LAKE HAVASU CITY
SECOND BRIDGE FEASIBILITY STUDY

Final Report

July 2024

Lake Havasu City Second Bridge Feasibility Study

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1.0 Project Introduction

Lake Havasu City has entered into an Intergovernmental Agreement with the State of Arizona (ADOT) to accept the state-appropriated funding of $35,500,000 for the study, design and construction of an emergency evacuation route second bridge. The notion of a second bridge connecting Lake Havasu's mainland to the island has been a local desire for over two decades in the making. A second bridge to the island, to complement the existing London Bridge, will provide enhanced emergency evacuation and emergency access.

Second Bridge Feasibility Study Purpose

The purpose of the Second Bridge Feasibility Study is to meet the legislative requirements of SB 1722 (55th Legislature) by conducting a feasibility study to analyze and recommend preliminary design options and cost estimates for a second bridge and approaching roadway alignments in advance of the design and construction of these improvements, as authorized and funded by the Arizona Legislature.

The Second Bridge Feasibility Study is the required first step in the process to conceptually evaluate suitable roadway alignments and bridge type alternatives. This Feasibility Study then introduces and describes a multitude of roadway alignments and bridge type options that are evaluated and ranked through a series of qualitative and quantitative evaluation criteria to select a Preferred Alternative recommended for advancing to the design, permitting and construction stages of a Second Bridge.

Arizona State Legislative Appropriation

As noted above, Laws 2023, 1st Regular Session, Chapter 135 (Senate Bill 1722), Section 10 appropriated funding from the State general fund for highway projects in Arizona. This included the appropriation of $35,500,000 to Lake Havasu City to construct an emergency evacuation bridge, or "Second Bridge" as it is known for purposes of this Feasibility Study.

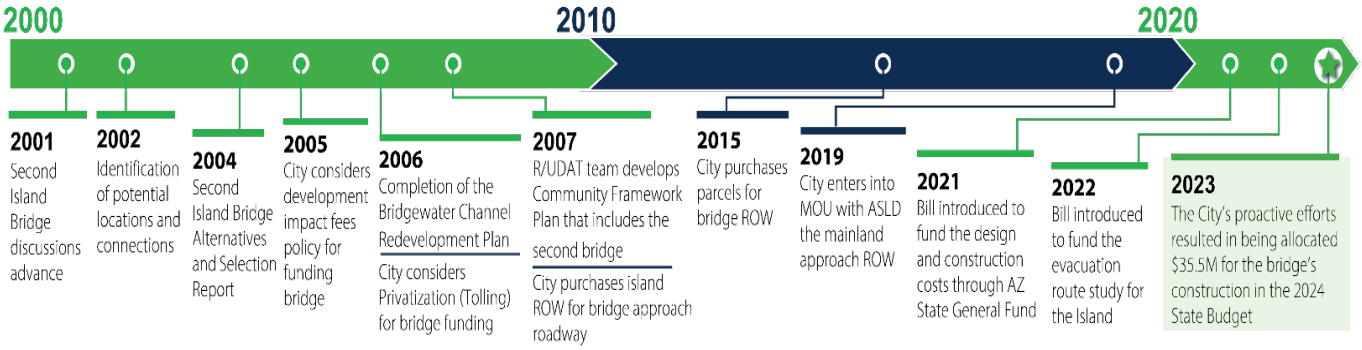
The State is empowered by A.R.S. § 28-401 to delegate the Arizona Department of Transportation (ADOT) to act with and through Lake Havasu City to execute the purpose and intent of SB 1722. As such, ADOT and Lake Havasu City have entered into an Intergovernmental Agreement (IGA) to accept the state-appropriated funding and execute the provisions of SB 1722 for the study, design, permitting and construction of the Second Bridge. Please refer to **Appendix A** for a complete copy of the IGA.

Second Bridge Background/History

The notion of a second bridge to the island in Lake Havasu City is not a new concept. In fact, initial community discussions date back to the 1990's, but in 2001 discussions about the possibility of a second bridge to the island begin to advance. As **Figure 1** illustrates, there have been several

past actions and inputs that have incrementally evolved the Second Bridge concept into the reality it is today.

FIGURE 1: SECOND BRIDGE FEASIBILITY STUDY TIMELINE



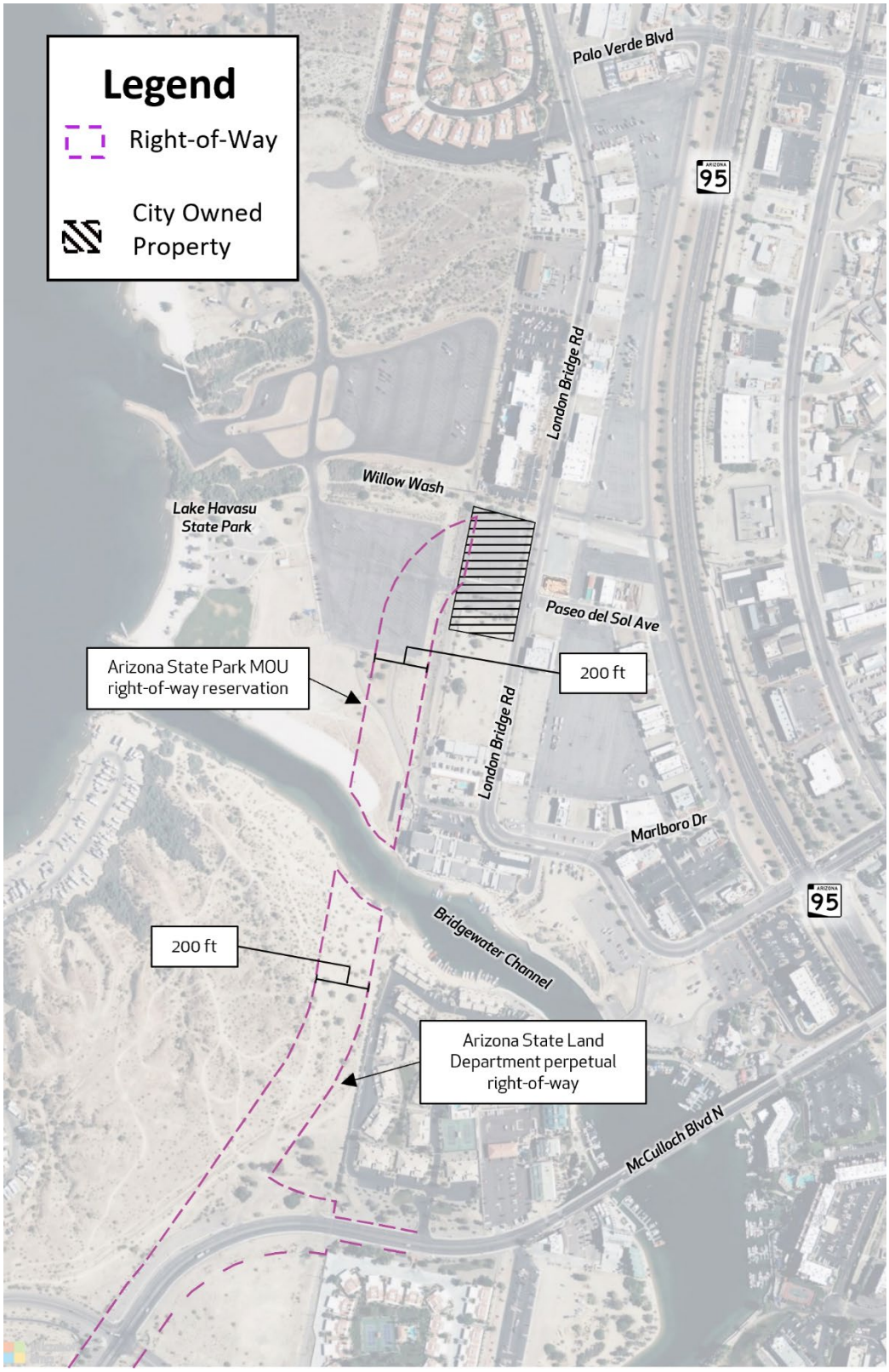
As **Figure 1** shows, previous reports and studies pertaining to a potential bridge and Bridgewater Channel and a series of proactive steps initiated by Lake Havasu City to purchase various rights-of-way (2007 and 2015) from the Arizona State Land Department and entering into a Memorandum of Understanding with the Arizona State Parks Department represent important and strategic steppingstones to facilitate the advancement of the Second Bridge today.

Arizona State Parks Memorandum of Understanding

Lake Havasu City and Arizona State Parks (ASP) Department have entered into Memorandums of Understanding (MOU) in 1997 & 2019 for the exchange of properties for the improvement of Lake Havasu State Park and the reservation of right-or-way across a small portion of Lake Havasu State Park for a future roadway approach and second bridge. Please refer to **Appendix B** for a complete copy of the 2019 MOU.

The 2019 MOU denotes that ASP and Lake Havasu City desire to renew the reservation of right-of-way across the Windsor Beach Unit of Lake Havasu State Park as originally described in the 1997 MOU. Please see **Figure 2** for illustration of the right-of-way location on ASP property.

FIGURE 2: EXISTING AND RESERVED ROADWAY RIGHTS OF WAY CORRIDORS



Arizona State Land Department Agreement

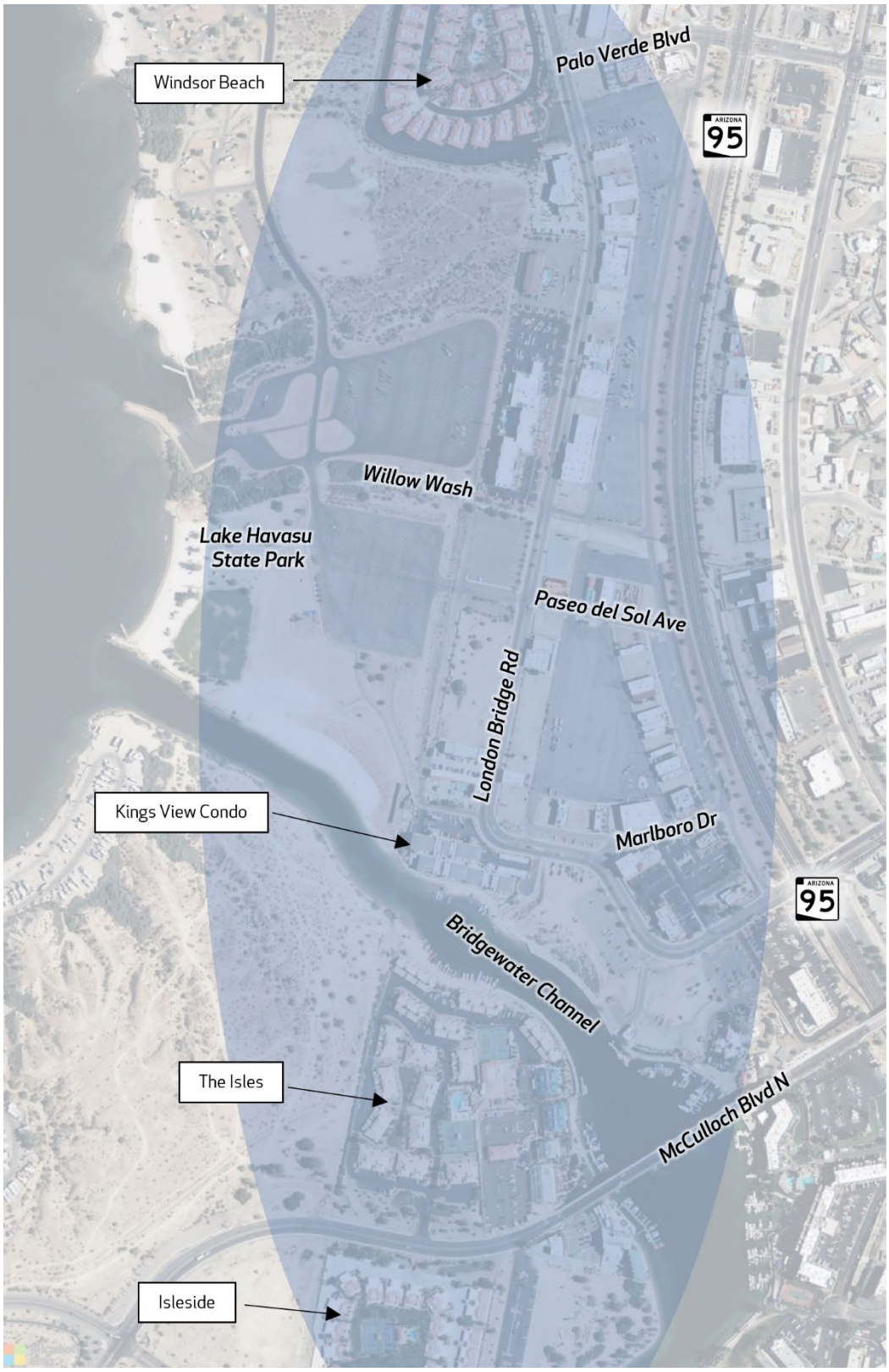
In 2007, Lake Havasu City entered into an agreement with the Arizona State Land Department (ASLD) to obtain rights-of-way for the improvement of a roadway and utilities across ASLD lands on the island. The agreement provides that the ASLD, in exchange for payment from Lake Havasu City, grants right-of-way over ASLD managed parcels of land on the island.

Figure 2 shows the location of this right-of-way reservation area on the island. This right-of-way is approximately 200-feet in width, aligns with the ASP future right-of-way reservation area north of Bridgewater Channel, and provides sufficient right-of-way for connection to McCulloch Blvd. on the island.

Second Bridge Feasibility Study Corridor & Guiding Principles

As described above, Lake Havasu City has been fortuitous in their advanced planning and preparations in anticipation of the Second Bridge. Prior agreements with ASP and right-of-way acquisition from ASLD on the island side have defined and reserved a generic right-of-way footprint for the roadway approaches and likely Second Bridge location. Within the broader right-of-way reservation areas, the Project Team has developed a series of refined roadway alignments and bridge type alternatives within the existing rights-of-way/reservation areas and have expanded the Feasibility Corridor as shown in **Figure 3**.

FIGURE 3: SECOND BRIDGE FEASIBILITY CORRIDOR



Second Bridge Feasibility Study Priorities

The various elements of the Second Bridge Feasibility Study utilized in the creation, evaluation and ranking of the alternatives including the eight (8) priority elements described below. Lake Havasu City staff, stakeholder and public input obtained early in the Feasibility Study process provided guidance to the Project Team in defining what is important to consider with each study element. These study priorities include:

- ***Bridge Structure Type/Architecture***
    a. The Second Bridge structure type and aesthetics should complement, but not overshadow/draw attention away from the London Bridge.
    b. Ensure the Second Bridge is visually appealing while also being realistic by staying within the prescribed construction budget.
- ***Roadway Approach Concepts/Alternatives***
    a. Develop a series of roadway alignment alternatives that stay within existing/prescribed rights-of-way and/or city owned parcels.
    b. Provide sufficient roadway capacity (number of lanes) that maintain an acceptable level of service for at least 20 years.
    c. Roadway alternatives shall provide for a new, full-time access driveway entrance into Lake Havasu State Park.
- ***Bridgewater Channel Impacts***
    a. The Second Bridge design and construction technique shall not impede recreational or commercial boating activity (including the Havasu Landing Resort and Casino ferry) in Bridgewater Channel.
    b. If feasible, all bridge alternatives presented should incorporate a clear span over Bridgewater Channel (i.e., no piers/pylons (within the Ordinary High Water Mark).
    c. Minimizing impacts to the channel will also be favorable for future environmental/regulatory permitting with other agencies.
- ***Public & Stakeholder Engagement***
    a. Lake Havasu City places great value on a proactive and robust public and stakeholder engagement process for the Second Bridge Feasibility Study process.
    b. Two rounds of public and stakeholder engagement are an essential component to the success of the Feasibility Study. Round #1 introduced the project to the public and stakeholders, soliciting their comments and input via a community survey. Round #2 provided an overview of all roadway and bridge alternatives analyzed, explained the rationale in the selection of the Preferred

Alternative and offered the public and stakeholder the opportunity to provide their input. All public and stakeholder comments received are included in the Feasibility Study reporting. Please refer to **Section 2.0** and **Appendix D** for additional information.

c. Lake Havasu City and ASP value their strong partnership and the Project Team conducted numerous coordination meetings with the ASP over the course of the Feasibility Study to obtain their input and support.

- ***Environmental Overview***

  a. A high-level environmental overview was conducted to determine if there are any fatal flaws with any roadway or bridge alternatives presented. Any fatal flaw identified would likely eliminate that alternative from further analysis.

  b. The environmental overview also provides important guidance by identifying likely federal environmental permitting requirements anticipated during the Second Bridge engineering design and construction processes.

- ***Utility Conflicts***

  a. The Project Team obtained data on existing above ground and below ground utilities in proximity to the roadway and bridge alternatives. While new construction design alternatives can't always avoid conflicts with existing utilities, each alternative was developed to minimize utility conflicts where practicable.

  b. Identifying the presence of existing utilities early in the Feasibility Study process is essential to incorporating the mitigation of any known conflicts into the future engineering design and avoid construction cost surprises later in the process.

- ***Minimize Impacts to Adjacent Property Owners***

  a. Lake Havasu City has emphasized that a key priority for the Project Team is to develop roadway alignment alternatives and select a Preferred Alternative that does not require the acquisition of additional rights-of-way.

  b. All roadway alignment and bridge alternatives considered in the Feasibility Study attempt to minimize any noise and/or visual impacts the Second Bridge may pose to adjacent property owners.

- ***Multimodal Operations/Infrastructure***

  a. Lake Havasu City recognizes and values the importance of providing a multimodal, connected community. As such, an emphasis to incorporate safe and desirable bicycle and pedestrian amenities into all alternatives presented is a minimum expectation.

b. Comfortable sidewalks, bicycle lanes and a wide multi-use path are essential ingredients in the roadway and bridge design to enhance multimodal connectivity between the Island and Mainland.

2.0 Public & Stakeholder Engagement Summary

As noted above, Lake Havasu City emphasized the need to inform and engage the public and stakeholders throughout the Feasibility Study process. Below is a summary description of the two rounds of public and stakeholder engagement activities for the Second Bridge Feasibility Study.

Round One

Community Open House Meeting #1: January 29, 2024

Community Open House Meeting #1 was held on January 29, 2024, at the Aquatic Center. Notification of the meeting was posted on the city's events calendar on their website approximately two weeks prior to the meeting. Approximately 115 people attended the meeting. The public received a PowerPoint presentation overview of the project objectives, tasks to be performed, and project timeline. Utilizing on-site comment cards, an open-ended question and answer session was also conducted. Councilmember Nancy Campbell offered some prepared remarks on behalf of State Representative Biasiucci.

In addition, a public survey, utilizing the comment card instrument, was conducted electronically over the course of a two-week period immediately following the community open house. A total of 337 responses were received. The vast majority of the comments received were generally supportive of the project.

Stakeholder Meetings – March 5, 2024

To supplement the Community Open House meeting, two separate stakeholder meetings were conducted to enhance the exposure of the Second Bridge Feasibility Study and obtain additional input. Letter invitations were sent via first class mail to 423 property owners in the vicinity of the study area.

To enhance participation and stakeholder convenience, one meeting was held at 1:00 pm and a second meeting held at 5:30 pm on March 5th. Attendees received the same PowerPoint presentation offered at the Community Open House meeting, an open question and answer session was held, and attendees were notified of the electronic survey that was available for them to complete for an extended two-week period.

Please refer to **Appendix D** for copies of all public and stakeholder meeting materials, including public notice, letter invitations, PowerPoint presentation, sign in sheets, sample comment card and summary of all public and stakeholder comments received.

Round Two

Community Open House Meeting #2: June 27, 2024

Community Open House Meeting #2 was held on June 27, 2024, at the LHC City Council chambers. Notification of the meeting was posted on the city's events calendar on their website approximately two weeks prior to the meeting.

Approximately 65 people attended the meeting. The public received a PowerPoint presentation overview of the project history, traffic modeling summary results, proposed roadway and bridge cross sections, roadway alignment alternatives, and bridge type alternatives. The PowerPoint presentation concluded with an overview of the evaluation criteria used to select the Preferred Alternative, scoring results and overall description of the Preferred Alternative.

An open-ended question and answer session was also conducted. Questions and comments posed by attendees generally include:

- What is a Florida T intersection?
- Why spend more budget dollars on the bridge aesthetics? The roadway is more important.
- Question and concern about the future traffic generated on London Bridge Road. One observation questioned the impact on London Bridge Road north of South Palo Verde Blvd.
- Support for the multiuse path included in the roadway design.
- Observations on London Bridge Road has the space (pavement width) to be two lane road in each direction.
- Question and group discussion on the timing and length of the construction process.
- Question and group discussion on the application of bike lanes on the roadway but not the bridge.
- Questions and group discussion about the application of a roundabout in the Preferred Alternative. The general public concern about adequate sizing to accommodate longer recreational vehicles and trucks pulling large boats. An explanation of the rationale for recommending the roundabout was provided. Attendees generally are not in support of a roundabout.

In addition, two information "stations" with oversized presentation boards were set up at the meeting - one for the preferred roadway alignment alternative and the second for the preferred bridge type. Attendees were encouraged to fill out comment cards at each station. Please see **Appendix D** for a copy of PowerPoint presentation, presentation boards and comment cards received.

Stakeholder Meetings – June 28, 2024

To supplement the Community Open House meeting, two separate stakeholder meetings were conducted to enhance the exposure of the Second Bridge Feasibility Study and obtain additional input. Letter invitations were sent via first class mail to 423 property owners in the vicinity of the study area.

To enhance participation and stakeholder convenience, one meeting was held at 1:00 pm and a second meeting held at 5:30 pm on June 28th. Attendees received the same PowerPoint presentation offered at the Community Open House meeting, and an open question and answer session was held.

In addition, two information "stations" with oversized presentation boards were set up at the meeting - one for the preferred roadway alignment alternative and the second for the preferred bridge type. Attendees were encouraged to fill out comment cards at each station.

An open-ended question and answer session was also conducted. Questions and comments posed by attendees generally include:

- What is proposed for Veteran's Way for alternatives 2-5?
- How will London Bridge Road handle added traffic, especially for large events?
- Can the roundabout design as presented accommodate trucks with large boat trailers?
- Can you describe what is meant by "property encroachment" and where the areas where avoiding encroachment was a concern?
- Were the cost estimates developed by your firm in conjunction with the preparation of the alternatives?
- Will access onto Paseo del Sol from London Bridge Rd. change with the Preferred Alternative?
- What will the speed limit be on the roadway and bridge? Desire to have slower speeds to reduce traffic noise generated.
- What is the cost of a roundabout vs. a standard traffic signal? Lots of people here from out of town not familiar with how to use a roundabout. Concern for accidents.
- The location of the bridge is outside our front door. Concern about the height and impact to their current view.
- How high will the retaining walls be?
- Who owns the area under the bridge and will there be improvements made there?
- Concern about the use of e-bikes on the multiuse path.
- Question and concern about the proximity of the roadway alignment to the Kings View condo property line. Concern about noise and view proximity…can the road be shifted to the west to expand the roadway buffer?
- When did the city purchase the ASLD ROW? How much did it cost?

