3 years	
Particulate matter (PM_{10})	Primary and secondary	24 hours	150 µg/m³	Not to be exceeded more than once per year on average over 3 years	Maintenance area
Nitrogen dioxide (NO_2)	Primary	1 hour	100 ppb	98th percentile of 1-hour daily maximum concentrations, averaged over 3 years	Attainment area
	Primary and secondary	1 year	53 ppb	Annual mean	Attainment area
Sulfur dioxide (SO_2)	Primary	1 hour	75 ppb	99th percentile of 1-hour daily maximum concentrations, averaged over 3 years	Attainment area
	Secondary	3 hours	0.5 ppm	Not to be exceeded more than once per year	Nonattainment area
Lead (Pb)	Primary and secondary	Rolling 3-month average	0.15 µg/m³	Not to be exceeded	Attainment area

Sources: 49 CFR Part 50 (NAAQS) and 40 CFR Part 81 (attainment status)

µg/m³ = micrograms per cubic meter; ppm = parts per million; ppb = parts per billion; $PM_{2.5}$ = particulate matter 2.5 microns in diameter or less; PM_{10} = particulate matter 10 microns in diameter or less

[a] A section of Salt Lake County is a CO maintenance area, but the rest is an attainment area. The air quality impact analysis area is located in the attainment area.

The air quality impact analysis area for the S.R. 210 Project is located in Salt Lake County, which is a nonattainment area for $PM_{2.5}$, O_3, and SO_2. Salt Lake County is a maintenance area for PM_{10}, having recently transitioned from a nonattainment area effective March 27, 2020. Table 10.2-1 above shows Salt Lake County's attainment status for each criteria pollutant.

Sulfur dioxide (SO_2) and lead (Pb) are not considered transportation-related criteria pollutants and are not discussed further.

10.2.2 Transportation Conformity Requirements

Transportation conformity is a process required by Clean Air Act Section 176(c), which establishes the framework for improving air quality to protect public health and the environment. All state governments are required to develop a state implementation plan (SIP) for each pollutant for which an area is in nonattainment or maintenance status. The SIP explains how the State will comply with the requirements of the Clean Air Act.

What is transportation conformity?

Transportation conformity is a process required by Clean Air Act Section 176(c), which establishes the framework for improving air quality to protect public health and the environment.

Section 176(c) of the Clean Air Act, and its related amendments, require that transportation plans, programs, and projects that are developed, funded, or approved by the Federal Highway Administration (FHWA) and/or Federal Transit Administration, and metropolitan planning organizations, must demonstrate that such activities conform to the SIP. Transportation conformity requirements apply to any transportation-related criteria pollutants for which the project area is designated a nonattainment or maintenance area.

Unless the project is exempt from conformity requirements, federal agencies are required to make a conformity determination before adopting, accepting, approving, or funding an activity or project located in a nonattainment or maintenance area. A conformity determination is a finding that the activity or project conforms to the SIP's purpose of "eliminating or reducing the severity and number of violations" of the NAAQS and "achieving expeditious attainment of the NAAQS" [42 USC Section 7506(c)] and that the project or activity will not:

- Cause or contribute to new air quality violations of the NAAQS,
- Worsen existing violations of the NAAQS, or
- Delay timely attainment of the NAAQS or required interim milestones.

A project-level conformity determination for ozone can be made by confirming that the project is included in the currently conforming regional transportation plan (RTP) and transportation improvement program (TIP). A project-level conformity determination might also require a hot-spot analysis for CO, PM_{10}, and/or $PM_{2.5}$ in areas that are designated as nonattainment or maintenance. A hot-spot analysis is defined in 40 CFR Section 93.101 as an estimation of likely future local pollutant concentrations and a comparison of those concentrations to the relevant NAAQS. A hot-spot analysis assesses air quality impacts on a smaller scale than an entire nonattainment or maintenance area.

What is a hot-spot analysis?

A hot-spot analysis is an estimation of likely future local pollutant concentrations and a comparison of those concentrations to the relevant NAAQS.

A PM hot-spot analysis is required only for specific types of projects, which are listed in the transportation conformity regulations at 40 CFR Section 93.123(b)(1). EPA uses the term *project of air quality concern* (POAQC) to refer to any of the project types for which a PM hot-spot analysis is required.

The S.R. 210 Project is not an exempt project for transportation conformity purposes under 40 CFR Section 93.126. The current RTP for the project area is the Wasatch Front Regional Council's (WFRC) 2019–2050 *Wasatch Front Regional Transportation Plan* (WFRC 2019). Key aspects of the S.R. 210 Project are identified in WFRC's conforming 2019–2050 RTP as well as in WFRC's conforming 2021–2026 TIP. (For a list of the planned highway and transit projects in the 2019–2050 RTP that influence the S.R. 210 Project, see Table 1.3-1, Planned and Funded Transportation Improvements in the 2019–2050 RTP in the Study Area, in Chapter 1, Purpose and Need.)

Conformity for O_3 is met due to the requirement that the RTP and TIP approvals must be based on a finding that O_3 precursor emissions of volatile organic compounds and nitrogen oxides from projects in the RTP and TIP are consistent with the SIP to bring the area into attainment with the O_3 national standard. EPA approved the maintenance plan for the Salt Lake County 1-hour O_3 nonattainment area on July 17, 1997 (62 Federal Register [FR] 38213). However, the 1-hour standard was replaced by an 8-hour standard on July 18, 1997 (62 FR 38856). EPA partially approved the maintenance plan for the Salt Lake County 8-hour O_3 standard on September 26, 2013 (78 FR 59242), and the SIP for PM_{10} on July 8, 1994 (59 FR 35036). Salt Lake County does not yet have an approved SIP for $PM_{2.5}$.

Because the project alternatives would be located in a $PM_{2.5}$ nonattainment and PM_{10} maintenance area, the S.R. 210 Project is subject to the procedures described in 40 CFR Section 93.123(b)(1), which determine whether a project should be classified as a POAQC such that quantitative hot-spot analysis is warranted. Projects that require quantitative hot-spot analyses for $PM_{2.5}$ and PM_{10} include:

i. New highway projects that have a significant number of diesel vehicles, and expanded highway projects that have a significant increase in the number of diesel vehicles

ii. Projects affecting intersections that are at a level of service (LOS) of LOS D, E, or F with a significant number of diesel vehicles, or those that will change to LOS D, E, or F because of increased traffic volumes from a significant number of diesel vehicles related to the project

iii. New bus and rail terminals and transfer points that have a significant number of diesel vehicles congregating at a single location

iv. Expanded bus and rail terminals and transfer points that significantly increase the number of diesel vehicles congregating at a single location

v. Projects in or affecting locations, areas, or categories of sites that are identified in the PM_{10} or $PM_{2.5}$ applicable implementation plan or implementation plan submission, as appropriate, as sites of violation or possible violation

At a minimum, item (iii) applies to the S.R. 210 Project, so the S.R. 210 Project is a POAQC and requires quantitative $PM_{2.5}$ and PM_{10} hot-spot analyses (for more information, see Attachment A, POAQC Evaluation, in Appendix 10A, Air Quality Technical Report).

There are no project-level CO requirements because the air quality impact analysis area is not in a CO nonattainment or maintenance area.

10.2.2.1 Hot-spot Analysis

In general, a hot-spot analysis compares the air pollutant concentrations that would occur with a proposed project (the build scenario) to the air pollutant concentrations without the project (the no-build scenario). The air pollutant concentrations are determined by calculating a "design value," a statistic that describes a future air pollutant concentration in the project area that can be compared to a particular NAAQS. The EPA guidance *Transportation Conformity Guidance for Quantitative Hot-spot Analysis in $PM_{2.5}$ and PM_{10} Nonattainment and Maintenance Areas* (EPA 2015a) suggests modeling the build scenario first. If the design values for the build scenario are less than or equal to the relevant NAAQS, the project meets the conformity rule's hot-spot requirements, and no further modeling is needed.

Section 93.116(a) of the conformity rule requires that PM hot-spot analyses consider either the full timeframe of an area's transportation plan or, in an isolated rural nonattainment or maintenance area, the 20-year regional emissions analysis. Conformity requirements are met if the analysis demonstrates that no new or worsened violations would occur in the year(s) of highest expected air pollutant emissions, which includes the project's emissions in addition to background concentrations. Analysis years must be within the timeframe of the transportation plan. For the S.R. 210 Project, analyses were conducted for the year 2050.

Additionally, hot-spot analyses should include the entire project area [40 CFR Section 93.123(c)(2)]. However, for larger projects, it might be appropriate to focus the analysis only on the locations with the highest predicted concentrations of air pollutants. If conformity is demonstrated at such locations, then it can be assumed that conformity requirements would be met in the entire project area.

