

Final Planning Memorandum

For

Arroyo Chico Multi-Use Path

Tucson Boulevard to Broadway Boulevard (Snake Bridge)

TDOT Job No.: SP15
TRACS No.: SL736 02D
Federal Project No.: TAP-TUC-0(256)



Prepared For:
Tucson Parks and Recreation
900 South Randolph Way
Tucson, Arizona 85716

Prepared By:

AECOM

333 East Wetmore Road, Suite 400
Tucson, AZ 85705

July 2017



Charlene J. Robinson

Expires: 3/31/2020

Table of Content

| | |
|---|----|
| 1.0 INTRODUCTION | 1 |
| 1.1 Purpose and Justification..... | 5 |
| 2.0 EXISTING CONDITIONS | 5 |
| 2.1 Project Area..... | 5 |
| 2.2 Existing Roadways and Intersections..... | 6 |
| 2.3 Drainage Considerations..... | 13 |
| 2.4 Traffic Considerations..... | 14 |
| 3.0 PROPOSED ALTERNATIVES | 15 |
| 3.1 Arroyo Chico Greenway at Parkway Terrace to the Arroyo Chico Detention Basin..... | 15 |
| 3.2 Arroyo Chico Detention Basin to the Barraza-Aviation Shared-Use Path..... | 21 |
| 3.3 Arroyo Chico Detention Basin to Broadway Boulevard..... | 23 |
| 4.0 CONCLUSIONS AND RECOMMENDATIONS | 25 |
| 5.0 RECOMMENDATIONS FOR PROJECT PHASING | 26 |
| 6.0 REFERENCES | 28 |

List of Tables

| | |
|--|----|
| Table 1 – Physical Features of Existing Roadway..... | 8 |
| Table 2 – Alignment Evaluation..... | 20 |

List of Figures

| | |
|---|----|
| Figure 1 – Project Location Map..... | 2 |
| Figure 2 – Project Vicinity Map..... | 3 |
| Figure 3 – Arroyo Chico Greenway Project Overview..... | 4 |
| Figure 4 – Existing and Alternative Signal Phasing Arrangements – AM and PM Peak Hours .. | 18 |
| Figure 5 – Shared Lane Marking (Sharrow)..... | 22 |

Appendices

- Appendix A – Concept Plans and Cross Sections
- Appendix B – Before and After Perspectives
- Appendix C – Toole Design Group’s Memorandum – Concept Designs for E 15th Street and S. Park Avenue Sections
- Appendix D – Toole Design Group’s – Issues and Opportunities Analysis
- Appendix E – Probable Construction Quantities and Cost Estimates



Charlene J. Robinson
Expires: 3/31/2020

1.0 INTRODUCTION

The Arroyo Chico Multi-Use Path (MUP), Tucson Boulevard (Blvd.) to Snake Bridge project is located within the City of Tucson, Pima County, and the Arizona Department of Transportation's (ADOT) Tucson District. The project limits extend from Parkway Terrace to Park Avenue (Ave.) and is located within Sections 17 and 18 of Township 14 South, Range 14 East (T14S R14E). Project Location and Project Vicinity Maps are shown in Figures 1 and 2, respectively.

The Arroyo Chico Multi-Use Path is part of the Arroyo Chico Greenway Master Plan (Greenway) by Tucson Parks and Recreation that generally follows the Arroyo Chico Wash to provide continuous and accessible pedestrian and bicycle connectivity from Reid Park (Randolph) to the Downtown Business District. The Greenway would also connect city residents to the regional trail system and adjacent central neighborhoods. Segments of the Greenway are either constructed or are currently under design. This project studied the following segments (shown in yellow on Figure 3):

- Arroyo Chico Greenway at Parkway Terrace to the Arroyo Chico Detention Basin (approximately 0.70 miles)
- Arroyo Chico Detention Basin to the Barraza-Aviation Shared-Use Path (approximately 300 feet)
- Arroyo Chico Detention Basin to Broadway Blvd. (approximately 880 feet)

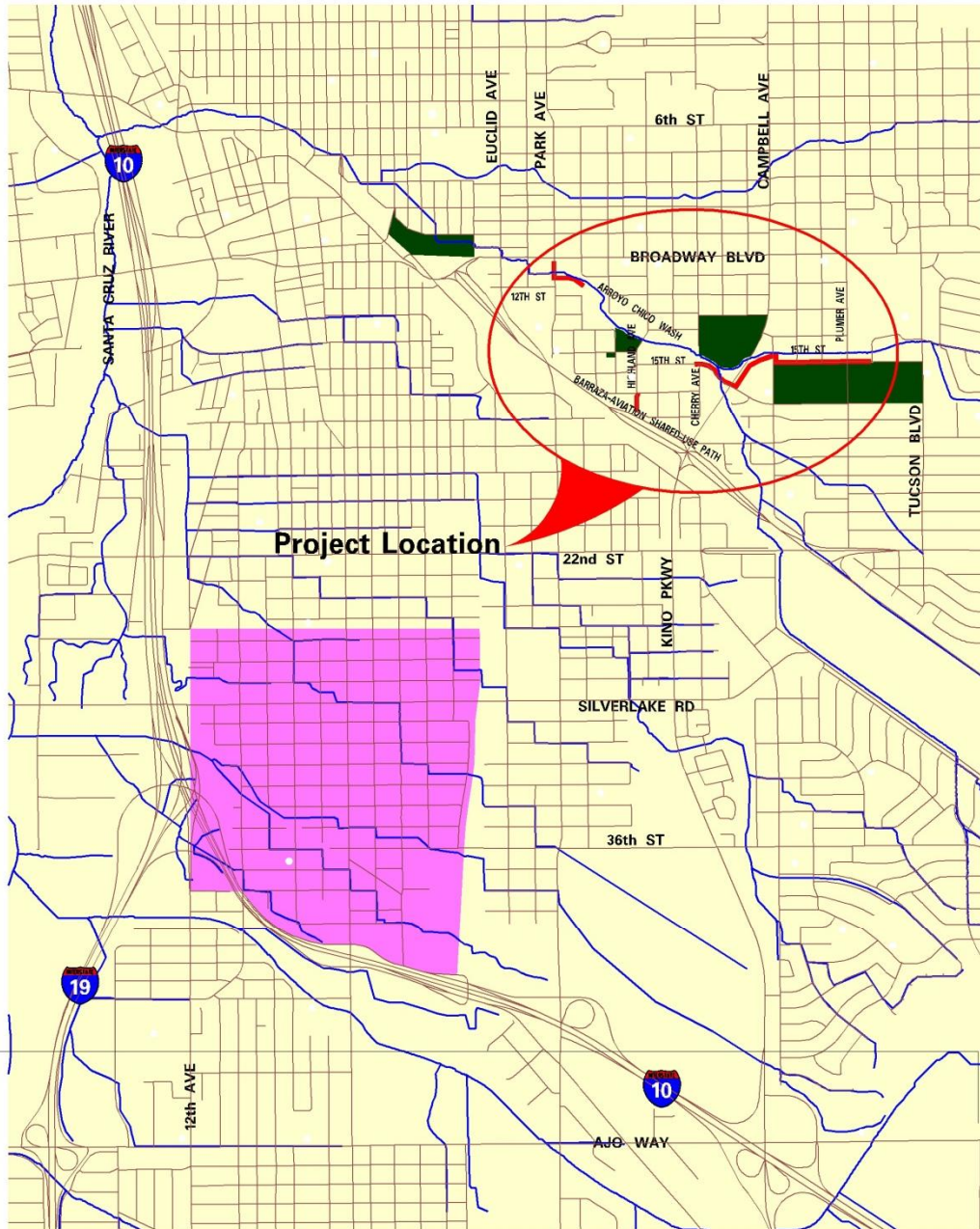
This Planning Memorandum has been prepared to present pertinent information related to these sections of the Arroyo Chico Greenway. The descriptions of the sections are as follows:

Arroyo Chico Greenway at Parkway Terrace to the Arroyo Chico Detention Basin






This section of the Greenway is proposed to be constructed along the north side of 15th Street (St.) from Parkway Terrace to Campbell Ave. A short stretch would extend on the east side of Campbell Ave. to a crossing of Campbell Ave. to run along the south side of the Arroyo Chico Wash. From the Arroyo Chico Wash, the path would run along the east side of Kino Parkway to the Kino Parkway/Winsett St./15th St. signalized intersection where it would cross along the north leg of the intersection to 15th St. The path would continue west on the north side of 15th St. and tie into the existing Arroyo Chico Detention Basin (ACDB) paved multi-use path. The proposed path would be a 12-foot wide asphaltic concrete (AC) pathway as shown on the graphics contained in Appendix A (Plans 1 - 4). The length of this section is approximately 0.70 miles.

Arroyo Chico Detention Basin to the Barraza-Aviation Shared-Use Path

This section of the Greenway is proposed to run along the west side of Highland Ave. from the ACDB paved multi-use path to tie into ADOT's Barraza-Aviation (BA) shared-use path. Bicycles would continue to use the roadway. Shared lane pavement markings (sharrows) (Figure 5) would be installed to serve as wayfinding devices and reinforce the use of this facility as a bike route. There is an existing four-foot wide sidewalk that ties into the curb access ramp on the southwest corner of the Highland Ave./16th St. intersection and extends approximately 120 feet south of the intersection. This sidewalk would be removed and a new six-foot wide sidewalk would be constructed in back of new concrete vertical curb from the curb access ramp to the BA shared-use path for pedestrian use. This stretch of Greenway improvements is approximately 300 feet long (see Appendix A, Plan 5).



LEGEND:

- | | | | |
|---|----------------|---|---------|
|  | City of Tucson |  | Washes |
|  | South Tucson |  | Parks |
| | |  | Schools |

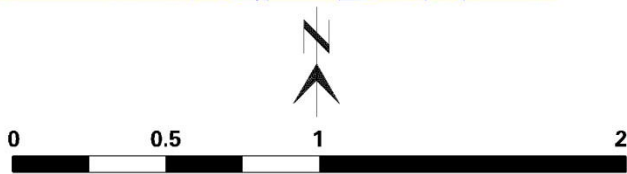


Figure 1 – Project Location Map

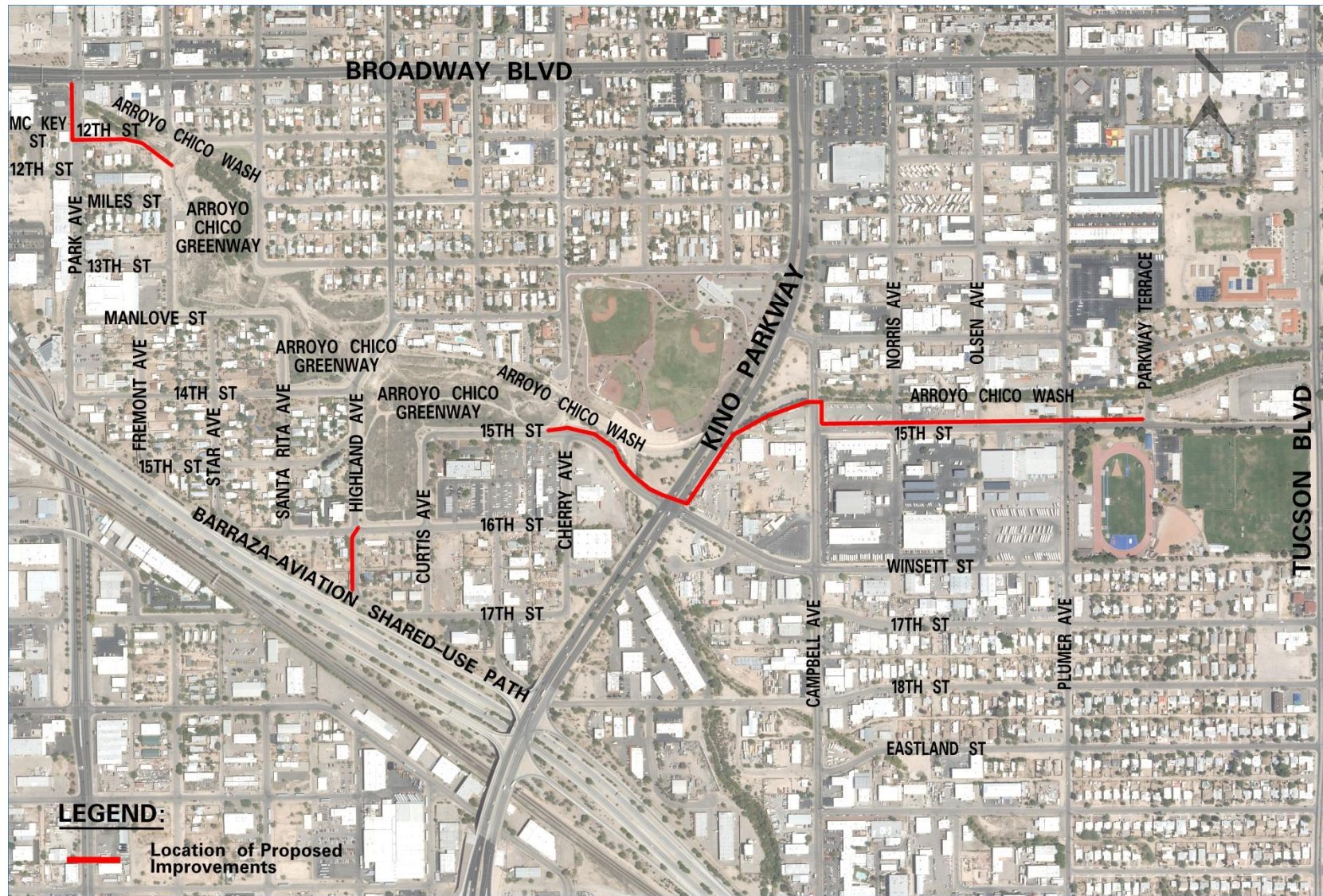


Figure 2 – Project Vicinity Map

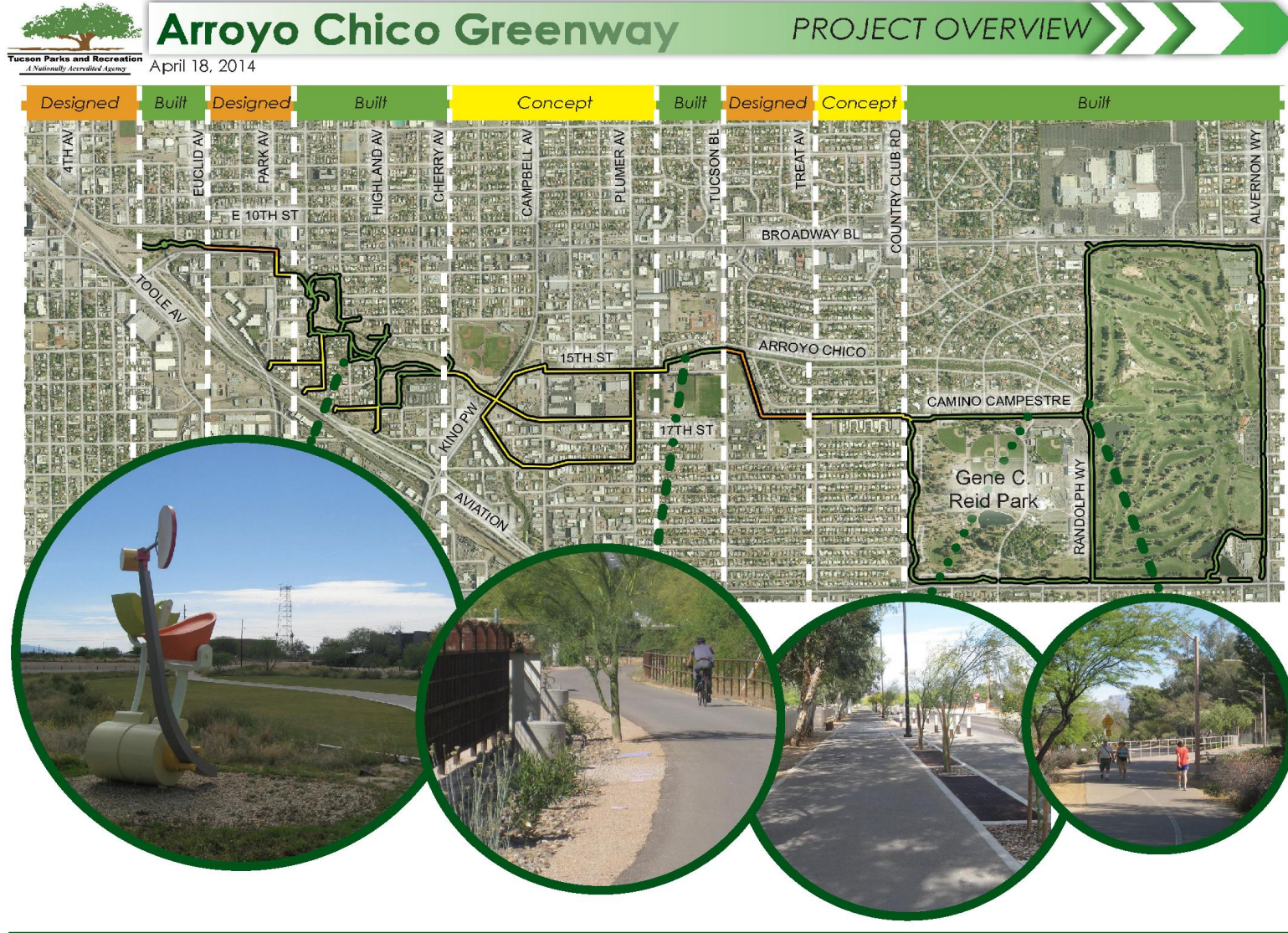


Figure 3 – Arroyo Chico Greenway Project Overview
(Developed by Norris Design Group)

Arroyo Chico Detention Basin to Broadway Blvd.

This section of the Greenway would begin at the ACDB paved multi-use path and continue northwest along the far south side of the Arroyo Chico Wash to 12th St. This AC path section would be 12-foot wide. From 12th St., the path would cross Park Ave. and then transition to go north along the west side of Park Ave. to a pedestrian signal crossing that is proposed at Broadway Blvd. New eight-foot wide concrete sidewalks would be installed along both sides of 12th St. for pedestrian use and bicycles would share the roadway. Shared lane pavement markings (sharrows) (Figure 5) would be installed to serve as wayfinding devices and reinforce the use of this facility as a bike route. Along Park Ave., the cross section would include an existing eight-foot wide sidewalk for pedestrian use and a new ten-foot wide AC path for bicycle use. A two-foot wide buffer would separate the sidewalk from the bicycle path (see Appendix A, Plan 6 and 7). The length of this section is approximately 880 feet.

The design and construction of these segments of the Arroyo Chico Greenway are currently unfunded.

1.1 Purpose and Justification

The purpose of this project is to develop a Greenway alignment that generally follows the Arroyo Chico Wash from Reid Park to the Downtown Business District. The proposed Greenway would also connect city residents to the regional trail system and to adjacent central neighborhoods. The project limits for this study of the Arroyo Chico Greenway is from Parkway Terrace to Broadway Blvd. (near the Snake Bridge); which is a distance of approximately 1.25 miles. The project would connect to the existing Arroyo Chico Greenway at the east end and the proposed crossing of Broadway Blvd. and pedestrian/bicycle facilities along Broadway Blvd. at the west end. The section along Highland Ave. would connect into ADOT's existing BA shared-use path.

A majority of the proposed Greenway alignment would be on or run along existing roadways and tie into the existing multi-use pathway at the Arroyo Chico Detention Basin. The existing roadway characteristics are defined under Section 2.0 - Existing Conditions.

The proposed Greenway improvements would include high visibility and/or curbed median refuge roadway crossings, separate pathways from the roadways, and in some cases separate paths for pedestrian and bicycle use. Once completed, the improvements would provide safer roadway crossings; and continuous and accessible pathways to the rest of the Arroyo Chico Greenway making it a more inviting environment for multi-modal users.

This study addresses:

- The preferred alignments to complete the Arroyo Chico Greenway
- The characteristics and features of the preferred alignments
- The design and construction costs associated with each alignment
- Recommendations for project phasing

2.0 EXISTING CONDITIONS

2.1 Project Area

The project area is located in the central area of Tucson, Arizona in Pima County and consists of a mixture of residential and commercial properties. The terrain is generally flat.