- Will the lake Havasu State Park parking lot be wiped out?
- Will the new bridge have lighting?

Please refer to **Appendix D** copies of all public and stakeholder meeting materials, including public notice, letter invitations, PowerPoint presentation, sign in sheets, sample comment card and summary of all public and stakeholder comments received.

Arizona State Parks Partnering Meetings

Lake Havasu City and the Arizona State Parks (ASP) have a long-standing history of collaboration and partnership. The Lake Havasu State Park is an important asset and destination for residents and tourists alike.

As previously noted, Lake Havasu City and ASP entered into Memorandums of Understanding (MOU) in 1997 & 2019 for the exchange of properties for the improvement of Lake Havasu State Park and the reservation of 200-feet of right-or-way across a small portion of Lake Havasu State Park for a future roadway approach and Second Bridge. This location is shown in **Figure 2**.

The Project Team has held four coordination meetings with ASP over the course of the Second Bridge Feasibility Study process. A brief summary of each meeting is as follows:

Meeting #1: February 14, 2024 – this first meeting introduced ASP to the Second Bridge Feasibility Study objectives, tasks and schedule.

Meeting #2: February 21, 2024 – a follow up to meeting #1 whereby ASP identified their desire to include a new formal entrance into Lake Havasu State Park and to maintain secondary access provisions into the roadway alignment alternatives.

Meeting #3: March 21, 2024 – another project status meeting conducted prior to the Project Team developing the roadway alignment alternatives. ASP noted that, as the roadway alignment alternatives were developed, their preference, where possible, was to have the new entrance driveway into Lake Havasu State Park align with the northern edge of their existing parking lot and that all roadway alignment alternatives be contained within the 200-foot reservation area described in the 2019 MOU.

Meeting #4: May 14, 2024 – project status meeting to offer ASP a preview of the LHC City Council briefing presentation illustrating and describing each of the roadway alignment and bridge type alternatives.

City Council Briefing

At their regular meeting of May 14, 2024, Lake Havasu City Council received a project briefing. The PowerPoint presentation included a brief summary overview of round one of the public and stakeholder engagement process, traffic modeling results, and Arizona State Parks coordination

efforts. The presentation then focused on a thorough overview of the various roadway alignment alternatives and bridge type alternatives.

In the Public hearing portion of the Council briefing, members of the public in attendance asked questions and made observations on various aspects of the roadway and bridge alternatives and considerations moving forward. Mr. Dan Roddy from the Arizona State Parks Department also appeared and thanked Council for the collaboration throughout the Feasibility Study process and inquired on the project budget related to likely modifications that will be needed to the Lake Havasu State Park parking lot.

Some City Council members asked questions and offered observations on the various roadway and bridge type alternatives. Generally speaking, Council observed that they preferred roadway alternatives that did not trigger the acquisition of any private property and had the least impact onto existing city rights-of-way.

3.0 Traffic Modeling Summary

Michael Baker, in association with Kittelson & Associates, performed a travel demand model analysis using VISSIM software to assess the existing and future roadway capacity and operational characteristics of a second bridge to the Lake Havasu Island. Traffic volumes generated from this travel demand model analysis were used to determine the roadway capacity needed and operations of the roadways for the proposed second bridge and the roadways surrounding the bridge for the existing year, 2030 and 2045 future conditions.

Travel demand modeling for the Second Bridge Feasibility Study second island bridge evacuation analysis was based on the Lake Havasu MPO's 2022 Regional Travel Demand Model that was developed as part of the 2045 Regional Transportation Plan. Travel demand model network and socioeconomics were updated to reflect current conditions around the project area. The model was then validated against the traffic count data. LHMPO model's future socioeconomic data was updated to include the island's latest development plans which formed the basis for the future year traffic projections.

Michael Baker also coordinated with the city to identify and estimate the likely land use composition and potential construction timing of any planned developments in the study area, with particular focus on the island.

Analysis Years: The traffic model analysis was completed for the existing year (Year 2022), near-term (Year 2030) and long-term (Year 2045) for both No-BUILD and BUILD scenarios.

NO-BUILD Analysis: No-build analysis was completed for the existing, near-term and long-term analysis years using the following data:

- Existing 2022: 2022 roadway network, 2022 socioeconomic data,
- Year 2030: 2022 roadway network without the new bridge, 2030 socioeconomic data including expected new developments on the island,
- Year 2045: 2022 roadway network without the new bridge, 2045 socioeconomic data including expected new developments on the island.

BUILD Scenario: A build scenario analysis was completed for the new bridge and roadways. The following scenarios were analyzed as part of the study:

- Build Scenario 1A – 3 lane bridge across Bridgewater Channel connecting to SR 95 along the Willow Wash alignment, just north of existing Paseo Del Sol intersection,
- Build Scenario 1B – 5 lane bridge across Bridgewater Channel connecting to SR 95 along the Willow Wash alignment just north of existing Paseo Del Sol intersection,
- Build Scenario 2A – 3 lane bridge across Bridgewater Channel connecting to Palo Verde Boulevard in the vicinity of London Bridge Road,
- Build Scenario 2B – 5 lane bridge across Bridgewater Channel connecting to Palo Verde Boulevard in the vicinity of London Bridge Road.

Year 2030 Scenario: 2030 analysis includes the analysis with a new 3 lane bridge and 5 lane bridge across Bridgewater Channel with 2030 roadway network and 2030 socioeconomic data including new developments on the island.

Year 2045 Scenario: 2045 analysis includes the new 3 lane bridge and 5 lane bridge across Bridgewater Channel with 2045 roadway network and 2045 socioeconomic data including new developments on the island.

Travel Demand Model Outputs

Daily Traffic volumes generated using the VISSIM model were used to determine the capacity of the proposed approaching roadways and Second Bridge to the Island. Daily traffic volumes were generated for various roadways in the vicinity of the proposed Second Bridge. Daily traffic volume outputs from the model are included in **Appendix E**.

Traffic volumes were generated at multiple locations along various roadway segments. For the purposes of this analysis, an average of the traffic volumes along each roadway segment are used to determine the capacity needs of a particular segment. A summary of the average daily traffic volumes for each segment and analysis scenario generated by the VISSIM model are shown in **Table 1**.

TABLE 1: AVERAGE DAILY TRAFFIC VOLUME SUMMARY

Segment	No Build			BUILD							
				Scenario 1: 3 Lane Bridge				Scenario 2: 5 Lane Bridge			
				1A: at Paseo		2A: at Palo Verde		1B: at Paseo		2B: at Palo Verde	
	2022	2030	2045	2030	2045	2030	2045	2030	2045	2030	2045
Lake Havasu	7,956	9,437	11,342	8,438	9,859	7,528	9,090	8,414	9,857	7,518	9,074
SR 95	21,673	22,035	22,802	21,884	22,488	21,632	22,186	21,887	22,486	21,632	22,185
London Bridge Rd	3,935	4,541	5,457	4,598	5,808	6,657	7,476	4,593	5,754	6,403	7,490
Palo Verde W of SR 95	5,848	6,620	8,160	6,298	7,951	10,571	11,965	6,304	8,001	10,587	11,997
Palo Verde E of SR 95	5,482	5,829	5,257	6,029	6,311	5,820	5,971	6,036	6,339	5,826	5,974
Mesquite W of SR 95	-	-	-	-	-	5,351	-	-	-	-	-
Mesquite E of SR 95	6,352	7,888	8,778	7,116	8,034	7,807	7,622	7,118	7,495	7,219	7,628
Beachcomber	2,317	3,447	4,042	2,902	3,358	1,809	2,436	2,907	3,415	1,824	2,456
McCulloch at Beachcomber	5,636	7,469	8,239	7,169	7,884	6,863	7,442	7,179	7,845	6,876	7,466
McCulloch at New Bridge	-	-	-	2,898	2,506	2,582	2,446	2,896	2,449	2,579	2,453
McCulloch W of SR 95	10,430	16,252	20,521	8,091	9,882	8,423	10,314	8,076	9,834	8,399	10,267
McCulloch E of SR 95	5,255	6,262	7,241	5,502	6,272	5,494	6,262	5,494	6,242	5,493	6,261
Swanson	5,633	6,222	6,612	5,619	6,135	5,881	6,430	5,618	6,136	5,876	6,426
Smoketree	6,387	6,584	6,706	6,699	6,759	6,651	6,698	6,700	6,759	6,653	6,699
New Bridge S of Paseo Connection	-	-	-	5,783	7,210	-	-	5,799	7,258	-	-
New Bridge W of SR 95	-	-	-	10,379	10,784	-	-	10,386	10,775	-	-
New BridgeS of London Bridge Rd	-	-	-	-	-	5,394	6,701	-	-	5,419	6,749

Capacity and Operational Analysis

Capacity analysis to determine the required number of lanes and operational analysis to determine the level-of-service (LOS) was conducted for the roadways in the vicinity of the proposed new bridge.

Florida Department of Transportation (DOT) 2023 Multimodal Quality/Level-of-Service Handbook was used to determine the LOS of the study segments. This handbook is intended to be used by engineers, planners and decision-makers to evaluate the roadway users' quality/level-of-service at generalized planning levels. This handbook includes generalized service volume tables by roadway and area types.

Generalized service volumes on arterial roadways in an urban area, shown in **Table 2** and included in **Appendix E**, are used for this study.

TABLE 2: FLORIDA DOT GENERALIZED SERVICE VOLUMES FOR ARTERIAL ROADWAYS IN URBAN AREAS

Lanes/LOS	B	C	D	E
2 Lane	*	*	17,600	24,000
4 Lane	*	24,400	36,100	40,800
6 Lane	*	44,700	56,800	60,400
8 Lane	*	52,300	66,900	70,900

Florida Department of Transportation generalized service volumes table for arterial roadways in urban areas recommend increasing the daily traffic volumes by 5% for roadways with an exclusive left-turn lane. Exclusive left-turn lanes exist on the following roadways that are analyzed for this study:

- Lake Havasu Avenue
- State Route (SR) 95
- Palo Verde Boulevard west of SR 95
- Mesquite Avenue
- McCulloch Boulevard on the Island
- Swanson Avenue

Daily traffic volumes shown in **Table 1** for the above listed roadways are increased by 5% to account for the exclusive left-turn lanes.

Table 3 shows the daily traffic volumes adjusted for the exclusive left-turn lanes on the study roadway segments.

TABLE 3: DAILY TRAFFIC VOLUMES ADJUSTED FOR EXCLUSIVE LEFT-TURN LANES

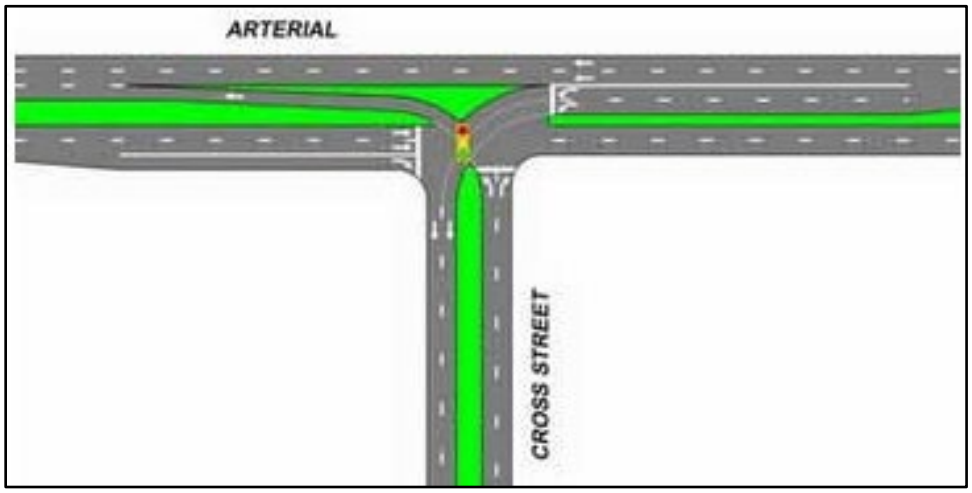
ADJUSTED AVERAGE DAILY TRAFFIC VOLUMES											
Location	No Build			BUILD							
				Scenario A: 3 Lane Bridge				Scenario B: 5 Lane Bridge			
				1A: at Paseo		2A: at Palo Verde		1B: at Paseo		2B: at Palo Verde	
	2022	2030	2045	2030	2045	2030	2045	2030	2045	2030	2045
Lake Havasu (4 LANES)	8,354	9,909	11,909	8,860	10,352	7,904	9,545	8,835	10,350	7,894	9,528
SR 95 (4 LANES)	22,757	23,137	23,942	22,978	23,612	22,714	23,295	22,981	23,610	22,714	23,294
London Bridge Rd (4 LANES)	4,132	4,768	5,730	4,828	6,098	6,990	7,850	4,823	6,042	6,723	7,865
Palo Verde W of SR 95 (2 LANES)	6,140	6,951	8,568	6,613	8,349	11,100	12,563	6,619	8,401	11,116	12,597
Palo Verde E of SR 95 (2LANES)	5,482	5,829	5,257	6,029	6,311	5,820	5,971	6,036	6,339	5,826	5,974
Mesquite W of SR 95 (4 LANES)	-	-	-	-	-	5,619	-	-	-	-	-
Mesquite E of SR 95 (4 LANES)	6,670	8,282	9,217	7,472	8,436	8,197	8,003	7,474	7,870	7,580	8,009
Beachcomber (2 LANES)	2,317	3,447	4,042	2,902	3,358	1,809	2,436	2,907	3,415	1,824	2,456
McCulloch at Beachcomber (4 LANES)	5,918	7,842	8,651	7,527	8,278	7,206	7,814	7,538	8,237	7,220	7,839
McCulloch at New Bridge (4 LANES)	-	-	-	3,043	2,631	2,711	2,568	3,041	2,571	2,708	2,576
McCulloch W of SR 95 (3 LANES)	10,430	16,252	20,521	8,091	9,882	8,423	10,314	8,076	9,834	8,399	10,267
McCulloch E of SR 95 (4 LANES)	5,255	6,262	7,241	5,502	6,272	5,494	6,262	5,494	6,242	5,493	6,261
Swanson (3 LANES)	5,915	6,533	6,943	5,900	6,442	6,175	6,752	5,899	6,443	6,170	6,747
Smoketree (2 LANES)	6,387	6,584	6,706	6,699	6,759	6,651	6,698	6,700	6,759	6,653	6,699
New Bridge S of Paseo Connection	-	-	-	5,783	7,210	-	-	5,799	7,258	-	-
New Bridge W of SR 95	-	-	-	10,379	10,784	-	-	10,386	10,775	-	-
New BridgeS of London Bridge Rd	-	-	-	-	-	5,394	6,701	-	-	5,419	6,749

Florida-T Intersection

A Florida-T intersection is a specialized traffic signal design used at T-shaped (3-legged) intersections to improve traffic flow and safety. This design was developed in Florida to address unique challenges presented by these intersections. Florida-T signal-controlled intersections allow free-flow through movements for one direction along a major roadway while also allowing protected left-turn movements into and out of a minor street. This continuous flow of vehicles on the major road is expected to minimize stops and delays. Florida-T intersections also cost less than a traditional signal and are expected to have fewer conflict points and enhanced safety.

An example of Florida-T intersection schematic is shown in **Figure 4**.

FIGURE 4: FLORIDA-T INTERSECTION SCHEMATIC



State Route 95 is an Arizona Department of Transportation (ADOT) controlled access facility. As mentioned in the section above, Scenario 1 connects the proposed new bridge to SR 95 along the Willow Wash alignment just north of the existing Paseo Del Sol intersection. Based on preliminary discussions with ADOT staff, any proposed new roadway connection to SR 95 shall be a signal-controlled intersection.

The approximate distance between the proposed new roadway connection to SR 95 at the Willow Was and or Paseo del Sol alignment is about ¼ mile from the Mesquite Avenue signalized intersection. The minimum acceptable distance between signalized intersections along ADOT roadways is 1/4th mile. Therefore, any new proposed connection to SR 95 at Willow Wash (alternatives 2A,B – 4A,B) meets the minimum acceptable distance standards between signalized intersections, but any proposed connection to SR 95 at Paseo del Sol Ave. (Alternative 5) does not.

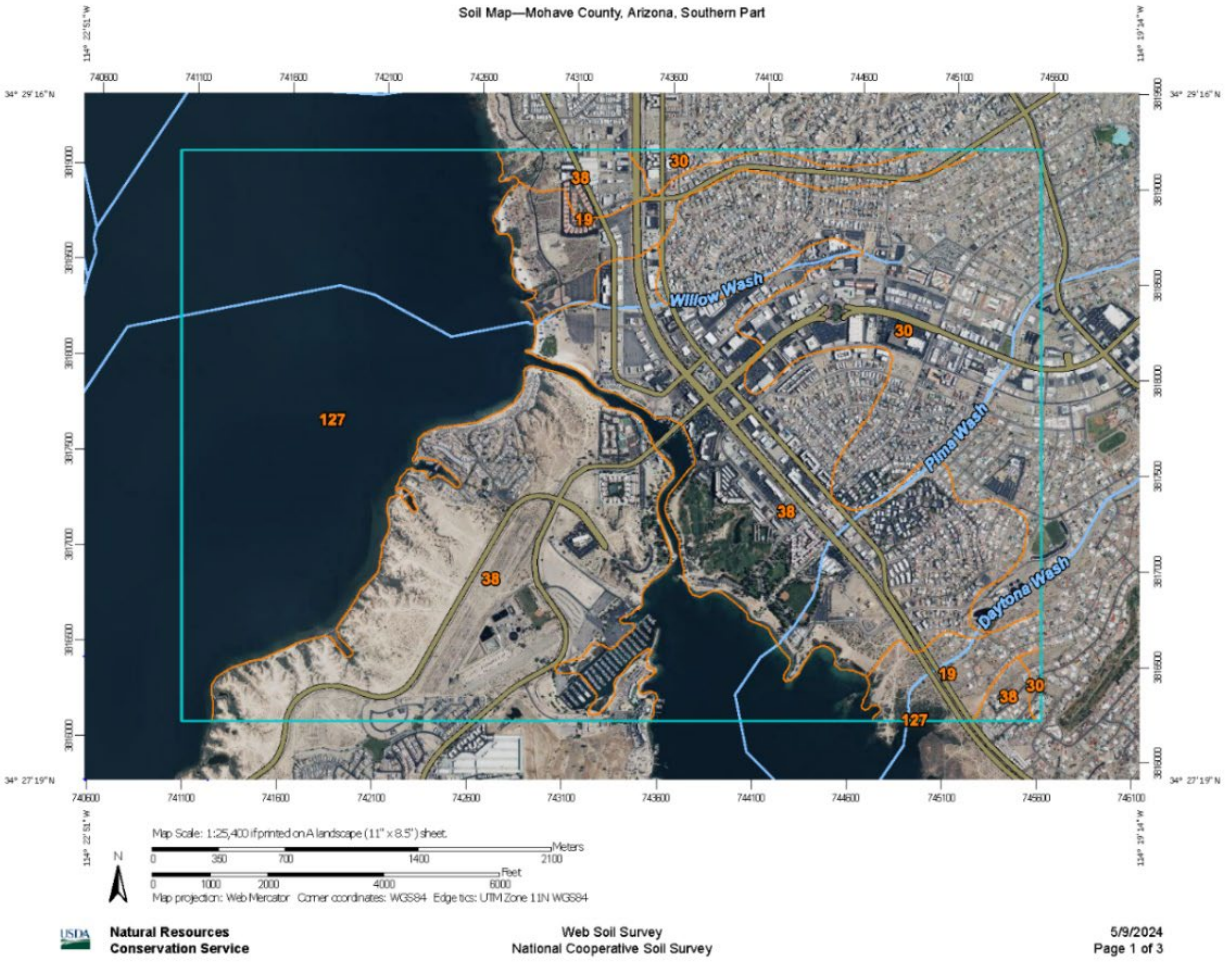
However, based on preliminary discussions with the ADOT staff, there are concerns regarding the northbound traffic queuing between any potential new roadway connection and Mesquite Avenue on SR 95. To mitigate this northbound queuing, a Florida-T intersection with a free-flow northbound through movements is recommended for any roadway alignment alternatives that propose connection to SR 95.

4.0 Geotechnical Considerations

To aide in the consideration and evaluation of bridge type alternatives and offer an early line of sight for potential pier design and construction techniques, a high level, desktop analysis of the geotechnical characteristics of the north and south shores of Bridgewater Channel was conducted. No field investigations of soil borings were conducted at this early, Feasibility Study stage.

Using the Web Soil Survey, **Figure 5** illustrates the soil characteristics in proximity to Bridgewater Channel and future location of the Second Bridge.

FIGURE 5: SOIL CHARACTERISTICS IN PROXIMITY TO THE SECOND BRIDGE CROSSING LOCATION



The surficial geology underlying the site is described as Pleistocene alluvium deposits consisting of sand, gravel, and conglomerates (Wilson et al., 1959). According to the USDA National Resources Conservation Service Web Soil Survey, the on-site soils generally consist of the Coolidge-Denure complex. More specifically, based on previously drilled geotechnical borings

logged by Ninyo & Moore, the alluvium deposits are anticipated to consisted of medium to very dense poorly graded fine to coarse sands with trace gravels and medium dense to very dense fine to coarse gravels. These alluvium deposits are capable of supporting shallow spread foundations if moderate loading is utilized. Alternatively, if heaver loading is applied, drilled shafts that are embedded within the deeper layers of these alluvium deposits are possible.

5.0 Environmental Overview

Himes Consulting, LLC conducted an environmental overview of the proposed Second Bridge and roadway alignment alternatives. Discussions were held with the primary agencies to determine likely regulatory permitting requirements in conjunction with the upcoming engineering design and construction processes associated with the Second Bridge and roadway approaches. Discussions were held with the following agencies: the U.S. Coast Guard (Carl Hausner, Commander, Eleventh District, Alameda, CA), the U.S. Bureau of Reclamation (Chris Wallis, Resources Management Office Chief, Yuma, AZ), and the U.S. Army Corps of Engineers (Therese Carpenter, Colorado River Project Manager, Regulatory Division, Arizona Branch, Los Angeles District, Phoenix, AZ). Discussions were also held with the Chemehuevi Indian Tribe (Realty Specialist, Havasu Lake, CA).

Table 4 illustrates the anticipated required environmental permits and approving agencies in conjunction with the upcoming Second Bridge (and approaching roadways) design and construction processes.

TABLE 4: ENVIRONMENTAL PERMITS OVERVIEW

Agency	Approval
US Coast Guard	Bridge Permit & NEPA Review
US Coast Guard	Bridge Lighting Plan
US Army Corps of Engineers	Section 10 (Rivers and Harbors Act) Permit
US Army Corps of Engineers	Section 404 (Clean Water Act) Permit (for bridge alternatives with work below the OHWM)
US Bureau of Reclamation	Structures below 455 foot elevation
US Fish & Wildlife Service	Endangered Species Section 7 Consultation
Arizona State Land Department	Right of Way Submittals: Native Plant Inventory, Cultural Resources Survey, Design Plan and Permit Application Review
Arizona State Parks & Trails	Right of Way dedication (per 2019 MOU); Cultural Survey, Design Plan Review.
State Historic Preservation Office	Section 106 consultation/cultural survey report approval
Arizona Department of Environmental Quality	401 Water Quality Certification & AZPDES Permit
Arizona Department of Transportation	SR 95 Encroachment Permit (SR 95 only)

Based on agency input, the timeframe to complete environmental studies and permitting for the Preferred Alternative is approximately one year, if an Environmental Impact Statement (EIS) is not required.