10.2.3 Hazardous Air Pollutants

The Clean Air Act Amendments of 1990 listed 188 hazardous air pollutants (also referred to as air toxics or HAPs) that are known to cause or are suspected of causing cancer or other serious health effects or adverse environmental effects. Most air toxics originate from human-made sources including road mobile sources, nonroad mobile sources (such as locomotives, construction equipment, and airplanes), and stationary sources (such as factories or refineries). Section 112 of the Clean Air Act Amendments of 1990 requires EPA to establish emission standards that require the maximum degree of reduction in emissions of hazardous air pollutants. Unlike the criteria pollutants, HAPs do not have NAAQS, making evaluation of their impacts more subjective.

In 2001, EPA issued its first Mobile-source Air Toxics Rule, which identified 21 mobile-source air toxic compounds (MSATs) as being HAPs that required regulation. EPA issued a second MSAT Rule in 2007 that generally supported the findings in the first rule and specified several emissions standards that must be implemented.

Using the 2011 National Air Toxics Assessment, EPA further identified nine MSATs that are among the national and regional-scale cancer risk drivers or contributors and noncancer hazard contributors. These are the MSATs that should be evaluated during NEPA analysis. FHWA's *Updated Interim Guidance on Mobile-source Air Toxic Analysis in NEPA Documents* (FHWA 2016) specifies how MSATs should be considered in NEPA documents. FHWA developed a tiered approach for analyzing MSATs in NEPA documents, depending on the following specific project circumstances:

- **Tier 1:** No analysis for projects with no potential for meaningful MSAT effects;
- **Tier 2:** Qualitative analysis for projects with low potential MSAT effects; or
- **Tier 3:** Quantitative analysis to differentiate alternatives for projects with higher potential MSAT effects.

The S.R. 210 Project is considered a Tier 2 project. The types of projects included in the Tier 2 category are those that serve to improve operations of highway, transit, or freight without adding substantial new capacity or without creating a facility that is likely to meaningfully increase MSAT emissions. Examples of these types of projects include minor widening projects, new interchanges, replacing a signalized intersection on a surface street, and projects for which design-year traffic is projected to be less than 140,000 to 150,000 annual average daily traffic (AADT).

The project alternatives would increase roadway capacity on S.R. 210 by adding travel lanes on a 1.3-mile segment of Wasatch Boulevard from Bengal Boulevard to North Little Cottonwood Road with all of the action alternatives and by adding peak-period bus shoulder lanes from North Little Cottonwood Road to the Alta Bypass Road near the Snowbird ski resort with the Enhanced Bus Service in Peak-period Shoulder Lane Alternative (the shoulder lanes would operate for bus use only during peak periods in the winter). The remainder of the improvements associated with the project alternatives would involve adding snow sheds and improving trailhead parking on S.R. 210 in Little Cottonwood Canyon, which would not change vehicle emissions.

For the 1.3-mile segment of Wasatch Boulevard, the design-year traffic is expected to be about 25,700 AADT, which would not exceed the threshold for quantitative analysis in FHWA's guidance (a threshold of 140,000 to 150,000 AADT). For the segment of S.R. 210 from North Little Cottonwood Road to the Alta Bypass Road, the design-year AADT would be less than 15,000.

Tier 3 projects that require quantitative analysis include (1) projects that create or significantly alter a major intermodal freight facility that has the potential to concentrate high levels of diesel particulate matter in a single location, involving a significant number of diesel vehicles for new projects or expansion projects accommodating a significant increase in the number of diesel vehicles; or (2) projects that create new capacity or add significant capacity to urban highways such as interstates, urban arterials, or urban collector-distributor routes with traffic volumes where the AADT is projected to be in the range of 140,000 to 150,000 or greater by the design year. The S.R. 210 Project does not meet either of these conditions.

10.3 Affected Environment

10.3.1 Attainment Status

The air quality impact analysis area is in a nonattainment area for $PM_{2.5}$, O_3, and SO_2 and is a maintenance area for PM_{10}.

10.3.2 Existing Air Quality Data

The Utah Division of Air Quality maintains a network of air quality monitoring stations throughout the state. In general, these monitoring stations are located where there are known air quality problems, so they are usually in or near urban areas or close to specific emission sources. Other stations are located in suburban locations or remote areas to provide an indication of regional air pollution levels.

The Utah Department of Transportation (UDOT) used data from the Hawthorne Monitoring Station (#490353006), located at 1675 South 600 East in Salt Lake City, to compile air quality data for the years 2015–2019. The Hawthorne Monitoring Station is the closest air quality monitor to S.R. 210. Table 10.3-1 shows the monitoring results at the Hawthorne Monitoring Station for transportation-related criteria pollutants (PM_{10}, $PM_{2.5}$, O_3, CO, and NO_2).

Table 10.3-1. Air Quality Monitoring Data from the Hawthorne Monitoring Station in Salt Lake County

Pollutant	Standard	Value	Monitoring Year and Data				
			2015	2016	2017	2018	2019
PM_{10}	24-hour standard[a]	150 μg/m³	80 μg/m³	85 μg/m³	84 μg/m³	111 μg/m³	69 μg/m³
$PM_{2.5}$	24-hour standard[b]	35 μg/m³	29.3 μg/m³	42.0 μg/m³	38.5 μg/m³	28.4 μg/m³	26.4 μg/m³
	Annual standard[c]	12 μg/m³	7.38 μg/m³	8.15 μg/m³	8.56 μg/m³	7.98 μg/m³	6.4 μg/m³
O_3	8-hour standard[d]	0.070 ppm	0.081 ppm	0.074 ppm	0.081 ppm	0.074 ppm	0.073 ppm
CO	8-hour standard[e]	9 ppm	1.8 ppm	1.4 ppm	1.7 ppm	1.6 ppm	1.2 ppm
	1-hour standard[f]	35 ppm	3.4 ppm	3.0 ppm	5.0 ppm	2.5 ppm	1.9 ppm
NO_2	Annual standard[g]	53 ppb	15.6 ppb	18.1 ppb	12.7 ppb	15.1 ppb	14.3 ppb
	1-hour standard[h]	100 ppb	52.0 ppb	59.0 ppb	51.0 ppb	49.0 ppb	55.4 ppb

Source: UDEQ 2020

$\mu g/m^3$ = micrograms per cubic meter, ppb = parts per billion, ppm = parts per million

[a] The PM_{10} 24-hour standard is exceeded when the peak 24-hour value exceeds 150 $\mu g/m^3$. One exceedance of the NAAQS is allowed per year. The values listed are the first maximum for each year.

[b] The $PM_{2.5}$ 24-hour standard is exceeded when the 3-year average of the 98th-percentile value (rounded to the nearest whole number) exceeds 35 $\mu g/m^3$.

[c] The $PM_{2.5}$ annual standard is exceeded when the 3-year average of the weighted arithmetic mean exceeds 12.0 $\mu g/m^3$.

[d] The O_3 8-hour standard is exceeded when the annual fourth-highest daily maximum 8-hour concentration averaged over 3 years exceeds 0.070 ppm.

[e] The CO 8-hour standard is exceeded when the 8-hour concentration exceeds 9 ppm more than once per year. The values listed are the first high each year.

[f] The CO 1-hour standard is exceeded when the 1-hour concentration exceeds 35 ppm more than once per year. The values listed are the first high each year.

[g] The NO_2 annual standard is exceeded when the annual average exceeds 53 ppb.

[h] The NO_2 1-hour standard is exceeded when the 3-year average of the 98th-percentile of 1-hour daily maximum concentrations exceeds 100 ppb.

10.4 Environmental Consequences and Mitigation Measures

This section describes the effects of the project alternatives on air quality. The impacts of construction activities would be temporary and are discussed in Section 19.2.2.4, Air Quality Impacts from Construction, in Chapter 19, Construction Impacts. The operational impacts of the project alternatives would be long-term and would be directly due to highway traffic; buses and automobiles idling and moving at the park-and-ride, gondola, and cog rail facilities; and cog rail locomotives operating in Little Cottonwood Canyon.

10.4.1 Methodology

Under transportation conformity requirements, UDOT conducted a quantitative hot-spot analysis for PM_{10} and $PM_{2.5}$. The design for Gondola Alternative A includes the most buses (108 per day) departing from a single mobility hub and the most buses (216 per day) dropping off passengers at a single location (the gondola base station). Therefore, quantitative hot-spot analysis of PM_{10} and $PM_{2.5}$ was conducted for Gondola Alternative A. This analysis modeled the vehicle activity associated with the Gondola Alternative A base station as well as the gravel pit mobility hub given that this mobility hub accommodates the highest number of personal vehicles (a 1,500-vehicle parking structure) and buses. UDOT assumes that the PM_{10} and $PM_{2.5}$ concentrations would be the highest at these locations for the activities described for Gondola Alternative A compared to other alternatives. EPA's *Transportation Conformity Guidance for Quantitative Hot-spot Analyses in $PM_{2.5}$ and PM_{10} Nonattainment and Maintenance Areas* states that it "may be appropriate in some cases to focus the PM hot-spot analysis only on the locations of highest air quality concentrations" (EPA 2015a).