2.2 Existing Roadways and Intersections

2.2.1 Arroyo Chico Greenway at Parkway Terrace to the Arroyo Chico Detention Basin

This section of the Greenway is proposed to be constructed along the north side of 15th St. from Parkway Terrace to Campbell Ave. A short stretch would extend on the east side of Campbell Ave. to a crossing of Campbell Ave. to run along the south side of the Arroyo Chico Wash. From the Arroyo Chico Wash, the path would run along the east side of Kino Parkway to the Kino Parkway/Winsett St./15th St. signalized intersection where it would cross along the north leg of the intersection to 15th St. The path would continue west on the north side of 15th St. and tie into the existing ACDB paved multi-use path. The proposed path would be a 12-foot wide AC pathway as shown in Appendix A (Plans 1 - 4). The length of this section is approximately 0.70 miles. Physical features of the roadways are presented in Table 1. Other roadway characteristics are presented below.

2.2.1.1 Fifteenth Street

Fifteenth St. is an east-west, two-lane minor local road from Parkway Terrace to Campbell Ave. Between Parkway Terrace and Plumer Ave. it creates a T-intersection with Parkway Terrace at the east end and a four leg intersection with Plumer Ave. at the west end. The land use is residential on the north side of the road and there are four driveways servicing these residences. The Rincon Vista Sports Complex is located on the south side of the road. Street lights are located along the south side of the road behind the sidewalk and there is one on the northeast corner of the Parkway Terrace/15th St. intersection. The roadway has a double yellow centerline stripe and a white high visibility crosswalk across the north leg of the Parkway Terrace/15th St. intersection. Parking is allowed on both sides of the road. This section of roadway is designated as a bike route on the Tucson Bikeways map.

Between Plumer Ave. and Campbell Ave., 15th St. creates a four leg intersection with Plumer Ave. at the east end and a T-intersection with Campbell Ave. at the west end. The land use is zoned as industrial on the north side and residential on the south side. The businesses on the north side of the road are primarily commercial (i.e. Spray Master Auto Body & Paint Shop - see photo on next page). Bethel Community Baptist Church (see photo below) is situated on the northwest corner of the Plumer Ave./15th St. intersection. Between Norris Ave. and Campbell Ave. there is a parking lot owned by the Tucson Unified School District (TUSD) (see photo on next page). TUSD facilities are located on the south side of the road. Within this section there are ten driveways/curb cuts on the north side of the road and Olsen Ave. and Norris Ave. intersect with 15th St. Parking is allowed on both sides and there is no striping/pavement marking on the road. This section is also designated as a bike route on the Tucson Bikeways map.



Bethel Community Baptist Church (looking west on 15th St.)



Spray Master Auto Body & Paint Shop (looking west on 15th St.)



TUSD Parking Lot (looking west on 15th St.)

2.2.1.2 Campbell Avenue

Campbell Ave. is a north-south, three-lane (two travel lanes and a center left-turn lane) minor local road. Campbell Ave. creates a T-intersection with 15th St. The land use on both sides of Campbell Ave. is zoned as industrial and residential within the project limits. TUSD facilities are on both sides of the road. There are no driveways on the east side of the road where the proposed Greenway alignment would be constructed. The roadway is striped with a yellow center left-turn lane and solid white edge stripes. Parking is not allowed along either side of the road. Campbell Ave. is designated as a route with bike lanes on the Tucson Bikeways map.

2.2.1.3 Kino Parkway

Kino Parkway is a north-south six-lane divided roadway (three travel lanes in each direction and a curbed median) that is classified as a major arterial. The land use on the east side of the roadway is zoned as industrial. The property is owned by TUSD and two driveways provide access to their existing facilities off of Kino Parkway. Two street light poles are adjacent to the existing sidewalk. The roadway is striped with white dashed lines for the three travel lanes and a white solid edge stripe that delineates a four-foot wide shoulder in each direction. The striped shoulders on both sides of the road are designated as bike lanes on the Tucson Bikeways map. Parking is not allowed along either side of the road.

Table 1 – Physical Features of Existing Roadway

| Existing Roadway | Physical Features | Remarks | Utilities |
|--|--|---|---|
| <i>Arroyo Chico Greenway at Parkway Terrace to the Arroyo Chico Detention Basin</i> | | | |
| 15 th St. – Between Parkway Terrace & Plumer Ave. | <ul style="list-style-type: none"> • Vertical curb on both sides • 4' wide sidewalk on north side • 5.5' wide sidewalk on south side • Curb access ramps at the intersections of 15th St. with Parkway Terrace/Plumer Ave. • Roadway width = 40'. • Right-of-way width = 78.5'± • Posted speed limit = 25 mph | <ul style="list-style-type: none"> • No trucks over 26' are allowed • Designated as a bike route between Parkway Terrace and Plumer Ave. • A stand with 6 mailboxes are mounted behind the curb • 3 sign assemblies - 1 along the roadway behind the curb and 2 (Stop signs) at the intersections | <ul style="list-style-type: none"> • Water lines and meters (north side) • Sanitary sewer lines (north side) |
| 15 th St. – Between Plumer Ave. and Campbell Ave. | <ul style="list-style-type: none"> • Vertical curb on both sides • Intermittent 4' wide sidewalk on the south side • 4' wide sidewalk on the north side from the northeast corner of the Norris Ave./15th St. intersection to about 120' east of the intersection. • Curb access ramps at the corner of the Plumer Ave./15th St. intersection and on the northeast corner of the Norris Ave./15th St. intersection • Roadway width = 40' • Right-of-way width = 79.2' (39.6' on each side of the roadway centerline) • No posted speed limit | <ul style="list-style-type: none"> • Designated as a bike route between Plumer Ave. and Norris Ave. • 8 sign assemblies – 5 along the roadway behind the curb and 3 (Stop signs) at the intersections | <ul style="list-style-type: none"> • Water lines and meters • Sanitary sewer lines • TEP overhead power lines and poles on south side • TEP overhead power and poles along Olsen Ave. and crossing 15th St. (includes telecommunications and/or cable) |
| Campbell Ave. – Between 15 th St. and Arroyo Chico Wash | <ul style="list-style-type: none"> • Vertical curb on both sides • No sidewalk • No curb access ramps • Roadway width = 48' • Right-of-way width = 60' • No posted speed limit | <ul style="list-style-type: none"> • Designated as a bike route • 1 sign assembly along the roadway behind the curb | <ul style="list-style-type: none"> • TEP overhead and poles (east side) (includes telecommunications/cable) • 2" gas line in roadway (east side of centerline) • 8" water line in roadway (west side of centerline) |

Table 1 (Cont.)

| Existing Roadway | Physical Features | Remarks | Utilities |
|---|--|---|---|
| Kino Parkway | <ul style="list-style-type: none"> • Vertical curb on both sides • 4' wide sidewalk on both sides • Curb access ramps on all four corners of the Kino Parkway/Winsett St./15th St. signalized intersection • Roadway width = 100' • Right-of-way width = 150' • Posted speed limit = 45 mph | <ul style="list-style-type: none"> • Designated as a bike route | <ul style="list-style-type: none"> • Sanitary sewer lines • TDOT Street Lights |
| 15 th St. – Between Kino Parkway & Cherry Ave. | <ul style="list-style-type: none"> • Vertical curb on both sides • 5' wide sidewalk on north side • Curb access ramps at all four corners of the Kino Parkway/Winsett St./15th St. signalized intersection and on the southeast and southwest corner of the Cherry Ave./15th St. intersection • Roadway width = 64' • Right-of-way width = 100' (50' on each side of the roadway centerline) • No posted speed limit | <ul style="list-style-type: none"> • Designated as a bike route • 4 sign assemblies along the roadway behind the sidewalk | <ul style="list-style-type: none"> • Water lines • Sanitary sewer lines • TEP overhead power lines and poles crossing 15th St. along the east side of Cherry Ave. (includes telecommunications and/or cable) |
| Arroyo Chico Detention Basin to the Barraza-Aviation Shared-Use Path | | | |
| Highland Ave. – Between 16 th St. and 17 th St. | <ul style="list-style-type: none"> • Wedge curb on both sides • 4' wide sidewalk on the west side that extends about 120' south of Highland Ave./16th St. intersection • 4' wide sidewalk on the east side the extends about 50' south of Highland Ave./16th St. intersection • Curb access ramps at the corner of the Highland Ave./16th St. intersection • Access ramp at the Barraza-Aviation (BA) shared-use path • Roadway width = 36' • Right-of-way width = 30' from road centerline to the east; 30' from road | <ul style="list-style-type: none"> • 2 sign assemblies along the roadway • 1 mailbox between curb and sidewalk | <ul style="list-style-type: none"> • TEP overhead electric and poles (overhead perpendicular to roadway within a utility easement and includes telecommunications, cable, and a dusk to dawn light); TEP underground electric vault, and manhole • Gas line in roadway (east side of centerline) • Water line in roadway (west centerline) and meter • Fire hydrant between curb and sidewalk near Highland Ave./16th St. intersection |

Table 1 (Cont.)

| Existing Roadway | Physical Features | Remarks | Utilities |
|---|--|--|--|
| Highland Ave. – Between 16 th St. and 17 th St. (Cont.) | <ul style="list-style-type: none"> • centerline to the west for about 176’ south of the Highland Ave./16th St. intersection; ADOT right-of-way from this point to the BA shared-use path • No posted speed limit | | |
| <i>Arroyo Chico Detention Basin to Broadway Blvd.</i> | | | |
| 12 th St. – Between Park Ave. & Detention Basin | <ul style="list-style-type: none"> • Wedge curb on both sides • Sidewalk only at the curb returns • Curb access ramps on the northeast and southeast corner of the intersection with Park Ave. • Roadway width = 36’ • Right-of-way width = 60’ • No posted speed limit | <ul style="list-style-type: none"> • 3 sign assemblies along the roadway • 1 mailbox between curb and sidewalk | <ul style="list-style-type: none"> • Gas line in roadway (south of centerline) • Water line in roadway (south of centerline), manhole and meters • Sewer line and manhole (north of centerline) |
| Park Ave. – Between 12 th St. & Broadway Blvd. | <ul style="list-style-type: none"> • Vertical curb on both sides • 5’ wide sidewalk on north side • Curb access ramps at all four corners of the Park Ave./Broadway Blvd. intersection and on the northwest corner of the Park Ave./Mc Key St. intersection • Roadway width = 57’± minimum • Right-of-way width = 80’ (40’ on each side of the roadway centerline) • No posted speed limit | <ul style="list-style-type: none"> • No curb access ramp on the southwest curb return of the Park Ave./Mc Key St. intersection. Asphaltic concrete pavement was placed to provide access from roadway to sidewalk | <ul style="list-style-type: none"> • Water lines • Sanitary sewer line |

2.2.1.4 Kino Parkway/Winsett Street/15th Street Signalized Intersection

At the Kino Parkway/Winsett St./15th St. signalized intersection, both approaches on Kino Parkway have three through lanes, and a dedicated left-turn lane. Right turning traffic shares the outside lanes with through traffic. The eastbound approach on 15th St. has a through lane and dedicated left- and right-turn lanes. The westbound approach on Winsett St. has a left-turn lane, a shared left-turn and through lane, and a dedicated right-turn lane. The intersection currently has pedestrian crosswalks on all approaches that are activated by push buttons. The intersection currently operates as a two-phase signal with one phase serving Kino Parkway in the north-south direction and the other serving 15th St. and Winsett St. in the east-west direction. There is no dedicated signal phases provided for east-west turning traffic; therefore, when there is a pedestrian call at the intersection, left- and right-turning motorists run at the same time as pedestrians crossing the street.

2.2.1.5 Fifteenth Street

Fifteenth St., west of the Kino Parkway/Winsett St./15th St. intersection (see photo below), is a five-lane section with two eastbound lanes (one of which turns into a right-turn lane at the Kino Parkway intersection), an eastbound left-turn lane, and two westbound lanes. All of the movements at the intersection that flow into the westbound lanes on 15th St. are single lane movements, i.e., the westbound through movement from Winsett St., the northbound left-turn lane, and the southbound right-turn. Beyond the intersection, 15th St. is a three-lane cross section, one travel lane in each direction and a westbound to southbound left-turn lane onto Cherry Ave. West of Cherry Ave., 15th St. tapers from a three-lane to a two-lane road. There is an eastbound to southbound right-turn lane onto Cherry Ave. Arroyo Chico Wash runs along the north side of the road. The property on the southwest corner of the intersection is owned by the City of Tucson. Development on the south side, west the City of Tucson property, is commercial. There are no driveways on either side of the road. Two street light poles are situated behind the existing sidewalk just west of the intersection and a curb in back of the sidewalk transitions to a 5'-9" tall wall to the tie in of the sidewalk to the ACDB multi-use path. A four-barrel 8'x12' reinforced concrete box culvert runs under 15th St. about 160 feet west of the Kino Parkway/Winsett St./15th St. intersection. The roadway is striped to about 360 feet west of the Cherry Ave./15th St. intersection. There is also a double yellow centerline stripe at the curve in the road where it becomes Curtis Ave. The solid white edge striping transitions away from the vertical curb to a six-foot wide shoulder that can be used by bicycles to access the ACDB multi-use path. Parking is not allowed along either side of the road.



15th St. West of Kino Parkway (looking west)

2.2.2 Arroyo Chico Detention Basin to the Barraza-Aviation Shared-Use Path

This section of the Greenway is proposed to run along the west side of Highland Ave. (see photos below) from the ACDB multi-use path to tie into ADOT's BA shared-use path. Highland Ave. is a north-south, two-lane minor local road. Highland Ave. is a four leg intersection with 16th St. The land use within the project limits is residential. Parking is allowed on both sides and there is no striping/pavement marking on the road. Highland Ave. is designated as a bike route. Physical features of Highland Ave. are presented in Table 1.



Highland Ave. – Between 16th St. & BA Shared-Use Path (looking south)



Highland Ave. – Between 16th St. & BA Shared-Use Path (looking south)

2.2.3 Arroyo Chico Detention Basin to Broadway Blvd.

This section of the Greenway is proposed to run from the ACDB paved multi-use path northwest along the far south side of the Arroyo Chico Wash to tie into 12th St. The Greenway would run along 12th St. to Park Ave. and then run north along the west side of Park Ave. to a future pedestrian signal crossing on the west leg of the Broadway Blvd./Park Ave. intersection. None of the roadways within this segment is designated as a bike route or having bike lanes on the Tucson Bikeways map.

2.2.3.1 Twelfth Avenue

Twelfth Ave. is an east-west, two-lane minor local road that terminates as a cul-de-sac at the east end of the road and creates a T-intersection with Park Ave. to the west. The land use is residential on the south side and commercial on the north side. There is concrete wedge curb along the roadway edges; therefore, no driveways or curb cuts exist. Parking is allowed on both sides and there is no striping/pavement marking on the road.

2.2.3.2 Park Avenue

Park Ave. is a north-south, two-lane minor local road. At the north project limit, Park Ave. creates a four leg intersection with Broadway Blvd. and is controlled by a stop sign on Park Ave. There is one driveway/curb cut and a T-intersection with Mc Key St. on the west side. The land use on both sides is mostly commercial; however, the property just north of Mc Key St. is a paved parking lot. Parking is allowed on both sides of Park Ave. and the roadway is striped with a double yellow center lane stripe. There is a High Intensity Activated Crosswalk (HAWK) pedestrian crossing signal on the east leg of the Broadway Blvd./Park Ave. intersection.

2.3 Drainage Considerations

Overall, the terrain within the project limits is relatively flat. Following is a description of the drainage patterns on each of the facilities.

15th Street – Between Parkway Terrace and Campbell Avenue

The general drainage pattern on 15th St. is from east to west. The roadway is crowned so that flows are along both sides of the road. There are no storm drain facilities such as curb inlets or catch basins.

Between Parkway Terrace and Plumer Ave., the flow runs north along the east curb of Plumer Ave. to the dip at the Arroyo Chico Wash. Flow that crosses Plumer Ave. may run along the west curb to the wash.

The drainage between Plumer Ave. and Campbell Ave. are as follows:

- At Plumer Ave. - Drainage runs along the west curb of Plumer Ave. to the dip at the Arroyo Chico Wash. In heavy storm events some drainage may continue west towards Olsen Ave. or further to Campbell Ave.
- Between Plumer Ave. and Olsen Ave. - Drainage runs along the curb on both sides of the road. Drainage along the north curb may flow to Olsen Ave. and run along the east curb to the dip at the wash. Drainage along the south curb may continue west. In heavy storm events some flow may cross Olsen Ave. and run along the west curb to the wash.
- Between Olsen Ave. and Norris Ave. - Drainage runs along the curb on both sides of the road. Drainage along the north curb may flow to Norris Ave. and run along the east curb to the dip at the wash. Drainage along the south curb may continue west. In heavy storm events some flow may cross Norris Ave. and run along the west curb to the wash.
- Drainage after Norris Ave. continues west to Campbell Ave. where it flows north to the curb inlet at the wash.

Campbell Avenue

Campbell Ave. is crowned so that drainage flows along both curb lines. Flows that get to the west side of the road will end up in the Arroyo Chico Wash via a curb inlet.

Kino Parkway

The travel and shoulder lanes are sloped towards the outside curb. There are intermittent catch basins along the curb line that captures flows.

15th Street – Between Kino Parkway and Cherry Avenue

Fifteenth St. is crowned and is longitudinally sloped to the west; therefore, drainage runs along both curb sides and west. There is a catch basin on the north side at the Cherry Ave. intersection that captures flow and outlets into the Arroyo Chico Wash.

Highland Avenue and 12th Street

Highland Ave. and 12th St. is crowned so that drainage runs along the curb. There are no drainage facilities on the road.

Park Avenue

Park Ave. is crowned; therefore, drainage runs along both curb lines. There are catch basins at the low points along both sides of the road that captures flows from the north and south and outlets into the Arroyo Chico Wash. Between 12th St. and the catch basins the drainage runs to the north. Between the catch basins and Broadway Blvd. the drainage runs to the south.

2.4 Traffic Considerations

2.4.1 Roadways

Fifteenth St. (between Parkway Terrace and Campbell Ave.), Campbell Ave., Highland Ave., 12th St. and Park Ave. are minor local roads that experience low traffic volumes; therefore, no traffic data is available for these roadways. Traffic data for Kino Parkway is available through Pima Association of Governments (PAG) website. According to the PAG website, day time 2014 traffic volume data were 57,338 vehicles per day (vpd) recorded on Kino Parkway north of the Kino Parkway/Winsett St./15th St. intersection and 63,957 vpd south of the intersection. Winsett St. experienced day time traffic volumes of 8,970 vpd and 15th St. 4,066 vpd.

The capacity of a roadway segment depends on intersection traffic control types along the segment, as well as street environment factors including driveway density, speed limit, median types, intersection density, etc. The Florida Department of Transportation (FDOT) has established capacity tables at the planning level and determined that a six-lane arterial can generally accommodate 59,900 vpd at “level of service” (LOS) D. LOS analysis is a qualitative measure of effectiveness used to determine the ability of a transportation system to satisfy the transportation demand. It uses a rating system ranging from “A”, which signifies little to no congestion or free flow conditions, to “F”, which signifies severe congestion. Based on the traffic volumes on Kino Parkway, south of the Kino Parkway/Winsett St./15th St. intersection, the roadway operates below LOS D; which indicates that this section is operating at a poor LOS. Based on traffic volumes on Winsett St. and 15th St. these roads operate at an acceptable LOS.

2.4.2 Kino Parkway/Winsett Street/15th Street Intersection

As part of this study, Toole Design Group analyzed the existing traffic operations of the intersection and summarized the results in the Memorandum contained in Appendix C. As described in the Memorandum, intersection turning movement counts were conducted at the intersection on Thursday, March 22, 2012. The weekday AM peak hour was identified between 7:15 AM and 8:15 AM and the weekday PM peak hour between 4:15 PM and 5:15 PM. The intersection geometry and peak hour turning movements are shown on Figure 3 of the Memorandum.

The heaviest traffic volumes at the intersection are the north-south movements on Kino Parkway. These movements are over 1,000 vehicles per hour (vph) and up to 1,450 vph in the northbound direction during the AM peak hour. The east-west through volumes are very low in both peak hours and represent less than ten vph. Most of the turning movements at the

intersection are between 40 and 50 vph with the exception of the westbound left-turn; which is much higher than the other movements with approximately 110 vph during the AM peak hour and approximately 225 vph during the PM peak hour. No pedestrian calls were registered at the intersection in either peak periods.

Traffic operations were evaluated using the Synchro intersection analysis software. Intersection and individual movement LOS and volume-to-capacity (v/c) ratios were reported and form a baseline from which to compare possible changes to the signal timing to incorporate the Greenway crossing.