NEPA Review

Meetings to evaluate the scope of the analysis would begin at the initiation of project permitting. Preliminary discussions indicate that the U.S. Coast Guard (USCG) would act as federal lead agency due to the requirement of a Bridge Permit. The lead federal agency is responsible for complying with the National Environmental Policy Act (NEPA). The USCG indicates that the project evaluated under NEPA would include both the roadway improvements and bridge, as the roadway improvements would not be built without the bridge. In addition, the evaluation must include any island development that is dependent on the road improvements. Once the project is initiated with the USCG, they would consider whether an Environmental Impact Statement (EIS) or Environmental Assessment (EA) is appropriate. The U.S. Army Corps of Engineers (Corps) and the U.S. Bureau of Reclamation (Bureau) would likely act as cooperating agencies throughout the NEPA process. The Bureau's primary concerns are issues related to the operation and maintenance of Lake Havasu. The Bureau reserves the right to enter lands lying below 455 feet (ft) above mean sea level (msl) and approve any structures constructed below this elevation.

NEPA categories likely to be considered in-depth by the USCG as part of the EA or EIS are outlined and briefly analyzed below. As the Federal Highway Administration (FHWA) is not involved, Section 4(f) would not be required to be considered. Other categories may be considered as part of the NEPA document based on feedback during scoping.

Air Quality

Mohave County, in the vicinity of Lake Havasu City, is designated as an Attainment Area by the Arizona Department of Environmental Quality (ADEQ), which means that the area has pollution levels equal to or less than the national air quality standards. Existing air emissions in the project vicinity include dust from off-road vehicles and mobile source emissions (cars and boats). Impacts to air quality from all Second Bridge alternatives would include short-term construction-related air emissions such as dust and equipment emissions. Water would be provided during construction as dust control on an as-needed basis. All alternatives would result in short-term, minor, adverse impacts on air quality during construction. Mobile sources would increase in the immediate area over the long-term from the introduction of a new street/bridge alignment.

Biological Resources

Biological resources include plants, wildlife, invasive species, and migratory birds. Lake Havasu City is located within Lower Colorado River Subdivision of the Sonoran Desertscrub vegetation community. Wildlife observed within the undeveloped portions of the proposed Second Bridge alignment on May 15, 2024 include cliff swallow (*Petrochelidon pyrrhonota*), northern mockingbird (*Mimus polyglottos*), Gambel's quail (*Callipepla gambelii*), verdin (*Auriparus flaviceps*), white-winged dove (*Zenaida asiatica*), Brewer's blackbird (*Euphagus cyanocephalus*), Abert's towhee (*Pipilo aberti*), American coot (*Fulica americana*), mallard (*Anas platyrhynchos*), greater roadrunner (*Geococcyx californianus*), ring-billed gull (*Larus delawarensis*), and desert cottontail (*Sylvilagus audubonii*). All Second Bridge alternatives would impact the undeveloped bridge alignment area, which would result in a direct impact to a small amount of habitat and

wildlife. If vegetation removal is conducted within the bird nesting season (February 15 through August 31), then a pre-construction bird nest survey would be conducted to identify any active nests in accordance with the Migratory Bird Treaty Act. Bridge alternatives would also increase potential nesting surfaces for some bird species (swallows, etc.).

Cultural Resources/Native American Consultation

A cultural resources survey was conducted by SWCA Environmental Consultants on Pittsburg Point (the island) in 1992. No archaeological sites were identified within the proposed Second Bridge alignment. Cultural resources surveys would be conducted within undeveloped portions of the project if no recent surveys have been conducted. These survey reports would be coordinated through the Arizona State Land Department (ASLD), Arizona State Parks & Trails (ASPT), and the State Historic Preservation Office (SHPO) for review and approval. Under Section 106, a historic property is "any prehistoric or historic district, site, building, structure, or object included in, or eligible for inclusion in, the National Register of Historic Places" (NRHP; 36 CFR 800.16(l)(1)). Traditional Cultural Properties may also be historic properties. Under the Section 106 process, federal agencies must consider the effects of their undertakings on historic properties and consult with interested and affected Native American Tribes and the SHPO on potential impacts to historic properties. The USCG would initiate consultation with Native American Tribes under Section 106 of the NHPA.

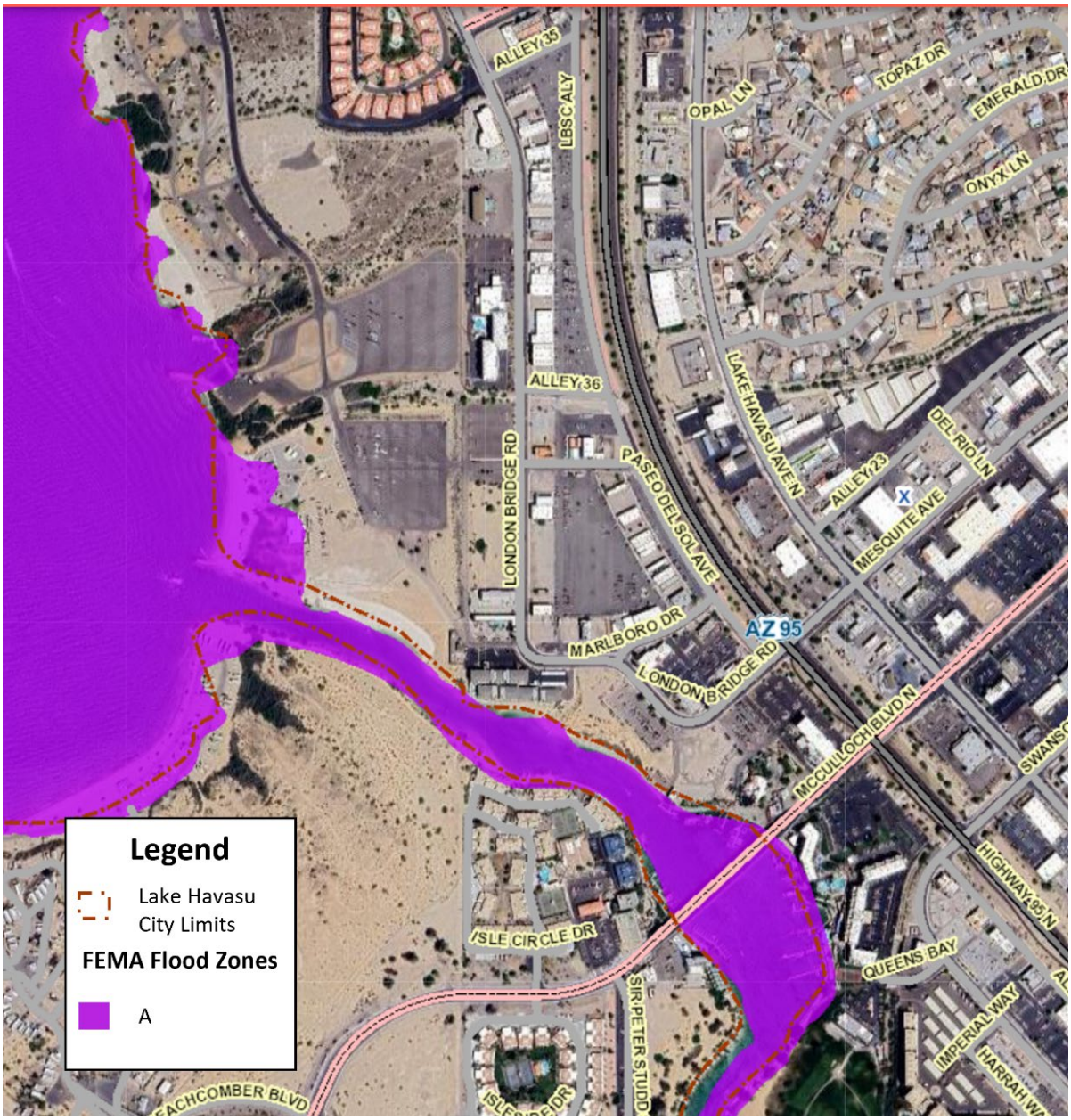
Endangered Species

Federally-listed species in the project vicinity include California least tern (*Sterna antillarum browni*), southwestern willow flycatcher (*Empidonax traillii extimus*), yellow-billed cuckoo (*Coccyzus americanus*), Yuma Ridgeway's rail (*Rallus obsoletus yumanensis*), bonytail chub (*Gila elegans*), and razorback sucker (*Xyrauchen texanus*). The Colorado River and its floodplain is also designated critical habitat for the bonytail chub. The proposed roadway and Second Bridge improvements would have no impact on these species due to the developed nature of the areas. There is no suitable habitat for tern, flycatcher, cuckoo or rail within the Second Bridge alignment, apart from migratory stop-over vegetation. With storm water controls in place during construction, impacts to the endangered fish would be limited to work below the Ordinary High Water Mark (OHWM), as well as indirect impacts from the added shading of a new bridge.

Floodplains

The 450 ft elevation is considered full reservoir for Lake Havasu. Floodplain elevations along Lake Havasu generally follow the 455 ft elevation (FIRM Map Panel 04015C6176G 11/18/2009). See **Figure 6** for FEMA FIRM map of Lake Havasu. Due to the relatively steep slopes at the bridge alignment, all areas above 455 ft above msl are located in an area of minimal flood hazard. There would be little impact to floodplains with all alternatives. Work below 455 ft above msl would be coordinated with the Bureau to ensure structures would not adversely impact flood elevations.

FIGURE 6: FEMA FLOOD HAZARD MAP



Hazardous Materials

A database search would be completed to identify any hazardous materials that occur within the project site. No indication of spills or staining was observed within the undeveloped portions of the bridge alignment during a site visit on May 15, 2024. Waste handling and disposal methods during construction, including a Spill Prevention Control and Countermeasures Plan (SPCC) if

appropriate, would be incorporated into the design features during the upcoming design and construction stages.

Hydrology

The proposed Second Bridge site crosses Bridgewater Channel, a part of the Colorado River and Lake Havasu. The river channel is approximately 180 feet wide in the area of the proposed Second Bridge alignment. Bridgewater Channel is considered a traditionally navigable water and water of the U.S. A Section 10 permit from the Corps is required for structures crossing over a Section 10 (Navigable) Waterway. The Corps has established the 450 ft above msl as the OHWM for Lake Havasu. Alternatives that involve work below the OHWM, including seawalls or other falsework in the channel, would require a Section 404 permit from the Corps. Based on bridge concept designs, no alternative, including the Preferred Alternative, would permanently alter hydrology within Bridgewater Channel.

Potential water quality concerns with the proposed project focus on storm water runoff during construction into the Colorado River. Compliance with the Arizona Pollutant Discharge Elimination System (AZPDES) construction permit would ensure the use of Best Management Practices (BMPs) during construction to minimize water quality impacts from construction. If a Section 404 permit is required for work below the OHWM, then a Section 401 water quality certification may be required from ADEQ. Any work below the OHWM could be conducted in the fall (November-December) when water levels are low to reduce the potential for impact.

Noise Analysis

Additional noise would be generated during construction and operation of the new Second Bridge and street improvements. A detailed noise analysis would be conducted as part of the NEPA analysis to evaluate short-term (construction) and long-term (operation) impacts. Existing noise levels in the project area from stationary and mobile sources would be measured from sensitive receptors. Existing noises would generally include boat traffic, general neighborhood sounds, and local and regional roadway traffic. Estimated increase in decibels to King's View Condominiums (mainland side) and The Isles Condominiums (island side) and other sensitive receptors would be assessed. Construction-related noise impacts can be mitigated through construction timing restrictions, establishing equipment noise limitations, designating construction staging areas, quiet pile-driving technologies, and other strategies.

Socioeconomics/Environmental Justice

Lake Havasu City is the largest city in Mohave County, covering 46 square miles. Founded in 1964, Robert P. McCulloch famously purchased and re-located the London Bridge to Bridgewater Channel in 1967. Estimated resident population in 2023 is nearly 58,000. The area attracts one million visitors each year with its ideal weather, natural lake beauty, 450 miles of shoreline, annual events, and wide range of restaurants and lodging (Arizona Commerce Authority, Community Profile for Lake Havasu City, 2023). Prime boating season in Lake Havasu is March to September. Lake Havasu is also rated as one of the top 100 best bass fishing lakes in America. In

terms of socioeconomics, all Second Bridge alternatives would provide an emergency evacuation route for current residents, businesses, and visitors to the island and improve traffic congestion at peak periods.

An in-depth analysis of minority and low-income populations would be conducted as part of the NEPA analysis. While it is not anticipated that there are significant minority or low-income populations within or adjacent to the construction areas, the Chemehuevi Indian Tribe (Tribe), located at Havasu Lake, California, is considered a minority population. The Tribe operates the Tecopa ferry, a 65 ft passenger catamaran, daily every ½ hour from 6:45 am to midnight from their dock next to the English Village (Arizona side) to Havasu Landing (California side). The Tribe owns several parcels along and near the channel for ferry operations and parking. Ensuring the continued operation of the ferry is essential to the livelihood of the Tribe. All bridge alternatives currently meet or exceed the existing London Bridge vertical navigational clearances (34.4 ft above 450 ft elevation) and that of the Tecopa ferry (27.25 ft above waterline). Due to the unreliability of the Dreamcatcher, the Tribe's backup ferry, a new ferry design has been completed with funding contributions from California Department of Transportation (CalTrans) and the Arizona Department of Transportation (ADOT). Clearance specifications on the new ferry are not yet available from Tribal Planning.

Transportation

In addition to street traffic analysis, of primary importance to the USCG for Bridge Permit approvals are navigational clearances of the proposed new bridge. All bridge alternatives, including the Preferred Alternative, are designed to match or exceed the vertical clearance of the London Bridge, which is 34.4 ft above msl at the 450 ft water level. All bridge alternatives would allow the passage of the Tecopa ferry. None of the bridge alternatives propose piers within the channel which would allow for suitable navigation within this portion of the channel.

Visual

The project site is located within the city's core urban area, which is characterized by a mix of residential, commercial, and recreational, with a featured view of the London Bridge to the southeast and of the wider lake views to the northwest. A detailed visual assessment with key observation points would be conducted as part of the NEPA analysis to identify permanent visual changes that would occur. Adjacent residential owners to the bridge alignment include King's View Condominiums (mainland side) and The Isles Condominiums (island side). All Second Bridge alternatives are located at the same alignment. Long-term mitigation measures that can contribute to the reduction of visual impacts can include the use of lighting shields, vegetation screening, structural screening, and architectural features of the bridge.

Wetlands

The USFWS wetland inventory mapper indicates that potential wetlands do not occur along the Colorado River in the project area. No emergent wetland vegetation or potential wetlands were observed during a site visit on May 15, 2024. None of the Second Bridge alternatives would affect wetlands.

Utilities

The City has expressed that an equally important opportunity for this project to incorporate a planned set of new and redundant utility lines to be available within the Second Bridge structure should the existing utility lines under the Bridgewater Channel fail. The redundant utility lines will include water (raw and potable), sewer, and reclaimed water, and also include new dry conduits for power, communications, and internet capacity. The City desires that the Second Bridge and approaching roadways become an independent, planned utility corridor that provides redundancy to the existing water, sewer, and reclaimed water lines underneath the Bridgewater Channel. If the existing lines fail, these redundant utility lines will act as backup systems in place to switch over to maintain capacity and service. The bridge design must accommodate positioning of these utility lines, the structural capacity to support these lines, and consider both initial constructability, the ability to periodically exercise this independent system to keep gaskets from drying out/failing, and then future access to these lines, valves, and other requisite infrastructure.

As **Figure 7** shows, numerous utilities exist within the project area. At the south end of the project, on the island, water, sewer, and gas lines are aligned with the north side of McCulloch Blvd. between the Beachcomber Blvd. intersection and the curve of the roadway. Parallel to the east boundary of the ASLD right-of-way (ROW), overhead power lines, sewer and fiber optic exist, crossing Bridgwater Channel. These same existing utilities extend northerly immediately east of the Arizona State Parks right-of-way reservation area to Willow Wash and beyond. All alternatives presented cross over/under these utilities in between the existing Arizona State Parks paved parking and the existing city-owned paved parking areas west of existing London Bridge Road.

There's also an overhead power line that crosses the ASLD ROW on the island side about 250' south of the Bridgewater Canal.

Within London Bridge Road, an existing waterline is parallel to and west of the roadway centerline and a second waterline is also parallel and east of the roadway centerline.

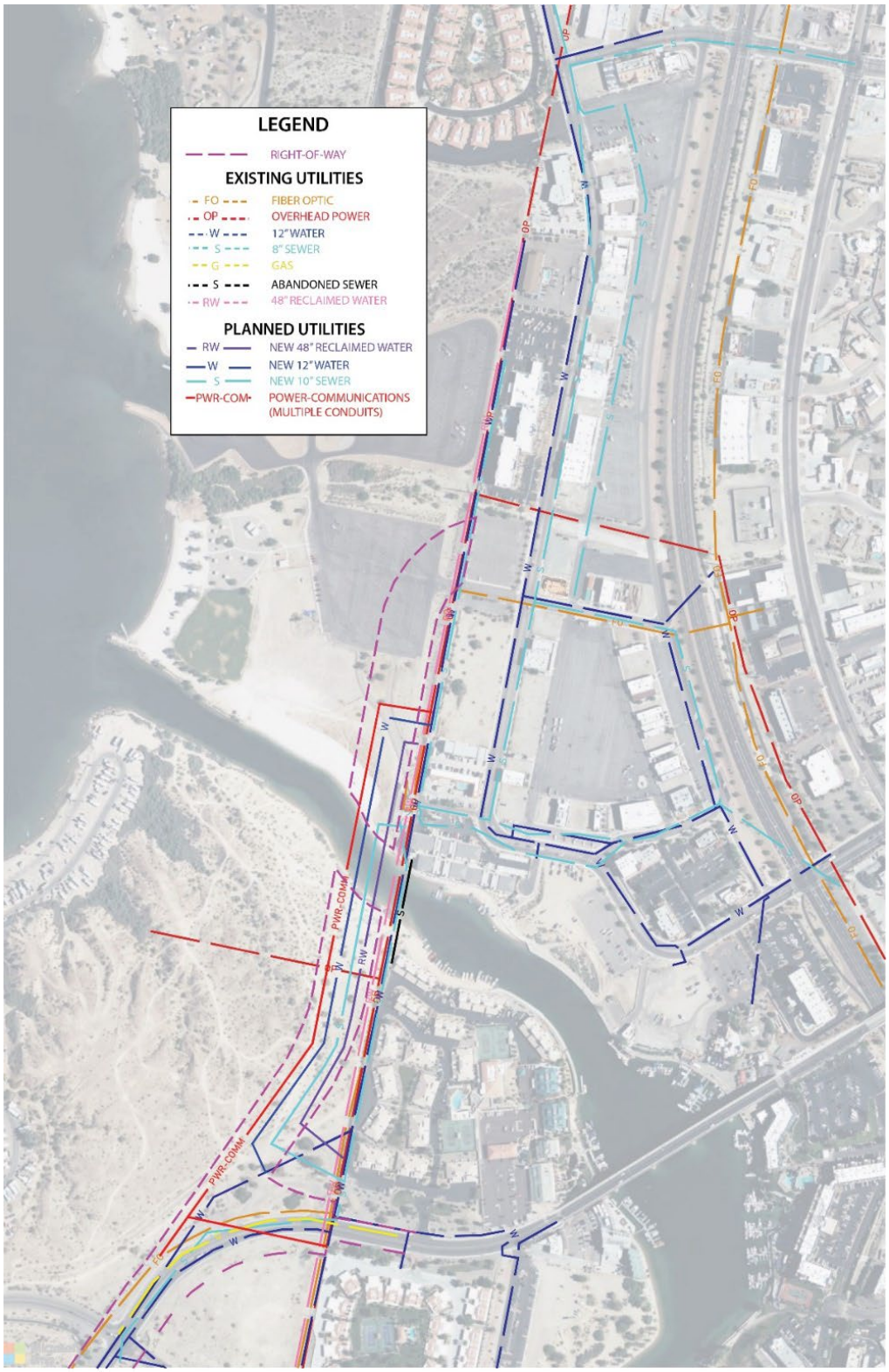
Overhead power crosses over existing London Bridge Road on both sides (north and south) of and parallel to Willow Wash.

Within the Paseo Del Sol ROW, water, sewer, and fiber optic lines exist. The water and fiber cross under SR 95, whereas the sewer follows Veterans Way to the south of Willow Wash. Another sewer line parallels existing London Bridge Road 150' to the east, connecting with the sewer line that is within the Paseo Del Sol right-of-way.

Within S. Palo Verde Blvd an existing sewer line parallels the roadway alignment south of the centerline. Field observations by the Project Team found water valves and a sewer manhole within the roadway pavement near the Texaco Station.

At the intersection of Existing London Bridge Road and S. Palo Verde Blvd, overhead power traverses over the intersection on essentially a diagonal alignment. Overhead power also crosses over S. Palo Verde Blvd at the intersection of Veterans Way.

FIGURE 7: EXISTING AND PLANNED UTILITIES



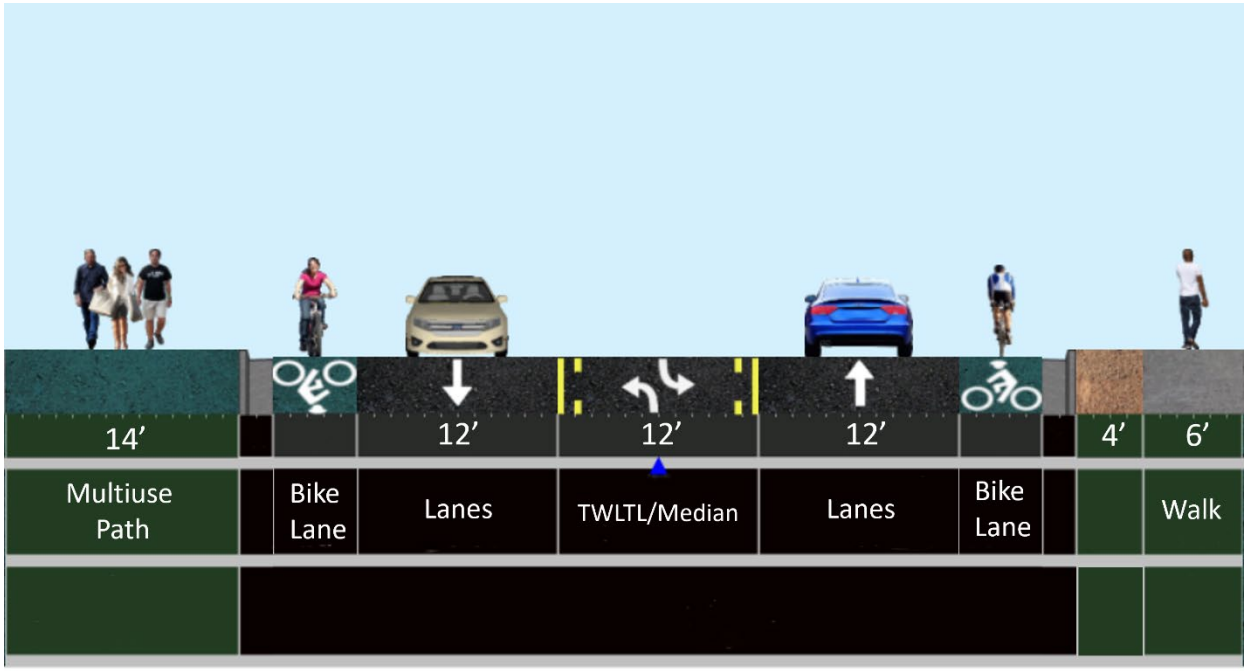
6.0 Roadway and Second Bridge Conceptual Cross Sections

As described in **Section 3.0**, the traffic modeling results concluded that a three-lane roadway (one travel lane in each direction with a two way left turn lane) will offer adequate vehicular capacity and level of service for the proposed roadway and Second Bridge.