UDOT used the MOVES2014b emissions model to estimate on-road and off-network motor vehicle emission rates from vehicle exhaust, brake wear, and tire wear caused by the project alternatives. These estimates were then used in AERMOD, an air quality dispersion model, which estimates PM concentrations. UDOT followed EPA guidelines (EPA 2015a, 2015b) to complete the hot-spot analyses for 24-hour PM_{10}, 24-hour $PM_{2.5}$, and annual $PM_{2.5}$.

Emissions from vehicles on roads within 300 meters (984 feet) of the center of each analysis location (gravel pit mobility hub and Gondola Alternative A base station) were included in the analysis. Roads and other emissions sources beyond this radius were assumed to be part of the background concentrations used for this analysis.

What is a mobility hub?

A mobility hub is a location where users can transfer from their personal vehicle to a bus.

Since winter is expected to have the greatest traffic levels in the air quality impact analysis area, the analysis was performed for January. The year 2050 was modeled for analysis because traffic and demand for transit will not reach their peaks until 2050. Prior to 2050, the enhanced bus system would be built in phases, starting with a limited number of buses and growing each year, gradually ramping up to maximum capacity in 2050. At the midpoint of this ramp-up period, only about 50% to 60% of the buses might be operating, and traffic would not be at its peak.

If the model results for the winter scenario of Gondola Alternative A are found to be below air quality standards, then further analysis of other alternatives or time periods would not be needed, since UDOT expects the winter scenario of Gondola Alternative A to represent the worst case in terms of air quality. If Gondola Alternative A's air quality impacts are not below standards, mitigation measures would need to be considered for this alternative, and other alternatives might need to be analyzed as well to demonstrate acceptable levels of air quality impacts. Given that the mobility hubs and base stations would be separated by more than 2 miles, there would be no combined local impacts.

Appendix 10A, Air Quality Technical Report, provides more information about the data and methodology used for the analyses. The process of making a project-level conformity determination requires consultation between UDOT and EPA to evaluate and choose models and associated methods and assumptions to be used in the hot-spot analyses. UDOT prepared and submitted a draft *Modeling Protocol for $PM_{2.5}$ and PM_{10} Quantitative Hot-spot Analysis Technical Memorandum* to EPA for its review and comment in June 2020 and a revised draft in September 2020. EPA responded in January 2021 that UDOT could proceed with the air quality modeling after adjusting the modeling protocol as recommended by EPA in its responses from July and November 2020 (EPA 2021a). UDOT incorporated EPA's recommendations in the methodology used to conduct the hot-spot analyses. In March 2021, EPA reviewed the final modeling files used in the analysis and concluded that they are sufficient, and additional and updated modeling is not needed (EPA 2021b).

10.4.2 No-Action Alternative

This section describes the air quality impacts of the No-Action Alternative in the Wasatch Boulevard segment of S.R. 210, in the segment of S.R. 210 from North Little Cottonwood Road to the town of Alta, at the gravel pit, and at the park-and-ride lot at 9400 South and Highland Drive.

With the No-Action Alternative, the improvements associated with the S.R. 210 Project would not be made. However, other regionally significant transportation projects identified in WFRC's 2019–2050 RTP would still be built and would contribute to local air quality impacts throughout the air quality impact analysis area.

10.4.2.1 S.R. 210 – Wasatch Boulevard

With the No-Action Alternative, congestion levels on Wasatch Boulevard would increase compared to existing conditions. Segments of Wasatch Boulevard from Fort Union Boulevard to North Little Cottonwood Road would operate at levels of service of LOS D, E, and F (Table 10.4-1). In addition, travel time during the PM peak hour would more than double compared to existing conditions (from 4:37 minutes to 10:15 minutes) for the 2.2-mile segment of Wasatch Boulevard. Compared to the existing conditions in 2018, vehicle emissions would be greater with the No-Action Alternative in 2050 due to increased traffic congestion and travel time.

What is level of service?

Level of service is a measure of the operating conditions on a road or at an intersection. Level of service is represented by a letter "grade" ranging from A (free-flowing traffic and little delay) to F (extremely congested, stop-and-go traffic and excessive delay).

Table 10.4-1. Wasatch Boulevard – Travel Time and Level of Service by Segment for the Existing Conditions and Project Alternatives

	Travel Time from Fort Union Blvd. to North Little Cottonwood Road (minutes)		Level of Service by Segment (Passing Criteria Are LOS A–D)			
Conditions or Alternative	Northbound in AM/PM Peak Hour	Southbound in AM/PM Peak Hour	Fort Union Blvd. to Bengal Blvd.	Bengal Blvd. to 3500 East	3500 East to Kings Hill Drive	Kings Hill Drive to North Little Cottonwood Rd.
Existing conditions (2018)	4:08 / 4:10	3:38 / 4:37	B	C	E	C
No-Action Alternative (2050)	4:22 / 4:40	3:53 / 10:15	F	E	E	D
Imbalanced-lane Alternative (2050)	4:05 / 4:37	3:32 / 4:21	C	C	C	C
Five-lane Alternative (2050)	3:51 / 4:00	3:32 / 4:12	C	B	B	C

Source: Fehr & Peers 2019

10.4.2.2 S.R. 210 – North Little Cottonwood Road to Alta

With the No-Action Alternative, increased traffic would cause per-person travel times on S.R. 210 from Fort Union Boulevard to the town of Alta to increase from 40 to 45 minutes in 2018 to 80 to 85 minutes in 2050 (Table 10.4-2). Traffic backups on S.R. 209 would increase from 50 feet to 6,700 feet, or past the intersection of Wasatch Boulevard and 9400 South. On S.R. 210, traffic backups would increase from 2,775 feet to 13,000 feet, or past the intersection of Wasatch Boulevard and North Little Cottonwood Road.

Compared to the existing conditions in 2018, vehicle emissions would be greater with the No-Action Alternative in 2050 due to increased traffic congestion and travel time.

Table 10.4-2. S.R. 210 – Travel Times and Vehicle Backup Lengths for the Existing Conditions and Project Alternatives

Conditions or Alternative	Travel Time[a] (minutes)	Vehicle Backup Distance from S.R. 209/S.R. 210 Intersection (feet)	
		On S.R. 209	On S.R. 210
Existing conditions (2018)	40–45	50	2,775
No-Action Alternative (2050)	80–85	6,700	13,000
Enhanced Bus Service Alternative (2050)	45–50	1,275	4,300
Enhanced Bus Service in Peak-period Shoulder Lane Alternative (2050)	35–40	350	3,050
Gondola Alternatives A and B (2050)	45–50	350	3,050
Cog Rail Alternative (2050)	45–50	350	3,050

[a] Fort Union Boulevard to Alta ski resort

10.4.2.3 Mobility Hubs

10.4.2.3.1 Gravel Pit

With the No-Action Alternative, Cottonwood Heights City is planning for development of the gravel pit. Current plans include a mix of commercial and residential uses. With the development, traffic would increase over that with the current gravel pit operation. Depending on the density of the development, the traffic entering and leaving the site during peak periods could increase congestion on Wasatch Boulevard, thereby increasing vehicle emissions over the existing conditions. With the commercial and residential development, there would be far less fugitive-dust emissions because the current aggregate (gravel) mine would not be in operation.

What is the gravel pit?

The gravel pit is an existing aggregate (gravel) mine located on the east side of Wasatch Boulevard between 6200 South and Fort Union Boulevard.

10.4.2.3.2 9400 South and Highland Drive

With the No-Action Alternative, there would be no change to the operation of the park-and-ride lot at 9400 South and Highland Drive as a bus park-and-ride lot. Therefore, traffic conditions and vehicle emissions would be same as the existing conditions.

10.4.2.4 Avalanche Mitigation

With the No-Action Alternative, snow sheds would not be built, and Little Cottonwood Canyon is projected to be closed on up to about 21 days per winter season for avalanche-mitigation work (Table 10.4-3). The increase in closures is based on the greater risk with higher traffic volumes in 2050 compared to 2018 (Dynamic Avalanche Consulting 2018). The potential average increase in road closures would result in more days when traffic backs up from the intersection of S.R. 209 and S.R. 210 leading to the potential for greater vehicle emissions. Compared to existing conditions, vehicle emissions would be greater with the No-Action Alternative due to increased traffic congestion and travel time.

Table 10.4-3. Avalanche Mitigation – Average Days and Hours of Road Closures on S.R. 210 with the Existing Conditions and Project Alternatives

Conditions or Alternative	Average Days with Closures	Average Hours of Closures
Existing conditions (2018)	10.4	56.3
No-Action Alternative (2050)	10.5 to 21	56 to 108+
Snow Sheds with Berms Alternative (2050)	4 to 6	2 to 11

Source: Dynamic Avalanche Consulting 2018

10.4.2.5 Trailhead Parking

With the No-Action Alternative, there would be no change to trailhead parking and no elimination of roadside parking near trailheads. However, as the population continues to grow along the Wasatch Front, more people would recreate in Little Cottonwood Canyon. Vehicle emissions at the trailheads could increase compared to existing conditions.