For the AM and PM peak hour north-sound movements on Kino Parkway, the LOS is A with the exception of the northbound to eastbound left-turn movement operating at a LOS B in the AM peak hour period. The v/c ratios vary between 0.11 and 0.46. On 15th St. and Winsett St. all movements operate at LOS D with the exception of the PM peak hour westbound through and left-turn movements which operate at LOS E. The v/c ratios vary between 0.01 and 0.66. The LOS and v/c ratios are shown on Figure 5 of the Memorandum contained in Appendix C.

3.0 PROPOSED ALTERNATIVES

Based on the evaluation of the concepts developed for this segment of the Greenway, the recommended alignments and proposed improvements are described in the following sections. As part of the evaluation process, consideration was given to the requirements that any improvements must be in compliance with the American's With Disabilities Act (ADA), Federal Highways Administration and COT current standards and practices.

3.1 Arroyo Chico Greenway at Parkway Terrace to the Arroyo Chico Detention Basin

Proposed Greenway Alignment

The recommended alignment in this section of the Greenway would be constructed along the north side of 15th St. from Parkway Terrace to Campbell Ave.; which is approximately 1,720 feet and then extend north on the east side of Campbell Ave. for about 110 feet. The Greenway would cross Campbell Ave. in a new high visibility crosswalk with a median refuge to run along the south side of the Arroyo Chico Wash for about 350 feet. From the Arroyo Chico Wash, the path would run along the east side of Kino Parkway for about 460 feet to the Kino Parkway/Winsett St./15th St. signalized intersection where it would cross the north leg of the intersection to 15th St. The path would continue west on the north side of 15th St. for about 750 feet to tie into the existing ACDB paved multi-use path. The proposed path would be 12 feet wide (see Appendix A, Plans 1 - 4). Proposed improvements would include new curb access ramps at intersections, and warning and traffic control signage as applicable for motorist and Greenway users. The total length of this section is approximately 0.70 miles.

Cross Sections

This segment of the Greenway includes five cross sections showing how the 12-foot wide AC path fits within the existing terrain of the area. In all cases, the AC path pavement structural section would be two-inches of AC over four-inches of aggregate base course.

The section along 15th St. and Campbell Ave. from Parkway Terrace to the Campbell Ave. crossing would maintain the existing roadway and right-of-way widths and vertical curb. The existing sidewalk would be removed as applicable and a 12-foot wide AC pathway constructed. The cross section would include a six-foot wide buffer area between the curb and path that

could be landscaped. Landscaping could also be placed behind the path. There would be minor utility adjustments and sign relocations. On-street parking and driveway access points would be maintained on 15th St. This cross section is presented in Appendix A, Plan 1. A before and after perspective for 15th St. between Plumer Ave. and Olsen Ave. looking east is presented in Appendix B.

The segment along the Arroyo Chico Wash would include a 12-foot wide AC pathway. There could be sufficient space to place landscaping on both sides of the path. The existing landscaping and irrigation system would be removed. This cross section is presented in Appendix A, Plan 2.

Along the east side of Kino Parkway, the existing four-foot wide concrete sidewalk would be removed and the 12-foot wide AC path constructed from the Arroyo Chico Wash to the Kino Parkway/Winsett St./15th St. intersection. There would be a minimum of a five-foot wide buffer area between the path and the vertical curb. Landscaping could be placed on the east side of the pathway. There would be adjustments/removals of the existing landscaping and irrigation system. The path could meander to the east of two existing street light poles to avoid relocating them. This cross section is presented in Appendix A, Plan 3. A before and after perspective for Kino Parkway looking north is presented in Appendix B

Along 15th St., west of the Kino Parkway/Winsett St./15th St. intersection, the north side would be reconstructed to accommodate a 12-foot wide AC path. This would involve removing the existing vertical curb and concrete sidewalk and reconstructing the vertical curb to the south to narrow the roadway, and new pavement marking and signing. There are two cross sections within this area. The first section is just west of the intersection and would include an eight-foot wide pullout, five-foot wide buffer area between the curb and path, and a 12-foot wide path. Landscaping could be placed on both sides of the path. West of this area, the section would include a six-foot wide buffer area between the curb and path, 12-foot wide path and a four-foot wide minimum buffer between the existing wall and the path. There would be minor utility adjustments and modifications to the existing storm drain system. The proposed improvements would also include new pavement marking and signing. These cross sections are presented in Appendix A, Plans 3 and 4.

Kino Parkway/Winsett Street/15th Street Signalized Intersection Improvements

The Greenway is proposed to cross the north leg of the Kino Parkway/Winsett St./15th St. intersection. The proposed improvements at the intersection include reconstructing the northwest and northeast curb returns to accommodate the pedestrian and bicycle crossing and new pavement marking/crosswalk striping. This would involve removing the existing concrete vertical curb and curb access ramps and replacing them with new vertical curb and curb access ramps that can accommodate the path width. There would also be modifications to the existing traffic signal design. A before and after perspective for the crosswalk crossing the intersections north leg (looking west) is presented in Appendix B.

As summarized in Toole Design Group's Memorandum (Appendix C), the intersection currently has pedestrian crosswalks on all legs that are activated by push buttons. However, the Greenway would include moving bicycle traffic to the crosswalk on the north leg that would introduce a different expectation dynamic for motorists. The intersection currently operates as a two-phase signal. As a consequence, there are no separate signal phases provided for turning traffic, and when there is a pedestrian call at the intersection, left- and right-turning motorists run at the same time as pedestrians crossing the street. A traffic analysis was conducted using the

Synchro software to analyze existing conditions and to develop an alternative signal phasing plan that allows the Greenway crossing movement to proceed with no motor vehicle conflicts.

Currently, the pedestrian crossing on the north leg runs at the same time as the eastbound left-turn and the westbound right-turn. As well, the southbound right-turn is allowed to perform a right-turn-on-red after checking for vehicle and pedestrian conflicts. This means that approximately 140 vph are in conflict with the crosswalk during the AM peak hour and approximately 120 vph during the PM peak hour. The Greenway is expected to introduce moving bicycle traffic to this crosswalk; which creates a completely different expectation dynamic for motorists – bicyclists move faster and can enter the conflict zone with turning motorists much quicker than pedestrians.

For the majority of signal cycles called up on a typical day, the north crossing would not be called up and therefore would have no effect on existing signal operations. However, the project team explored the impact of introducing a new signal phasing option that would separate out conflicting movements with the north crosswalk when a call is received. The existing phasing arrangement is shown on Figure 4 (taken from Memorandum in Appendix C) along with an alternative signal phasing arrangement.

Under the proposed signal phasing option, the north-south signal phase would not change with the left-turns running permitted. However, if a call is received, time may be diverted from the north-south phase to serve an additional phase that is needed to separate the north crosswalk from its conflicting movements.

In the east-west direction, a leading interval would be provided where the westbound left and through movements run with the north crosswalk. During this phase, all other movements including the westbound right-turn, the eastbound left-turn, and the southbound right-turn-on-red would be stopped. Following clearance of the pedestrian phase, all east-west movements would be permitted to move as per the current signal phasing with the left-turns running permitted.

A comparison of intersection performance metrics (LOS and v/c ratio) is included on Figure 5 of the Memorandum (Appendix C) for the existing and proposed signal phasing arrangements. It shows that the proposed phasing changes would have some impact on all movements, with the largest differences being the north-south through movements and the southbound left-turn (particularly during the AM peak hour).

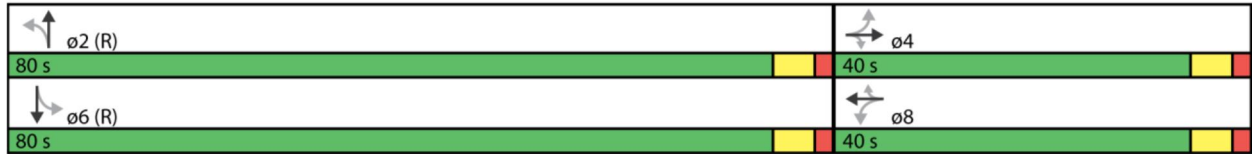
The analysis took into account the frequency of pedestrian calls on the north leg of the intersection. It considered four scenarios:

- (1) No pedestrian calls (this reflects existing conditions and is described under Section 2.4 of this report)
- (2) Low pedestrian calls (10 calls per hour or 1 out of every 3 signal cycles)
- (3) Medium pedestrian calls (20 calls per hour or 2 out of every 3 signal cycles)
- (4) High pedestrian calls (30 calls per hour or one every signal cycle)

The results of the analysis are reflected on Figure 5 in the Memorandum (Appendix C). It shows that all of the northbound and southbound movements would operate at a lower LOS and v/c performance with the proposed signal phasing; however, the movements would still operate at a LOS C or better. The eastbound left-turn and westbound right-turn would operate at LOS E. The other east-west movements would operate at LOS D or better.

As pedestrian calls increase, as reflected on Figure 5 in the Memorandum (Appendix C), the intersection would experience lower LOS and v/c performance; but the intersection would continue to operate within acceptable LOS and v/c performance limits.

AM Existing (120 second cycle length)



AM Proposed (120 second cycle length)



PM Existing (120 second cycle length)



PM Proposed (120 second cycle length)

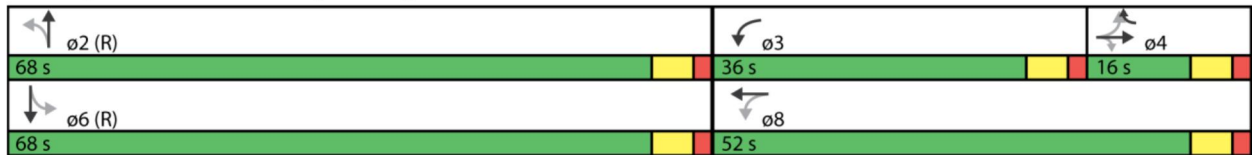


Figure 4 – Existing and Alternative Signal Phasing Arrangements – AM and PM Peak Hours

Intersection Traffic Signal Modifications Considerations

Providing a protected pedestrian crossing phase requires a number of engineering solutions to (1) detect pedestrians and bicyclists at the intersection; and (2) to stop the westbound right-turn and the southbound right-turn-on-red when the north crosswalk is called.

The intersection currently operates with push-buttons to activate the crosswalks. With the reconstruction of the northeast and northwest corners of the intersection to accommodate the Greenway, there may also be an opportunity to relocate the push buttons or provide additional push buttons to make them accessible for bicyclists as well as pedestrians using the Greenway. Having bicyclists stop at the intersection to push the button would bring their speeds more into alignment with motorists' expectations.

The westbound right-turn is provided its own lane and therefore, a right-turn arrow display could be provided to stop the right-turn during the pedestrian phase. There are a number of options for stopping the southbound right-turn-on-red movement. One option is to use static "NO TURN ON RED" signs (R10-11a – MUTCD) to ban right-turn-on-red at all times. However, it is not

expected that the north crosswalk would be called often and banning right-turn-on-red at all times may lead to a high level of sign violation. Realistically, it would be preferable to only stop the southbound right-turn-on-red when the north crosswalk is called. A number of jurisdictions have tested this sort of dynamic signage and found that violation rates are lower than for static signs using dynamic “NO TURN ON RED” signs that only illuminate when there is an active pedestrian call at the crossing. Examples of these signs are shown in the Memorandum contained in Appendix C.

Segment Opportunities:

The proposed Greenway alignment presents several opportunities. These include:

- Safe pedestrian and bicycle environment along the roadways
- 15th St. already designated as a bike route on the Tucson Bikeways Map
- Campbell Ave. and Kino Parkway already designated as having bike lanes on the Tucson Bikeways Map
- Sufficient right-of-way for a 12-foot wide path along the designated roadways
- Fewer driveway conflicts with the pathway along the designated roadways
- Close proximity to the Arroyo Chico Wash alignment
- More direct route to the ACDB multi-use path
- Less impact to existing roadway features; i.e., the roadway width and vertical curb would be maintained on most of the designated roadways
- Traffic volumes low on all of the designated roadways except Kino Parkway
- Does not restrict traffic movements on any of the roadways

Segment Constraints

- Minor utility modifications/relocations on a few roadways
- Bethel Community Baptist Church utilizes the area where the path alignment would be placed for perpendicular parking. Parking would need to be moved to the west side of the building
- Would impact the location of Spray Master Auto Body & Paint shop’s waste management services and overflow parking; which is currently in the path alignment
- Introduces a conflict at the existing driveway location of the TUSD parking lot between Norris Ave. and Campbell Ave.; which is primarily used by buses
- May require extensive coordination with TUSD
- Modifications are needed to the existing storm drain system on 15th St. west of the Kino Parkway/Winsett St./15th St. signalized intersection

Probable Construction Quantities and Cost Estimates

The total estimated cost to construct the Greenway for this section is approximately \$868,490. This estimate is based on the concept described above and current bid prices from recent projects. The detailed breakdown of the probable cost estimate is presented in Appendix E.

Other alignments evaluated and eliminated from further consideration within this segment are described below and shown on Figure 3 (highlighted in yellow). The alignment option evaluations are presented in Table 2.

Alignment Option 2

From the Plumer Ave./15th St. intersection, Alignment Option 2 would run south along the east side of Plumer Ave. past the Rincon Vista Sports Complex to the Winsett St. intersection. It would cross Plumer Ave. and continue along the north side of Winsett St. past several TUSD

properties including the main TUSD operations center and a body shop to the Kino Parkway/Winsett St./15th St. intersection.

Alignment Option 3

From the Plumer Ave./15th St. intersection, Alignment Option 3 would run south along the east side of Plumer Ave. past the Rincon Vista Sports Complex to the 18th St. intersection. It would cross Plumer Ave. and continue along the north side of 18th St. through a residential neighborhood before crossing Campbell Ave. From there, users would have the option to continue along 18th St. and use the underpass crossing at Kino Parkway or connect to a new section of the Greenway that would run along Railroad Wash to the Kino Parkway/Winsett St./15th St. intersection.

All three options include a crossing at the Kino Parkway/Winsett St./15th St. intersection and run along the north side of 15th St. to connect to the ACDB multi-use path.

Table 2 – Alignment Evaluation

| Design Criteria | Alignment Option 1 | Alignment Option 2 | Alignment Option 3 |
|----------------------------------|---|---|---|
| Distance | <ul style="list-style-type: none"> • Most direct option • Represents a logical continuation of the existing Greenway along the Arroyo Chico Wash • Distance: 0.53 miles | <ul style="list-style-type: none"> • Option is longer than Option 1 • Some users may feel that they are heading “out of the way” by having to go south from the existing Greenway section • Distance: 0.63 miles | <ul style="list-style-type: none"> • Option is the longest • Requires users to go significantly out of their way to get back to the Kino Parkway/Winsett St./15th St. intersection • Distance: 0.90 miles |
| Intersection Crossings | Four roadway crossings: <ul style="list-style-type: none"> ○ Plumer Ave. ○ Olsen Ave. ○ Norris Ave. ○ Campbell Ave. (with a high visibility and median refuge crossing) | Five roadway crossings: <ul style="list-style-type: none"> ○ 15th St. ○ Plumer Ave. ○ Olsen Ave. ○ Norris Ave. ○ Campbell Ave. (with a high visibility crossing) | Five roadway crossings: <ul style="list-style-type: none"> ○ 15th St. ○ Winsett St. ○ 17th St. ○ Plumer Ave. ○ Campbell Ave. (with a high visibility crossing) |
| Driveway Crossings | Driveway crossings: <ul style="list-style-type: none"> ○ 22 curb cuts ○ 6 defined driveways | Driveway crossings: <ul style="list-style-type: none"> ○ 3 curb cuts ○ 9 defined driveways (conflict includes TUSD school buses at different times of the day) | Numerous driveways on the east side of Plumer Ave. south of Winsett St. and along the north side of 18 th St. Most are low turnover residential driveways |
| Right-of-Way Availability | Sufficient ROW along 15 th St., Campbell Ave., Kino Parkway and 15 th St., west of Kino Parkway | Sufficient ROW along Plumer Ave. and Winsett St.; however, there is a fence that encroaches on the required right-of-way. Further analysis is required to determine if property acquisition is required. | ROW limited on Plumer Ave. and 18 th St. due to: <ul style="list-style-type: none"> ○ Angle parking along Plumer Ave. ○ Utility conflicts on Plumer Ave. (i.e., TEP overhead power and poles) ○ Residential landscaping, fencing or walls and mailboxes along 18th St. |

Table 2 (Cont.)

| | | | |
|--|--|--|--|
| Right-of-Way Availability (Cont.) | | | (May be able to reconstruct the north side curb to narrow the travel lanes; however, on-street parking would be eliminated) |
| Bicycle & Pedestrian Accessibility & Safety | Requires the following: <ul style="list-style-type: none"> ○ Installing a crosswalk at roadway crossings and a crosswalk or median refuge area across Campbell Ave. ○ Modifications to the curb returns on the north leg of the Kino Parkway/Winsett St./15th St. signalized intersection ○ Revisions to the signal and signal phasing ○ Defining the driveways along 15th St. and eliminating some of the curb cuts | Requires the following: <ul style="list-style-type: none"> ○ Installing a crosswalk at roadway crossings as applicable ○ Modifications to the curb returns on the north leg of the Kino Parkway/Winsett St./15th St. signalized intersection ○ Revisions to the signal and signal phasing ○ Eliminating some of the curb cuts along Plumer Ave. | Requires the following: <ul style="list-style-type: none"> ○ Installing a crosswalk at roadway crossings as applicable ○ Eliminating parking within path alignment ○ Modifications to the curb returns on the north leg of the Kino Parkway/Winsett St./15th St. signalized intersection ○ Revisions to the signal and signal phasing ○ Eliminating some of the curb cuts along Plumer Ave. ○ Modifications to existing driveways along 18th St. |
| Summary | Option 1 is the preferred alignment given it is the most direct connection and minimizes the number of conflicts with intersections and driveways. ROW is available for the Greenway; however, coordination would be needed for several properties that would need to change how and/or where they park vehicles. | Option 2 is a viable alternative and is a reasonably direct connection. However, it would expose Greenway users to more conflicts with TUSD bus operations and driveways. May need to acquire some ROW to maintain a 12-foot wide Greenway on Winsett St. west of Campbell Ave. | Option 3 is the least direct option and would send Greenway users well out of their way. This option would provide a direct connection to the BA shared-use path via the underpass crossing of Kino Parkway; however, it should still be considered as part of the City's Neighborhood Greenway proposal for Eastland St. and 19 th St. |

3.2 Arroyo Chico Detention Basin to the Barraza-Aviation Shared-Use Path

Proposed Greenway Alignment and Cross Section

This section of the Greenway is proposed to run along Highland Ave. from the ACDB paved multi-use path to tie into ADOT's BA shared-use path. The existing roadway and right-of-way widths would be maintained on Highland Ave. Bicycles would continue to use the roadway; therefore, shared lane pavement markings (sharrows) (Figure 5) would be installed to serve as wayfinding devices and reinforce the use of this facility as a bike route. For pedestrian mobility, improvements would occur on the west side of Highland Ave. There is an existing four-foot wide sidewalk that ties into the curb access ramp on the southwest corner of the Highland Ave./16th St. intersection and extends approximately 120 feet south of the intersection. The existing sidewalk, wedge curb, landscaping and irrigation would be removed and a new six-foot wide sidewalk and vertical curb constructed to tie into the BA shared-use path. The sidewalk would be constructed in back of the new vertical curb. One new driveway may be needed to provide access to a utility easement. New warning and traffic control signage would be installed along

the Greenway as applicable for motorist and Greenway users. This stretch of Greenway improvements is approximately 300 feet long. This concept is presented in Appendix A, Plan 5. There would be utility adjustments and sign relocations. The existing landscaping would need to be removed. New landscaping could be placed behind the sidewalk. On-street parking would be maintained.



Figure 5 – Shared Lane Marking (Sharrow)

Segment Opportunities:

This segment of the proposed Greenway alignment presents several opportunities. These include:

- Safe pedestrian and bicycle environment along the designated roadway
- Low traffic volumes on surrounding roadways
- Direct access to the BA shared-use path from the ACDB multi-use path
- Sufficient space for the six-foot wide sidewalk on the west side of Highland Ave.
- Maintains on-street parking
- Maintains the roadway width
- No restriction to traffic movements on any of the roadways

Segment Constraints

- Would involve utility modifications/relocations

Probable Construction Quantities and Cost Estimates

The total estimated cost to construct the Greenway for this section is approximately \$120,070. This estimate is based on the concept described above and current bid prices from recent projects. The detailed breakdown of the probable cost estimate is presented in Appendix E.