In response to the traffic modeling results, the Project Team then prepared a typical roadway and bridge cross section that reflects the guiding principles by ensuring the new roadway and bridge facilities support all modes of transportation. Offering comfortable bicycle and pedestrian infrastructure is considered a high priority to connect the island with a new access into Lake Havasu State Park.

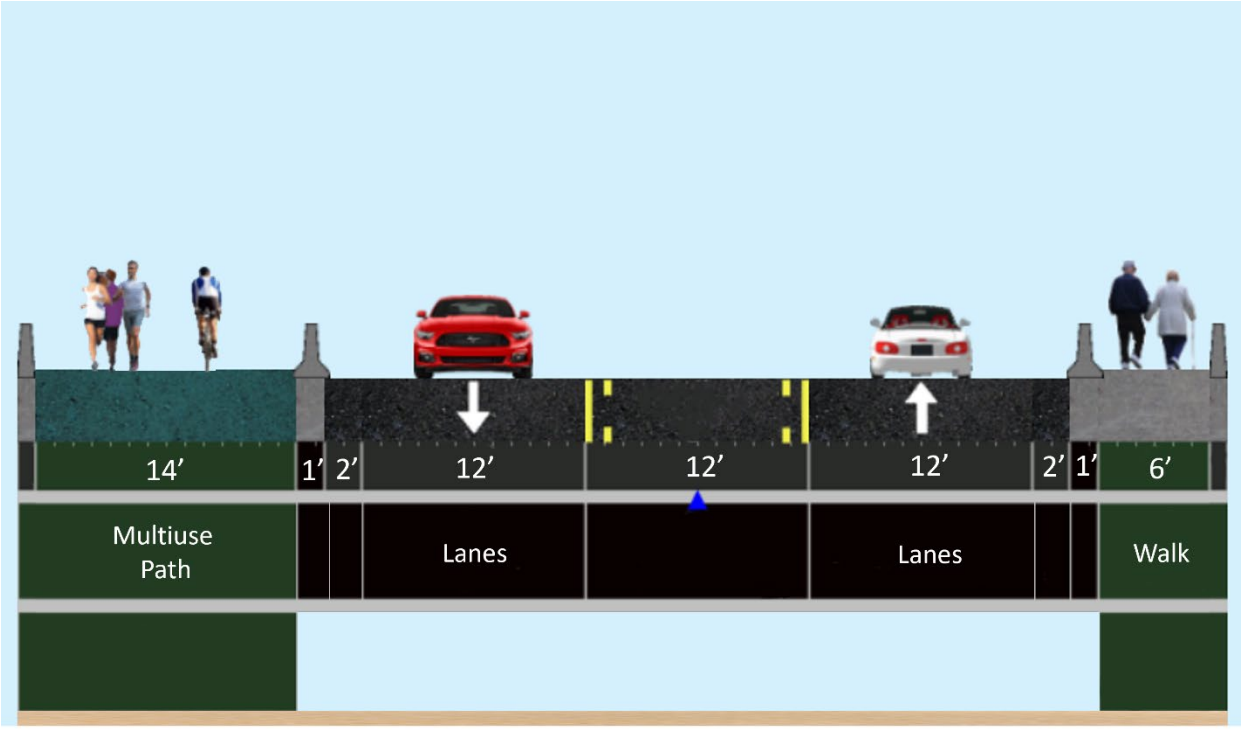
Figure 8 and **Figure 9** depict the proposed roadway and bridge cross sections that are utilized in all roadway alignment and bridge type alternatives described in this section. As **Figure 8** shows, the roadway cross section consists of one, 12-foot vehicular travel lane in each direction, a 12-foot two way left turn lane (TWLTL)/raised median, a 14-foot multi-use path and a 6-foot detached sidewalk.

FIGURE 8: ROADWAY CROSS SECTION



As **Figure 9** indicates, the bridge cross section is consistent with the roadway cross section with subtle variations that are common in the transition from the approaching roadway to the bridge deck itself.

FIGURE 9: SECOND BRIDGE CROSS SECTION



7.0 Roadway Alignment Alternatives

This section introduces, describes and illustrates each of the roadway alignment alternatives considered for this Feasibility Study. The preparation of the roadway alignment (and bridge type) alternatives reflects the existing 200-foot ASP right-of-way reservation area, the 200-foot right-of-way on the island side and were intentionally crafted to best leverage use of the existing city-owned parcels.

Each of the first four (4) roadway alignment alternatives presented include an "A" option that includes traditional signalized intersections and a "B" option that offers a roundabout design option at intersections where physically and operationally practical.

Alternatives 1A &1B

Roadway Design Features

As **Figure 10** illustrates, roadway alignment alternative 1A includes a horizontal alignment that begins at the existing intersection of McCulloch Blvd. and Beachcomber Blvd. to the south extending to an existing intersection at London Bridge Road and SR 95/S. Palo Verde Blvd. to the north, including roadway widening along the south side of S. Palo Verde Blvd. from London Bridge Rd. to SR 95.

For purposes of the description of roadway alignment alternative 1A/B, this alternative consists of the following design features:

- For the segment between McCulloch Blvd. and Beachcomber Blvd. to the Bridgewater Channel, the new two-lane road will include a center left turn lane and a new signalized "T" intersection with McCulloch Blvd.
- For the segment between McCulloch Blvd. to the Bridgewater Channel, a new 2-lane roadway with a center left turn lane and bridge over the channel is proposed (see **Section 8.0** for bridge type alternatives discussion).
- The segment north of the Bridgewater Channel – is proposed as a 2-lane roadway with a center left turn lane to a tie into existing London Bridge Road. This segment will be positioned within an Arizona State Parks MOU right of way reservation area, as well as utilize the three lots owned by the City (currently paved parking) between Lake Havasu State Park and the existing 70-foot right of way for London Bridge Road.
- A second, signalized 4-legged intersection is proposed at the intersection of the new roadway and London Bridge Road. This new intersection and road alignment will also serve as a new access to Lake Havasu State Park.
- The existing London Bridge Road is proposed to be incorporated into this alternative for approximately 1,700 feet to the intersection with South Palo Verde Blvd. A "mill

and overlay" is included in the construction cost for this segment. This alternative will also use the existing sidewalks on both sides of London Bridge Road.

- Between the intersection of London Bridge Road and S. Palo Verde Blvd and SR 95, the existing 80' right of way and 700' long section of roadway will be incorporated along with auxiliary lanes to accommodate left and right turning movements as determined by a future operations analysis to be included during final design.
- The existing signal at S. Palo Verde Blvd. and SR 95 intersection will be upgraded to accommodate the projected increase in traffic, turning movements, and queuing and storage requirements.
- A multi-use path is proposed on the west side of the new roadway alignment and will extend from the McCulloch Blvd./Beachcomber Blvd. intersection to existing London Bridge Road. Thereafter the multi-use path will tie into the existing sidewalk.
- A detached sidewalk is proposed on the east side of the new roadway alignment and will extend from the McCulloch Blvd./Beachcomber Blvd. intersection to existing London Bridge Road. Thereafter the sidewalk will tie into the existing sidewalk on London Bridge Road.
- Drainage concepts will include linear detention/retention/first flush basins within the ASLD and ASP ROW and use of existing drainageways via curb and gutter and pavement surfaces along existing London Bridge Road and S. Palo Verde Blvd. No storm drain system exists nor is proposed within these roadways.

Alternative 1B contains the same features as alternative 1A, except for the introduction of a single-lane roundabout option at McCulloch Blvd. and London Bridge Road. Please see **Figure 11** for illustration of alternative 1B.

Alternative 1A & 1B Pros

- Utilizes existing SR 95 connection at Palo Verde Blvd., ADOT's preferred connection point on SR 95.
- Incorporates existing S. Palo Verde Blvd right of way, maintains access to existing businesses and Veterans Way.
- Incorporates 1,700' of existing London Bridge Road, retains sidewalks, curb and gutter, and business access, minimizing the amount of new roadway construction.
- Least impact and cost on existing LHC roadways.
- Efficient use of London Bridge Rd. tie-in.
- Preferred connection location to the Lake Havasu State Park.

Alternative 1A & 1B Cons

- Replace existing stop sign controlled intersection with signal at S Palo Verde and London Bridge Rd.
- Will likely require some modification to S. Palo Verde Blvd to accommodate turning movements with auxiliary lanes to accommodate additional traffic and turning movements.
- Will add a new signalized intersection between this new alignment alternative and existing London Bridge Road north of the existing Paseo Del Sol intersection.
- Paseo del Sol and London Bridge Road intersection will likely transition to limited right-in, right out only turning movements.

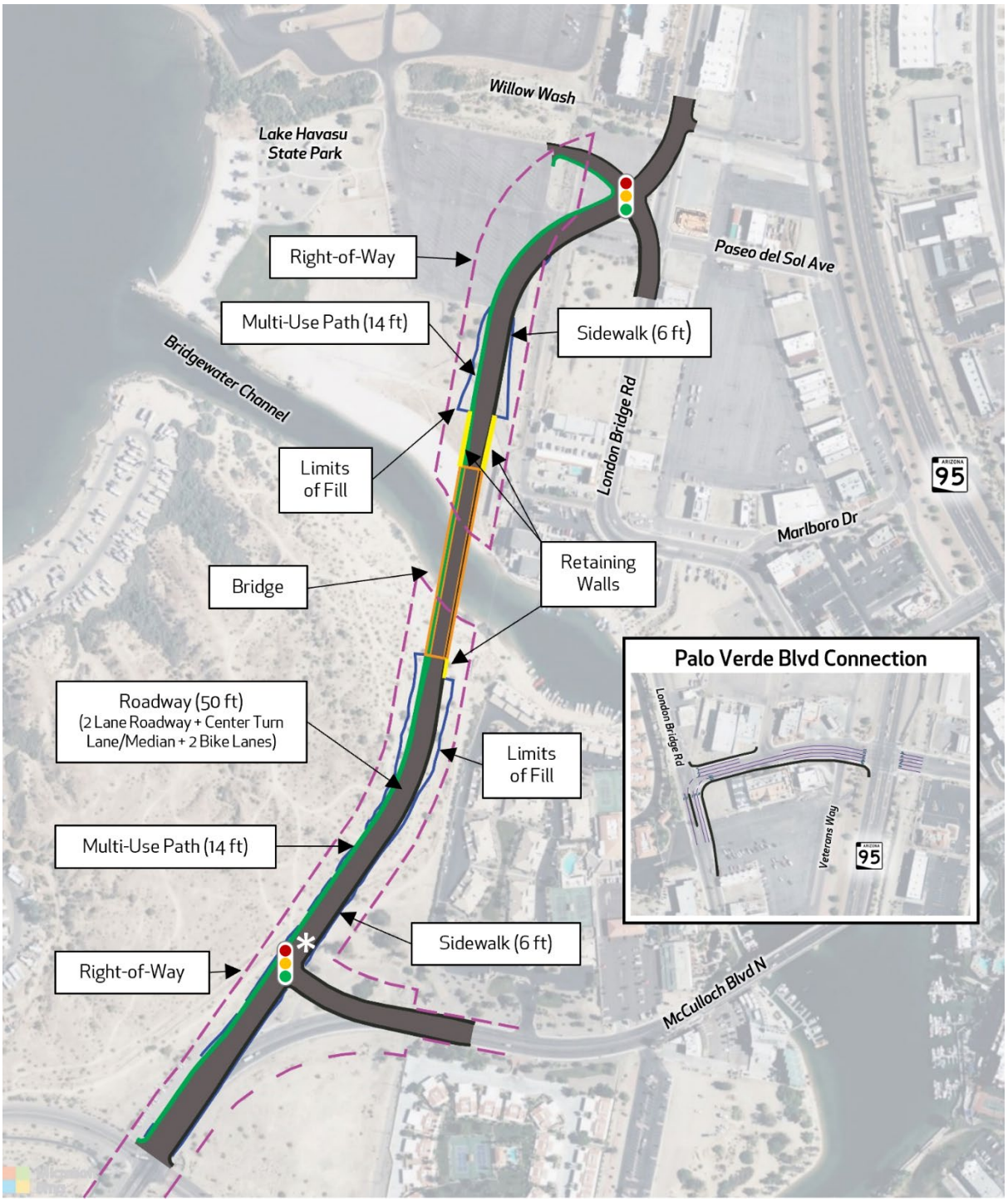
Alternative 1A Preliminary Roadway Cost

- $11M to $13M (bridge cost not included)

Alternative 1B Preliminary Roadway Cost

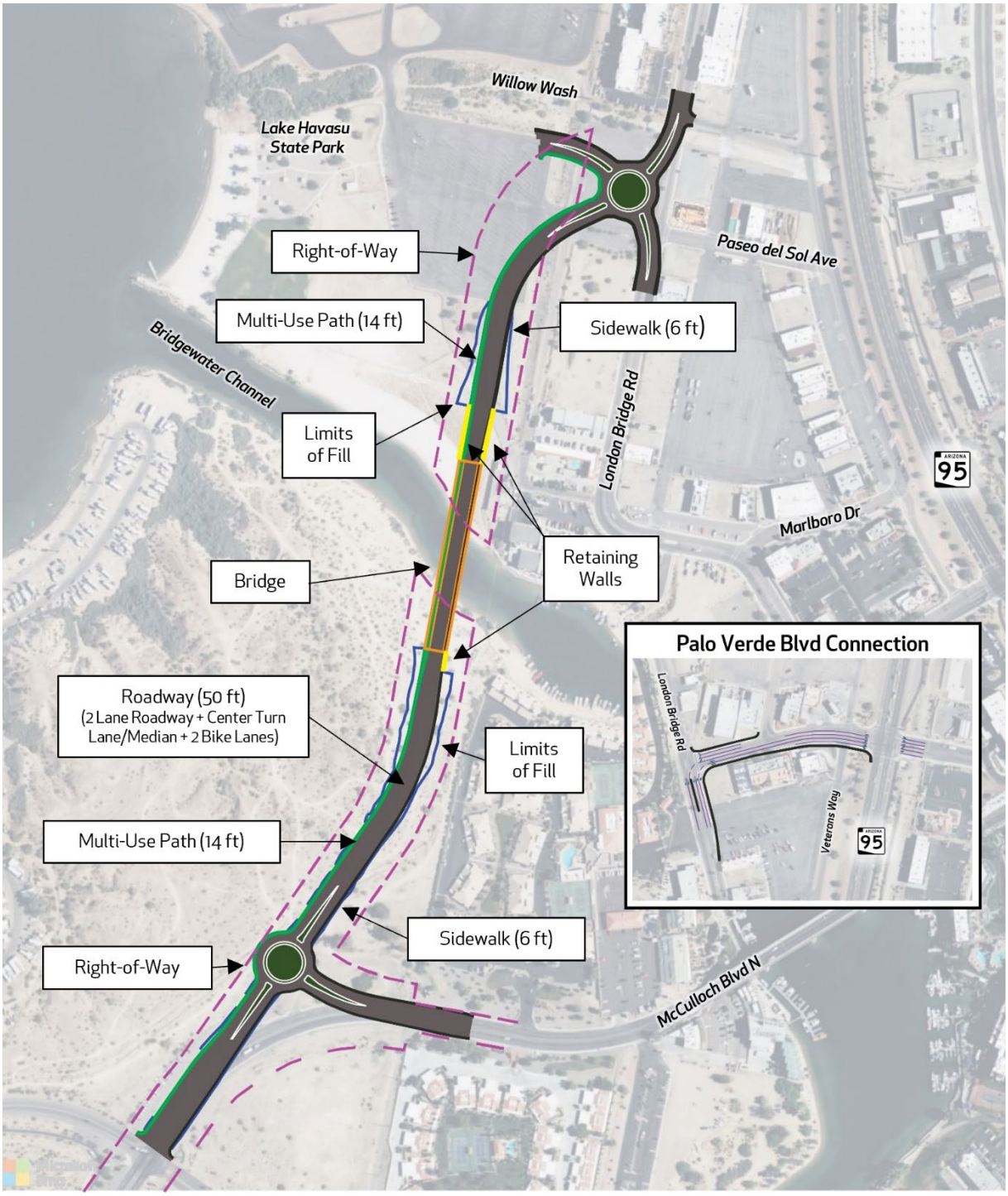
- $13M to $15M (bridge cost not included)

FIGURE 10: ROADWAY ALIGNMENT 1A



*Signal warrant analysis shall be completed to determine if a traffic signal is warranted at this intersection. If a signal is not warranted, the intersection may operate as a stop-controlled intersection.

FIGURE 11: ROADWAY ALTERNATIVE 1B



Alternative 2A & 2B

Roadway Design Features

The roadway alignment and design features of Alternative 2A and 2B are identical to roadway alignment alternative 1A/1B from McCulloch Blvd./Beachcomber Blvd. intersection over the Bridgewater Channel to the north end of the State Parks right of way. These features are more thoroughly described with roadway alignment alternative 1A/1B and not repeated here. **Figure 12** shows alternative 2A and **Figure 13** depicts alternative 2B.

From the State Parks property, through the city-owned parcels, a 90-degree curve turns this alignment east-west from the State Park right of way to intersect with London Bridge Road approximately 200' north of, and essentially parallel to, the existing Paseo Del Sol intersection (just south of Willow Wash).

This east-west alignment extends approximately 600' from existing London Bridge Road to intersect with SR 95 at a new signalized intersection. A "Florida 'T'" intersection is proposed on SR 95.

The "Florida 'T'" type intersection will allow free-flowing northbound traffic on SR 95; only the SB traffic will be affected to allow northbound to westbound traffic to left-turn onto this alternative alignment.

Drainage concepts will include linear detention/retention/first flush basins within the ASLD and ASP ROW and use of existing drainageways via curb and gutter and pavement surfaces along existing London Bridge Road. A closed storm drain system with catch basins may be necessary to drain the elevated section of roadway between existing London Bridge Road and SR 95 to outfall into Willow Wash.

Alternative 2B contains the same features as alternative 2A, except for the introduction of a single-lane roundabout option at McCulloch Blvd. and London Bridge Road. Please see **Figure 13** for illustration of alternative 2B.

Alternative 2A & 2B Pros

- State Park access provided.
- Introduces Florida-T intersection at SR 95 to minimize interruptions and free flow NB traffic continuing on SR 95.
- Stays south of Willow Wash channel, minimizing improvement costs.
- Avoids conflict with existing overhead powerlines.

- "Parking in Common" use property (Tract 2183) dedicated to the city is also being utilized between London Bridge Road and SR 95 north and south of Willow Wash.

Alternative 2A & 2B Cons

- Requires a new intersection with SR 95, which will likely be acceptable to ADOT given its proposed proximity to the Mesquite Ave. intersection to the south and the South Palo Verde intersection to the north.
- Increased construction costs with retaining walls and embankment to elevate roadway to SR 95.
- Existing business access from Veterans Way would be negatively impacted due to the addition of retaining walls and embankments to elevate this alignment to match vertically with SR 95.
- Would add a new signalized intersection between this new alignment alternative and existing London Bridge Road, 300' north of the existing Paseo Del Sol intersection.
- Utilities that cross Willow Wash including gas, telephone, electric, and water will may require relocation or protection from the weight of the retaining wall foundations and additional fill placed over them to complete the connection to SR 95 vertically.