10.4.2.6 No Winter Parking

With the No-Action Alternative, there would be no change to roadside winter parking or associated vehicle emissions.

10.4.3 Enhanced Bus Service Alternative

This section describes the air quality impacts of the Enhanced Bus Service Alternative, which includes improvements to the Wasatch Boulevard segment of S.R. 210, two mobility hubs, avalanche mitigation alternatives, trailhead parking alternatives, and the No Winter Parking Alternative.

10.4.3.1 S.R. 210 – Wasatch Boulevard

This section describes the air quality impacts of the Imbalanced-lane Alternative and the Five-lane Alternative, which would both widen the Wasatch Boulevard segment of S.R. 210.

10.4.3.1.1 Imbalanced-lane Alternative

With the Imbalanced-lane Alternative, vehicle capacity would be added to Wasatch Boulevard, and the level of service and associated congestion levels on Wasatch Boulevard would improve from LOS D through

LOS F with the No-Action Alternative to LOS C with this alternative (Table 10.4-1 above, Wasatch Boulevard – Travel Time and Level of Service by Segment for the Existing Conditions and Project Alternatives). Vehicle emissions would be reduced with the Imbalanced-lane Alternative due to decreased traffic congestion and reduced travel times compared to the existing conditions and the No-Action Alternative.

10.4.3.1.2 Five-lane Alternative

With the Five-lane Alternative, vehicle capacity would be added to Wasatch Boulevard, and the level of service and associated congestion levels on Wasatch Boulevard would improve from LOS D through LOS F with the No-Action Alternative to LOS B and C with this alternative (Table 10.4-1 above, Wasatch Boulevard – Travel Time and Level of Service by Segment for the Existing Conditions and Project Alternatives). Vehicle emissions would be reduced with the Five-lane Alternative due to decreased traffic congestion and travel times compared to the existing conditions, the No-Action Alternative, and the Imbalanced-lane Alternative.

10.4.3.2 S.R. 210 – North Little Cottonwood Road to Alta

Local Air Quality Analysis

With the Enhanced Bus Service Alternative, there would be no improvements to S.R. 210, but bus service would be substantially increased and personal vehicle use on S.R. 210 in Little Cottonwood Canyon would be reduced by implementing a toll or a ban on single-occupant vehicles. The purpose of the toll or ban is to reduce personal vehicle use by 30% to the ski resorts by incentivizing transit use. The toll would apply only to the segment of S.R. 210 just west of Snowbird Entry 1 to the road terminus east of the town of Alta.

As shown in Table 10.4-2 above, S.R. 210 – Travel Times and Vehicle Backup Lengths for the Existing Conditions and Project Alternatives, by increasing bus use and reducing personal vehicle use, the per-person travel times in 2050 would decrease from 80 to 85 minutes with the No-Action Alternative to 45 to 50 minutes with the Enhanced Bus Service Alternative (these are average combined travel times for buses and personal vehicles). The 45-to-50-minute travel time would be similar to the existing travel time in 2018 of 40 to 45 minutes.

On S.R. 210, traffic backups would decrease from 13,000 feet, or past the intersection of Wasatch Boulevard and North Little Cottonwood Road, to 4,300 feet. On S.R. 209, traffic backups would decrease from 6,700 feet, or past the intersection of 9400 South and Wasatch Boulevard, to 1,275 feet.

Vehicle emissions would likely be reduced with the Enhanced Bus Service Alternative due to decreased traffic congestion and travel time compared to the No-Action Alternative. Although bus emissions would increase due to increased trips, this increase would be more than offset by the reduction in personal vehicle emissions, congestion, and travel time (FTA 2010).

Greenhouse Gas Analysis

Section 10.4.9, Comparison of Greenhouse Gas Emissions by Alternative, provides a detailed comparison of the greenhouse gas emissions from each project alternative. As shown in that section, the enhanced bus service alternatives would have the lowest greenhouse gas emissions of the action alternatives.

10.4.3.3 Mobility Hubs Alternative

The Enhanced Bus Service Alternative includes two mobility hubs: a mobility hub at the gravel pit and a mobility hub at the park-and-ride lot at 9400 South and Highland Drive.

10.4.3.3.1 Gravel Pit

Traffic Characteristics. With this mobility hub, a 1,500-space parking garage would be built at the gravel pit along with other commercial and residential development planned by Cottonwood Heights City. The gravel pit mobility hub would include a diamond interchange designed to handle the volume of traffic and thereby minimize congestion impacts on Wasatch Boulevard. During peak travel periods, the traffic signals at the interchange would be designed to give priority to vehicles going to the parking garage. During peak periods (6 hours per day, for 3 hours during the morning and 3 hours during the afternoon), about 12 buses per hour would originate from the mobility hub, and during off-peak periods (about 6 hours per day) about 6 buses per hour would originate from the mobility hub. On average, a total of 108 bus trips would be made per day from this mobility hub.

Hot-spot Analyses. Table 10.4-4 shows the results of the project-level hot-spot analyses for 24-hour PM_{10}, 24-hour $PM_{2.5}$, and annual $PM_{2.5}$ for the gravel pit mobility hub with the Enhanced Bus Service Alternative (for specific details regarding the methodology and calculations, refer to Appendix 10A, Air Quality Technical Report). For all pollutants, the design values for 2050 were modeled as being less than the NAAQS. This demonstrates that the S.R. 210 Project would not contribute to any new local violations, increase the frequency or severity of any existing violation, or delay timely attainment of the PM_{10} or $PM_{2.5}$ NAAQS.

10.4.3.3.2 9400 South and Highland Drive

Traffic Characteristics. With this mobility hub, a 1,000-space parking garage would be built at the existing UTA park-and-ride lot at 9400 South and Highland Drive. During the AM peak hour, about 430 vehicles could access the parking garage. Given the current site configuration, no additional access or access improvements would be required. During peak periods (6 hours per day, for 3 hours during the morning and 3 hours during the afternoon), about 12 buses per hour would originate from the mobility hub, and during off-peak periods (about 6 hours per day), about 6 buses per hour would originate from the mobility hub. On average, a total of 108 bus trips would be made per day from this mobility hub. Traffic on both 9400 South and Highland Drive would increase to some extent, but no substantial traffic congestion is anticipated.

Vehicle Emissions. Vehicle emissions at the 9400 South and Highland Drive mobility hub would be less than those at the gravel pit mobility hub. The 9400 South and Highland Drive mobility hub would have a smaller parking garage and less traffic than near the gravel pit mobility hub; therefore, the 9400 South and Highland Drive mobility hub would not contribute to any new local violations, increase the frequency or severity of any existing violation, or delay timely attainment of the PM_{10} or $PM_{2.5}$ NAAQS.

Table 10.4-4. Modeled Design Values for PM_{10} and $PM_{2.5}$ at the Gravel Pit Mobility Hub with the Enhanced Bus Service Alternative in 2050

In μg/m³

Pollutant	Modeled Value[a]	Background Concentration[b]	Design Value[c]	NAAQS
24-hour PM_{10}	5.1	85.0	90[d]	150
24-hour $PM_{2.5}$	0.2	29.3	30[e]	35
Annual $PM_{2.5}$	0.09	7.47	7.6[f]	12.0

[a] Modeled values were derived from AERMOD, an air quality dispersion model. Modeled values are reported to one decimal place beyond the NAAQS value.

[b] Background concentrations were derived using the methodology described in Appendix 10A, Air Quality Technical Report. Background concentrations are reported to one decimal place beyond the NAAQS value.

[c] Design values were calculated by adding modeled receptor values to background monitor values. The resulting design value concentration was then compared to the NAAQS.

[d] 24-hour PM_{10} design value is rounded to the nearest 10 μg/m³ (EPA 2015a).

[e] 24-hour $PM_{2.5}$ design value is rounded to the nearest 1 μg/m³ (EPA 2015a).

[f] Annual $PM_{2.5}$ design value is rounded to the nearest 0.1 μg/m³ (EPA 2015a).

10.4.3.4 Avalanche Mitigation Alternatives

The Enhanced Bus Service Alternative includes two alternatives for avalanche mitigation: the Snow Sheds with Berms Alternative and the Show Sheds with Realigned Road Alternative.

10.4.3.4.1 Snow Sheds with Berms Alternative

With the Snow Sheds with Berms Alternative, the snow sheds would reduce the number of days and hours when S.R. 210 is closed due to avalanches and avalanche-mitigation work. As shown in Table 10.4-3 above, Avalanche Mitigation – Average Days and Hours of Road Closures on S.R. 210 with the Existing Conditions and Project Alternatives, by 2050, the duration of avalanche closures would decrease from 21 days and 108 hours with the No-Action Alternative to 6 days and 11 hours with the Snow Sheds with Berms Alternative. The decrease in closure time would result in fewer vehicles waiting to enter Little Cottonwood Canyon and less traffic backing onto S.R. 210 and S.R. 209. With the snow sheds, the decrease in the number and hours of closure could improve closure-related congestion and vehicle emissions.