Other alignments evaluated and eliminated from further consideration within this segment are described below and shown on Figure 3 (highlighted in yellow).

16th Street

From the ACDB multi-use path the alignment would run along the south side 16th St. to a ramp for the BA shared-use path. 16th St. is a low volume road. The wedge and vertical curb on the south side of the street could be reconstructed to the north to provide a two-way pathway to connect to the BA shared-use path. The pathway would cross two designated driveways and three curb cuts in the vertical curb. The distance of this option would be approximately 650 feet. Due to this option being longer, having a high number of conflicting points and the chance that some users may feel that they are heading “out of the way” this option was removed from consideration.

Star Avenue and 14th Street

This option evaluated an alignment that would run from the ACDB multi-use path along Star Ave. and then along 14th St. to the BA shared-use path. Star Ave. is a low volume street; however, it is fully developed with residential on both sides of the road. This results in numerous driveways being in conflict with Greenway users. The section of 14th St. between Star Ave. and Park Ave. is also a low volume street which has numerous residential and commercial driveways and several curb extensions that appear to be recently constructed to visually narrow the street. The street would need to be reconstructed to include the Greenway.

At the west end of 14th St., the Greenway would cross Park Ave., just north of the cul-de-sac at the end of Park Ave. to connect to and head west on the BA shared-use path. The cul-de-sac is used by all types of vehicles including service vehicles from Lost Barrio that could introduce conflicts with Greenway users.

Due to this option having a high number of conflicting points, the need to reconstruct 14th St. and the chance that there would be more conflicts between Greenway users and larger vehicles on Park Ave. this option was removed from consideration.

3.3 Arroyo Chico Detention Basin to Broadway Boulevard

The preferred alignment in this section of the Greenway is proposed to run along the far south side of the Arroyo Chico Wash from the ACDB paved multi-use path to 12th St. It would continue along 12th St. to Park Ave. and then north along the west side of Park Ave. to a future HAWK (pedestrian crossing signal) on the west leg of the Broadway Blvd./Park Ave. intersection. New warning and traffic control signage would be installed along the Greenway as applicable for motorist and Greenway users. The total length of this section is approximately 880 feet.

On 12th Ave., bicycles would use the roadway. Shared lane pavement markings (sharrows) (Figure 5) would be installed to serve as wayfinding devices and reinforce the use of this facility as a bike route.

Cross Sections

This segment of the Greenway includes three cross sections.

The first segment would extend from the ACDB multi-use path to 12th St. along the far south side of the Arroyo Chico Wash and would be a 12-foot wide AC pathway with concrete header at the pathway edges to prevent the edges from degrading. This property is owned by the Pima County Flood Control District. Landscaping could be placed on both sides of the path. Existing post and cable and chain link fencing would need to be removed and possibly replaced. This cross section is presented in Appendix A, Plan 6. A before and after perspective for this segment looking west is presented in Appendix B.

The proposed improvements along 12th St. would extend to Park Ave. and would include narrowing the roadway to construct vertical curb and eight-foot wide sidewalks on both sides of the roadway for pedestrian access. Bicycles would continue to use the roadway; therefore, shared lane pavement markings (sharrows) (Figure 5) would be installed to serve as wayfinding devices and reinforce the use of this facility as a bike route. The proposed improvements would also include new driveways, utility adjustments and sign relocations. Landscaping could be placed behind the sidewalk. On-street parking would be maintained. Crosswalk striping would be placed across Park Ave. from the curb returns on 12th St. This cross section is presented in Appendix A, Plan 6. A before and after perspective of the Park Ave./12th St. intersection looking west is presented in Appendix B.

The proposed improvements along Park Ave. would include constructing a new eight-foot wide concrete sidewalk, a new ten-foot wide AC path and vertical curb on the west side of the road between 12th Ave. and Broadway Blvd. A two-foot wide buffer area would separate the sidewalk and AC path. These improvements would be within the existing right-of-way; therefore the roadway would be narrowed to accommodate the improvements. There would be modifications to the existing storm drain system. There would be no changes to the right-of-way or sidewalk widths or the location of the vertical curb on the east side of the road. Landscaping could be placed behind the AC path and the vertical curb on the west side of the road. No utility adjustments or sign relocations are anticipated. On-street parking and the intersection with Mc Key St. would be maintained. Crosswalks for separating pedestrians and bicycles would be placed across Mc Key St. The cross section is presented in Appendix A, Plan 6. A before and after perspective of Park Ave. looking north is presented in Appendix B.

Segment Opportunities:

The proposed Greenway alignment presents several opportunities. These include:

- Safe pedestrian and bicycle environment along the roadways
- Low traffic volumes on surrounding roadways
- Few driveway locations
- Sufficient space for the eight-foot wide sidewalks on 12th St.
- Proximity to the Arroyo Chico Wash
- Maintains on-street parking
- No restriction to traffic movements on any of the roadways

Segment Constraints

- Some minor utility modifications/relocations
- Vertical curb and sidewalk on 12th St. would restrict access to residences on the south side and the business on the north side. Would need to construct driveways
- Right-of-way acquisition from Pima County Flood Control District
- Modifications are needed to the existing storm drain system on Park Ave.

Probable Construction Quantities and Cost Estimates

The total estimated cost to construct the Greenway for this section is approximately \$541,790. This estimate is based on the concept described above and current bid prices from recent projects. The detailed breakdown of the probable cost estimate is presented in Appendix E.

Due to the project area constraints, no other alignments were considered for this segment.

Other Relevant Projects Within the Project Vicinity

This project is not currently funded or listed in the transportation improvement program (TIP). The purpose of this study is to perform an assessment of the alternative alignments developed for the City of Tucson Parks and Recreation Department to complete the Arroyo Chico Greenway (Figure 3). The overall plan for the Greenway is to have connectivity for pedestrian and bicycle use from Randolph/Reid Park to downtown.

Greenway segments are at various stages of development. As depicted in Figure 3, a majority of the Greenway has been completed. Other segments are either currently under design or designed and ready for construction. The segments evaluated in this report are the only segments left to be studied.

Other projects within the area include the following:

| TIP ID # | Name | Status |
|----------|--|--------|
| 22.05 | Broadway Blvd. Widening Project | Design |
| 78.12 | Treat Ave.: Rillito River to Barraza-Aviation Bike Boulevard | Design |

4.0 CONCLUSIONS AND RECOMMENDATIONS

The purpose of the Arroyo Chico Multi-Use Path study was to evaluate viable alignments to provide continuous and accessible pedestrian and bicycle connectivity from Reid Park (Randolph) to the Downtown Business District as part of the Arroyo Chico Greenway Master Plan (Greenway) by Tucson Parks and Recreation. The Greenway alignment generally follows the Arroyo Chico Wash with the goal of also connecting city residents to the regional trail system and adjacent central neighborhoods. Segments of the Greenway are either constructed or are currently under design. This project studied the following segments (shown in yellow on Figure 3):

- Arroyo Chico Greenway at Parkway Terrace to the Arroyo Chico Detention Basin (approximately 0.70 miles)
- Arroyo Chico Detention Basin to the Barraza-Aviation Shared-Use Path (approximately 300 feet)
- Arroyo Chico Detention Basin to Broadway Blvd. (approximately 880 feet)

The following recommendations should be implemented to meet the goals and objectives of this study:

- Design and construct a 12-foot wide AC path for the Greenway segment from the Arroyo Chico Greenway connection at Parkway Terrace to the Arroyo Chico Detention Basin along the:
 - North side of 15th St. between Parkway Terrace and Campbell Ave.
 - East side of Campbell Ave. to the Campbell Ave. crossing just south of the Arroyo Chico Wash

- South side of Arroyo Chico Wash between Campbell Ave. and Kino Parkway
- East side of Kino Parkway up to the Kino Parkway/Winsett St./15th St. intersection
- North side of 15th St. between the Kino Parkway/Winsett St./15th St. intersection and the ACDB multi-use path
- Other proposed improvements include:
 - ADA accessible curb access ramps at intersections
 - The appropriate traffic control signage for motorists and Greenway users.
 - Install a high visibility crosswalk and median refuge crossing on Campbell Ave.
- Design and construct a six-foot wide concrete sidewalk and vertical curb along the west side of Highland Ave. for the Greenway segment between the ACDB multi-use path and the BA shared-use path for pedestrian use. Bicycles would continue to use the roadway. Shared lane pavement markings (sharrows) (Figure 5) would be installed to serve as wayfinding devices and reinforce the use of this facility as a bike route.
- Design and construct the following for the Greenway segment from Arroyo Chico Detention Basin to Broadway Blvd.:
 - 12-foot wide AC path from the ACDB paved multi-use path to 12th St. The path would run northwest along the far south side of the Arroyo Chico Wash to 12th St.
 - Eight-foot wide concrete sidewalks and vertical curb along both sides of 12th St. for pedestrian use. Bicycles would continue to use the roadway. Shared lane pavement markings (sharrows) would be installed to serve as wayfinding devices and reinforce the use of this facility as a bike route.
 - New eight-foot wide concrete sidewalks, vertical curb and a ten-foot wide AC path for bicycle use along the west side of Park Ave. between 12th St. and Broadway Blvd. A two-foot wide buffer would separate the sidewalk from the bicycle path (see Appendix A, Plans 6 and 7).
 - Other proposed improvements include:
 - ADA accessible curb access ramps at intersections
 - The appropriate traffic control signage for motorists and Greenway users.
 - High visibility crosswalks across Park Ave. and Mc Key St.

Tucson Parks and Recreation should coordinate with the Broadway Blvd. design team to ensure that the design elements on the west leg of the intersection would accommodate a pedestrian and bicycle crossing, including separate pedestrian and bicycle friendly curb access ramps, bicycle friendly push buttons at the HAWK signal, and the appropriate crosswalk pavement marking and signage.

5.0 RECOMMENDATIONS FOR PROJECT PHASING

The purpose of this section is to recommend an implementation strategy for the preferred Greenway alignments. There is no funding currently identified in any of the local or regional transportation plans to initiate the design and construction of these proposed alignments and improvements.

The existing Greenway facilities tie into existing roadways within the project limits; however, due to the missing links of the Greenway, as defined on Figure 3, there is no Greenway connectivity from Reid Park (Randolph) to the Downtown Business District that is continuous and accessible to pedestrians and bicycles. Therefore, it is recommended that funding be allocated to the design and construction phase for the preferred alignments and proposed improvements described in this Planning Memorandum; with the exception of the Arroyo Chico Detention Basin to Broadway Blvd. segment.

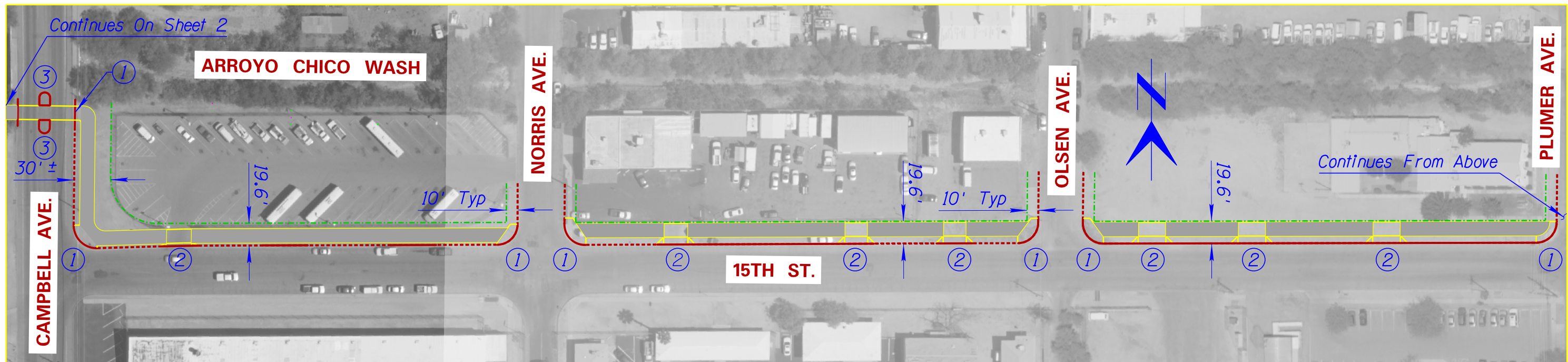
The Arroyo Chico Detention Basin to Broadway Blvd. segment should be implemented with the current Broadway Blvd. final design project since improvements for this segment is directly linked to the improvements along Broadway Blvd. and at the Broadway Blvd./Park Ave. intersection.

6.0 REFERENCES

1. *Arroyo Chico Greenway Issues and Opportunities Analysis*, Toole Design Group, October 2015.
2. *Tucson Arroyo Chico Greenway Concept Designs for the E 15th Street and S Park Avenue Sections Memorandum*, Toole Design Group, January 15, 2016

APPENDIX A

Concept Plans and Cross Sections




Legend

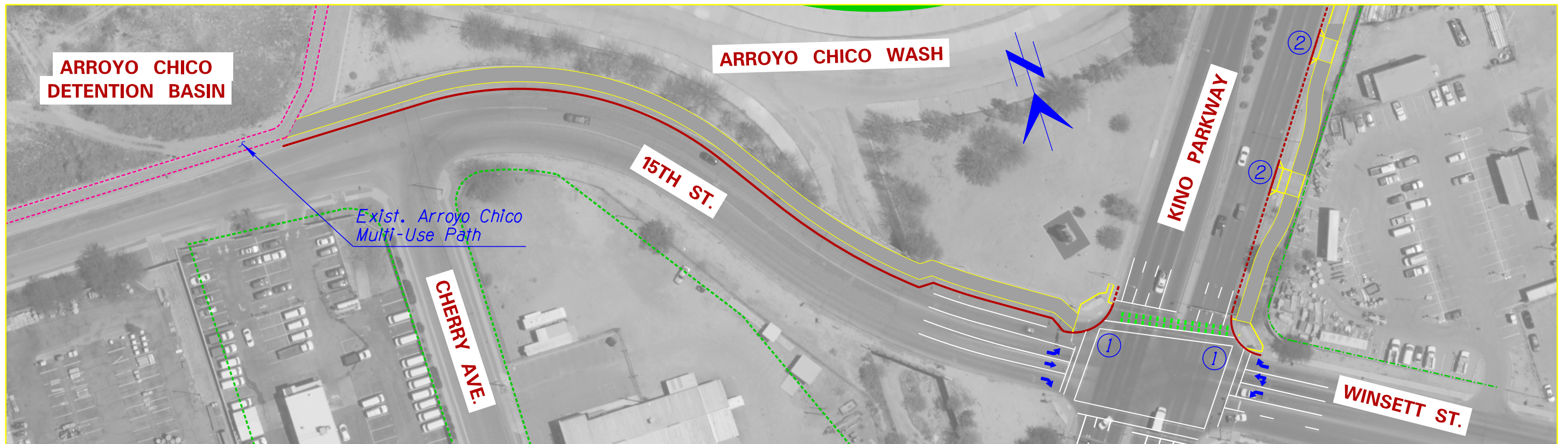
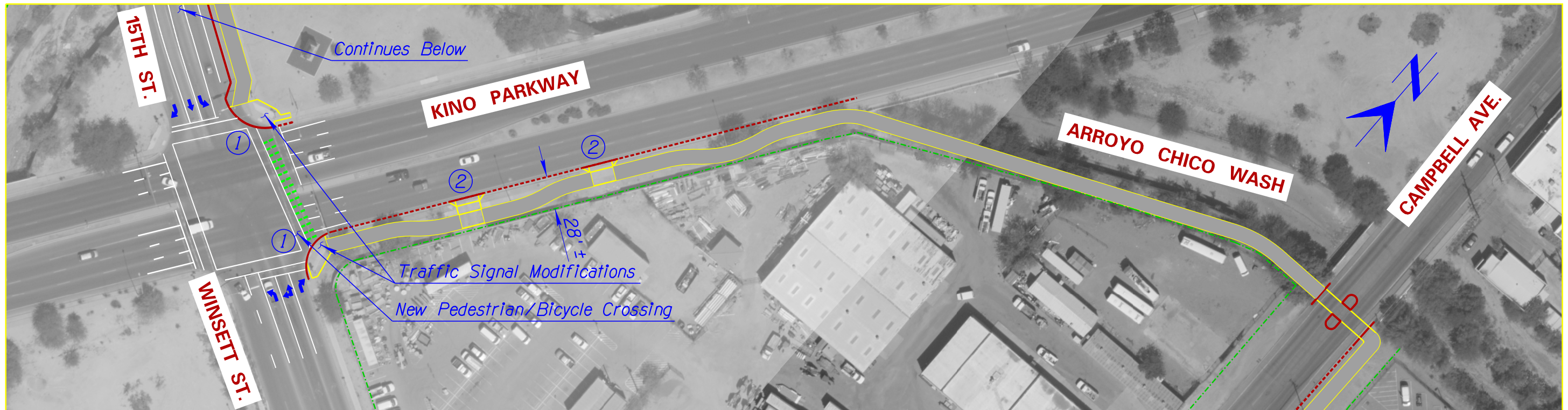
- ① New Concrete Curb Access Ramp
PAG Std Dtl 207
- ② New Concrete Driveway Apron
PAG Std Dtl 206
- ③ New Raised Median Refuge
- New 12' AC Multi-Use Path
- - - Existing Concrete Curb
- New Concrete Curb
- - - Existing Right-Of-Way

PLOTTED BY: 3/24/2017 9:03:24 AM
 Date Plotted: 3/24/2017 9:03:24 AM
 Time Plotted: 9:03:24 AM
 Pjname: T:\66428896 Arroyo Chico Multi-Use Path\989-Work\918-CAD\26-SHEETS\plan sheets 1.dgn



| | | | | |
|---|--|---|-------------------------|--------------------------|
| Conceptual Plans Not for Construction or Recording March 2017 | TUCSON PARKS AND RECREATION DEPARTMENT ARROYO CHICO MULTI-USE PATH TUCSON BOULEVARD TO BROADWAY BOULEVARD | | | 1 OF 4 |
| |  | DRWN. BY: CJR DSGN. BY: CJR CHKD. BY: MPK | 03/17 03/17 03/17 | REF. _____ SCALE: NTS |
| | PLAN NO. _____ | | | |
| | | | | |

| NO. | DATE | REVISION | BY | CHKD. | APPR. |
|-----|------|----------|----|-------|-------|
| | | | | | |




- Legend**
- ① New Concrete Curb Access Ramp
PAG Std Dtl 207
 - ② New Concrete Driveway Apron
PAG Std Dtl 206
 - New 12' AC Multi-Use Path
 - - - Existing Concrete Curb
 - New Concrete Curb
 - - - Existing Right-Of-Way

PLOTTED BY:
 Date Plotted: 3/24/2017 9:05:24 AM
 Time Plotted:
 Pjname: Arroyo Chico Multi-Use Path\980-Work\918-CAD\26-SHEETS\plan sheets 2.dgn