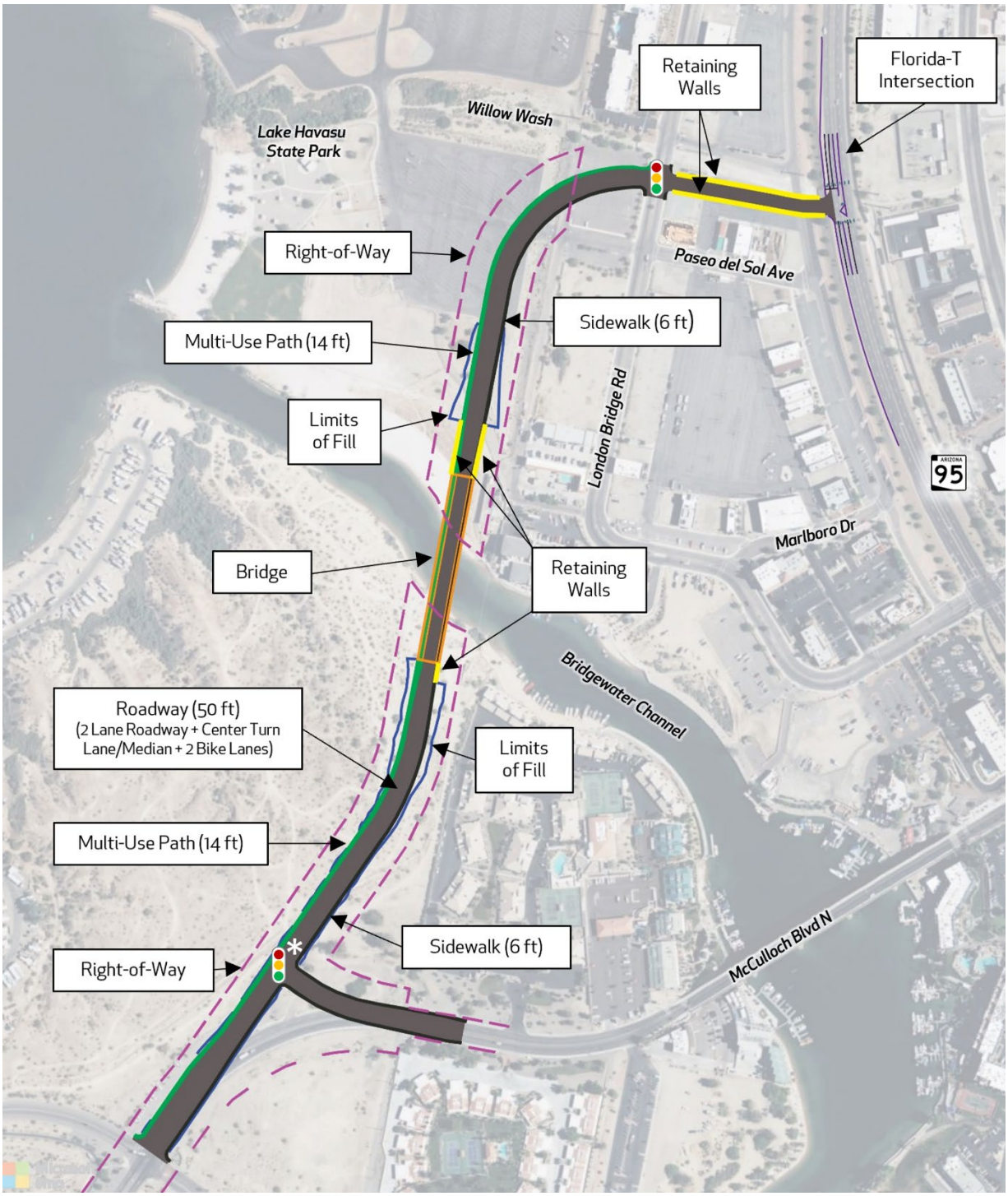
Alternative 2A Preliminary Roadway Cost

- $15M to $17M (bridge cost not included)

Alternative 2B Preliminary Roadway Cost

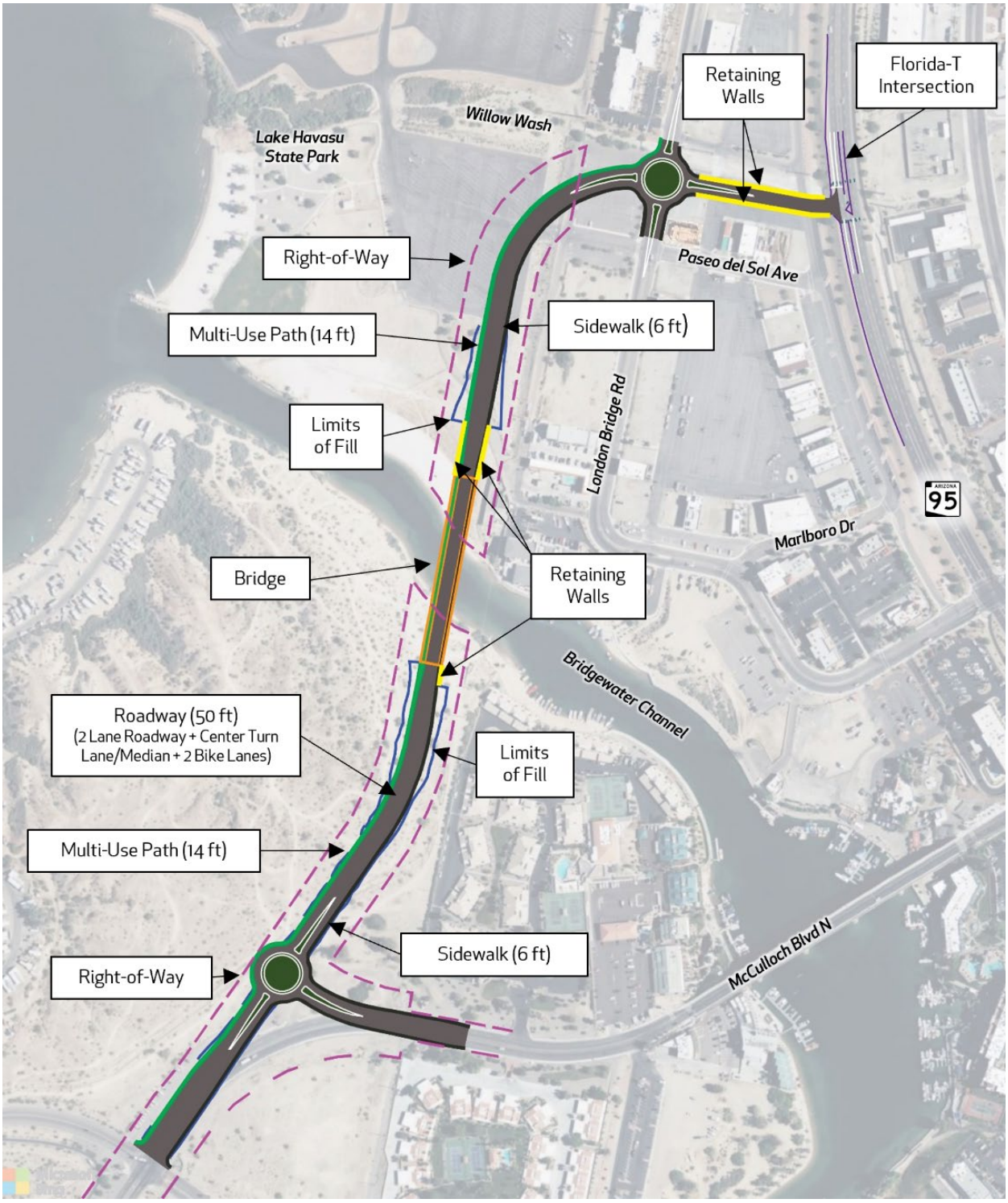
- $17M to $19M (bridge cost not included)

FIGURE 12: ROADWAY ALTERNATIVE 2A



*Signal warrant analysis shall be completed to determine if a traffic signal is warranted at this intersection. If a signal is not warranted, the intersection may operate as a stop-controlled intersection.

FIGURE 13: ROADWAY ALTERNATIVE 2B



Alternative 3A & 3B

Roadway Design Features

As **Figure 14** shows, roadway alignment alternative 3A and 3B has an alignment that is very similar to alternative 2A & 2B but incorporates a signalized "T" intersection at the State Parks right of way. The west leg of the T intersection would become the new access to State Park facilities and the east leg would extend across existing London Bridge Road to intersect with SR 95 using the identical east-west alignment, approximately 200' north of Paseo Del Sol Blvd.

Signalized intersections are introduced at McCulloch Blvd., the new "T" intersection west to the new Lake Havasu State Park access, at London Bridge Road, and at the "Florida T" intersection at SR 95 - north of the existing buildings that front on Paseo Del Sol.

The other roadway alignment and design features of Alternative 3A and 3B are identical to roadway alignment alternative 2A/2B from McCulloch Blvd./Beachcomber Blvd. intersection over the Bridgewater Channel to the north end of the State Parks right of way.

Alternative 3B contains the same features as alternative 3A, except for the introduction of a single-lane roundabout option at McCulloch Blvd. only. Please see **Figure 15** for illustration of alternative 3B.

Alternative 3A & 3B Pros

- State Park access provided at ASP preferred location.
- Introduces Florida-T intersection at SR 95 to minimize interruptions and free flow north bound traffic on SR 95.
- Stays south of Willow Wash channel, minimizing improvement costs.
- Avoids conflict with existing overhead powerlines.

Alternative 3A & 3B Cons

- Requires new intersection with SR 95.
- Increased construction costs with retaining walls to elevate roadway to SR 95.
- Adjustments to parking and business access b/w London Bridge Rd. and SR 95 likely needed.
- Existing business access from Veterans Way would be negatively impacted due to the addition of retaining walls and embankments to elevate this alignment to match vertically with SR 95.
- Concern over efficiency of future traffic operations due to proximity of signalized intersection spacing between this new "T" intersection and existing London Bridge Road (350' between the proposed T intersection and existing London Bridge Road and 600' between the latter intersection and SR 95).

- Utilities that cross Willow Wash including gas, telephone, electric, and water will may require relocation or protection from the weight of the retaining wall foundations and additional fill placed over them to complete the connection to SR 95 vertically.

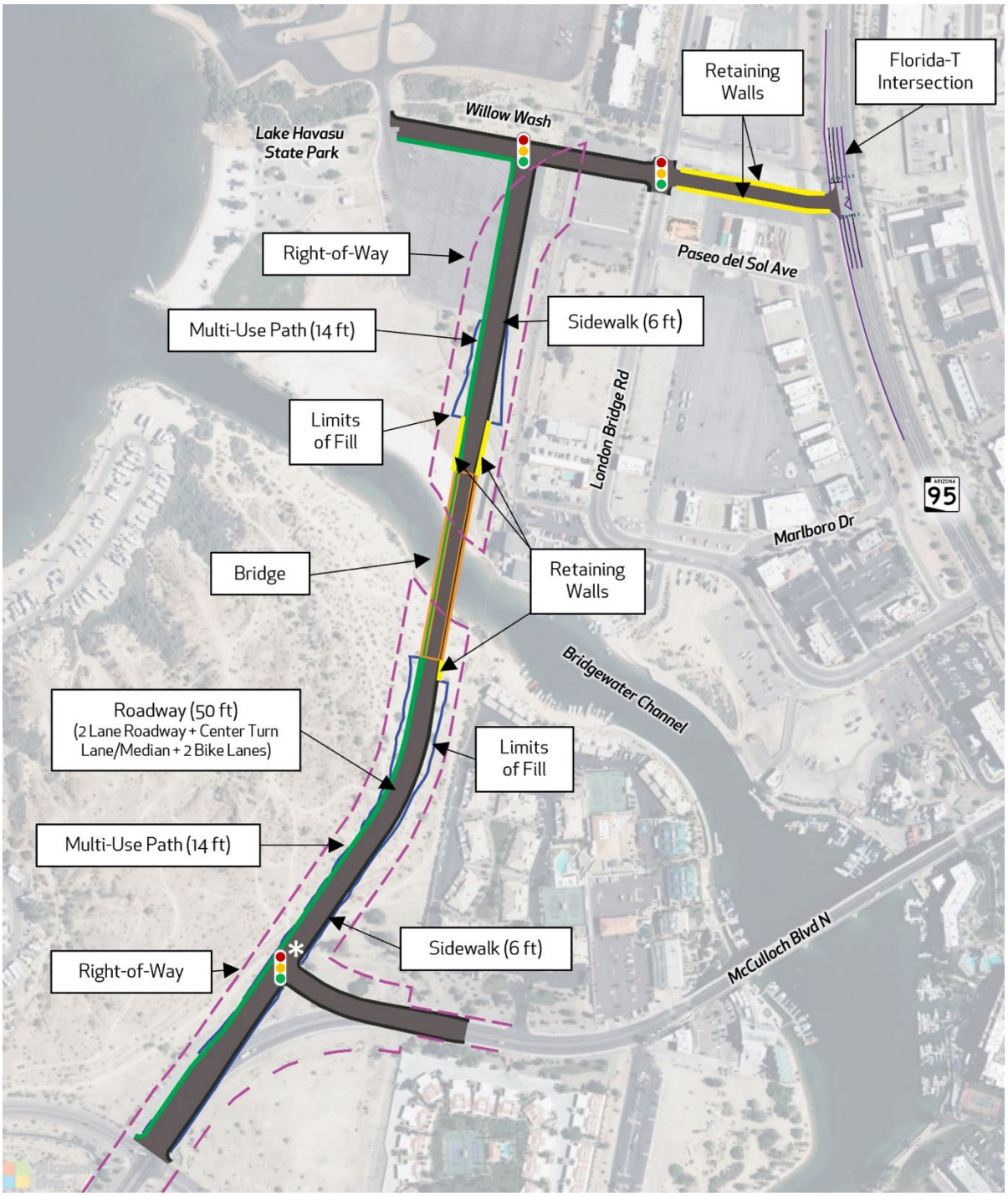
Alternative 3A Preliminary Roadway Cost

- $15M to $17M (bridge cost not included)

Alternative 3B Preliminary Roadway Cost

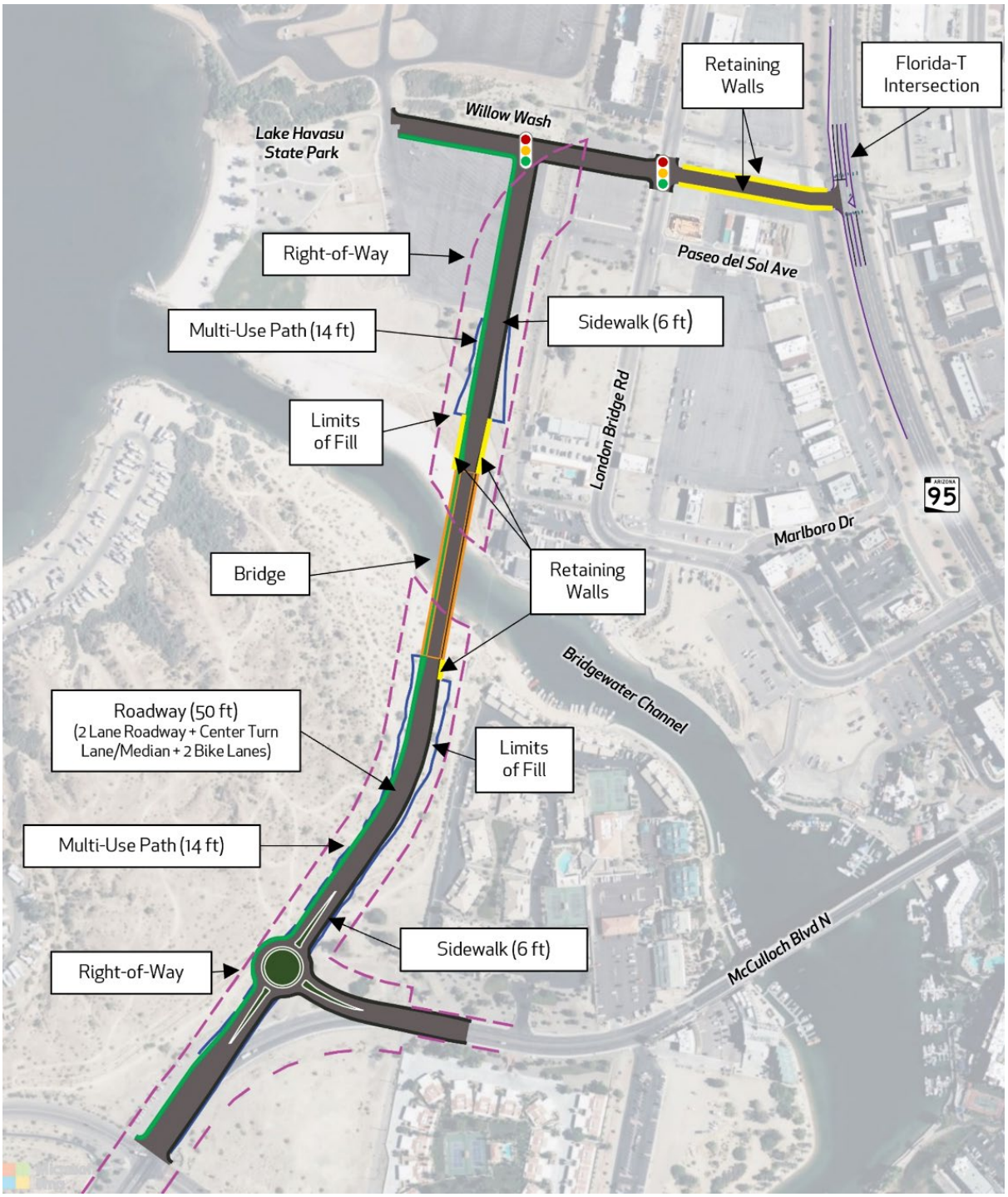
- $17M to $19M (bridge cost not included)

FIGURE 14: ROADWAY ALTERNATIVE 3A



*Signal warrant analysis shall be completed to determine if a traffic signal is warranted at this intersection. If a signal is not warranted, the intersection may operate as a stop-controlled intersection.

FIGURE 15: ROADWAY ALTERNATIVE 3B



Alternative 4A & 4B

Roadway Design Features

As **Figure 16** illustrates, roadway alignment alternative 4A and 4B has an alignment that is very similar to alternative 2A & 2B from McCulloch Blvd. to the ASP right-of-way, except that the goal of this alternative was to position the intersection at SR 95 equidistant between S Palo Verde Blvd. and Mesquite Avenue intersections with SR 95 (approximately a 1600' spacing and preferred by ADOT if an additional intersection on SR 95 is desired). To accomplish this, the alignment crosses over Willow Wash at a large skew.

The other roadway alignment and design features of Alternative 3A and 3B are identical to roadway alignment alternative 2A/2B from McCulloch Blvd./Beachcomber Blvd. intersection over the Bridgewater Channel to the north end of the State Parks right of way.

Signalized intersections are introduced at McCulloch Blvd., at London Bridge Road and at the "Florida T" intersection at SR 95 at the spacing noted above.

Alternative 4B contains the same features as alternative 4A, except for the introduction of a single-lane roundabout option at McCulloch Blvd. only. Please see **Figure 17** for illustration of alternative 4B.

Alternative 4A & 4B Pros

- State Park access provided.
- Introduces Florida-T intersection at SR 95 to minimize interruptions and free flow NB traffic on SR 95.
- Utilizes Willow Wash/PUE easement.
- Equidistant intersection spacing to SR 95 for ADOT.

Alternative 4A & 4B Cons

- Requires new intersection with SR 95.
- Increased construction costs with retaining walls and lengthy box culverts for Willow Wash improvements.
- Existing business access from Veterans Way would be negatively impacted due to the addition of retaining walls and embankments to elevate this alignment to match vertically with SR 95.
- Long term Willow Wash maintenance cost increases.
- Requires the relocation of overhead power that parallels Willow Wash to the north of the concrete channel.

- Utilities that cross Willow Wash including gas, telephone, electric, and water will may require relocation or protection from the weight of the retaining wall foundations and additional fill placed over them to complete the connection to SR 95 vertically.

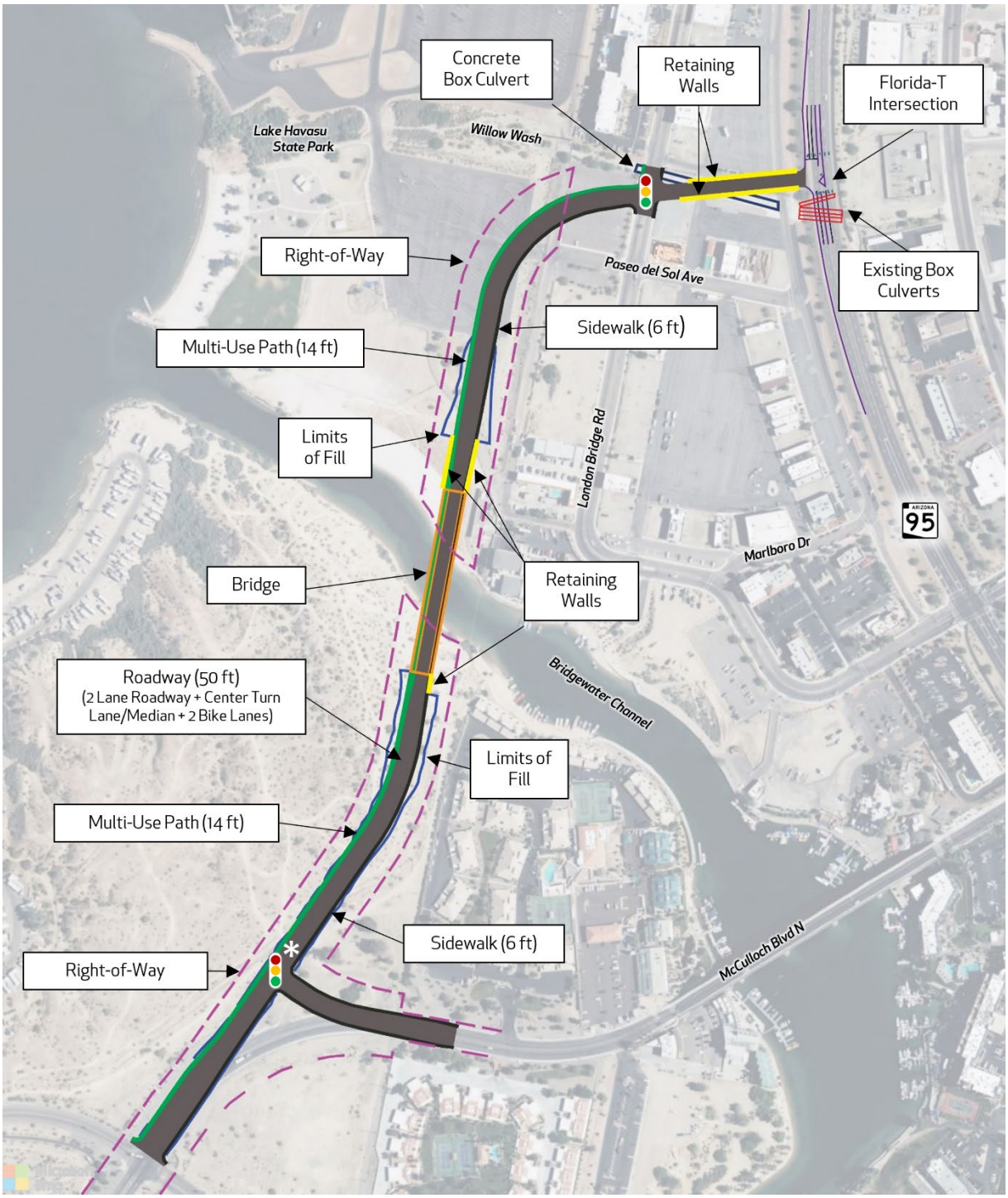
Alternative 4A Preliminary Roadway Cost

- $17.5M to $19.5M (bridge cost not included)

Alternative 4B Preliminary Roadway Cost

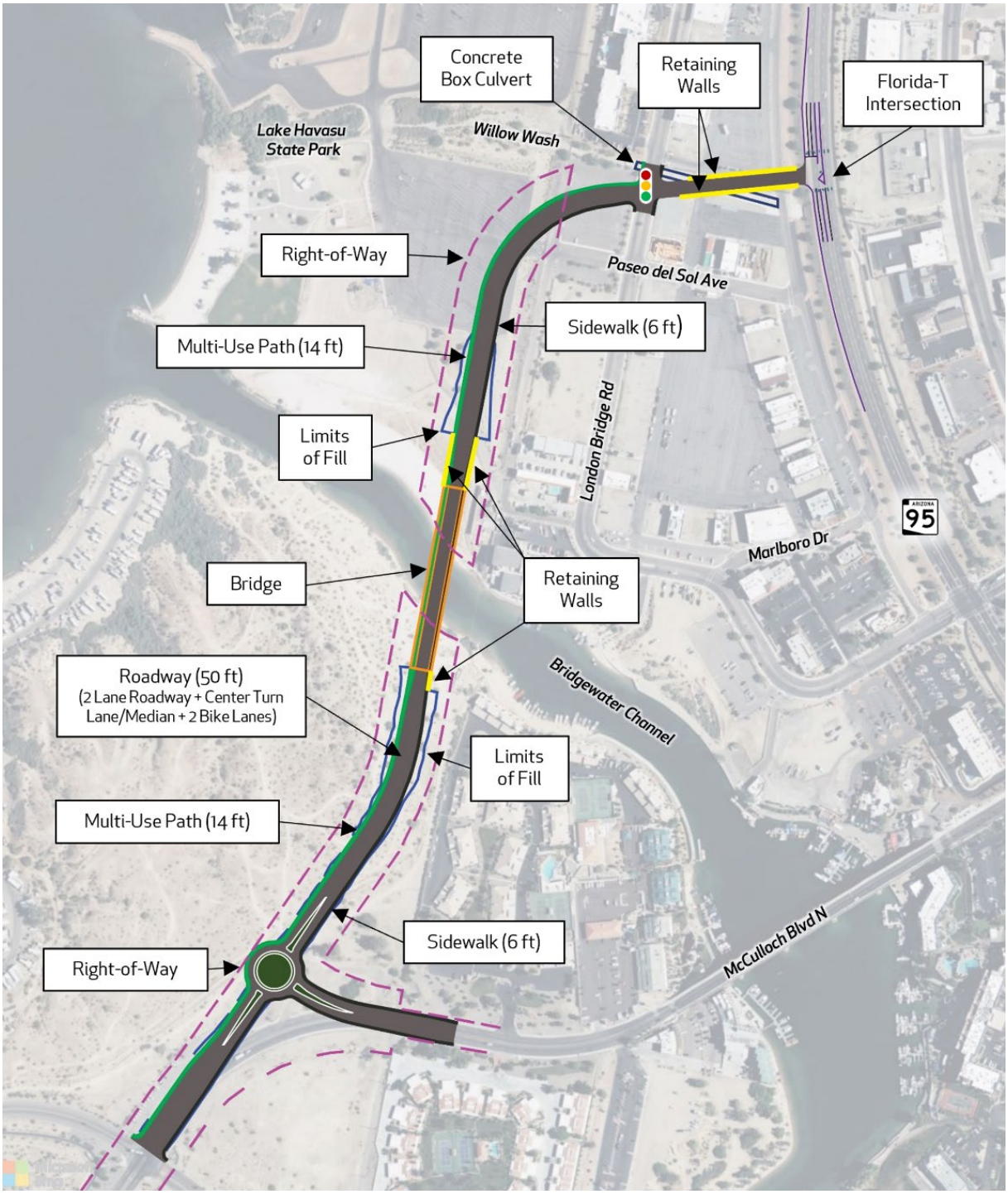
- $18M to $20M (bridge cost not included)

FIGURE 16: ROADWAY ALTERNATIVE 4A



*Signal warrant analysis shall be completed to determine if a traffic signal is warranted at this intersection. If a signal is not warranted, the intersection may operate as a stop-controlled intersection.