10.4.3.4.2 Show Sheds with Realigned Road Alternative

The emissions impacts from the Snow Sheds with Realigned Road Alternative would be the same as from the Snow Sheds with Berms Alternative.

10.4.3.5 Trailhead Parking Alternatives

The Enhanced Bus Service Alternative includes three alternatives to address trailhead parking:

- Trailhead Improvements and No S.R. 210 Roadside Parking within ¼ Mile of Trailheads Alternative
- Trailhead Improvements and No Roadside Parking from S.R. 209/S.R. 210 Intersection to Snowbird Entry 1 Alternative
- No Trailhead Improvements and No Roadside Parking from S.R. 209/S.R. 210 Intersection to Snowbird Entry 1 Alternative

10.4.3.5.1 Trailhead Improvements and No S.R. 210 Roadside Parking within ¼ Mile of Trailheads Alternative

This alternative would reduce travel friction between roadside parked vehicles and vehicles in the travel lane adjacent to trailheads. The trailhead improvements and reduced friction within ¼ mile would not appreciably change vehicle emissions.

10.4.3.5.2 Trailhead Improvements and No Roadside Parking from S.R. 209/S.R. 210 Intersection to Snowbird Entry 1 Alternative

The emissions impacts from this alternative would be similar to those from the Trailhead Improvements and No S.R. 210 Roadside Parking within ¼ Mile of Trailheads Alternative. However, by removing all roadside parking in Little Cottonwood Canyon, the travel friction between roadside parked vehicles and vehicles in the travel lane would be eliminated. The trailhead improvements and reduced friction would not appreciably change vehicle emissions.

10.4.3.5.3 No Trailhead Improvements and No Roadside Parking from S.R. 209/S.R. 210 Intersection to Snowbird Entry 1 Alternative

The emissions impacts from this alternative would be the same as those from the Trailhead Improvements and No Roadside Parking from S.R. 209/S.R. 210 Intersection to Snowbird Entry 1 Alternative.

10.4.3.6 No Winter Parking Alternative

By eliminating winter parking on S.R. 210, about 230 parking spaces on S.R. 210 would be removed adjacent to the ski resorts. The elimination of roadside parking in the winter could improve mobility by removing the conflicts between roadside parked vehicles and vehicles in the travel lane. In addition, in the afternoon when skiers leave the resorts, it has been observed that some vehicles currently make U-turns in the roadway, blocking traffic and causing congestion. Vehicle emissions could be reduced due to increased mobility and decreased congestion with no winter parking.

10.4.4 Enhanced Bus Service in Peak-period Shoulder Lane Alternative

This section describes the air quality impacts of the Enhanced Bus Service in Peak-period Shoulder Lane Alternative, which includes improvements to the Wasatch Boulevard segment of S.R. 210, improvements to the segment of S.R. 210 from North Little Cottonwood Road to the town of Alta, two mobility hubs, avalanche mitigation alternatives, trailhead parking alternatives, and the No Winter Parking Alternative.

10.4.4.1 S.R. 210 – Wasatch Boulevard

With the Enhanced Bus Service in Peak-period Shoulder Lane Alternative, the emissions impacts with the Imbalanced-lane and Five-lane Alternatives would be the same as with the Enhanced Bus Service Alternative. (The peak-period shoulder lane would be implemented both eastbound and westbound on S.R. 210 from the intersection with Wasatch Boulevard to the Alta Bypass Road. These lanes would be for buses only to improve bus travel times over that of personal vehicles.)

10.4.4.2 S.R. 210 – North Little Cottonwood Road to Alta

Local Air Quality Analysis

With the Enhanced Bus Service in Peak-period Shoulder Lane Alternative, dedicated bus shoulder lanes would be added on S.R. 210 from North Little Cottonwood Road to the Alta Bypass Road. As with the Enhanced Bus Service Alternative, a toll or a ban on single-occupant vehicles would be added on S.R. 210 in Little Cottonwood Canyon with the goal of reducing personal vehicle use by about 30%. As shown above in Table 10.4-2, S.R. 210 – Travel Times and Vehicle Backup Lengths for the Existing Conditions and Project Alternatives, by increasing bus use and reducing personal vehicle use, the per-person travel times in 2050 would decrease from 80 to 85 minutes with the No-Action Alternative to 35 to 40 minutes with the Enhanced Bus Service in Peak-period Shoulder Lane Alternative. The 35-to-40-minute travel time would be a slight improvement over the existing travel time in 2018 of 40 to 45 minutes.

On S.R. 210, traffic backups would decrease from 13,000 feet, or past the intersection of Wasatch Boulevard and North Little Cottonwood Road, with the No-Action Alternative to 3,050 feet with this alternative. On S.R. 209, traffic backups would decrease from 6,700 feet, or past the intersection of 9400 South and Wasatch Boulevard, with the No-Action Alternative to 350 feet with this alternative.

Vehicle emissions would likely be reduced with the Enhanced Bus Service in Peak-period Shoulder Lane Alternative due to decreased traffic congestion and travel time compared to the No-Action Alternative. Although bus emissions would increase due to increased trips, this increase would be more than offset by the reduction in personal vehicle emissions, congestion, and travel time (FTA 2010).

Greenhouse Gas Analysis

Section 10.4.9, Comparison of Greenhouse Gas Emissions by Alternative, provides a detailed comparison of the greenhouse gas emissions from each project alternative. As shown in that section, the enhanced bus service alternatives would have the lowest greenhouse gas emissions of the action alternatives.

10.4.4.3 Mobility Hubs Alternative

The emissions impacts from the mobility hubs with the Enhanced Bus Service in Peak-period Shoulder Lane Alternative would be the same as with the Enhanced Bus Service Alternative.

10.4.4.4 Avalanche Mitigation Alternatives

The emissions impacts from the avalanche mitigation alternatives with the Enhanced Bus Service in Peak-period Shoulder Lane Alternative would be the same as with the Enhanced Bus Service Alternative.

10.4.4.5 Trailhead Parking Alternatives

The emissions impacts from the trailhead parking alternatives with the Enhanced Bus Service in Peak-period Shoulder Lane Alternative would be the same as with the Enhanced Bus Service Alternative.

10.4.4.6 No Winter Parking Alternative

The emissions impacts from the No Winter Parking Alternative with the Enhanced Bus Service in Peak-period Shoulder Lane Alternative would be the same as with the Enhanced Bus Service Alternative

10.4.5 Gondola Alternative A (Starting at Canyon Entrance)

This section describes the air quality impacts of Gondola Alternative A, which includes a gondola alignment from the entrance to Little Cottonwood Canyon to the Snowbird and Alta ski resorts, improvements to the Wasatch Boulevard segment of S.R. 210, two mobility hubs, avalanche mitigation alternatives, trailhead parking alternatives, and the No Winter Parking Alternative.

> **What are gondola base, angle, and terminal stations?**
>
> As used in this chapter, the term *terminal station* refers to the first and last stations on a passenger's gondola trip. Passengers board and disembark the gondola cabins at the terminal stations.
>
> The *base station* is the terminal station at the bottom of the canyon, and a *destination station* is a terminal station at the top of the canyon.
>
> The gondola alternatives also include *angle stations*, which are needed to adjust the horizontal direction of the cabin; passengers remain in the cabin as it passes through an angle station.

10.4.5.1 S.R. 210 – Wasatch Boulevard

With Gondola Alternative A, the emissions impacts with the Imbalanced-lane and Five-lane Alternatives would be the same as with the Enhanced Bus Service Alternative.

10.4.5.2 S.R. 210 – North Little Cottonwood Road to Alta

Local Air Quality Analysis

Traffic Characteristics. With Gondola Alternative A, there would be no improvements to S.R. 210, but the gondola system would be used along with a toll or a ban on single-occupant vehicles on S.R. 210 in Little Cottonwood Canyon to substantially reduce personal vehicle use. Similar to the Enhanced Bus Service Alternative, the goal of the toll or ban would be to reduce personal vehicle use by about 30%. As shown above in Table 10.4-2, S.R. 210 – Travel Times and Vehicle Backup Lengths for the Existing Conditions and Project Alternatives, the per-person travel times would decrease from 80 to 85 minutes with the No-Action

Alternative to 45 to 50 minutes with Gondola Alternative A. The 45-to-50-minute travel time would be similar to the existing travel time in 2018 of 40 to 45 minutes.

On S.R. 210, traffic backups would decrease from 13,000 feet, or past the intersection of Wasatch Boulevard and North Little Cottonwood Road, with the No-Action Alternative to 3,050 feet with this alternative. On S.R. 209, traffic backups would decrease from 6,700 feet, or past the intersection of 9400 South and Wasatch Boulevard, with the No-Action Alternative to 350 feet with this alternative.