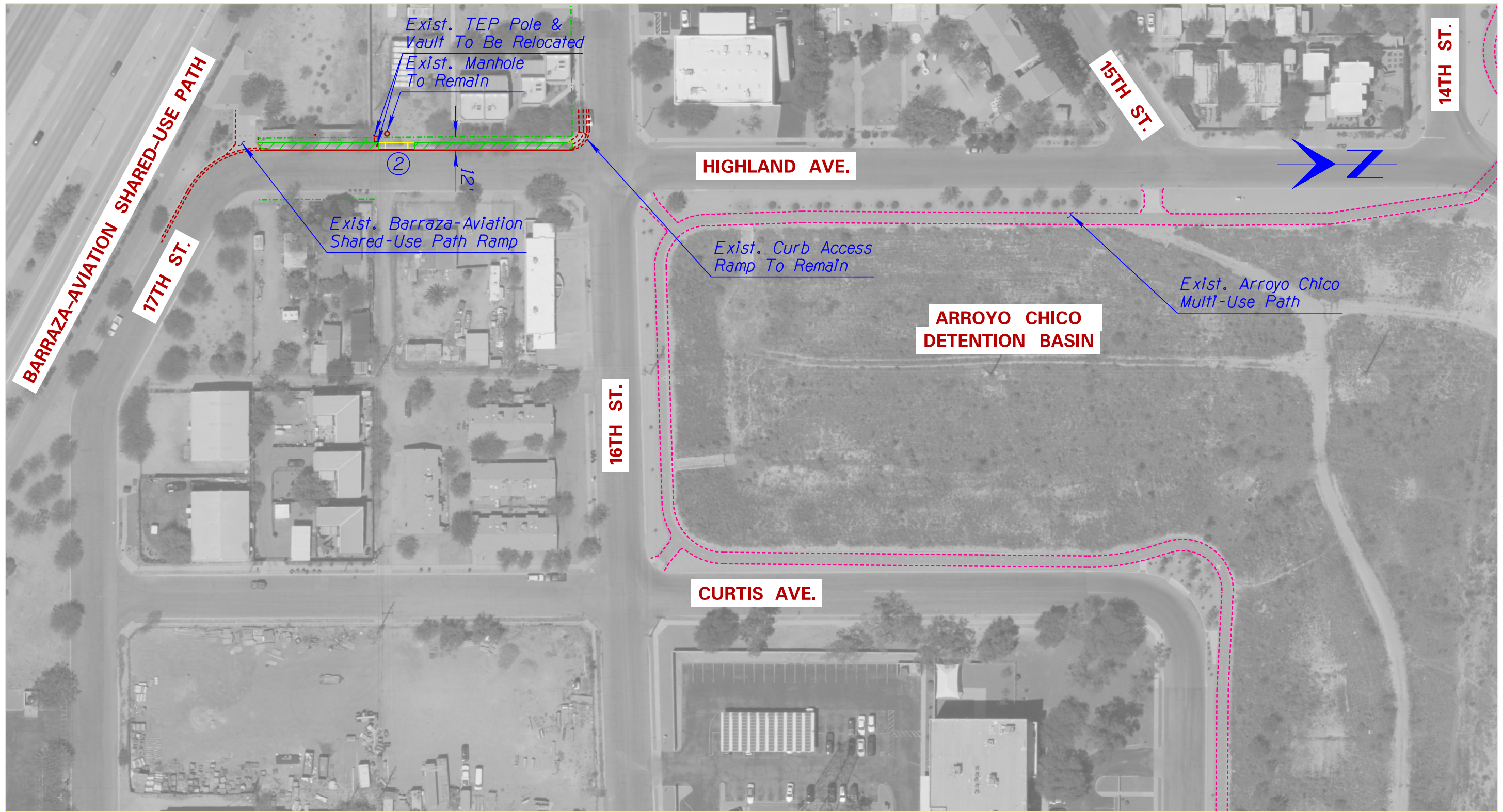
| NO. | DATE | REVISION | BY | CHKD. | APPR. |
|-----|------|----------|----|-------|-------|
| | | | | | |

Conceptual
Plans
Not for
Construction
or Recording
March 2017

| | | | | | |
|---|--|---------------|-------|----------|------------|
|  Tucson Parks and Recreation A Nationally Accredited Agency | | DRWN. BY: CJR | 03/17 | REF. | SCALE: NTS |
| | | DSGN. BY: CJR | 03/17 | | |
| TRANSPORTATION AECOM USA, INC. 555 E. WETMORE RD., SUITE 400 TUCSON, ARIZONA 85710 T: 520.745.2000 F: 520.745.2001 | | CHKD. BY: MPK | 03/17 | PLAN NO. | |



AECOM
www.aecom.com



Legend

- ① New Concrete Curb Access Ramp
PAG Std Dtl 207
- ② New Concrete Driveway Apron
PAG Std Dtl 206
- ▨ New 6' Concrete Sidewalk
- Existing Concrete Curb
- New Concrete Curb
- Existing Sidewalk/Multi-Use Path
- Existing Right-Of-Way

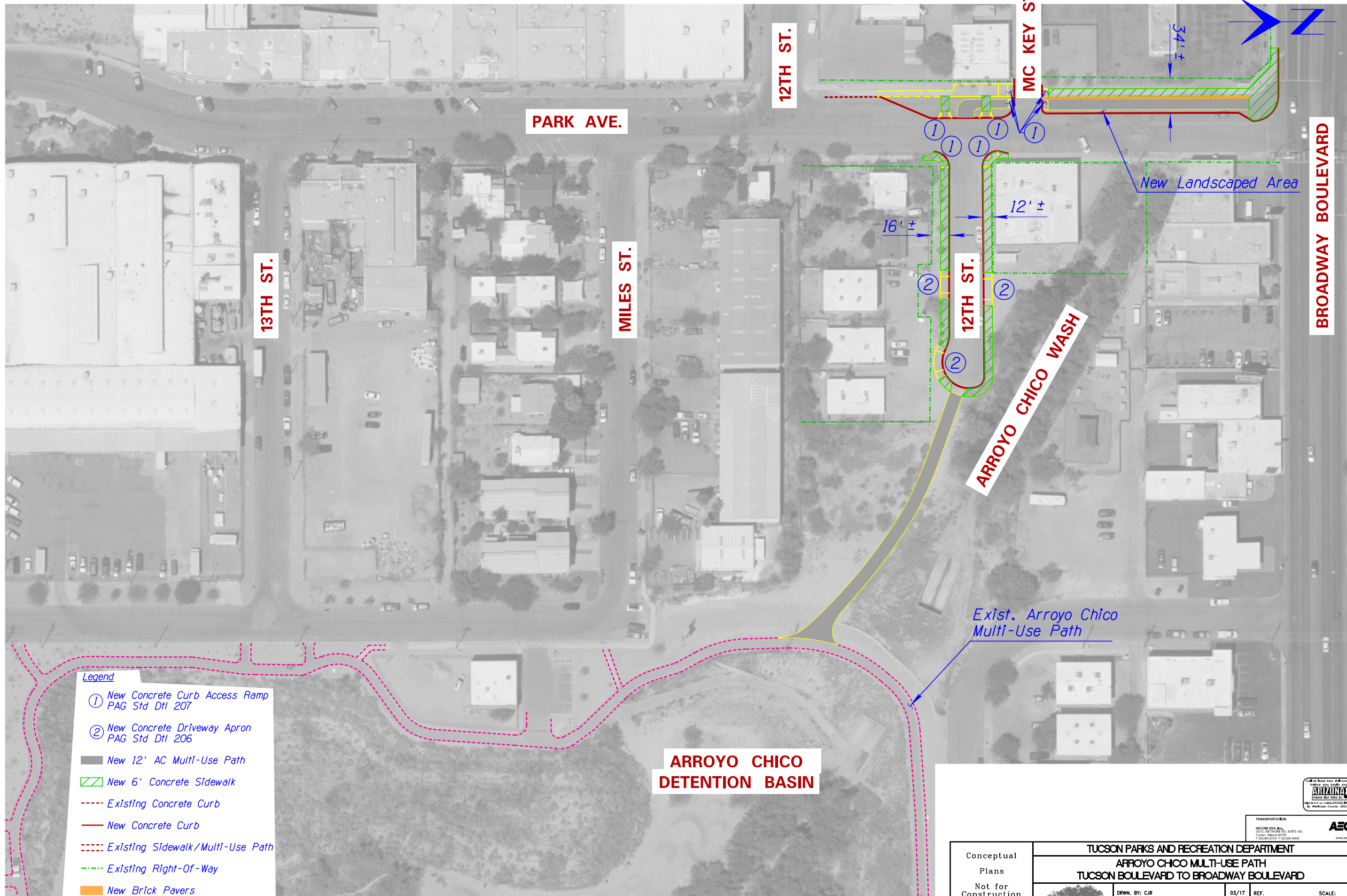
PLOTTED BY: RebruceC
 Date Plotted: 3/24/2017 9:05:03 AM
 Time Plotted: 11:56:42 AM
 Filename: Arroyo Chico Multi-Use Path\980-Work\918-CAD\26-SHEETS\plan sheet 3.dgn

| NO. | DATE | REVISION | BY | CHKD. | APPR. |
|-----|------|----------|----|-------|-------|
| | | | | | |

Conceptual Plans
 Not for Construction or Recording
 March 2017


| | | | | |
|---|--|--|-------------------------|--------------------------|
| | | TUCSON PARKS AND RECREATION DEPARTMENT ARROYO CHICO MULTI-USE PATH TUCSON BOULEVARD TO BROADWAY BOULEVARD | | 3 |
| | | DRWN. BY: CJR DSGN. BY: CJR CHKD. BY: MPK | 03/17 03/17 03/17 | REF. _____ SCALE: NTS |
| TRANSPORTATION AECOM USA, INC. 555 E. WETMORE RD., SUITE 400 TUCSON, ARIZONA 85710 TEL: 520.790.1234 FAX: 520.790.1235 WWW.AECOM.COM | | | | AECOM 3 OF 4 |

PLOTTED BY: RbrynesC
 Date Plotted: 3/24/2017
 Time Plotted: 9:10:31 AM
 Pjname: Arroyo Chico Multi-Use Path CAD\26-SHEETS\plan sheets 4.dgn



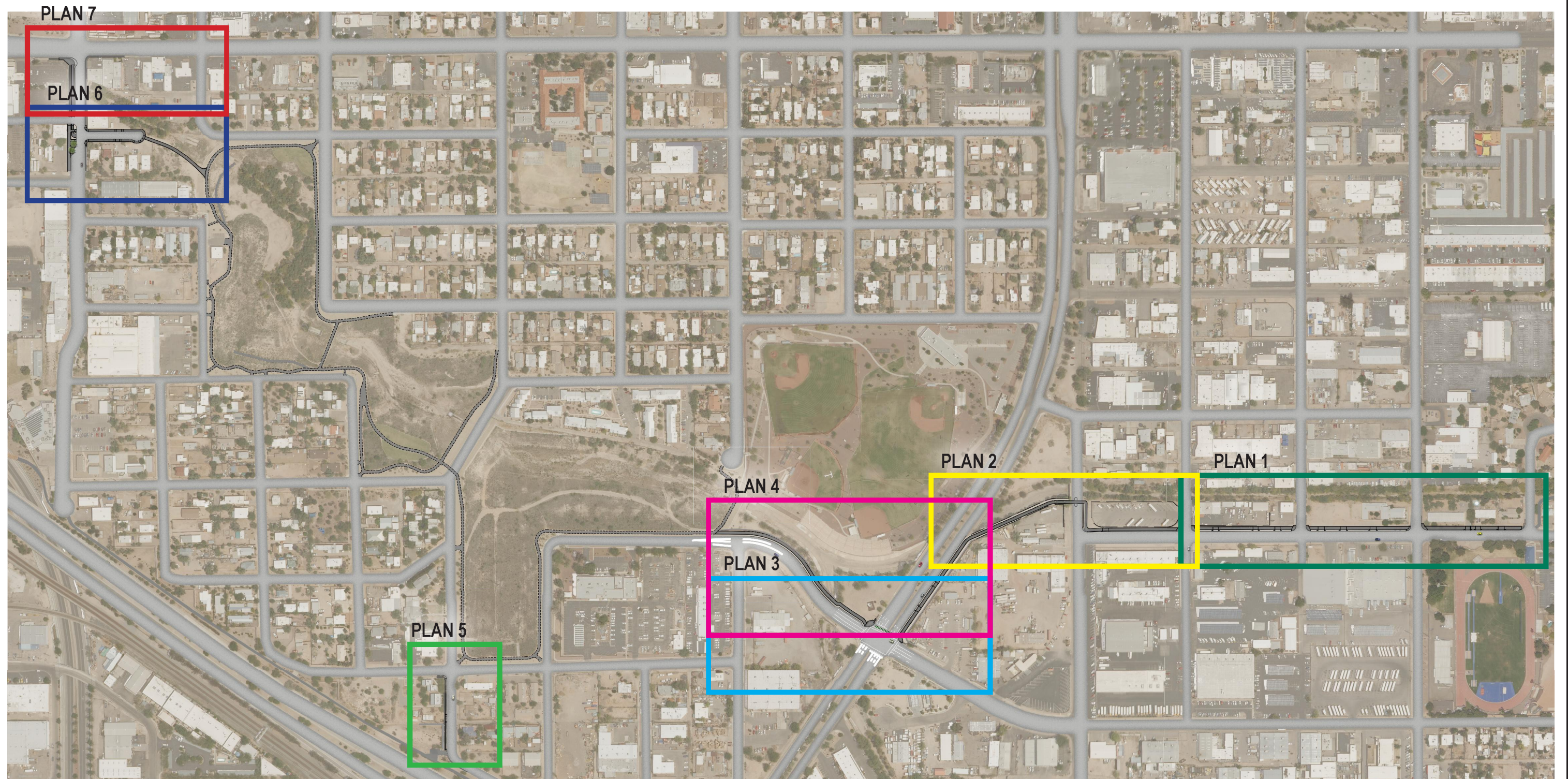
- Legend**
- ① New Concrete Curb Access Ramp
PAG Std Dtl 207
 - ② New Concrete Driveway Apron
PAG Std Dtl 206
 - New 12' AC Multi-Use Path
 - ▨ New 6' Concrete Sidewalk
 - - - Existing Concrete Curb
 - New Concrete Curb
 - - - Existing Sidewalk/Multi-Use Path
 - - - Existing Right-Of-Way
 - ▨ New Brick Pavers

**ARROYO CHICO
DETENTION BASIN**

| | | | |
|--|--|---|-------------------------|
| Conceptual Plans Not for Construction or Recording March 2017 | TUCSON PARKS AND RECREATION DEPARTMENT ARROYO CHICO MULTI-USE PATH TUCSON BOULEVARD TO BROADWAY BOULEVARD | | 4 OF 4 |
| |  | DRWN. BY: CJR DSGN. BY: CJR CHKD. BY: MPK | 03/17 03/17 03/17 |
| | REF. _____ SCALE: NTS PLAN NO. _____ | | |

| NO. | DATE | REVISION | BY | CHKD. | APPR. |
|-----|------|----------|----|-------|-------|
| | | | | | |





NOTE: GRAPHIC IS FOR ILLUSTRATIVE PURPOSE ONLY.

Arroyo Chico Greenway: Parkway Terrace to Broadway Boulevard

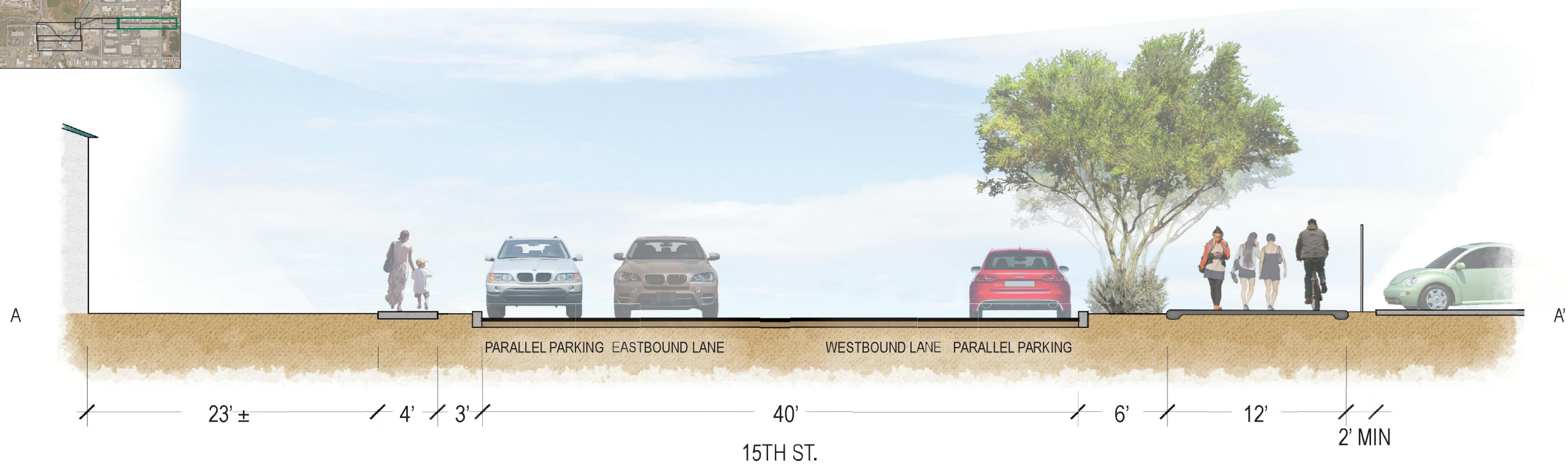
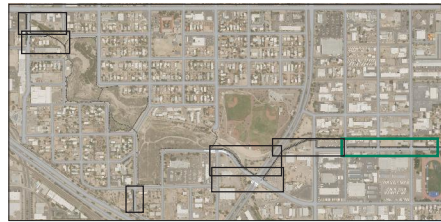
February 2017



418 North Toole Ave.
Tucson, Arizona 85701
P 520.622.9666
www.norris-design.com



PLAN 1



NOTE: GRAPHIC IS FOR ILLUSTRATIVE PURPOSE ONLY.

Arroyo Chico Greenway: Parkway Terrace to Broadway Boulevard

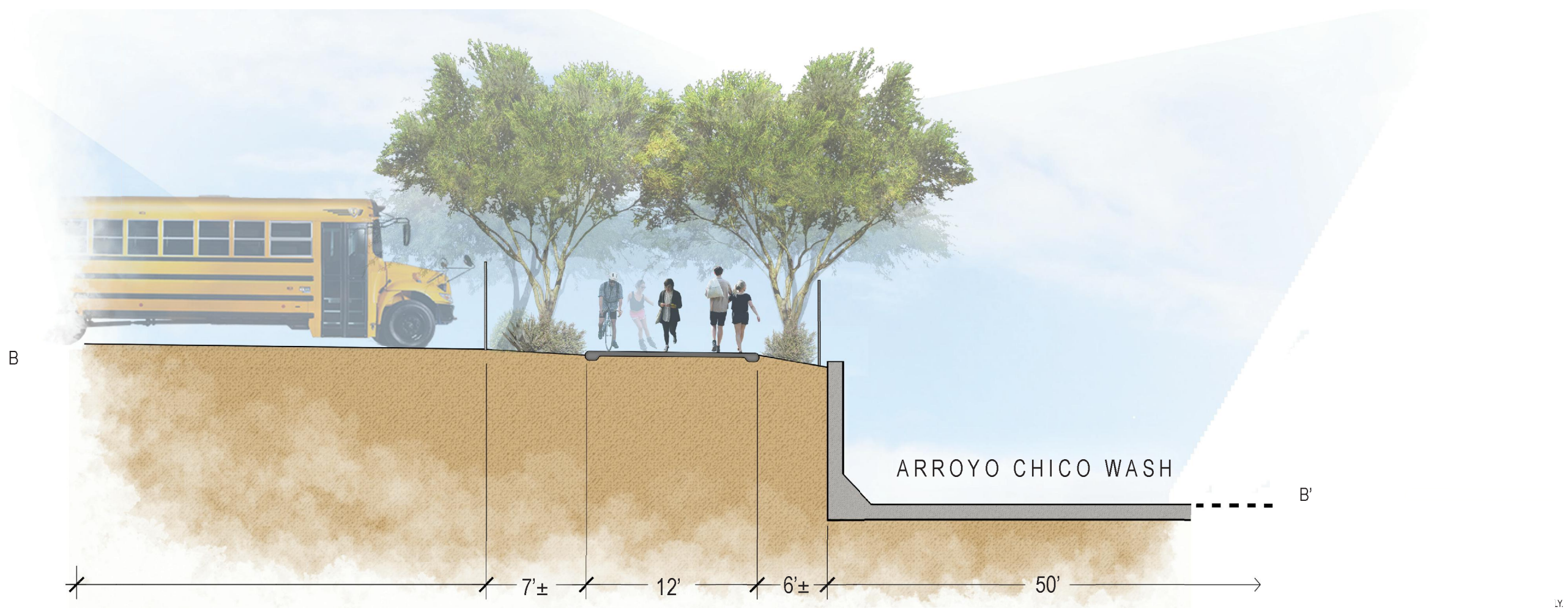
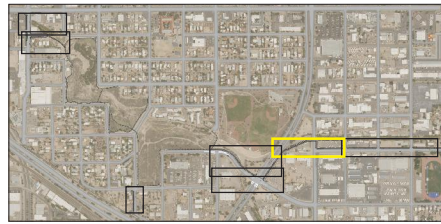
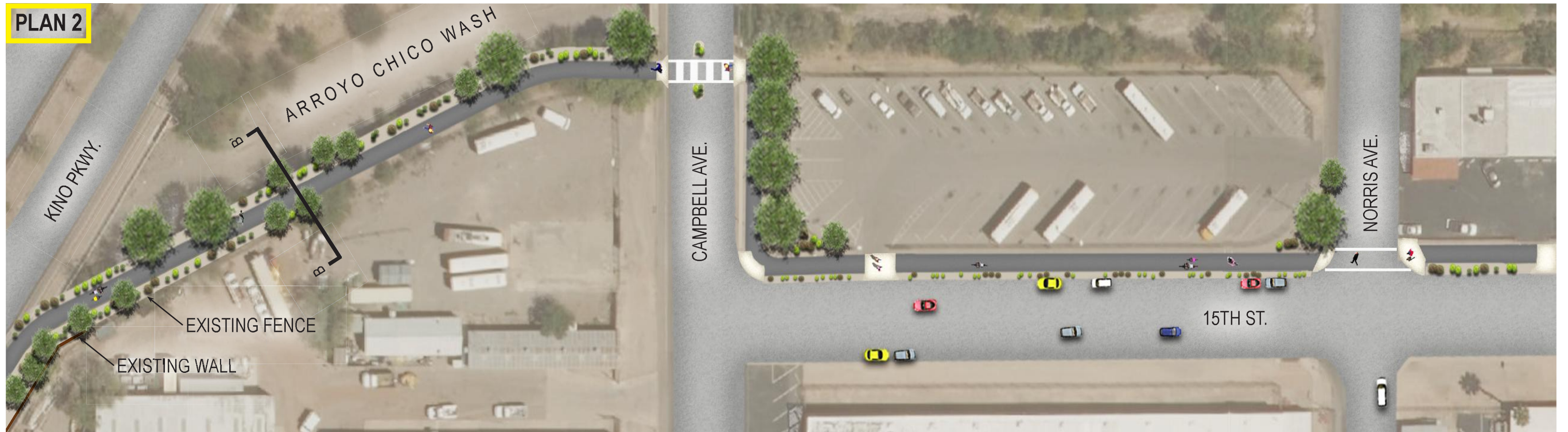
February 2017



418 North Toole Ave.
Tucson, Arizona 85701
P 520.622.9666
www.norris-design.com



PLAN 2



Arroyo Chico Greenway: Parkway Terrace to Broadway Boulevard

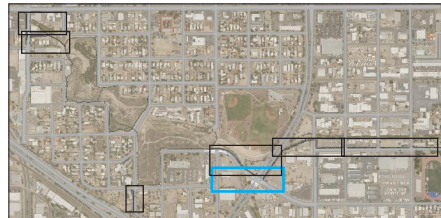
February 2017



418 North Toole Ave.
Tucson, Arizona 85701
P 520.622.9666
www.norris-design.com



PLAN 3



NOTE: GRAPHIC IS FOR ILLUSTRATIVE PURPOSE ONLY.