FIGURE 17: ROADWAY ALTERNATIVE 4B



Alternative 5

Roadway Design Features

As **Figure 18** illustrates, roadway alignment alternative 5 has an alignment that is very similar to alternative 2A & 2B from McCulloch Blvd. to the ASP right-of-way, except that the alignment will make use of the existing 70' right of way and the Paseo Del Sol alignment to intersect with SR 95 approximately 200' south of the Alternative 2A intersection.

The other roadway alignment and design features of alternative 5 are identical to roadway alignment alternative 2A/2B from McCulloch Blvd./Beachcomber Blvd. intersection over the Bridgewater Channel to the State Parks right of way.

In the preparation of the various roadway alignment alternatives and coordination with ADOT in that process, it was determined that the Paseo del Sol Avenue intersection with SR 95 is unlikely to be approved by ADOT due to Paseo del Sol not meeting ADOT minimum intersection spacing requirements.

Alternative 5 Pros

- Avoids any improvements/mitigation of Willow Wash.
- Limits utility relocation and powerline improvement costs.

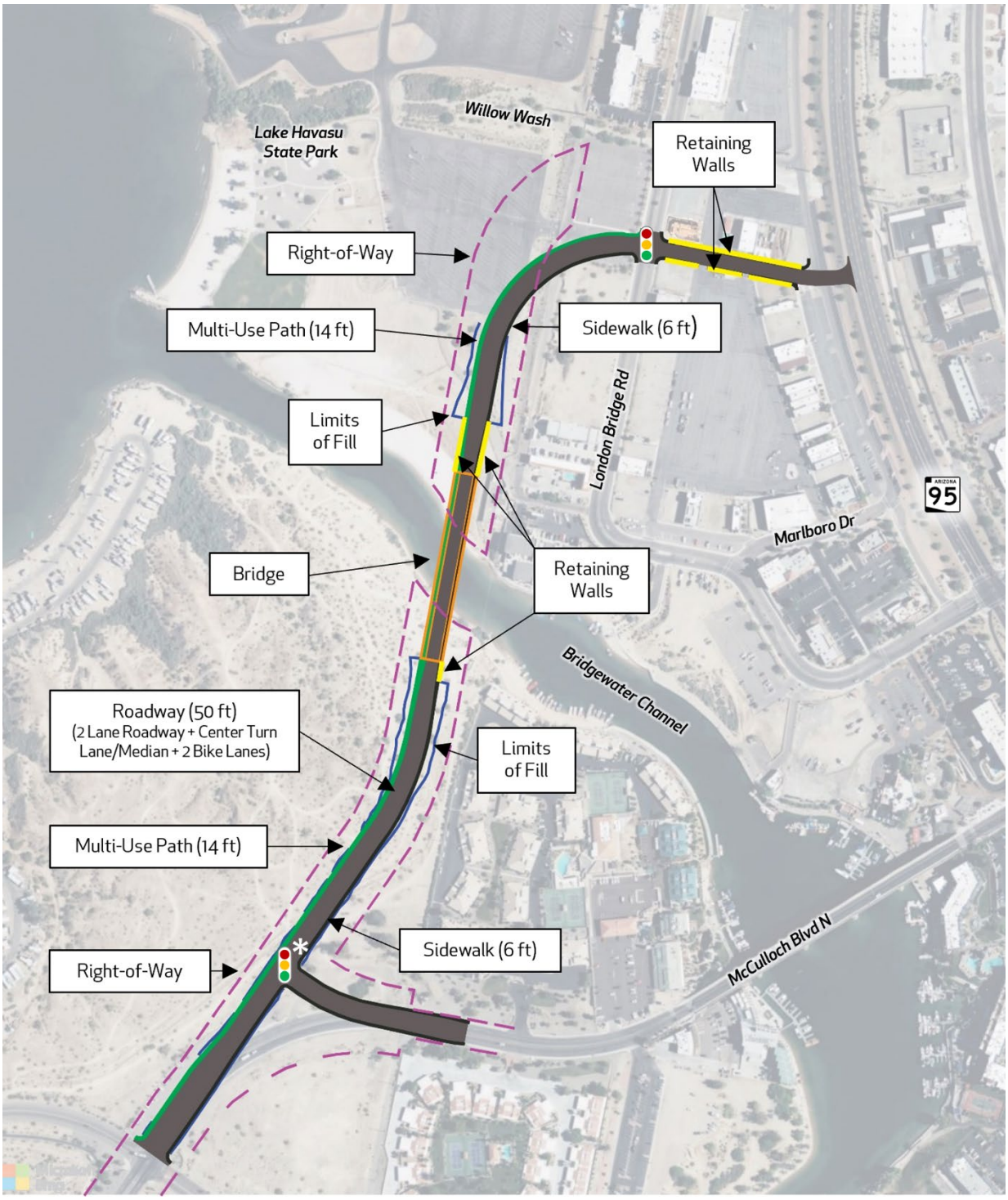
Alternative 5 Cons

- Paseo del Sol intersection with SR 95 unlikely to be approved by ADOT – it does not adhere to intersection spacing requirements as it is only 1000' from the Mesquite intersection to the south and the ADOT minimum spacing is 1200'.
- Less optimal State Park access provided.
- Requires lengthy retaining walls and expensive intersection improvements at SR 95.
- Some limited ROW acquisition may be needed along Paseo del Sol Ave. and south of city owned parcels.
- Business access modifications needed for businesses b/w London Bridge Rd. and SR 95.
- Utilities that cross Willow Wash including gas, telephone, electric, and water will may require relocation or protection from the weight of the retaining wall foundations and additional fill placed over them to complete the connection to SR 95 vertically.

Alternative 5 Preliminary Roadway Cost

- $15M to $17M (bridge cost not included)

FIGURE 18: ROADWAY ALTERNATIVE 5



*Signal warrant analysis shall be completed to determine if a traffic signal is warranted at this intersection. If a signal is not warranted, the intersection may operate as a stop-controlled intersection.

8.0 Bridge Type Alternatives

Alternatives Considered

The alternatives considered range in complexity and aesthetic enhancements to provide a new bridge structure crossing the Bridgewater Channel. The main span was set to provide a minimum clearance of 35 feet over the channel for a width of 100 feet. End spans were provided to allow for shoreline amenities and future development in addition to maintaining an open three span arrangement that largely preserves existing view sheds of the channel and lake beyond for the community residents and visitors. All bridge types developed use a similar span configuration, similar vertical profile and the same horizontal alignment. The following bridge alternatives were considered:

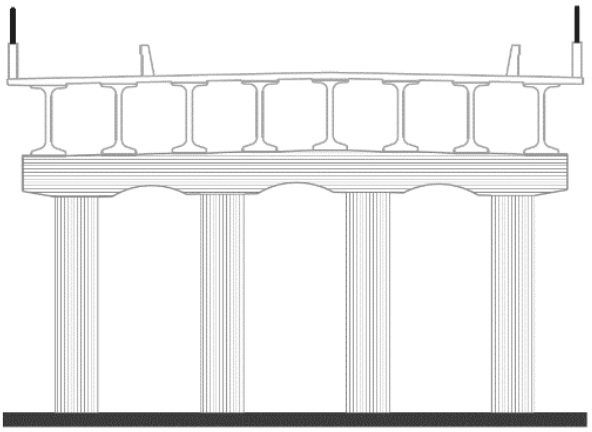
1. Constant Depth Wide Flange Girder - Common Finish
2. Constant Depth Wide Flange Girder – Enhanced Finish
3. Constant Depth Tub Girder
4. Constant Depth Tub Girder with Flared Piers
5. Tub Girder with Deepened Pier Segment and Flared Piers
6. Rib Arch with Adjacent Box Girders
7. Rib Arch with Spliced Tub Girders

The first five options all include precast concrete girders spliced and post-tensioned for continuity. Alternative 1 is the simplest option in terms of structural design and aesthetics and the only option to include no aesthetic treatment. Each additional alternative becomes progressively more complex and includes additional aesthetics.

The final two alternatives incorporate a structural arch into the design and use two different options for the superstructure girders.

1: Wide Flange Girder, Common Finish

Description of design features



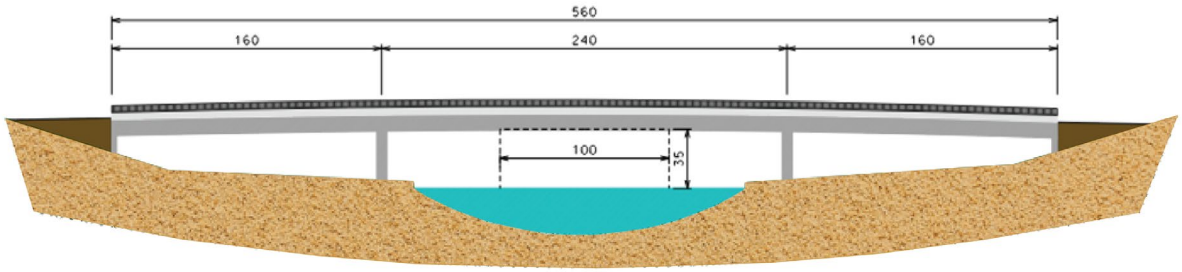
The structure consists of three continuous spans of spliced precast and prestressed Wide Flange girders. The structure width is 65’-5” and the structure length is 560’-0”. Eight girder lines are assumed for the preliminary design of the structure. The substructure consists of columns with pier caps supported on drilled shaft foundations. The three continuous span configuration provides an arrangement that balances the structural loading and provides a clear span

over the channel. No additional aesthetic treatments or features are included in the estimated cost.

- Efficient structure
- Construct with no Falsework in Channel
- Vertical Clearance over Full Channel
- Common / Basic Structural Aesthetics
- Utility Accommodation Between Girders

Cross section graphics

FIGURE 19: WIDE FLANGE GIRDER, TYPICAL FINISH



Pros

- The three-span arrangement of spliced prestressed concrete girders provides an efficient structure that provides a balanced configuration and includes a routine structural design.
- This alternative will require the least initial construction cost and the least ongoing maintenance.
- The eight girder lines of wide flange girders are generally more economical than tub girders.
- The structure type does not require complex construction techniques and can be placed with minimal falsework over the channel.
- The girder depth and span configuration provide the required vertical clearance across the entire channel.

Cons

- The primary disadvantage of the wide flange girders is based on aesthetics.
- Both the visual effect of the common, everyday finish on the girders, barriers, and fencing along with the view of multiple girder lines below the bridge provides a plain appearance.
- Any required utilities will be visible from below, regardless of type.

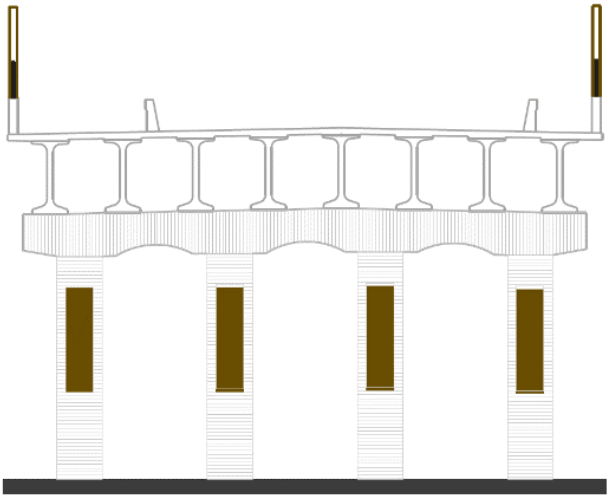
Preliminary Bridge Cost

- $12.5M to $16M (roadway cost not included)

2: Wide Flange Girder, Enhanced Finish

Description of design features

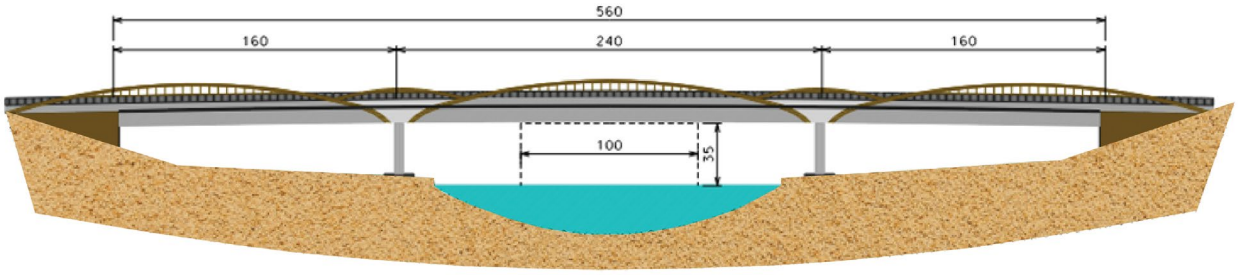
Similar to Alternative 1, the structure consists of three continuous spans of spliced precast and prestressed Wide Flange girders. The structure width is 65'-5" and the structure length is 560'-0". Eight girder lines are assumed for the preliminary design. The substructure consists of columns with pier caps supported on drilled shaft foundations. The three continuous span configuration provides an arrangement that balances the structural loading and provides a clear span over the channel. This option assumes some aesthetic treatments including form liner, colored coatings, and decorative fence.



- Efficient structure
- Construct with no Falsework in Channel
- Vertical Clearance over Full Channel
- Favorable Structural Aesthetics
- Economical Aesthetic Enhancements
- Utility Accommodation Between Girders

Cross section graphics

FIGURE 20: WIDE FLANGE GIRDER



Pros

- The three-span arrangement of spliced prestressed concrete girders provides an efficient structure that provides a balanced visual appearance and includes a routine structural design.
- The aesthetics can be improved compared to Alternative 1 by adding additional coatings, lighting, and other aesthetic elements.
- The eight girder lines of wide flange girders are generally more economical than tub girders.
- The structure type does not require complex construction techniques and can be placed with minimal falsework over the channel.
- The girder depth and span configuration provide the required vertical clearance across the entire channel.

Cons

- The primary disadvantage of the wide flange girders is based on aesthetics.
- The visual effect of the bridge provides a plain appearance even when augmented with additional aesthetic features and the aesthetic features will also require ongoing maintenance.
- Any required utilities will be visible from below, regardless of the type.

Preliminary Bridge Cost

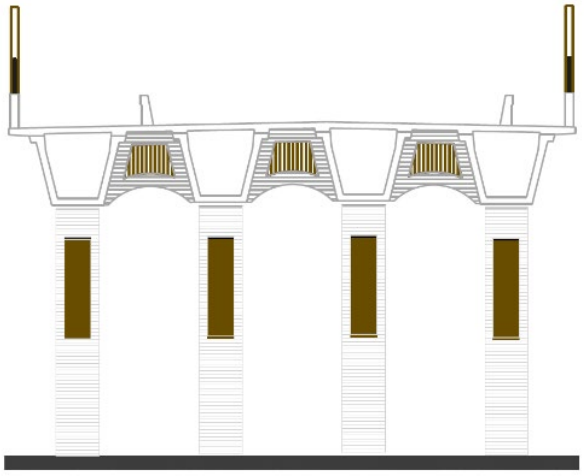
- $12.5M to $16.5M (roadway cost not included)

3: Constant Depth Tub Girder

Description of design features

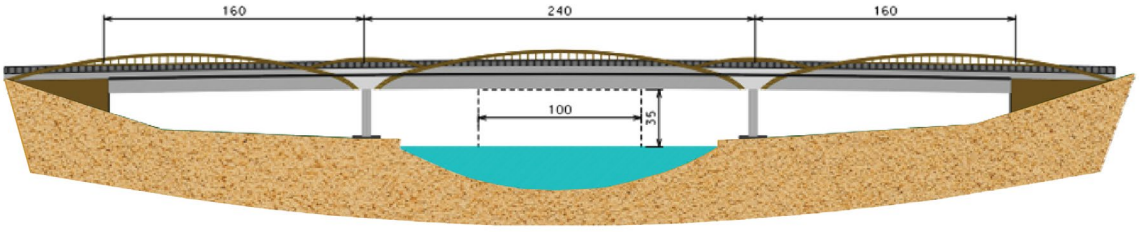
The structure consists of three continuous spans of spliced precast and prestressed concrete tub girders. The structure width is 65'-5" and the structure length is 560'-0". Four girder lines are assumed for the preliminary design. The substructure consists of columns supported on drilled shaft foundations. The three continuous span configuration provides an arrangement that balances the structural loading and provides a clear span over the channel. This alternative provides an aesthetic quality of the tub girder shape and assumes some aesthetic treatments including form liner, colored coatings, and decorative fence.

- Efficient structure
- Construct with no Falsework in Channel
- Vertical Clearance over Full Channel
- Favorable Structural Aesthetics including from under the bridge with fewer girder lines.
- Economical Aesthetic Enhancements
- Utility Accommodation Between Girders



Cross section graphics

FIGURE 21: TUB GIRDER



Pros

- The three-span arrangement of spliced prestressed concrete girders provides an efficient structure that provides a balanced visual appearance.
- The four girder lines of tub girders provide a cleaner appearance along the fascia of the structure and from below as compared to the wide flange girders.
- Constructability of the structure allows segments to be placed with minimal falsework over the channel and through typical construction methods.
- The girder depth and span configuration provide the required vertical clearance across the entire channel.
- Small utilities such as telecommunication lines may be placed within the tub girder to avoid visibility from below the structure.

Cons

- Although still constructable through typical methods, the tub girder segments are heavier than the wide flange segments and require larger equipment to transport and erect, although additional cost is mitigated by the design incorporating fewer total segments.
- Larger utilities still require attachment between girders to avoid conflicts with the structural components and to facilitate future maintenance and replacement.

Preliminary Bridge Cost

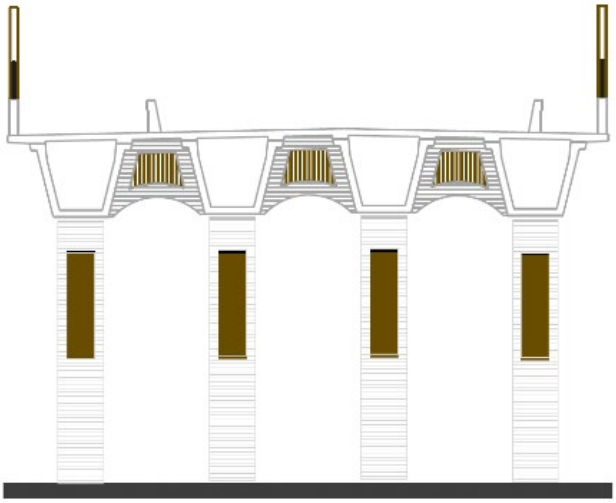
- $13M to $16.5M (roadway cost not included)

4: Constant Depth Tub Girder with Flared Piers

Description of design features

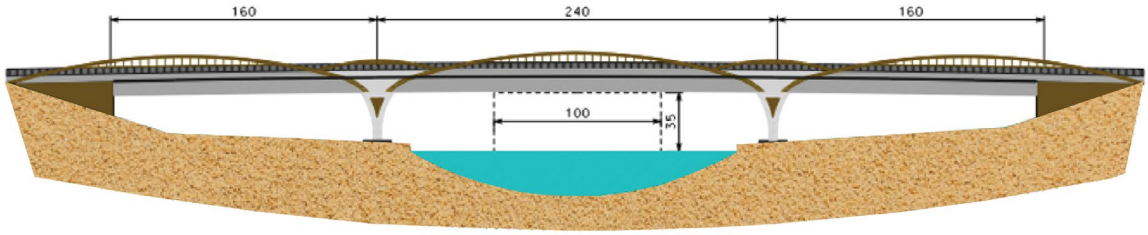
Similar to Alternative 3, the structure consists of three continuous spans of spliced precast and prestressed concrete tub girders. The structure width is 65’-5” and the structure length is 560’-0”. Four girder lines are assumed for the preliminary design. The substructure consists of columns supported on drilled shaft foundations and flared at the connection to the girder to provide an arched appearance. The three continuous span configuration provides an arrangement that balances the structural loading and provides a clear span over the channel. This alternative provides an aesthetic quality of the tub girder shape and assumes some aesthetic treatments including form liner, colored coatings, and decorative fence.

- Efficient structure
- Construct with no Falsework in Channel
- Vertical Clearance over Full Channel
- Structural Aesthetics with flared piers
- Utility Accommodation Inside and Between Girders for improved aesthetics



Cross section graphics

FIGURE 22: TUB GIRDER WITH FLARED PIERS



Pros

- The three-span arrangement of spliced prestressed concrete girders provides an efficient structure that provides a balanced visual appearance.
- The four girder lines of tub girders provide a cleaner appearance along the fascia of the structure and from below as compared to the wide flange girders and the flared pier columns enhance the structural geometry to provide the arched appearance.
- Constructability of the structure allows segments to be placed with minimal falsework over the channel and through typical construction methods.
- The girder depth and span configuration provide the required vertical clearance across the entire channel.
- Small utilities such as telecommunication lines may be placed within the tub girder to avoid visibility from below the structure.

Cons

- Although still constructable through typical methods, the tub girder segments are heavier than the wide flange segments and require larger equipment to transport and erect, although additional cost is mitigated by the design incorporating fewer total segments.

- Some additional formwork is required for the flared piers which adds some cost to the project.
- Larger utilities still require attachment between girders to avoid conflicts with the structural components and to facilitate future maintenance and replacement.