A gondola base station would be located at the existing park-and-ride lot on the north side of S.R. 210 at the entrance to Little Cottonwood Canyon. Gondola Alternative A would include two mobility hubs, at the gravel pit and at 9400 South and Highland Drive, and express bus service from the mobility hubs to the base station. During peak periods (6 hours per day, for 3 hours during the morning and 3 hours during the afternoon), about 12 buses per hour would originate from each mobility hub (24 per hour total) heading to the base station. During off-peak periods (about 6 hours per day), about 6 buses per hour would originate from each mobility hub (12 per hour) to the base station. On average, a total of 108 bus trips from each mobility hub per day would be made, for a total of 216 bus trips per day from both mobility hubs.

Hot-spot Analyses. Table 10.4-5 shows the results of the project-level hot-spot analyses for 24-hour PM_{10}, 24-hour $PM_{2.5}$, and annual $PM_{2.5}$ for Gondola Alternative A at the base station at the entrance to Little Cottonwood Canyon (for specific details regarding the methodology and calculations, refer to Appendix 10A, Air Quality Technical Report). For all pollutants, the design values for 2050 are less than the NAAQS. This demonstrates that the S.R. 210 Project would not contribute to any new local violations, increase the frequency or severity of any existing violation, or delay timely attainment of the PM_{10} or $PM_{2.5}$ NAAQS.

Summer operation of Gondola Alternative A would require less bus service, so PM_{10} or $PM_{2.5}$ would be less than during winter operation.

Table 10.4-5. Modeled Design Values for PM_{10} and $PM_{2.5}$ with Gondola Alternative A in 2050

In μg/m^3

Pollutant	Modeled Value[a]	Background Concentration[b]	Design Value[c]	NAAQS
24-hour PM_{10}	4.8	85.0	90[d]	150
24-hour $PM_{2.5}$	0.2	29.3	30[e]	35
Annual $PM_{2.5}$	0.07	7.47	7.5[f]	12.0

[a] Modeled values were derived from AERMOD, an air quality dispersion model. Modeled values are reported to one decimal place beyond the NAAQS value.

[b] Background concentrations were derived using the methodology described in Appendix 10A, Air Quality Technical Report. Background concentrations are reported to one decimal place beyond the NAAQS value.

[c] Design values were calculated by adding modeled receptor values to background monitor values. The resulting design value concentration was then compared to the NAAQS.

[d] 24-hour PM_{10} design value is rounded to the nearest 10 μg/m^3 (EPA 2015a).

[e] 24-hour $PM_{2.5}$ design value is rounded to the nearest 1 μg/m^3 (EPA 2015a).

[f] Annual $PM_{2.5}$ design value is rounded to the nearest 0.1 μg/m^3 (EPA 2015a).

Greenhouse Gas Analysis

Section 10.4.9, Comparison of Greenhouse Gas Emissions by Alternative, provides a detailed comparison of the greenhouse gas emissions from each project alternative. As shown in that section, winter operation of Gondola Alternative A would have slightly higher greenhouse gas emissions than the enhanced bus service alternatives but lower emissions than the Cog Rail Alternative. During summer operation, Gondola Alternative A would have lower greenhouse gas emissions than the Cog Rail Alternative.

10.4.5.3 Mobility Hubs Alternative

The emissions impacts from the mobility hubs with Gondola Alternative A would be the same as with the Enhanced Bus Service Alternative.

10.4.5.4 Avalanche Mitigation Alternatives

The emissions impacts from the avalanche mitigation alternatives with Gondola Alternative A would be the same as with the Enhanced Bus Service Alternative.

10.4.5.5 Trailhead Parking Alternatives

The emissions impacts from the trailhead parking alternatives with Gondola Alternative A would be the same as with the Enhanced Bus Service Alternative.

10.4.5.6 No Winter Parking Alternative

The emissions impacts from the No Winter Parking Alternative with Gondola Alternative A would be the same as with the Enhanced Bus Service Alternative.

10.4.6 Gondola Alternative B (Starting at La Caille)

This section describes the air quality impacts of Gondola Alternative B, which includes a gondola alignment from La Caille to the Snowbird and Alta ski resorts, improvements to the Wasatch Boulevard segment of S.R. 210, two mobility hubs, avalanche mitigation alternatives, trailhead parking alternatives, and the No Winter Parking Alternative.

10.4.6.1 S.R. 210 – Wasatch Boulevard

With Gondola Alternative B, the emissions impacts with the Imbalanced-lane and Five-lane Alternatives would be the same as with the Enhanced Bus Service Alternative.

10.4.6.2 S.R. 210 – North Little Cottonwood Road to Alta

Local Air Quality Analysis

Traffic Characteristics. With Gondola Alternative B, there would be no improvements to S.R. 210, but the gondola system would be used along with a toll or a ban on single-occupant vehicles on S.R. 210 in Little Cottonwood Canyon to substantially reduce personal vehicle use. Similar to the Enhanced Bus Service Alternative, the goal of the toll or ban would be to reduce personal vehicle use by about 30%. As shown above in Table 10.4-2, S.R. 210 – Travel Times and Vehicle Backup Lengths for the Existing Conditions and Project Alternatives, per-person travel times would decrease from 80 to 85 minutes with the No-Action Alternative to 45 to 50 minutes with Gondola Alternative B. The 45-to-50-minute travel time would be similar to the existing travel time in 2018 of 40 to 45 minutes.

A gondola base station would be located on North Little Cottonwood Road about 0.75 mile northwest of the intersection of S.R. 209 and S.R. 210. A 1,500-space parking structure would be built at the gondola base station to allow personal vehicles to park at the base station. Gondola Alternative B would include two mobility hubs, at the gravel pit and at 9400 South and Highland Drive, and express bus service from the mobility hubs to the base station. The gravel pit mobility hub would have a 600-car parking structure, and the 9400 South and Highland Drive mobility hub would have a 400-car parking structure. Six buses per hour would travel from each mobility hub to the base station from 7 AM to 6 PM.

Vehicle Emissions. Vehicle emissions would be reduced with Gondola Alternative B compared to the existing conditions and the No-Action Alternative due to decreased traffic congestion and travel time. With Gondola Alternative B, diesel bus emissions would be less than with Gondola Alternative A since fewer buses would service the base station. Therefore, Gondola Alternative B would not contribute to any new local violations, increase the frequency or severity of any existing violation, or delay timely attainment of the PM_{10} or $PM_{2.5}$ NAAQS.

Summer operation of Gondola Alternative B would not require bus service, so overall emissions during the summer would be less than during the winter.

Greenhouse Gas Analysis

Section 10.4.9, Comparison of Greenhouse Gas Emissions by Alternative, provides a detailed comparison of the greenhouse gas emission from each project alternative. As shown in that section, winter operation of Gondola Alternative B would have slightly higher greenhouse gas emissions than the enhanced bus service alternatives but lower emissions than the Cog Rail Alternative. During summer operation, Gondola Alternative B would have lower greenhouse gas emissions than the Cog Rail Alternative.

10.4.6.3 Mobility Hubs Alternative

With Gondola Alternative B, the emissions impacts from the mobility hubs would be less than those with the enhanced bus service alternatives and Gondola Alternative A since the mobility hubs with Gondola Alternative B would service fewer personal vehicles and diesel buses.

10.4.6.4 Avalanche Mitigation Alternatives

The emissions impacts from the avalanche mitigation alternatives with Gondola Alternative B would be the same as with the Enhanced Bus Service Alternative

10.4.6.5 Trailhead Parking Alternatives

The emissions impacts from the trailhead parking alternatives with Gondola Alternative B would be the same as with the Enhanced Bus Service Alternative.

10.4.6.6 No Winter Parking Alternative

The emissions impacts from the No Winter Parking Alternative with Gondola Alternative B would be the same as with the Enhanced Bus Service Alternative.

10.4.7 Cog Rail Alternative (Starting at La Caille)

This section describes the air quality impacts of the Cog Rail Alternative, which includes a cog rail alignment from La Caille to the Snowbird and Alta ski resorts, improvements to the Wasatch Boulevard segment of S.R. 210, improvements to the segment of S.R. 210 on North Little Cottonwood Road, two mobility hubs, avalanche mitigation alternatives, trailhead parking alternatives, and the No Winter Parking Alternative.

What are terminal and base stations?

As used in this chapter, the term *terminal station* refers to the first and last stations on a passenger's cog rail trip. Passengers board and disembark the cog rail vehicles at the terminal stations.

The *base station* is the terminal station at the bottom of the canyon, and a *destination station* is a terminal station at the top of the canyon.

10.4.7.1 S.R. 210 – Wasatch Boulevard

With the Cog Rail Alternative, the emissions impacts with the Imbalanced-lane and Five-lane Alternatives would be the same as with the Enhanced Bus Service Alternative.