Arroyo Chico Greenway: Parkway Terrace to Broadway Boulevard

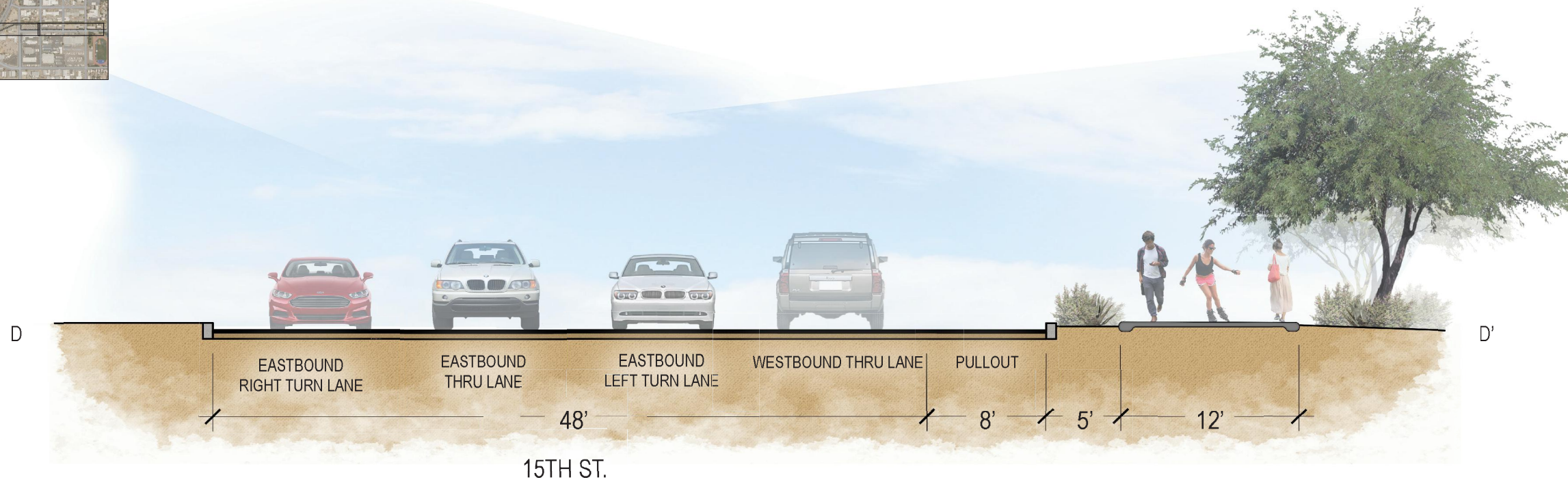
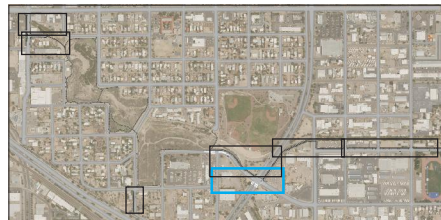
February 2017



418 North Toole Ave.
Tucson, Arizona 85701
P 520.622.9666
www.norris-design.com



PLAN 3



NOTE: GRAPHIC IS FOR ILLUSTRATIVE PURPOSE ONLY.

Arroyo Chico Greenway: Parkway Terrace to Broadway Boulevard

February 2017

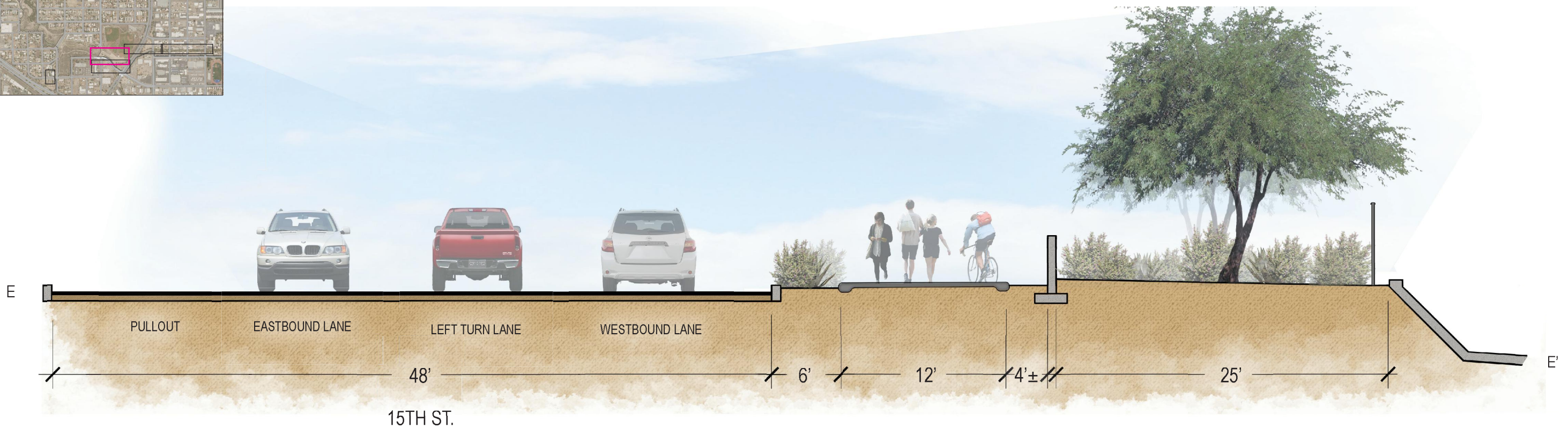
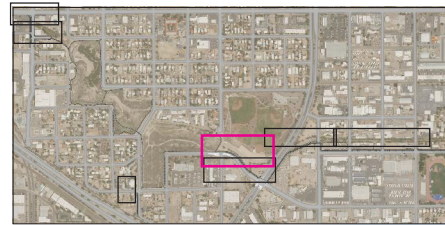
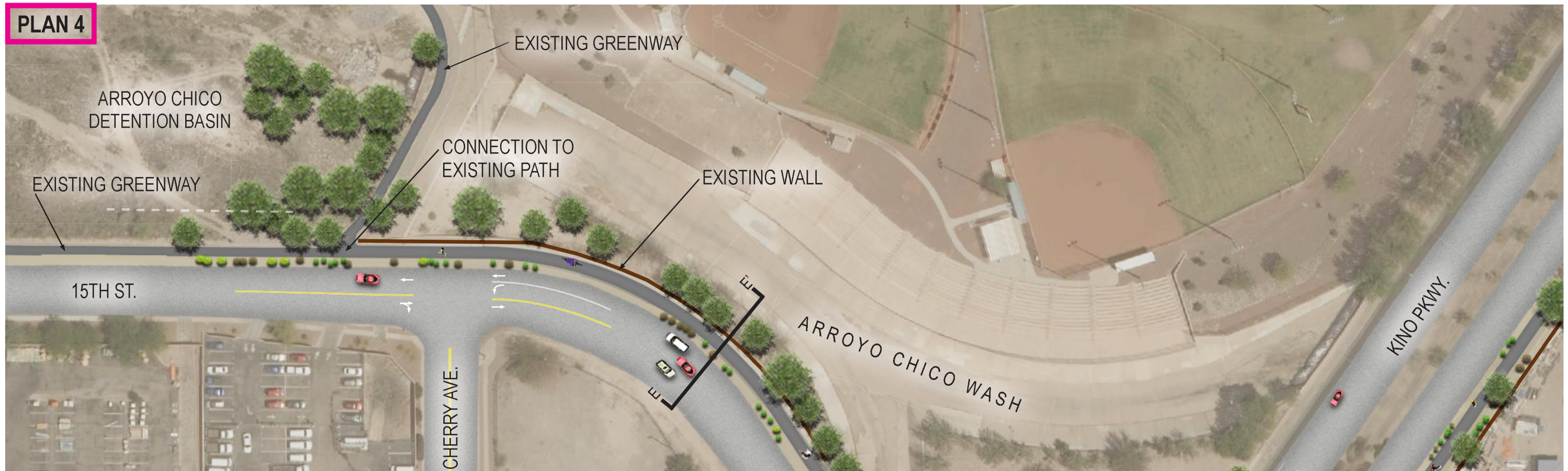


NORTH
NOT TO SCALE

418 North Toole Ave.
Tucson, Arizona 85701
P 520.622.9666
www.norris-design.com



PLAN 4



NOTE: GRAPHIC IS FOR ILLUSTRATIVE PURPOSE ONLY.

Arroyo Chico Greenway: Parkway Terrace to Broadway Boulevard

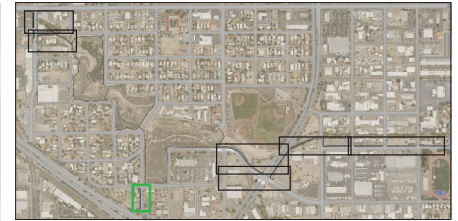
February 2017



418 North Toole Ave.
Tucson, Arizona 85701
P 520.622.9666
www.norris-design.com



PLAN 5



NOTE: GRAPHIC IS FOR ILLUSTRATIVE PURPOSE ONLY.

Arroyo Chico Greenway: Parkway Terrace to Broadway Boulevard

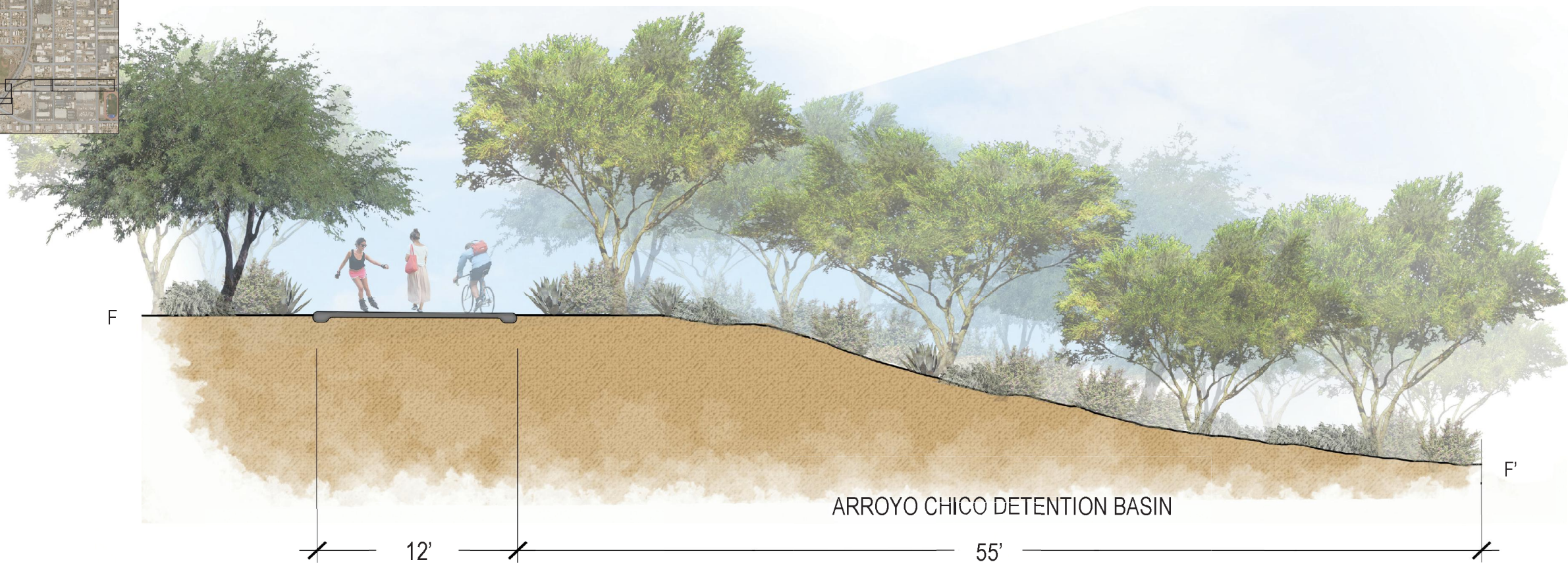
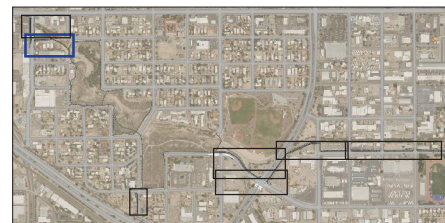
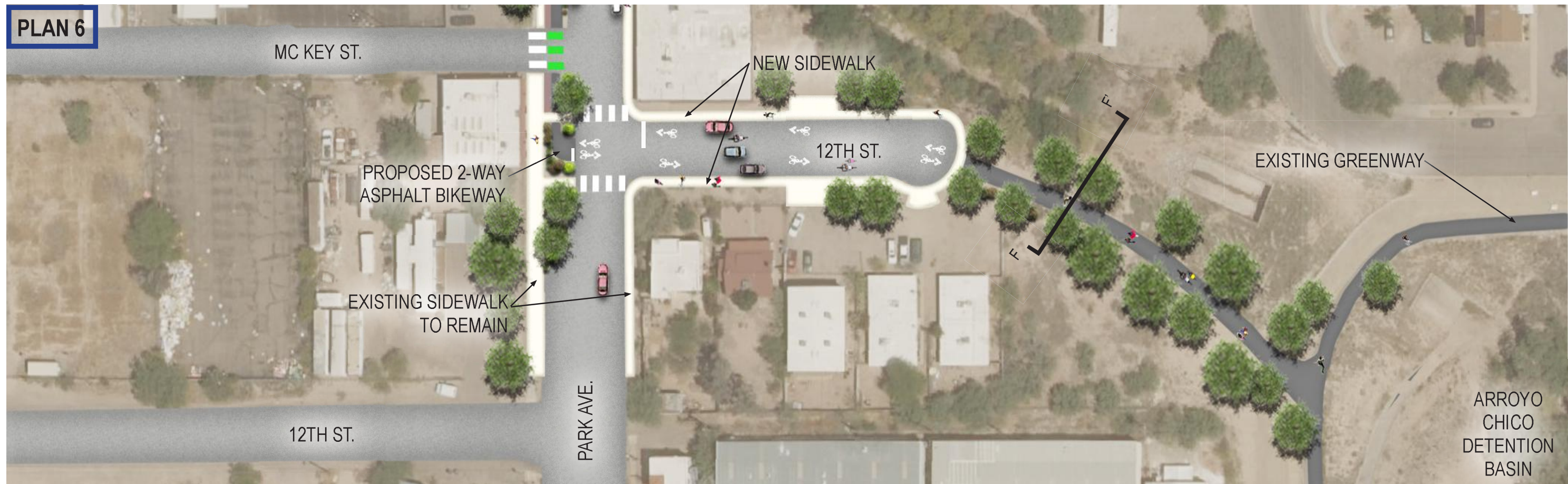
February 2017



418 North Toole Ave.
Tucson, Arizona 85701
P. 520.622.9666
www.norris-design.com



PLAN 6



NOTE: GRAPHIC IS FOR ILLUSTRATIVE PURPOSE ONLY.

Arroyo Chico Greenway: Parkway Terrace to Broadway Boulevard

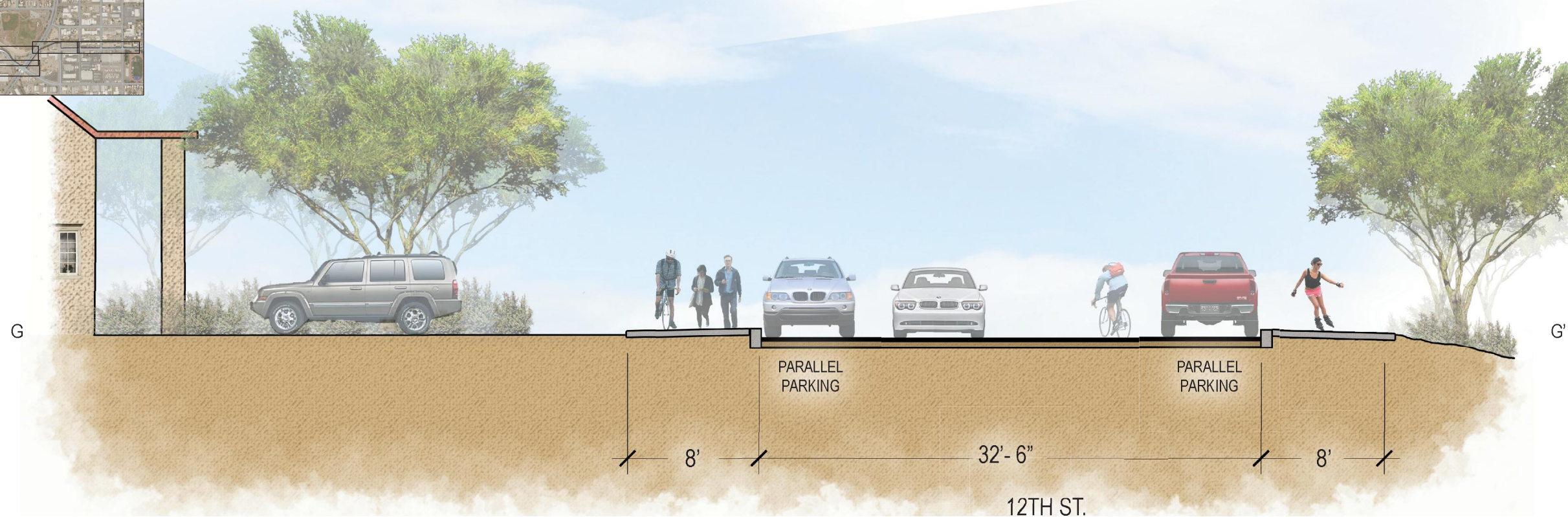
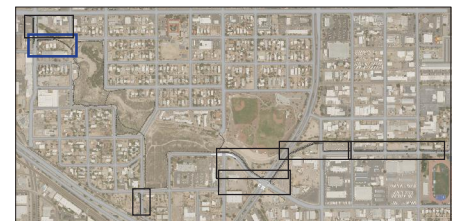
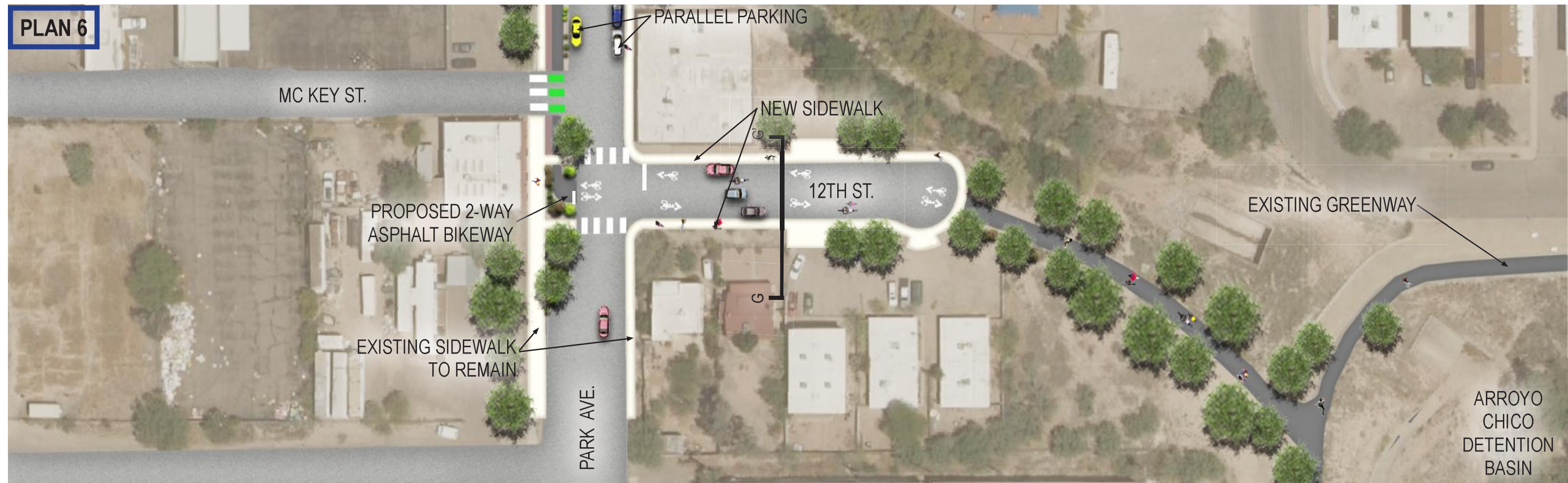
February 2017



418 North Toole Ave.
Tucson, Arizona 85701
P 520.622.9666
www.norris-design.com



PLAN 6



NOTE: GRAPHIC IS FOR ILLUSTRATIVE PURPOSE ONLY.