Preliminary Bridge Cost

- $13.5M to $17M (roadway cost not included)

5: Tub Girder with Deepened Pier Segment and Flared Piers

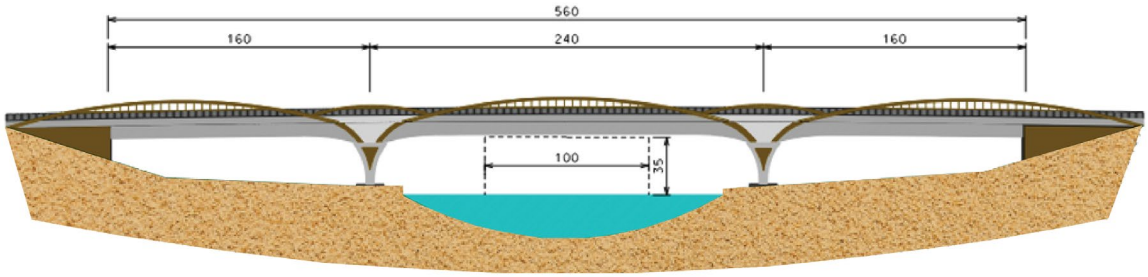
Description of design features

The structure consists of three continuous spans of spliced precast and prestressed concrete tub girders for the span segments and cast in place tub girder segments over the piers. The structure width is 65’-5” and the structure length is 560’-0”. Four girder lines are assumed for the preliminary design. The substructure consists of columns supported on drilled shaft foundations and flared at the connection to the girder to provide an arched appearance. The three continuous span configuration provides an arrangement that balances the structural loading and provides a clear span over the channel. This alternative provides an aesthetic quality of the tub girder shape and assumes some aesthetic treatments including form liner, colored coatings, and decorative fence.

- Structural Aesthetics improved with deep girders and flared piers
- Some Falsework in Channel for deepened pier segments is required
- Vertical Clearance over Full Channel
- Utility Accommodation Between Girders

Cross section graphics

FIGURE 23: TUB GIRDER WITH DEEPENED PIER SEGMENT



Pros

- The three-span arrangement of spliced concrete girders provides an efficient structure that is provides a balanced visual appearance.
- The four girder lines of tub girders provide a cleaner appearance along the fascia of the structure and from below as compared to the wide flange girders.
- The deepened pier segments along with the flared pier columns enhance the structural geometry to provide the arched appearance.
- Compared to previous alternatives, the deepened pier segments and flared pier columns are the most aesthetically appealing through the incorporation of structural elements rather than supplemental aesthetic treatment.
- Constructability of the structure allows the drop in segments to be placed with minimal falsework and through typical construction methods.
- The girder depth and span configuration provide the required vertical clearance across the entire channel.
- Small utilities such as telecommunication lines may be placed within the tub girder to avoid visibility from below the structure.

Cons

- The tub girder segments, particularly the deeper segments, are heavier than Alternative 3 and 4 tub girders which requires larger equipment to transport and erect.
- Additional formwork and falsework are required for the flared pier columns and deepened pier segments which adds cost to the project and extends into the channel.
- Larger utilities still require attachment between girders to avoid conflicts with the structural components and to facilitate future maintenance and replacement.

Preliminary Bridge Cost

- $14M to $18M (roadway cost not included)

6: Rib Arch with Adjacent Box Girders

Description of design features

The structure consists of eight spans of adjacent precast prestressed box girders with spans 3 through 6 supported on a structural arch over the channel. The structure width is 65'-5" and the structure length is 510'-0". Eight girder lines of adjacent boxes with four arch ribs are assumed for preliminary design. This alternative provides an aesthetic quality of the structural arch and assumes some aesthetic treatments including form liner, colored coatings, and decorative fence.

- Requires Falsework in Channel
- Complex Structure
- 35-foot Vertical Clearance over 100-ft of Channel only
- Favorable Structural Aesthetics
- Utility Accommodation Limited

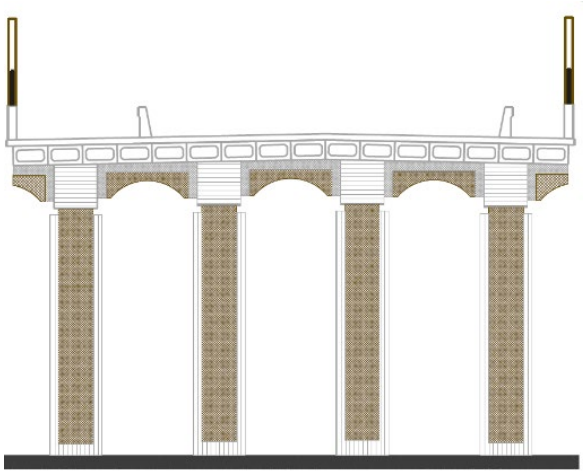
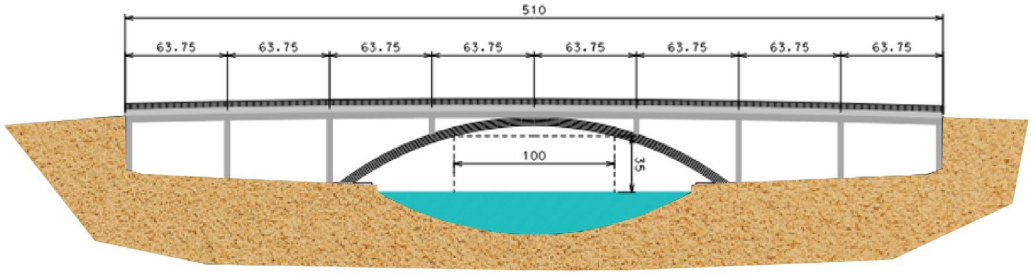


FIGURE 24: RIB ARCH WITH ADJACENT BOX GIRDERS



Pros

- The arch structure type with shallow adjacent box girders provides an aesthetically appealing structure with minimal supplemental aesthetics.
- The appearance from the side of the structure highlights the arch while the adjacent box girders provide a clean appearance from below.
- The short precast girder segments will be easily constructible.

Cons

- The arch rib of this structure type will be the most complex to construct and will require falsework in the channel.
- Large foundations will be required to support the arch and increase the cost.
- The shape of the arch will constrict the channel and provide the 35-foot vertical clearance for a width of 100 feet.
- An increase in the vertical profile is required to accommodate the clearance.
- Utilities will be the most difficult to install with the adjacent box girders and depending on the size of the utility, may need to be installed below the girder.

Preliminary Bridge Cost

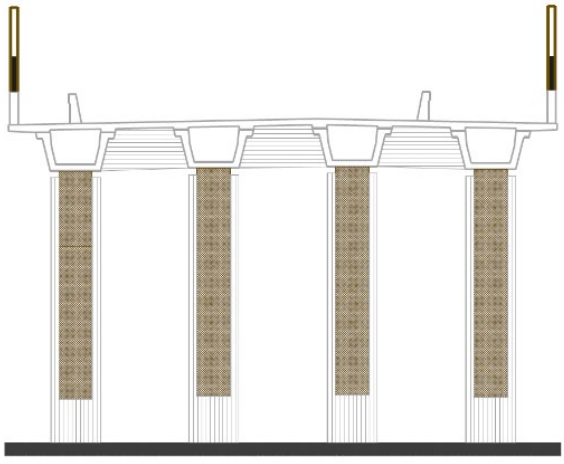
- $22.5M to $28.5M (roadway not included)

7: Rib Arch with Spliced Tub Girders

Description of design features

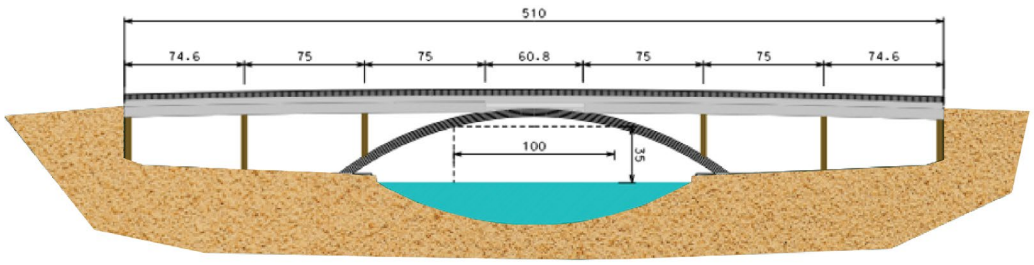
The structure consists of six spans of spliced precast prestressed tub girders with a central integral span. Spans 3 through 5 are supported by the structural arch. The structure width is 65'-5" and the structure length is 510'-0". Four girder lines of tub girders with four arch ribs are assumed for preliminary design. This alternative provides an aesthetic quality of the structural arch and assumes some aesthetic treatments including form liner, colored coatings, and decorative fence.

- Complex structure
- Requires Falsework in Channel
- 35-foot Vertical Clearance over 100-ft of Channel only
- Very Favorable Structural Aesthetics
- Utility Accommodation Between Girders



Cross section graphics

FIGURE 25: RIB ARCH WITH SPLICED TUB GIRDERS



Pros

- The arch structure type with shallow tub girders provides an aesthetically appealing structure with minimal supplemental aesthetics.
- The appearance from the side of the structure highlights the arch while the tub girders provide a clean appearance from below.
- The short precast girder segments will be easily constructible. The tub girders may accommodate small utilities within the tub.

Cons

- The arch rib of this structure type will be the most complex to construct and will require falsework in the channel.
- Large foundations will be required to support the arch and increase the cost.
- The shape of the arch will constrict the channel and provide the 35-foot vertical clearance for a width of 100 feet.
- An increase in the vertical profile is required to accommodate the clearance.
- Larger utilities still require attachment between girders to avoid conflicts with the structural components and to facilitate future maintenance and replacement.

Preliminary Bridge Cost

- $20.5M to $26M (roadway cost not included)

Bridge Aesthetic Variations

With every alternative considered above, the aesthetic treatments can be adjusted within the alternative without impacting the bridge structure design. Colored coatings, form liner finishes, aesthetic railings, and lighting can be adjusted to improve the visual appearance to fit within the budget or be detailed as later additions in the case of lighting and plaza treatments.

9.0 Selection of the Preferred Alternative

In the evaluation of the various roadway alignment and bridge type alternatives, the Project Team applied a two-step process to evaluate each of the roadway alignment and bridge type alternatives.

As previously noted, the primary object guiding the evaluation and selection of a roadway alignment and bridge type is to ensure that the roadway alignment and bridge type selected together do not exceed the State Legislature appropriation of $35.5 million. It is imperative that the cumulative roadway and bridge improvements proposed stay within this budget thereby not requiring additional supplemental funding from Lake Havasu City and/or other agency funding.

First Tier Budget Affordability Screening

Recognizing the priority importance of maintaining all roadway and bridge improvement costs (inclusive of design, permitting and construction costs) within the existing project budget, the Project Team first developed a matrix to illustrate how the potential pairing of the various roadway alignment alternatives with the various bridge type alternatives can be afforded within the prescribed $35.5 million budget. **Table 5** shows the comparison of roadway and bridge type budget affordability.

TABLE 5: BUDGET AFFORDABILITY COMPARISON OF ALTERNATIVES

Roadway	Bridge Type 1	Bridge Type 2	Bridge Type 3	Bridge Type 4	Bridge Type 5	Bridge Type 6	Bridge Type 7
1A	✓	✓	✓	✓	✓	X	X
1B	✓	✓	✓	✓	✓	X	X
2A	✓	✓	✓	✓	✓	X	X
2B	✓	✓	✓	X	X	X	X
3A	✓	✓	✓	✓	✓	X	X
3B	✓	✓	✓	X	X	X	X
4A	✓	X	X	X	X	X	X
4B	X	X	X	X	X	X	X
5*	✓	✓	✓	✓	✓	X	X

**Roadway Alternative #5 includes a Paseo del Sol Avenue intersection with SR 95 that is unlikely to be approved by ADOT due to intersection spacing requirements*

As the Project Team compared and vetted the affordability of the potential pairing combinations of the roadway alignment and bridge type alternatives, some key considerations are noted for this analysis:

1) Each roadway alignment and bridge type alternative utilize a preliminary cost estimate range. The conservative, or higher end of each budget range is applied to determine the budget affordability comparing and pairing of the various roadway and bridge types.
2) While roadway alignment alternative 5 is favorable from a budget cost perspective, roadway alignment alternative 5 will not advance for consideration as the Preferred Alternative because the proposed connection with SR 95 at the Paseo del Sol alignment is unlikely to be viewed favorably by ADOT. The Paseo del Sol alignment does not meet ADOT minimum signalized intersection spacing requirements on SR 95.
3) As **Table 5** indicates, bridge type alternatives 6 and 7 each represent the most expensive preliminary cost estimate for all bridge types. The preliminary cost estimate of each of these two bridge alternatives are deemed too expensive in and of themselves to also include sufficient budget for the roadway portion of the total construction improvement package.

The Project Team also presented an overview of all roadway alignment and bridge type alternatives and this budget affordability comparison matrix to the City Council at their regular meeting of May 14, 2024.

Application of the Second Tier Evaluation Criteria

Recognizing the findings from the first-tier evaluation screening focused upon construction budget affordability, a second-tier technical analysis and screening of each roadway alignment alternative and bridge type was conducted. The Project Team crafted a series of evaluation criteria to equitably assess key characteristics essential in determining the selection of a Preferred Alternative roadway alignment and bridge type that can be constructed under the project budget, is a long term, value-added asset for Lake Havasu City and meets community expectations and desires.

Each of the roadway alignment and bridge type evaluation criteria are introduced and defined below.

Evaluation Criteria – Roadway

Cost – Preliminary opinion of probable cost for the design, permitting and construction of each alternative and its relative affordability as compared to the overall project budget.

Constructability – Level of complexity/ease of construction as compared to other roadway alternatives. This can include level of utility conflicts, construction methods and application of certain design elements such as retaining walls and drainage features.

Utility Conflicts – Level or degree for potential conflicts and/or relocation of existing utilities associated with each roadway alternative.

Environmental/Regulatory Permitting – Level and complexity of likely federal environmental permitting process, cost and impact to construction schedule.

Durability/Maintenance – Order of magnitude of the anticipated impact to long term operations and maintenance efforts and costs based on the complexity and service life expectancy of the roadway features.

Traffic Operations – Alternative's likely impact to adjacent business ingress and egress; resulting operations and level of service of adjacent roadways (projected delays); safety considerations; favorability of driveway access to Lake Havasu State Park; SR 95/ADOT permitting.

Evaluation Criteria – Bridge

Cost – Preliminary opinion of probable cost for the design, permitting and construction of each alternative and its relative affordability as compared to the overall project budget.

Constructability – Level of complexity/ease of construction as compared to other bridge alternatives. This can include amount of cast-in-place concrete over the channel (lowers #5 and #6), the size and scale of erection equipment, sophistication of foundations and duration of construction.

Impacts to Channel - Environmental/Regulatory Permitting – Havasu Landing and other vessel vertical clearance requirements; the presence of falsework required in the channel to construct the bridge; maintaining daily boating operations by minimizing number and duration of construction closures; level and complexity of likely federal environmental permitting process, and impact to construction schedule.

Durability/Maintenance – Order of magnitude of the anticipated long-term operations and maintenance efforts and costs based on the complexity and service life expectancy of the bridge design features.

Aesthetics – As compared to other bridge alternatives considered, does the bridge possess aesthetically pleasing features, and/or provide for enhanced aesthetic treatments with minimal budget impact.

Utility Accommodations/Screening **–** Measure of each bridge alternative's ability to provide ease of access for maintenance purposes and screening of utilities from public view.

Ranking of the Roadway Alignment and Bridge Type Alternatives

The Project Team then applied the individual evaluation criterion to each roadway alignment and bridge type alternative. While a separate set of evaluation criteria were developed for the roadway alignments and bridge types, some of the roadway and bridge evaluation criteria overlap due to the natural interrelatedness of the roadway and bridge.

It is also noted that, for purposes of evaluating and ranking each of the roadway alignment alternatives, roadway alternatives 1-4 having an "a" option and a "b" option, each were combined into one score as each a and b option are essentially identical with the exception of the roundabout application in the "b" options.

Each criterion is assigned a value range of 0-4 for scoring. A score of four (4) represents the best or highest score, zero (0) being the lowest. With six evaluation criteria utilized for the roadway alignment and the bridge types, each roadway and bridge alternative can receive a maximum score of twenty-four (24).

The scoring results for the roadway alignment alternatives are located in **Table 6** and bridge type alternatives in **Table 7**.

TABLE 6: ROADWAY ALIGNMENT ALTERNATIVE SCORING RESULTS

Roadway Alternatives	Cost (0-4)	Constructability (0-4)	Utility Conflicts (0-4)	Environmental/Regulatory Permitting (0-4)	Durability/ Maintenance (0-4)	Traffic Operations (0-4)	Total Score (0-24)
1A, 1B	4	3	3	3	4	4	**21**
2A, 2B	3	3	3	3	2	3	**17**
3A, 3B	3	3	2	3	2	2	**15**
4A, 4B	2	1	1	3	1	2	**10**
5	2	2	3	3	2	0	**12**

**Roadway Alignment Alternatives 1-4 include a traditional intersection stop control option (option a) and a roundabout counterpart option (option b). Both are scored as one alternative. LHC community preference will determine which intersection treatment will be applied.*

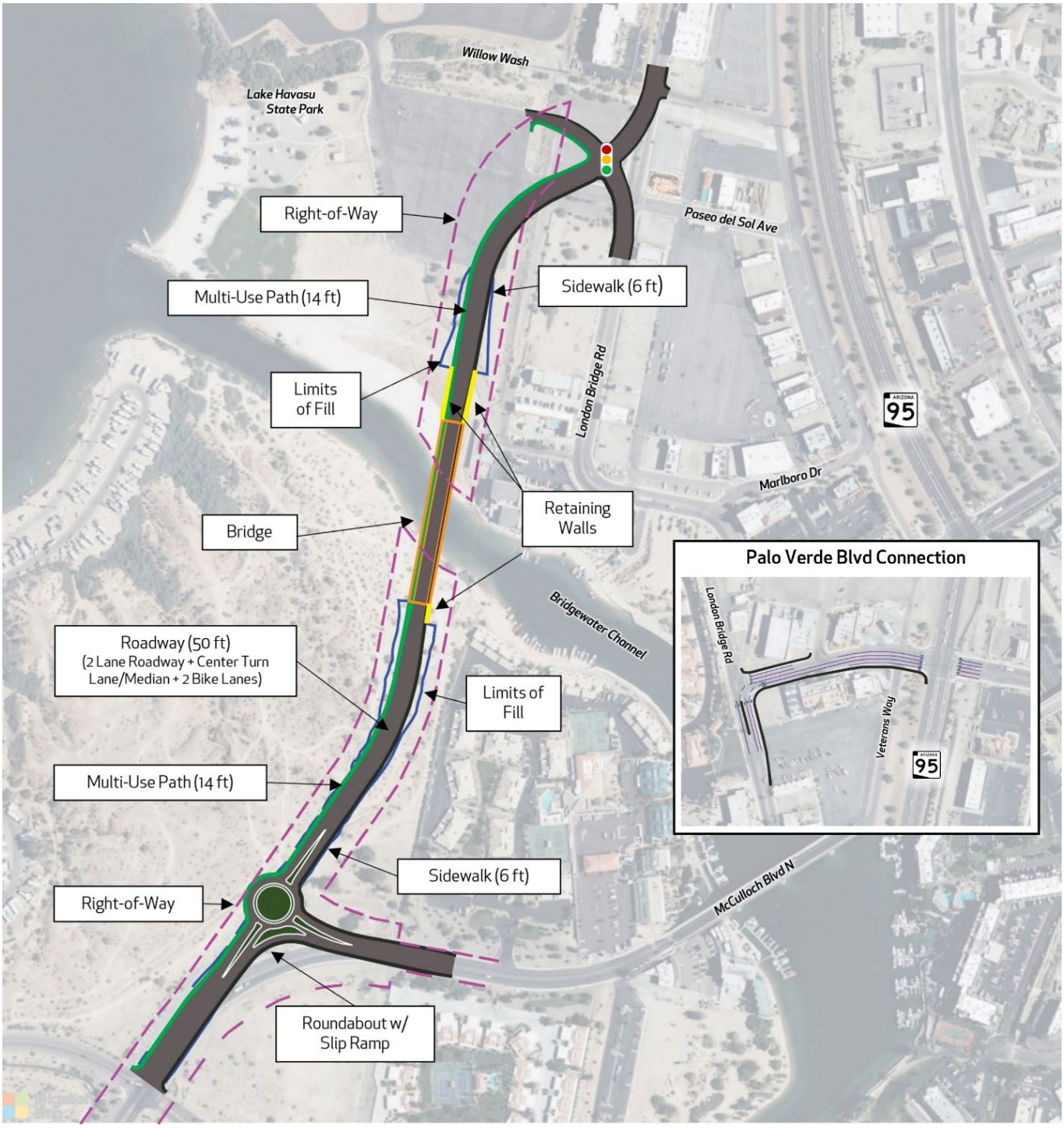
TABLE 7: BRIDGE EVALUATION CRITERIA

Bridge Type Alternatives	Cost (0-4)	Constructability (0-4)	Impacts to Channel (0-4)	Durability/ Maintenance (0-4)	Aesthetics (0-4)	Utility Accommodations /Screening (0-4)	Total Score (0-24)
1	4	3	3	4	0	3	**17**
2	4	3	3	3	1	3	**17**
3	3	4	3	3	2	4	**19**
4	3	4	3	3	3	4	**20**
5	2	2	2	3	3	3	**15**
6	2	1	2	2	4	1	**12**
7	2	1	2	3	4	2	**14**

Preferred Alternative: Roadway Alignment + Bridge Type

As the numeric rankings indicate in **Table 6** and **Table 7**, the recommended Preferred Alternative is a combination of roadway alignment alternative 1A/1B and bridge type alternative 4. The combination of this roadway and bridge type together offers the optimum balancing of roadway performance and operations, minimizes the impact to existing LHC roadways, roadway and bridge facilities are situated within the existing right-of-way and ASP MOU reservation area limits, provides optimal access location to Lake Havasu State Park, minimizes utility conflicts, stays within the right-of-way reservation area, provides a functional bridge type that has no to little impacts to the channel and is at the same time aesthetically complementary to the London Bridge, and also achieves the primary objective of staying within the overall state-appropriated design and construction budget. **Figure 26** illustrates the recommended roadway and bridge Preferred Alternative.

FIGURE 26: PREFERRED ALTERNATIVE



The roadway alignment recommended in the Preferred Alternative represents a combination of features from roadway alternative 1A and 1B, along with a subtle modification incorporated from the original 1B roadway alignment alternative.