10.4.7.1.1 S.R. 210 – North Little Cottonwood Road to Alta

Local Air Quality Analysis

Traffic Characteristics. With the Cog Rail Alternative, there would be no improvements to S.R. 210, but the cog rail system would be used along with a toll or a ban on single-occupant vehicles on S.R. 210 in Little Cottonwood Canyon to substantially reduce personal vehicle use. Similar to the Enhanced Bus Service Alternative, the goal of the toll or ban would be to reduce personal vehicle use by about 30%. As shown above in Table 10.4-2, S.R. 210 – Travel Times and Vehicle Backup Lengths for the Existing Conditions and Project Alternatives, per-person travel times would decrease from 80 to 85 minutes with the No-Action Alternative to 45 to 50 minutes with the Cog Rail Alternative. The 45-to-50-minute travel time would be similar to the existing travel time in 2018 of 40 to 45 minutes.

A cog rail base station would be located on North Little Cottonwood Road about 0.75 mile from the intersection of S.R. 209 and S.R. 210. The base station design, roadway improvements, traffic conditions, and use of mobility hubs would be the same as with Gondola Alternative B.

The Cog Rail Alternative would require an operations and maintenance facility located at the Little Cottonwood Canyon park-and-ride lot. The operations and maintenance facility would include an administrative and maintenance facility, fueling station, restrooms, and parking for employees.

Vehicle Emissions. Vehicle emissions would be reduced with the Cog Rail Alternative compared to the existing conditions and the No-Action Alternative due to decreased traffic congestion and travel time. Diesel bus emissions would be less than those with the enhanced bus service alternatives and Gondola Alternative A since fewer buses would service the cog rail base station.

Diesel-electric Locomotive Emissions. With the Cog Rail Alternative, diesel-electric locomotive engines would produce emissions when idling at the terminal stations and in transit between the terminal stations. These emissions would be similar to the bus engine emissions from the enhanced bus service alternatives. The locomotive engines would meet the most stringent Tier 4 emission standards by having extremely low emissions of PM and other pollutants. EPA's PM emissions standard for a Tier 4 locomotive is 0.015 gram per horsepower-hour (g/hp-hr). The PM emissions standard for a new diesel transit bus engine is 0.01 g/hp-hr. With the Cog Rail Alternative, one cog rail train, with a maximum power rating of 1,200 horsepower (hp), would carry the equivalent passengers of six buses. The buses are expected to be rated at 380 hp each, so the total power rating of six buses would be 2,280 hp.

What are Tier 4 standards?

Over time, EPA has adopted multiple tiers of emissions standards. Tier 4 are the most recent and stringent emissions standards for diesel locomotives for engines built in 2015 and later (40 CFR Part 1033).

Multiplying the emissions standard by the rated horsepower for the cog rail train gives a total of 18 grams/hour of PM emissions at maximum load. In comparison, the maximum total horsepower of the buses, multiplied by the emissions standard, yields a maximum total PM emissions rate of 22.8 grams/hour. Thus, the Cog Rail Alternative would generate similar, but slightly lower, PM emissions than the enhanced bus service alternatives when transporting passengers the same distance. Because the cog rail system would have lower PM emissions than what was modeled for the enhanced bus service alternatives, a separate model run was not necessary.

The dispersion analysis for the gravel pit mobility hub showed that the emissions from idling buses would be a very small contributor to total ambient air $PM_{2.5}$ and PM_{10} impacts (which were also quite small, compared to the NAAQS). Therefore, the combined idling of buses and cog rail locomotives at the cog rail base station would not measurably affect air quality in the vicinity of the base station.

Summer operation of the Cog Rail Alternative would not require bus service to the base station parking structure since the base station would provide enough summer parking. For this reason, overall emissions during the summer would be less than during the winter.

Greenhouse Gas Analysis

Section 10.4.9, Comparison of Greenhouse Gas Emissions by Alternative, provides a detailed comparison of the greenhouse gas emission from each project alternative. As shown in that section, winter operation of the Cog Rail Alternative would have the highest greenhouse gas emissions of any of the action alternatives. During summer operation, the Cog Rail Alternative would have higher greenhouse gas emissions than the gondola alternatives but lower emissions than the enhanced bus service alternatives.

10.4.7.2 Mobility Hubs Alternative

With the Cog Rail Alternative, the emissions impacts from the mobility hubs would be small and would be the same as the emissions from the mobility hubs with Gondola Alternative B. The impacts from the mobility hubs with the Cog Rail Alternative would be less than those with the enhanced bus service alternatives and Gondola Alternative A since the mobility hubs with the Cog Rail Alternative would service fewer personal vehicles and diesel buses.

10.4.7.3 Avalanche Mitigation Alternatives

With the Cog Rail Alternative, the emissions impacts from the mid-canyon snow sheds would be the same as with the Enhanced Bus Service Alternative. However, to reduce the avalanche risk to the cog rail system, two additional snow sheds would be constructed in the upper canyon between the west- and east-end connections of the Alta Bypass Road to S.R. 210. These upper-canyon snow sheds would cover the cog rail alignment and not S.R. 210; therefore, vehicle mobility and related emissions on S.R. 210 would not change from the operation of the upper-canyon snow sheds since vehicles would continue to use the Alta Bypass Road when S.R. 210 is closed for avalanche-mitigation operations.

10.4.7.4 Trailhead Parking Alternatives

The emissions impacts from the trailhead parking alternatives with the Cog Rail Alternative would be the same as with the Enhanced Bus Service Alternative.

10.4.7.5 No Winter Parking Alternative

The emissions impacts from the No Winter Parking Alternative with the Cog Rail Alternative would be the same as with the Enhanced Bus Service Alternative.

10.4.8 Understanding MSAT Emissions

A qualitative analysis provides a basis for identifying and comparing the potential differences among MSAT emissions, if any, from the various alternatives. The qualitative assessment presented below is derived in part from a study conducted by FHWA titled *A Methodology for Evaluating Mobile-source Air Toxic Emissions among Transportation Project Alternatives* (Claggett and Miller 2006).

For each alternative evaluated in this Environmental Impact Statement (EIS), the amount of MSATs emitted would be proportional to the vehicle-miles traveled (VMT), assuming that other variables such as fleet mix are the same for each alternative. The VMT estimated for each of the action alternatives is slightly higher than that for the No-Action Alternative due to added traffic capacity on Wasatch Boulevard. Although this increase in VMT would lead to higher MSAT emissions for the action alternatives, the emissions increase would be offset somewhat by lower MSAT emission rates due to increased speeds; according to EPA's MOVES2014 model, emissions of all of the priority MSATs decrease as speed increases.

As shown above in Table 10.4-2, S.R. 210 – Travel Times and Vehicle Backup Lengths for the Existing Conditions and Project Alternatives, travel times for each of the action alternatives are substantially lower than that for the No-Action Alternative. Regardless of the alternative chosen, emissions will likely be lower than present levels in the design year as a result of EPA's national control programs that are projected to reduce annual MSAT emissions by over 90% between 2010 and 2050 (FHWA 2016). Local conditions might differ from these national projections in terms of fleet mix and turnover, VMT growth rates, and local control measures. However, the magnitude of the EPA-projected reductions is so great (even after accounting for VMT growth) that MSAT emissions in the air quality impacts analysis area are likely to be lower in the future in nearly all cases.

10.4.8.1 Incomplete or Unavailable Information for Project-Specific MSAT Health Impacts Analysis

In FHWA's view, information is incomplete or unavailable to credibly predict the project-specific health impacts due to changes in MSAT emissions associated with a proposed set of highway alternatives. The outcome of such an assessment, adverse or not, would be influenced more by the uncertainty introduced into the process through assumption and speculation rather than any genuine insight into the actual health impacts directly attributable to MSAT exposure associated with a proposed action (FHWA 2016).

EPA is responsible for protecting the public health and welfare from the known or anticipated effects of an air pollutant. It is the lead authority for administering the Clean Air Act and its amendments and has specific statutory obligations with respect to hazardous air pollutants and MSATs. EPA is in the continual process of assessing human health effects, exposures, and risks posed by air pollutants. It maintains the Integrated Risk Information System (IRIS), which is "a compilation of electronic reports on specific substances found in the environment and their potential to cause human health effects" (https://www.epa.gov/iris). Each report contains assessments of noncancerous and cancerous effects for individual compounds and quantitative estimates of risk levels from lifetime oral and inhalation exposures with uncertainty spanning perhaps an order of magnitude (FHWA 2016).

Other organizations are also active in the research and analyses of the human health effects of MSATs, including the Health Effects Institute (HEI). Several HEI studies are summarized in Appendix D of FHWA's *Updated Interim Guidance on Mobile-source Air Toxic Analysis in NEPA Documents*. Among the adverse health effects linked to MSAT compounds at high exposures are cancer in humans in occupational settings, cancer in animals, and irritation to the respiratory tract, including the exacerbation of asthma. Less obvious is the adverse human health effects of MSAT compounds at current environmental concentrations (HEI 2007) or in the future as vehicle emissions substantially decrease.