Arroyo Chico Greenway: Parkway Terrace to Broadway Boulevard

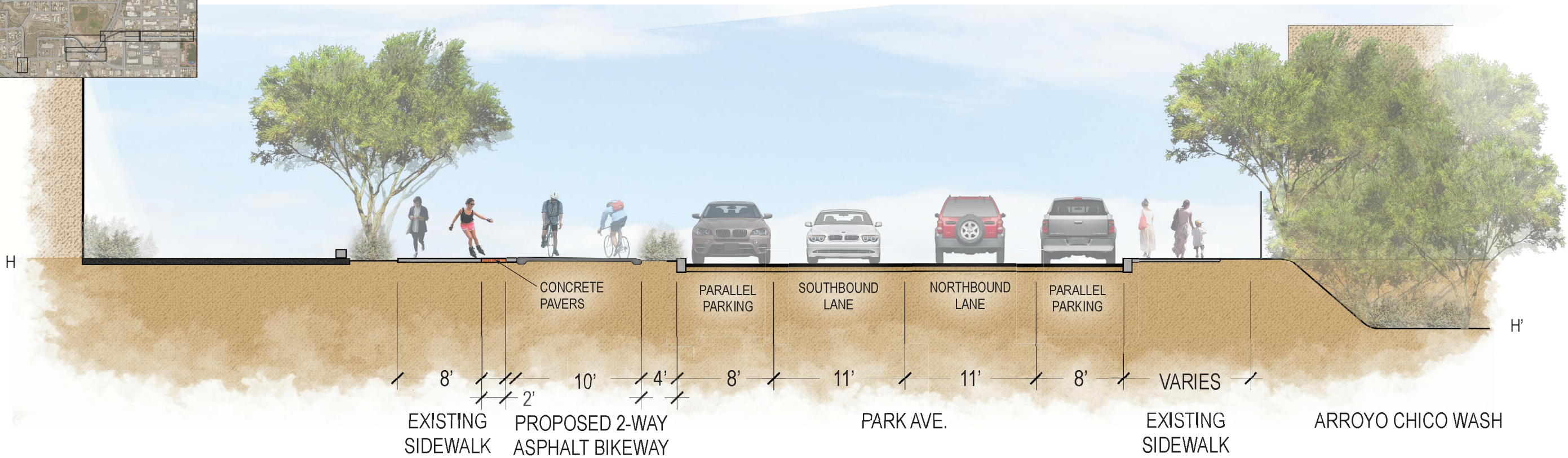
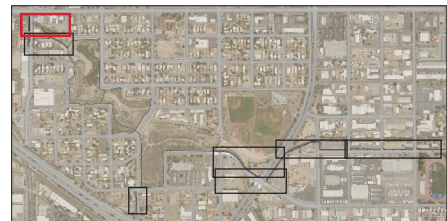
February 2017



418 North Toole Ave.
Tucson, Arizona 85701
P 520.622.9666
www.norris-design.com



PLAN 7



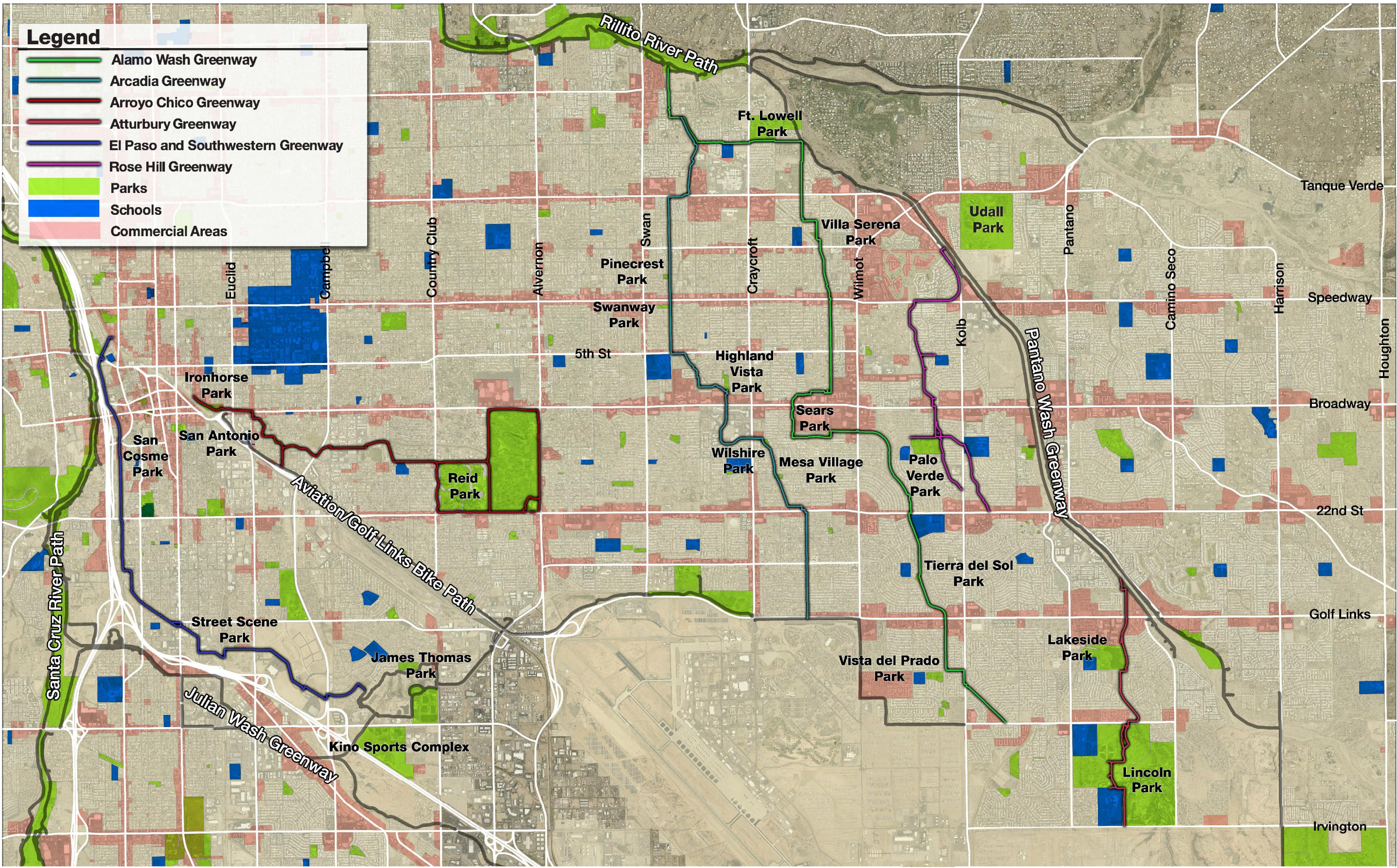
Arroyo Chico Greenway: Parkway Terrace to Broadway Boulevard

February 2017



418 North Toole Ave.
Tucson, Arizona 85701
P 520.622.9666
www.norris-design.com





NOTE: GRAPHIC IS FOR ILLUSTRATIVE PURPOSE ONLY.

Tucson Greenways

February 2017



418 North Toole Ave.
Tucson, Arizona 85701
P 520.622.9665
www.norris-design.com



APPENDIX B

Before and After Perspectives



BEFORE - 15TH ST. LOOKING EAST



AFTER - 15TH ST. LOOKING EAST

NOTE: GRAPHIC IS FOR ILLUSTRATIVE PURPOSE ONLY



BEFORE - KINO PKWY. LOOKING NORTH



AFTER - KINO PKWY. LOOKING NORTH

NOTE: GRAPHIC IS FOR ILLUSTRATIVE PURPOSE ONLY



BEFORE - INTERSECTION OF 15TH ST. AND KINO PKWY. LOOKING WEST



AFTER - INTERSECTION OF 15TH ST. AND KINO PKWY. LOOKING WEST

NOTE: GRAPHIC IS FOR ILLUSTRATIVE PURPOSE ONLY



BEFORE - ARROYO CHICO GREENWAY LOOKING WEST



AFTER - ARROYO CHICO GREENWAY LOOKING WEST

NOTE: GRAPHIC IS FOR ILLUSTRATIVE PURPOSE ONLY



BEFORE - INTERSECTION OF 12TH ST. AND PARK AVE. LOOKING WEST



AFTER - INTERSECTION OF 12TH ST. AND PARK AVE. LOOKING WEST

NOTE: GRAPHIC IS FOR ILLUSTRATIVE PURPOSE ONLY



BEFORE - PARK AVE. LOOKING NORTH



AFTER - PARK AVE. LOOKING NORTH

NOTE: GRAPHIC IS FOR ILLUSTRATIVE PURPOSE ONLY

APPENDIX C

Toole Design Group's Memorandum – Concept Designs
for E 15th Street and S Park Avenue Sections

MEMORANDUM

Project: Tucson Arroyo-Chico Greenway

Subject: Concept Designs for the E 15th Street and S Park Avenue Sections

Date: January 15, 2016

To: Charlene Robinson, AECOM

From: Adrian Witte, TDG

CC: Howard Dutt, City of Tucson Department of Parks and Recreation; Ann Chanecka, City of Tucson Department of Transportation; Julie Parizek, Norris Design

This memorandum describes concept designs prepared by Toole Design Group for the following two sections of the proposed Arroyo-Chico Greenway shown on **Figure 1**:

1. Multi-use pathway to connect segments of the Greenway from the east side of S Kino Parkway to the existing U.S. Army Corp detention basin trail system; and
2. Pedestrian and bicycling connections from the U.S. Army Corp detention basin trail system to the proposed multi-use pathway on the north side of E Broadway.

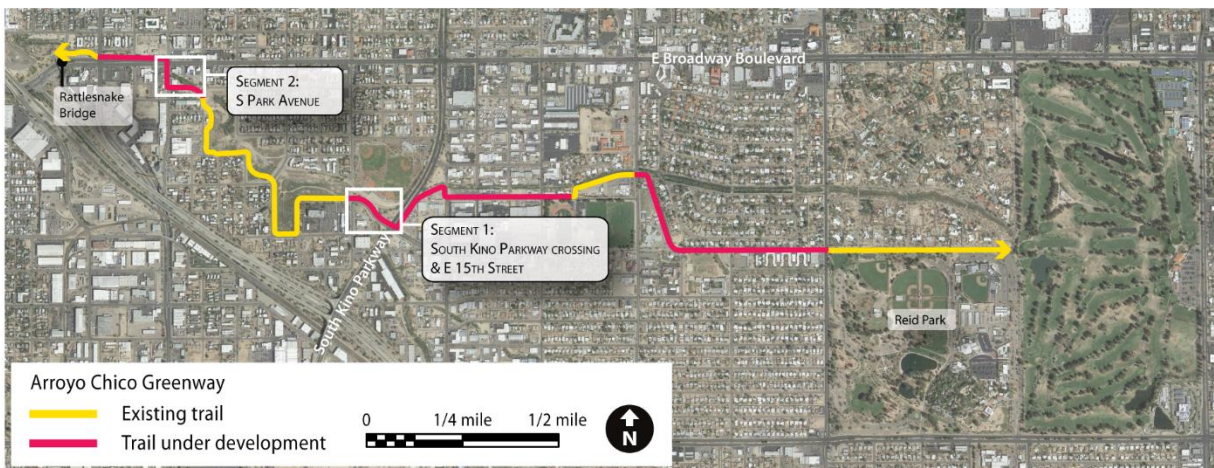


Figure 1: Location Map of Study Sections.

This memorandum is a follow up to Toole Design Group's *Opportunities and Constraints Analysis* report prepared in July 2015. A description of these concept plans and any associated analysis is included in the sections below.

Section from S Kino Parkway to U.S. Army Corp Detention Basin Trail System (E 15th Street Section)

The Arroyo-Chico Greenway is proposed as a 12-foot wide multi-use pathway that will run down the east side of S Kino Parkway and cross the north leg of the S Kino Parkway / E 15th Street / E Winsett Street intersection. West of the S Kino Parkway intersection, the north side of E 15th Street would be reconstructed to provide a multi-use pathway that connects the Greenway to the existing U.S. Army Corp detention basin trail system. A concept plan for this section of the Greenway is shown on **Figure 2**.

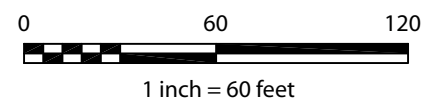
E 15th Street is currently a five lane cross-section with two eastbound lanes (one of which turns into a right-turn lane at the S Kino Parkway intersection), an eastbound left-turn lane, and two westbound lanes. All of the movements at the S Kino Parkway / E 15th Street / E Winsett Street intersection that flow into the westbound lanes are single lane movements, i.e., the westbound through movement from E Winsett Street, the northbound left-turn lane, and the southbound right-turn are all single lane movements. This means that only one westbound lane is required to accept these movements and the second westbound lane can be converted to provide space to expand the width of the sidewalk and incorporate a multi-use pathway. The proposed cross-section is included on Figure 2.

Analysis of the S Kino Parkway / E 15th Street / E Winsett Street Intersection

One of the major features of the design shown on Figure 2 is the crossing of the Arroyo-Chico Greenway at the north leg of the S Kino Parkway / E 15th Street / E Winsett Street intersection. The intersection currently has pedestrian crosswalks on all legs that are activated by push buttons. However, the Greenway will introduce moving bicycle traffic to the north crosswalk leg that will create a different expectation dynamic for motorists. The intersection currently operates as a two-phase signal. As a consequence, there are no separate signal phases provided for turning traffic, and when there is a pedestrian call at the intersection, left- and right-turning motorists run at the same time as pedestrians crossing the street. A traffic analysis was conducted using the Synchro software to analyze existing conditions and to develop an alternative signal phasing plan that allows the Greenway crossing movements to proceed with no motor vehicle conflicts.

Existing Conditions

The intersection currently operates as a two-phase signal with one phase serving S Kino Parkway in the north-south direction and the other serving E 15th Street and E Winsett Street in the east-west direction. Both approaches on S Kino Parkway have three through lanes and separate left-turn pockets. Right turning traffic shares the outside lanes with through traffic. The eastbound approach on E 15th Street has a through lane and separate left- and right-turn lanes. The westbound approach on E Winsett Street has a left-turn lane, a shared left-turn and through lane, and a separate right-turn lane. Currently, all left-turns run "permitted", which means that left-turning drivers must select appropriate gaps in the opposing traffic flow and wait for pedestrians in the crosswalk before making their turn.



ARROYO CHICO GREENWAY
S KINO PARKWAY INTERSECTION & E 15TH STREET CONCEPT
Tucson, Arizona

DESIGNED: AW
 DRAWN: EM
 CHECKED: AW
 DATE: 1/7/2016

REV 1:
 REV 2:
 REV 3:

SHEET NUMBER

1 OF **1**

Intersection turning movement counts were conducted at the intersection on Thursday March 22, 2012. The weekday AM peak hour was identified between 7:15 AM and 8:15 AM and the weekday PM peak hour between 4:15 PM and 5:15 PM. The intersection geometry and peak hour turning movements are shown on **Figure 3**.

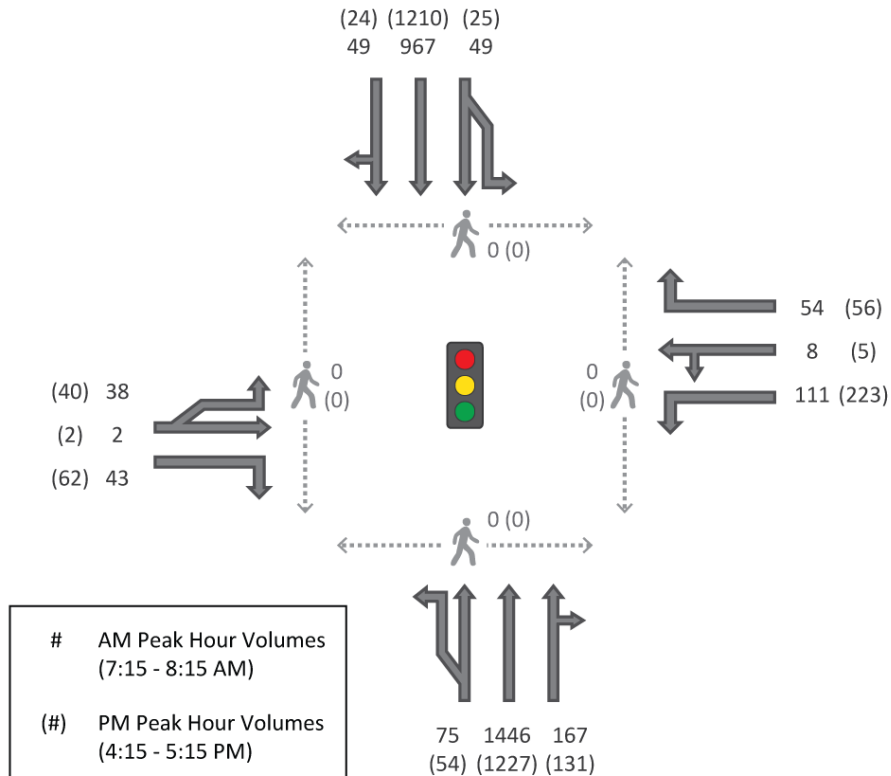


Figure 3: Existing Intersection Geometry and Turning Volumes.

The heaviest traffic volumes at the intersection are the north-south movements on S Kino Parkway, which is a major arterial. These movements are over 1,000 vehicles per hour (vph) and up to 1,450 vph in the northbound direction during the AM peak hour. The east-west through volumes are very low in both peak hours and represent less than 10 vph. Most of the turning movements at the intersection are between 40 and 50 vph. However, the westbound left-turn is much higher than the other movements with approximately 110 vph during the AM peak hour and approximately 225 vph during the PM peak hour. No pedestrian calls were registered at the intersection in either peak period, which is not surprising given the lack of destinations within walking distance of the intersection. However, it is expected that the Greenway will attract longer distance bicycle commuters, and when in place, will register calls for the crosswalk on the north leg.