The Preferred Alternative roadway features north of the Second Bridge consist of all roadway features previously described in roadway alternative 1A. This includes:

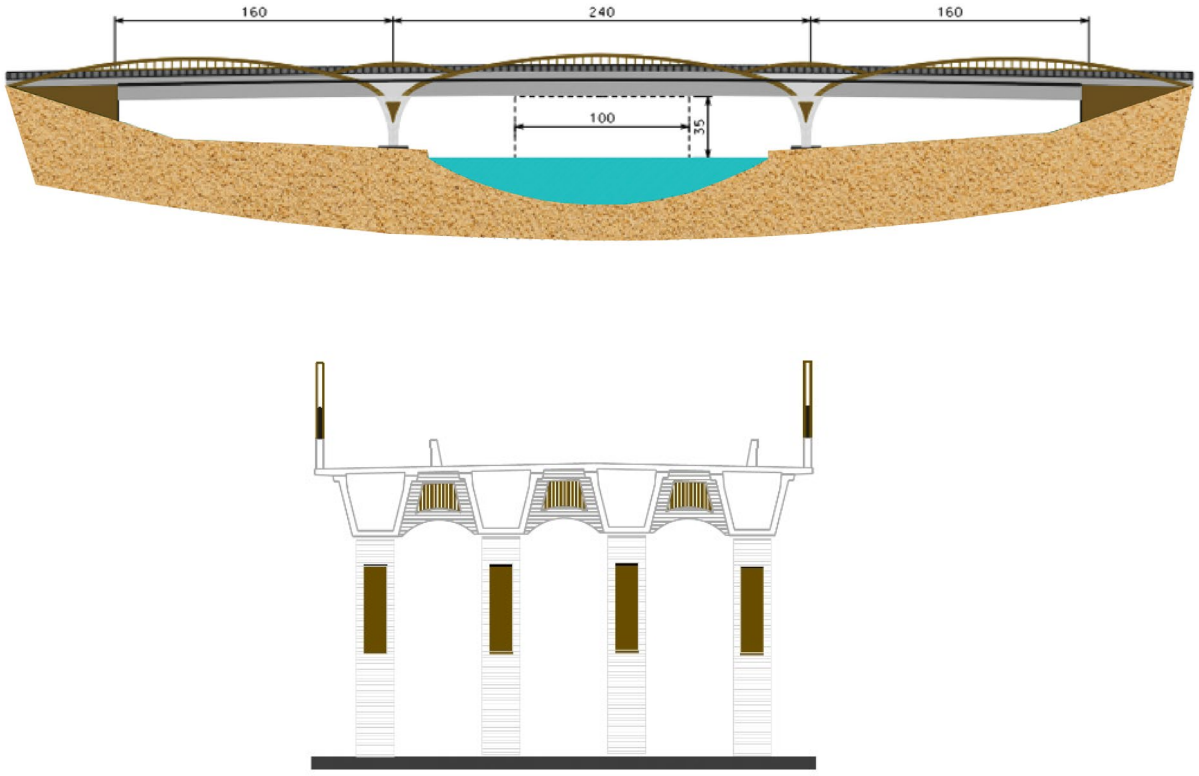
- Preferred connection location to the Lake Havasu State Park.
- Utilizes existing SR 95 connection at Palo Verde Blvd., ADOT's preferred connection point on SR 95.
- Will add a new signalized intersection between this new alignment alternative and existing London Bridge Road north of the existing Paseo Del Sol intersection.
- Maintains access to existing businesses and Veterans Way.
- Incorporates 1,700' of existing London Bridge Road, retains sidewalks, curb and gutter, and business access, minimizing the amount of new roadway construction.
- Replace existing stop sign controlled intersection with signal at S Palo Verde and London Bridge Rd.
- Will likely require some modification to S. Palo Verde Blvd to accommodate turning movements with auxiliary lanes to accommodate additional traffic and turning movements.
- Paseo del Sol and London Bridge Road intersection will likely transition to limited right-in, right out only turning movements.

South of the Second Bridge, on the island, the Preferred Alternative roadway alignment consists of the roadway features previously described in 1B, including a roundabout. However, the Preferred Alternative has enhanced the original 1B alternative by adding a "slip ramp" to facilitate enhanced free-flow traffic operations of vehicles moving in the northbound to eastbound direction (towards the London Bridge on McCulloch Blvd.

While the Project Team's typical approach is to not advocate for a roundabout (versus signalized intersection) and let the community voice its preference for a roundabout versus traditional intersection treatment, many factors suggest that a roundabout application at this location is preferred over a traditional signalized intersection design. These factors include: the existing McCulloch Blvd/Beachcomber Blvd. roadway geometry, the proposed right-of-way configuration, the ability to accommodate roadway connection for future development west of this roadway, and future anticipated traffic movements. These factors collectively suggest that a roundabout at this location will offer enhanced traffic operations and safety than a traditional signal-controlled intersection.

The scoring results in Table 7 suggest that bridge type alternative 4 (Constant Depth Tub Girder with Flared Piers) ranks slightly ahead of bridge type alternative 3 (Constant Depth Tub Girder) and is thereby recommended for the Preferred Alternative.

FIGURE 27: PREFERRED BRIDGE ALTERNATIVE



Bridge type 4 essentially consists of the same bridge type structural components as bridge type 3 using three continuous spans of spliced precast and prestressed concrete tub girders, but with aesthetic enhancements of the flared piers at the connection to the girder to provide an arched appearance. This alternative provides an aesthetic quality of the tub girder shape and assumes some aesthetic treatments including form liner, colored coatings, and decorative fence. This arched appearance is complementary to the London Bridge design/appearance while still maintained within the overall project budget. Additional considerations of the Constant depth Tub Girder with Flared Piers bridge design also include:

- Efficient structure with balanced visual appearance
- Construct with no Falsework in Channel
- Vertical Clearance over Full Channel
- Structural Aesthetics with flared piers

- Utility Accommodation Between Girders
- The girder depth and span configuration provide the required vertical clearance across the entire channel.
- Small utilities such as telecommunication lines may be placed within the tub girder to avoid visibility from below the structure.
- Although still constructable through typical methods, the tub girder segments are heavier than the wide flange segments and require larger equipment to transport and erect, although additional cost is mitigated by the design incorporating fewer total segments.
- Some additional formwork is required for the flared piers which adds some cost to the project.
- Larger utilities still require attachment between girders to avoid conflicts with the structural components and to facilitate future maintenance and replacement.

Preferred Alternative Budget

Preliminary order of magnitude cost estimates was prepared for all roadway alignment and bridge type alternatives, including the Preferred Alternative.

The preliminary order of magnitude cost estimates included the following:

- Removals
- Utility relocations and adjustments
- Redundant planned new utilities
- New pavement, curb & gutter
- Sidewalk and Multi-Use Trail
- Traffic Signals/Emergency Management and related systems
- Roundabouts
- Signing & Striping
- Retaining walls and screen/sound walls
- Bridge options
- Guardrail and barrier at bridge

- Earthwork
- Estimated Mill/Overlay of existing London Bridge Road
- Bridge roadway & Navigation lighting
- Final Design and Post Design
- Construction Administration/Management/Survey
- Erosion/Dust Control
- Mobilization
- Contingency

Table 8 summarizes the order of magnitude construction costs for the preferred alternative. The unit prices are based on recent ADOT bid results, discussions with contractor partners on other work, and other generally accepted planning level unit costs for the type of work listed in this area of the state. It should be noted that the construction cost for each road and bridge alternative given earlier in the report include costs for other construction related work items such as construction management, traffic control, mobilization, dust control and construction survey.

TABLE 8: PREFERRED ALTERNATIVE COST ESTIMATE

DESCRIPTION - ROADWAY & BRIDGE PROGRAM COST	PREFERRED ALT.
PREFERRED ROADWAY ALTERNATIVE CONSTRUCTION ESTIMATE	**$ 14,100,000**
PREFERRED BRIDGE ALTERNATIVE CONSTRUCTION ESTIMATE	**$ 16,800,000**
PERMITTING AND FINAL DESIGN ENGINEERING ESTIMATE	**$ 3,450,000**
TOTAL	**$ 34,350,000**

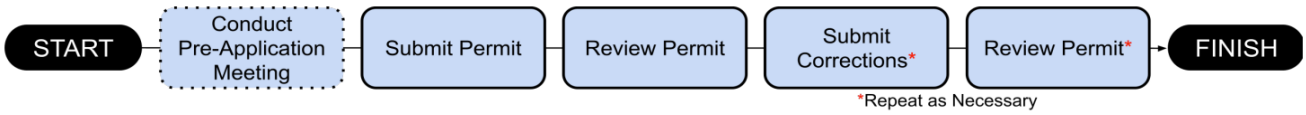
10.0 Considerations for Civil Design & Construction

The following provides a series of observations for consideration for the upcoming civil design and construction process for the Preferred Alternative roadway and bridge features.

ADOT Right-of-Way Encroachment Permit

Any connection contemplated to SR 95 will require an encroachment permit prepared for the review and ultimate approval by ADOT to construct any improvements within their right-of-way.

The process would begin with a request to conduct a pre-application meeting with appropriate ADOT staff from the Northwest District office in Kingman to discuss the scope of the improvements and elements required to submit a complete and comprehensive permit application. The graphic below represents the workflow for the permit approval:



The encroachment permit would include appropriate construction drawings of the improvements considering drainage and traffic impacts, potential utility relocations, and right-of-way needs would be prepared to ADOT's construction standards and specifications. In addition, applicable environmental permitting requirements would also be completed, such as biology surveys/report/permitting, grading impacts, drainage changes, Storm Water Pollution Prevention Plan, landscaping, and cultural resources evaluation/report.

Lake Havasu State Park ingress/egress

Both existing access points and roads to the Lake Havasu State Park will require relocation to provide new access reflecting the Preferred Alternative and existing parking facilities. Coupled with that change in access is the potential reconfiguration and/or reduction of the availability of parking spaces at Lake Havasu State Park, as well as those parking spaces that are currently on city property that will be eliminated with the construction of the Preferred Alternative. Reconfiguration and possible expansion of the existing parking facilities and access points, beyond the scope of this Feasibility Study, must be resolved during final design both to ASP and City approvals and included within a project wide operations analysis.

Regulatory Permitting

As Section 5 outlines in detail, there are several anticipated environmental permits through various approving federal and state agencies that will be required in conjunction with the civil

design and construction process. This will include a NEPA review likely led by the U.S. Coast Guard due to the requirement of a Bridge Permit. Please refer to Section 5 for more information regarding anticipated regulatory permitting requirements.

Key Roadway/Bridge Design Features

The horizontal and vertical roadway geometry for all alternatives, including the Preferred Alternative, were based on a minimum design speed of 30 mph, with roundabouts considered at a slightly lower design speed, which will require confirmation in final design. Consideration of existing conditions, such as keeping within city owned right-of-way and parcel boundaries, minimizing impact to existing utilities and accounting for the significance of the Willow Wash were key elements in the development of alternatives.

The impact of noise, especially in proximity to The Isles and Kings View condominiums will need further collaboration and consideration at final design. The construction cost estimates have included a line item for noise walls at these locations. However, residents of this development may choose to limit the visual impacts that a noise wall may present, as an example.

Matching into existing pavements, sidewalks, maintaining access to businesses and ASP facilities have also been key considerations, both on the island and along London Bridge Road and other roadways.

Another key feature worthy of further consideration will be providing an “all weather” crossing of Willow Wash at London Bridge Road – to the extent practical. An analysis of the wash for determining the best solution at this location will be concluded during final design.

Consideration of both roundabout and signalized intersection led to separate alternatives for each. The safety benefits of roundabouts cannot be overstated, both in the number of accidents and in accident severity. And, although they are more expensive to construct initially, they require less maintenance over time than that of a signalized intersection.

Second Bridge & Bridgewater Channel Features

Vertical clearance of the bridge over Bridgewater Channel was also a key consideration which controls the vertical alignment over the water course. For the purposes of this study, this clearance was based on a 35’ height dimension for 100’ minimum channel horizontal width, predicated mainly on the height of the Havasu Landing Tecopa ferry and maintaining a height equal to or greater than the existing London Bridge clearance.

The structural configurations of all bridge types, including the Preferred Alternative, are based on typical materials used in the Arizona and southern California markets. Preliminary designs consider the materials most readily available for each structure type, namely ADOT shapes for

the precast box girders and Caltrans shapes for the spliced wide flange and tub girders. Foundations are assumed to be large diameter drilled shafts; however, no geotechnical investigations or design were performed.

Preliminary bridge cost estimates were based on Arizona DOT past data and costs estimated from similar past projects.

All bridge alternatives, including the Preferred Alternative, are able to accommodate future widening of the structure, but the alternative with increased constructability challenges will be the most expensive to widen where complex construction techniques are required for a small portion of the structure. The tub girder alternatives with a column below each girder will be the easiest to widen.

The bridge generally parallels an existing buried and overhead utility corridor that will be protected and maintained. New planned utilities for this project include raw and potable water, sewer, reclaimed water, and dry utilities that will become a redundant system to maintain service and capacity should the existing utilities that exist underneath the Bridgewater Channel (See **Figure 7** and **Figure 28**) fail. The bridge design must accommodate positioning of these utility lines, the structural capacity to support these lines, and consider both initial constructability and then future access to these lines, valves, and requisite other infrastructure.

The final design must include coordination between these desired new and the existing utilities to ensure that there are no conflicts with the recommended bridge foundations once the foundation types are determined with the required geotechnical engineering.

Potential Utility Conflict Considerations with the Preferred Alternative

In the vicinity of the proposed new intersection at McCulloch Blvd. and London Bridge Road, an existing waterline traverses through this area – this may or may not require relocation to accommodate the new intersection design and will be evaluated and determined during final design. The adjacent gas and sewer line will also have to be verified for conflict.

The existing overhead power lines that cross over McCulloch Blvd. do not appear to be in conflict horizontally or vertically at this location. The areas of potential conflict with existing utilities will benefit from an accurate Subsurface Utility Engineering (SUE) to identify any necessary relocations during the final design stage.

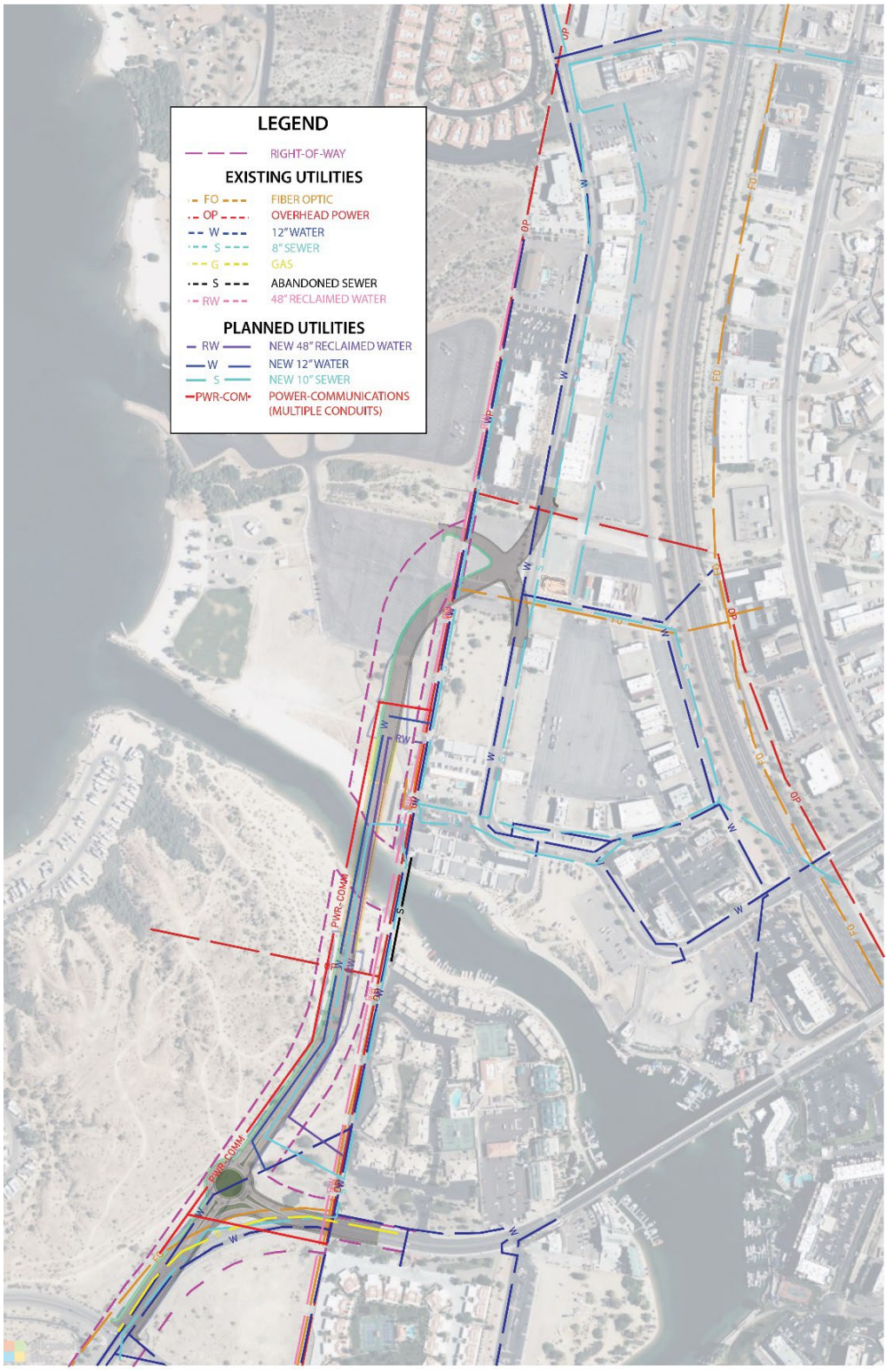
None of the existing utilities (gas, fiber, water, sewer) paralleling the island right-of-way and ASP right-of-way reservation area conflict with the proposed alignment as they are located east and outside of these rights of way, shown in **Figure 28**.

In addition, there is an east-west overhead power line that crosses the ASLD ROW (east to west) on the island side about 250’ south of the Bridgewater Canal. This line will likely require

undergrounding beneath the embankment for approximately 300', eliminating an existing pole that is near the center of the island right-of-way.

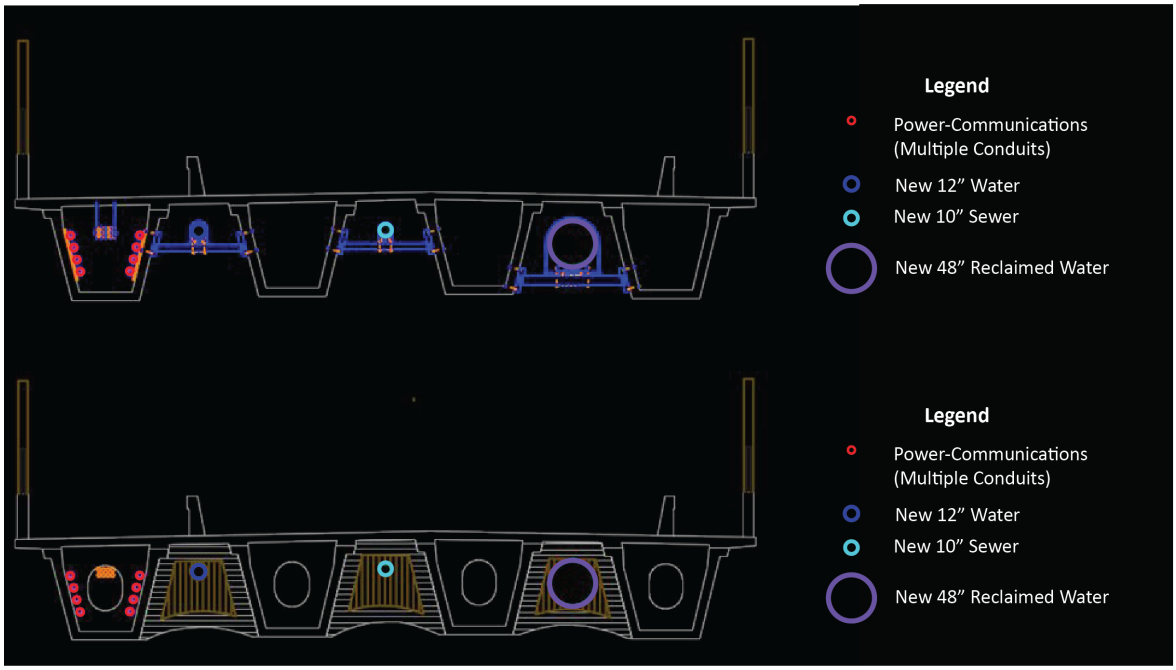
Where the Preferred Alternative alignment extends beyond ASP right-of-way reservation area east and onto the city owned lots and existing parking areas, an existing power pole for the overhead power line will likely require relocation.

Figure 28: Preferred Alternative with Utility Overlay



At the crossing of the Bridgewater Channel, it is worth noting that the bridge and roadway concepts and eventual final design accommodate the potential for future planned utility lines on the bridge and within the 2007 approved ROW. At this time, the expected utilities to be accommodated include a 10-inch waterline, a 36" raw water waterline, a 4-inch fiber optic line, a 4-inch power line, 48-inch reclaimed waterline and a 12-inch sewer line, shown in **Figure 29**. The final disposition of the utility type and size will be confirmed and addressed during final design in collaboration with the City. The final design must include coordination between these desired new and the existing utilities to ensure that there are no conflicts with the recommended bridge foundations, once the foundation types are determined with the required geotechnical engineering.

FIGURE 29: FUTURE UTILITIES ON BRIDGE



At the connection between the Preferred Alternative roadway alignment and London Bridge Road, no major conflicts with the sewer and water lines are anticipated. However minor conflicts such as sewer manhole and water valve adjustments, as well as relocating existing irrigation valves and points of service to those irrigation valves may be necessary. These specific elements are anticipated to be resolved during final design.

At Willow Wash, an "all weather crossing" of London Bridge Road is proposed with construction of new box culvert(s) to convey storm water runoff under the roadway. The clearance under the existing overhead power lines will have to be verified during final design to determine if any clearance requirements are violated.

No utility conflicts or adjustments are anticipated for the 1,700' of London Bridge Road between Willow Wash and S. Palo Verde Blvd, which is proposed to include a mill and overlay treatment.

At the intersection of S. Palo Verde Blvd and London Bridge Road, any proposed traffic signal and street lighting for this intersection will require coordination with the overhead power that crosses this intersection diagonally. Additional utility investigation during final design will be required to help determine potential conflicts with the new pole installations.

Along S. Palo Verde Blvd and Veterans Way to SR 95, any road widening that may be required to accommodate auxiliary lanes (left and right turn lanes) should only require adjustments to sewer manhole and water valve covers. The existing overhead power that crosses the roadway should not conflict with the Preferred Alternative.

Commodity and Construction Cost Fluctuations

Recently there has been some recognized stability in commodity and construction costs. Going forward, planning for price escalation is a must. Various factors may impact commodity, labor, and overall construction costs:

- Costs of materials due to inflationary trends have stabilized in the near term although the future is uncertain.
- The supply chain has also stabilized although some products still maintain availability issues and long lead times that should be considered in both cost and scheduling.
- Labor costs continue to escalate and there still is a shortage in skilled and trade labor.
- Cost of capital continues to fluctuate.
- Weather and geopolitical events.

Appendices

A. State of Arizona – Lake Havasu City Intergovernmental Agreement
B. Arizona State Parks MOU
C. ASLD ROW Documentation
D. Public and Stakeholder Engagement
E. Traffic Modeling Technical Results