The methodologies for forecasting health impacts include emissions modeling, dispersion modeling, exposure modeling, and then a final determination of health impacts, with each step in the process building on the model predictions obtained in the previous step. All methodologies are encumbered by technical shortcomings or uncertain science that prevents a more-complete differentiation of the MSAT health impacts among the project alternatives. These difficulties are magnified for lifetime (that is, 70-year) assessments, particularly because unsupportable assumptions would need to be made regarding changes in travel patterns and vehicle technology (both of which affect emissions rates) over that timeframe, since such information is unavailable.

It is particularly difficult to reliably forecast 70-year lifetime MSAT concentrations and exposure near roads, to determine the portion of time that people are actually exposed at a specific location, and to establish the extent attributable to a proposed action, especially given that some of the information needed is unavailable.

There are considerable uncertainties associated with the existing estimates of toxicity of the various MSATs, because of factors such as low-dose extrapolation and translation of occupational exposure data to the general population, a concern expressed by HEI (2007). As a result, there is no national consensus on air dose-response values assumed to protect the public health and welfare for MSAT compounds, and in particular for diesel PM. EPA states that, with respect to diesel engine exhaust, "[t]he absence of adequate data to develop a sufficiently confident dose-response relationship from the epidemiologic studies has prevented the estimation of inhalation carcinogenic risk" (EPA 2003, Section II.C).

There is also the lack of a national consensus regarding an acceptable level of risk. The current context is the process used by EPA as provided by the Clean Air Act to determine whether more-stringent controls are required in order to provide an ample margin of safety to protect public health or to prevent an adverse environmental effect for industrial sources subject to the maximum achievable control technology standards, such as benzene emissions from refineries. The decision framework is a two-step process. The first step requires EPA to determine an “acceptable” level of risk due to emissions from a source, which is generally no greater than approximately 100 in a million. Additional factors are considered in the second step, the goal of which is to maximize the number of people with risks less than 1 in a million due to emissions from a source.

The results of this statutory two-step process do not guarantee that cancer risks from exposure to air toxics are less than 1 in a million; in some cases, the residual risk determination could result in maximum individual cancer risks that are as high as approximately 100 in a million. In a June 2008 decision, the U.S. Court of Appeals for the District of Columbia Circuit upheld EPA’s approach to addressing risk in its two-step decision framework. Information is incomplete or unavailable to establish that even the largest of highway projects would result in levels of risk greater than those deemed acceptable (U.S. Court of Appeals for the District of Columbia Circuit, *Natural Resources Defense Council and Louisiana Environmental Action Network v. Environmental Protection Agency*, decided June 6, 2008).

Because of the limitations in the methodologies for forecasting health impacts described above, any predicted difference in health impacts among alternatives is likely to be much smaller than the uncertainties associated with predicting the impacts. Consequently, the results of such assessments would not be useful to decision-makers, who would need to weigh this information against project benefits—such as reducing traffic congestion, accident rates, and fatalities plus improved access for emergency response—that are better suited for quantitative analysis (FHWA 2016).

10.4.9 Comparison of Greenhouse Gas Emissions by Alternative

From a quantitative perspective, greenhouse gas (GHG) emissions can contribute to global climate change as the cumulative result of numerous and varied emissions sources (in terms of both absolute numbers and types), each of which makes a relatively small addition to global atmospheric GHG concentrations.

In contrast to broad-scale actions such as those involving an entire industry sector or very large geographic areas, it is difficult to isolate and understand the impacts of GHG emissions for a particular transportation project. Furthermore, there is currently no scientific methodology for attributing specific climatological changes to a particular transportation project’s emissions.

Carbon dioxide (CO_2) is frequently used as an indicator of overall transportation GHG emissions because the quantity of these emissions is much larger than that of all other transportation GHGs combined, and because CO_2 is estimated to account for 90% to 95% of the overall climate forcing of various GHGs related to transportation sources.

For informational purposes, UDOT estimated the CO_2 equivalent (CO_2e) emissions projected from the project’s No-Action and action alternatives (Table 10.4-6). For any quantity and type of GHG, CO_2e represents the amount of CO_2 that would have the equivalent global warming impact. In this analysis, CO_2e represents CO_2 as well as methane (CH_4) and nitrous oxide (N_2O). This analysis compares CO_2e emissions of bus service, gondola service from the proposed gondola base stations to the Alta ski resort, and cog rail service from the proposed cog rail base station to the Alta ski resort.

Electrical power in the project area is provided by Rocky Mountain Power, a division of PacifiCorp. Gondola emissions were estimated based on PacifiCorp's *2019 Integrated Resource Plan* (PacifiCorp 2019) and the estimated gondola facility power consumption and operating schedule. According to PacifiCorp's plan, for calendar year 2038 (the approximate midpoint for the project forecast from 2025 to 2050), the gondola system would be powered by electricity generated from a combination of coal (6%), natural gas (20%), and other non-GHG-emitting sources (74%). This power would be generated off site. Bus and personal vehicle emissions were estimated using MOVES2014b. For the buses, the estimate included the estimated number of buses, bus-miles traveled, and operating schedule, and for personal vehicles the estimate included the number of VMT. Cog rail emissions were estimated based on data presented in the paper *Analysis of Trends in Commuter Rail Energy Efficiency* (DiDomenico and Dick 2014).

As shown in Table 10.4-6, CO_2e emissions are expected to be marginally lower for bus service compared to gondola service, and CO_2e emissions with both the bus service and gondola service are expected to be lower than with the cog rail service. For context, the CO_2e emissions estimated for the action alternatives are far below EPA's mandatory reporting threshold for stationary sources, which is 25,000 tons/year, and far below EPA's threshold to trigger permitting requirements for major stationary sources, which is 100,000 tons/year. All of the action alternatives would have lower CO_2e emissions than the No-Action Alternative, resulting in a reduction in GHG emissions.

Table 10.4-6. Estimated CO_2 Equivalent (CO_2e) Emissions from Winter Operations with the No-Action and Action Alternatives in 2050

Travel Segment	Round Trip Distance (miles)	Annual CO_2e (tons/year)			
		No-Action Alternative	Enhanced Bus Service[a]	Gondola Service[b]	Cog Rail Service[c]
Personal vehicle use from North Little Cottonwood Road to Alta[d]	17	17,810	12,467	12,467	12,467
Enhanced bus service alternatives from the gondola or cog rail base stations to Alta ski resort	15.4 or 17	—	606 or 668	—	—
Gondola Alternative A base station to Alta ski resort	15.4	—	—	873	—
Gondola Alternative B base station to Alta ski resort	17	—	—	1,006	—
Cog Rail Alternative base station to Alta ski resort	17	—	—	—	1,803
Total emissions		**17,810**	**13,073 or 13,135**	**13,340 or 13,473**	**14,270**

[a] Buses are estimated to operate 140 days per year, with 216 buses traveling on S.R. 210 from the gondola or cog rail base stations to the Alta ski resort. Since all alternatives would have bus service to the gondola or cog rail base stations, the difference in the emissions estimates is due only to the difference in total miles traveled.

[b] Gondolas are estimated to operate 140 days per year and 12 hours per day. Gondola Alternative A is estimated to use 2,940 kilowatts of power per trip, and Gondola Alternative B is estimated to use 3,390 kilowatts of power per trip. Note that the up-to-5% loss of energy in the power grid is not included in the calculations.

[c] Cog rail is estimated to operate 140 days per year with 37 trips per day. Cog rail fuel efficiency is estimated to be 0.5 mile per gallon.

[d] The action alternatives assume about a 30% reduction in personal vehicle use as users use the bus, gondola, or cog rail instead of their personal vehicles for travel. The No-Action Alternative assumes a busy winter ski day with an average daily traffic volume of 9,900 vehicles.

The gondola and cog rail alternatives would have lower CO_2 emissions during summer operation.

For the Wasatch Boulevard alternatives (Five-lane Alternative and Imbalanced-lane Alternative), there would be a 4% increase in VMT compared to the No-Action Alternative in 2050 during an average weekday. For Wasatch Boulevard, the CO_2e analysis was based on commuter traffic occurring on 260 days per year (52 weeks × 5 days per week). The increase in VMT over the 2.2-mile segment of Wasatch Boulevard would increase CO_2e emissions from 21,618 tons per year to 22,483 tons per year, an increase of 865 tons of CO_2e emissions per year. The increase in emissions would likely be smaller than estimated because drivers would choose an alternate route to travel to work if no improvements were made to Wasatch Boulevard.

10.4.10 Mitigation Measures

Regional modeling conducted by WFRC for the 2050 transportation conformity analyses demonstrated that all regionally significant transportation projects (including aspects of the S.R. 210 Project) would not adversely affect local compliance with the NAAQS. Atmospheric CO_2 emissions are projected to increase in 2050 due to the higher number of vehicles and increased VMT in 2050. This increase would occur with or without the S.R. 210 Project. The amounts of all other pollutants are projected to decrease in future years due to improved fuel and emissions standards. No mitigation for air quality impacts is proposed. See Chapter 19, Construction Impacts, for the proposed air quality mitigation related to construction.

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