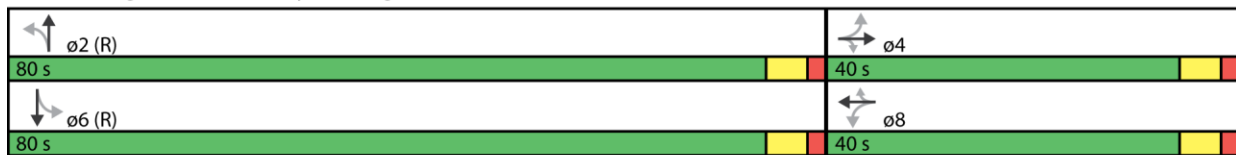
Traffic operations were evaluated using the Synchro intersection analysis software. Intersection and individual movement “level of service” (LOS) and volume-to-capacity (v/c) ratios were reported and form a baseline from which to compare possible changes to the signal timing to incorporate the Greenway crossing. Existing LOS and v/c ratios are described in the section below.

Incorporating the Greenway Crossing on the North Leg

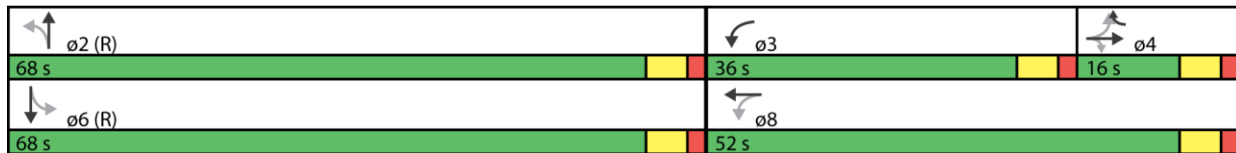
Currently, the crosswalk on the north leg runs at the same time as the eastbound left-turn and the westbound right-turn. As well, the southbound right-turn is allowed to perform a right-turn-on-red after checking for vehicle conflicts and checking the crosswalk for pedestrians. This means that approximately 140 vph are in conflict with the crosswalk during the AM peak hour and approximately 120 vph during the PM peak hour. As well, the Greenway is expected to introduce moving bicycle traffic to this crosswalk, which creates a completely different expectation dynamic for motorists – bicyclists move faster and can enter the conflict zone with turning motorists much quicker than pedestrians.

For the majority of signal cycles called up on a typical day, the Greenway and the north crosswalk will not be called up and therefore will have no effect on existing signal operations. However, the project team explored the impact of introducing a new signal phasing option that would separate out conflicting movements with the north crosswalk when a call is received. The existing phasing arrangement is shown on **Figure 4** along with an alternative signal phasing arrangement.

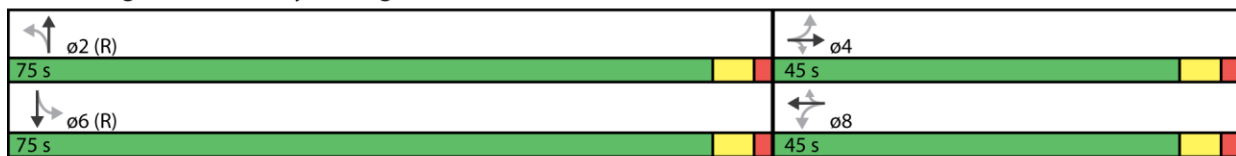
AM Existing (120 second cycle length)



AM Proposed (120 second cycle length)



PM Existing (120 second cycle length)



PM Proposed (120 second cycle length)

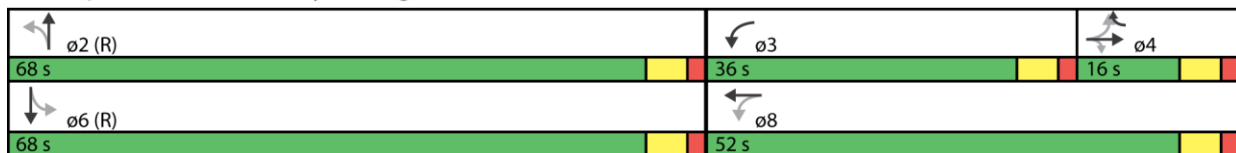


Figure 4: Existing and Alternative Signal Phasing Arrangements – AM and PM Peak Hours.

Under the proposed signal phasing option, the north-south signal phase will not change with the left-turns running permitted. However, if a call is received, some time may be diverted from the north-south phase to serve an additional phase that is needed to separate the north crosswalk from its conflicting movements.

In the east-west direction, a leading interval would be provided where the westbound left and through movements run with the north crosswalk. During this phase, all other movements, including the westbound right-turn, the eastbound left-turn, and the southbound right-turn-on-red would be stopped. Following clearance of the pedestrian phase, all east-west movements would be permitted to move as per the current signal phasing with the left-turns running permitted.

A comparison of intersection performance metrics (LOS and v/c ratio) are included on **Figure 5** for the existing and proposed signal phasing arrangements. It shows that the proposed phasing changes would have some impact on all movements, with the largest differences being the north-south through movements and the southbound left turn (particularly during the AM peak hour).

The analysis takes into account the frequency of pedestrian calls on the north leg of the intersection. It considers four scenarios:

- (1) No pedestrian calls (this reflects existing conditions)
- (2) Low pedestrian calls (10 calls per hour or 1 out of every 3 signal cycles)
- (3) Medium pedestrian calls (20 calls per hour or 2 out of every 3 signal cycles)
- (4) High pedestrian calls (30 calls per hour or one every signal cycle)

The results of the analysis are shown on Figure 5. It shows that the movements most impacted by the proposed signal phasing arrangement are the northbound and southbound through movements and the southbound left-turn movement (particularly during the AM peak hour).

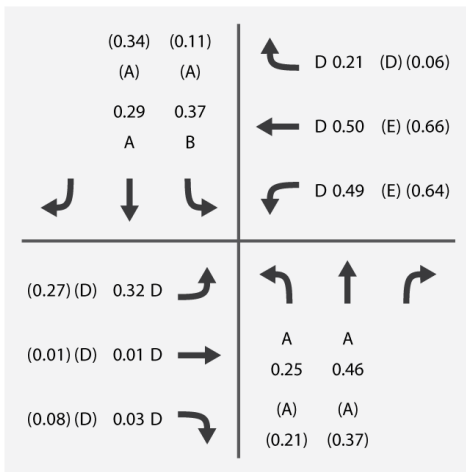
There is some impact on the intersection from the low and medium pedestrian call scenarios, but the intersection will continue to operate well within acceptable LOS and v/c performance limits. The high pedestrian call scenario will still operate within acceptable LOS and v/c criteria, however, the northbound and southbound movements will operate with increased delay (going from an existing LOS A to LOS B, or approximately 10 seconds/vehicle). Also, the southbound left-turn would change from LOS B to LOS D and operate with a volume-to-capacity ratio of 0.65 during the AM peak hour.

Intersection Design Considerations

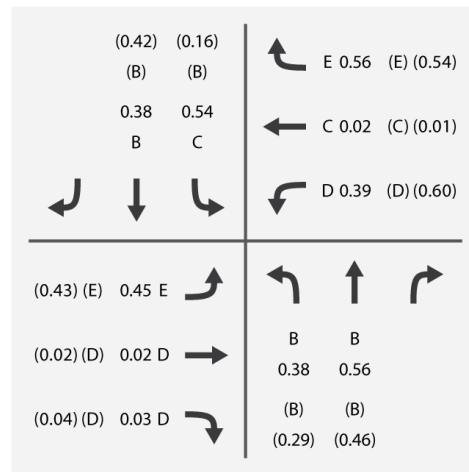
Providing a protected pedestrian crossing phase requires a number of engineering solutions to (1) detect pedestrians and bicyclists at the intersection; and (2) to stop the westbound right-turn and the southbound right-turn-on-red when the northern crosswalk is called.

The intersection currently operates with push-buttons to activate the crosswalks. With the reconstruction of the north-east and north-west corners of the intersection to accommodate the Arroyo-Chico Greenway, there may also be an opportunity to relocate the push buttons or provide additional push buttons to make them easy to reach for bicyclists as well as pedestrians using the Greenway. Having bicyclists have to stop at the intersection to push the button will bring their speeds more into line with existing motorists' expectations.

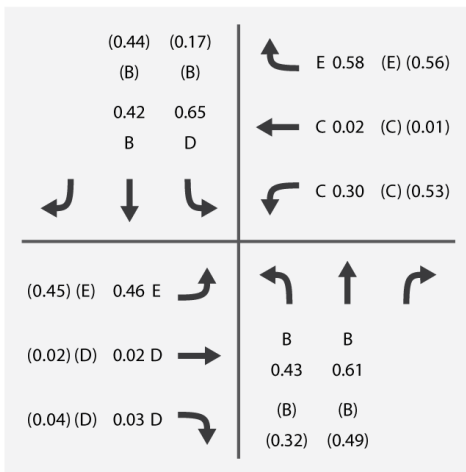
Scenario 1: No Pedestrian Calls (Existing Conditions)



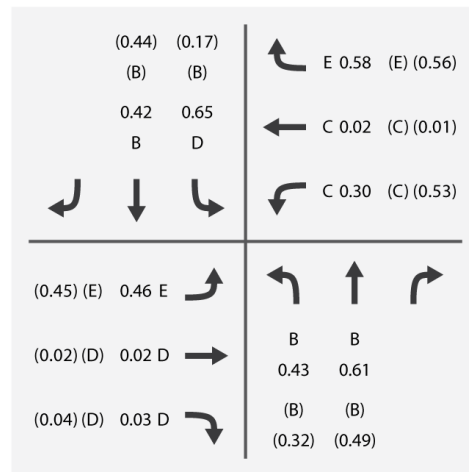
Scenario 2: 10 Pedestrian Calls on North Leg (Low)



Scenario 3: 20 Pedestrian Calls on North Leg (Medium)



Scenario 4: 30 Pedestrian Calls on North Leg (High)



X AM Peak Hour Level of Service
0.00 AM Peak Hour Volume-to-Capacity Ratio

(X) PM Peak Hour Level of Service
(0.00) PM Peak Hour Volume-to-Capacity Ratio

Figure 5: Comparison of Intersection Operations under the Existing and Proposed Phasing Plans.

The westbound right-turn is provided its own lane and therefore, a right-turn arrow display could be provided to stop the right-turn during the pedestrian phase.

There are a number of options for stopping the southbound right-turn-on-red movement. One option is to use static “NO TURN ON RED” signs (R10-11a – MUTCD) to ban RTOR at all times. However, it is not expected that the north crosswalk will be called all that often and banning RTOR at all times may lead to a high level of sign violation. Realistically, it would be preferable to only stop the southbound RTOR when

the north crosswalk is called. A number of jurisdictions have tested this sort of dynamic signage and found that violation rates are lower than for static signs using dynamic “NO TURN ON RED” signs that only illuminate when there is an active pedestrian call at the crossing. Examples of this type of signage is shown on **Figure 6**.^{1 2 3}



Figure 6: Examples of Dynamic Signage to Restrict Right-Turn-on-Red Movements.

Section from U.S. Army Corp Detention Basin Trail System to E Broadway (S Park Avenue Section)

The S Park Avenue section will connect the existing trail system around the U.S. Army Corp detention basin to the proposed Greenway section that will be constructed on the north side of E Broadway as part of the E Broadway widening project.

Several alignment options were considered for this section, including:

1. Following the Arroyo-Chico Wash to S Park Avenue and connecting the trail to the existing HAWK signal on the east leg of the E Broadway / S Park Avenue intersection via a completed sidewalk and two-way bikeway on the east side of S Park Avenue. There are two major limitations to this option. Firstly, the existing building on the east side of S Park Avenue, just north of E 12th Street, is built right up to the wash and leaves no room to create a multi-use pathway without expensive structures that would impact the banks of the wash. Secondly, the E Broadway widening project will relocate the HAWK signal from the east side of the E Broadway / S Park Avenue intersection to the west side of the intersection.

¹ Federal Highway Administration (FHWA) *Innovative Intersection Safety Improvement Strategies and Management Practices: A Domestic Scan*. Accessed online on January 6, 2016:

http://safety.fhwa.dot.gov/intersection/other_topics/fhwasa06016/chap_3.htm

² Boston Region Metropolitan Planning Organization, June 2015. *Pedestrian Signal Phasing Study*. Accessed online on January 6, 2015:

http://www.ctps.org/data/html/studies/bikeped/ped_signal_phase/Literature_Pedestrian_Signal.html

³ FHWA Safety. *Hispanic Pedestrian and Bicycle Safety*. Accessed online on January 6, 2015:

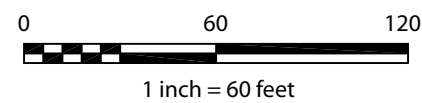
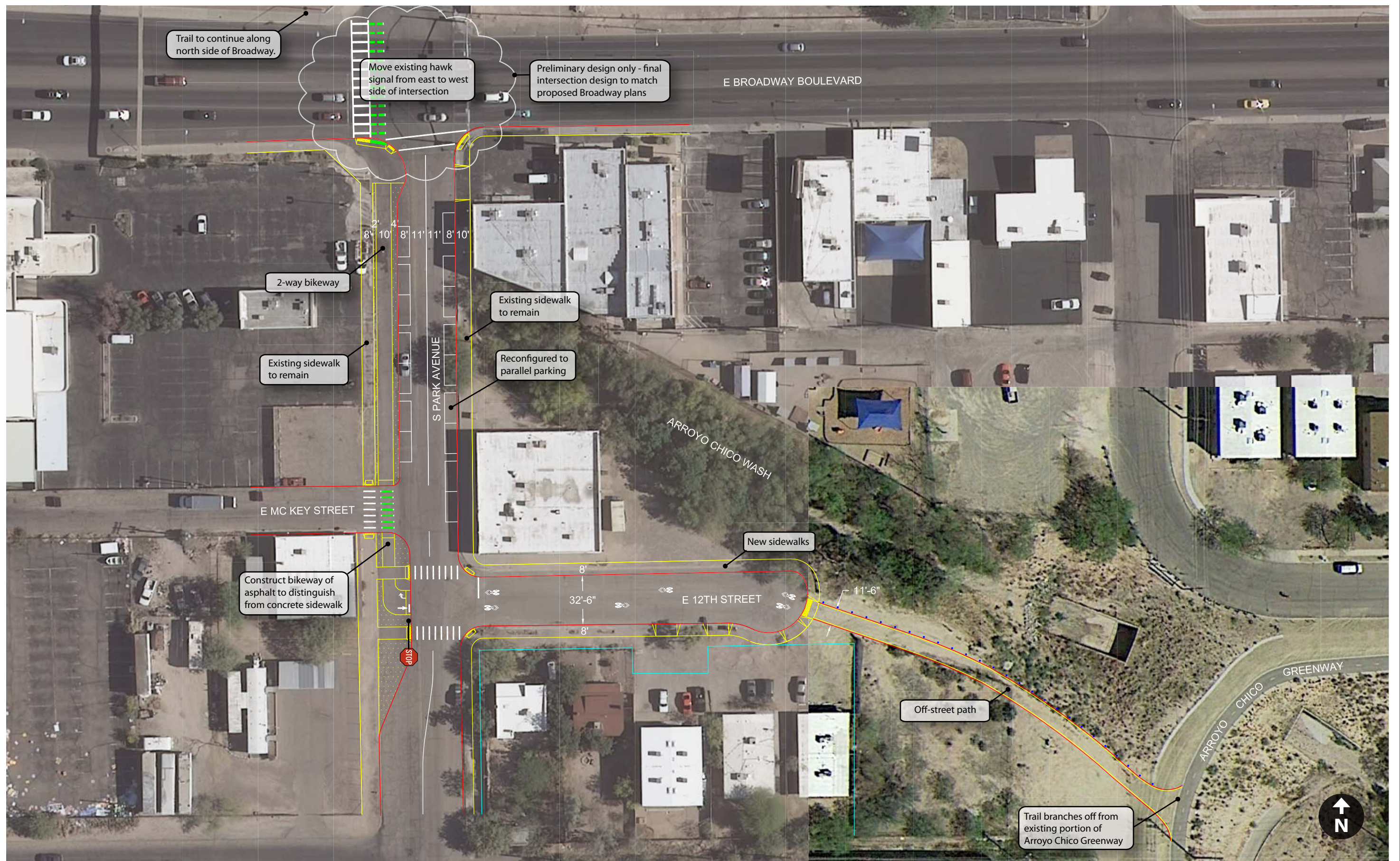
http://safety.fhwa.dot.gov/ped_bike/tools_solve/ped_scdproj/sys_impact_rpt/chap_2.cfm

2. Connecting to S Park Avenue via E 12th Street and providing a protected bikeway on the east side of S Park Avenue to the existing HAWK signal on the east leg of the E Broadway / S Park Avenue intersection. There are existing storefronts on the east side of S Park Avenue that would need to be designed around and secondly, as above, the E Broadway widening project will switch the HAWK signal from the east side of the E Broadway / S Park Avenue intersection to the west side of the intersection.
3. Connecting to S Park Avenue via E 12th Street and crossing the street to provide a protected bikeway and sidewalk along the west side of S Park Avenue to the relocated HAWK signal on the west side of the E Broadway / S Park Avenue intersection. This is a viable option that matches the E Broadway widening plans, avoids the constraints of the wash, and minimizes conflicts with existing buildings, although future development that could occur at the site on the west side of S Park Avenue between E McKey Street and E Broadway (referred to as the Broadway Volvo property) will need to coordinate with the proposed design. We believe this is the most viable option and it is explored further below.

A concept design for this section is shown on **Figure 7**. It shows that there will need to be a new pathway section created from the existing trail around the U.S. Army Corp detention basin to the cul-de-sac at the east end of E 12th Street. This will require civil engineering design to avoid the existing retaining wall and fit with the topography. The new pathway section will meet the east end of E 12th Street via a ramp. This section of E 12th Street is a very low traffic street and has three residential driveways on the south side of the street and a single driveway to a little used parking lot behind the existing buildings on the north side of the street. This street is comfortable for all level of bicyclists and can be enhanced with sharrow markings to show to vehicle traffic to expect bicyclists on this street. To serve pedestrians, there is sufficient width to reconstruct the curbs and provide a sidewalk on the north side of E 12th Street.

The crossing at the E 12th Street / S Park Avenue intersection will be fitted with marked crosswalks on the north and south legs. Curb extensions on the west side of the intersection and on the north-east and south-east corners of the intersection would shorten crossing distances across S Park Avenue. Bicyclists would cross S Park Avenue to a dedicated two-way bikeway on the west side of the intersection. From the west side of the intersection, the two-way bikeway will continue along the west side of S Park Avenue, crossing E McKey Street, up to the new location of the HAWK signal on the west side of the E Broadway / S Park Avenue intersection. The sidewalk on the west side of the street will be separated from the bikeway and will also extend from the E 12th Street intersection to the E Broadway intersection.

The proposed cross-section of S Park Avenue is included on Figure 7 and will consist of two 11-foot wide travel lanes, 8-foot wide parking lanes on both sides of the street, a 10-foot wide sidewalk on the east side of the street, and an 8-foot wide sidewalk with a 2-foot wide buffer separating it from a 10-foot wide two-way bikeway and a 4-foot buffer between the bikeway and the street. The west side of the street will need to be reconstructed to provide the two-way bikeway. This will narrow the curb-to-curb width and require that the existing angle parking on the east side of the street be converted to parallel parking. To make up for any loss of parking spaces, parallel parking will be extended north to the E Broadway intersection on both sides of the street.



**ARROYO CHICO GREENWAY
E 12TH STREET & S PARK STREET CONCEPT
Tucson, Arizona**

DESIGNED: AW
DRAWN: EM
CHECKED: AW
DATE: 1/7/2016

REV 1:
REV 2:
REV 3:

SHEET NUMBER

1 OF 1

The two-way bikeway on the west side of S Park Avenue will cross the E McKey Street intersection using a transverse crosswalk. Traffic volumes on E McKey Street are low. Currently, the site on the west side of S Park Avenue, between E McKey Street and E Broadway is undeveloped. There are no development plans for this site currently and any future plans will need to consider the two-way bikeway in planning the location and design of driveways.

E Broadway Widening Plan and Proposed Trail

The sidewalk and two-way bikeway on the west side of S Park Avenue will connect to the HAWK signal on the west side of the E Broadway / S Park Avenue intersection. The E Broadway widening plan is currently in preliminary design to create additional motor vehicle capacity along E Broadway. The expansion project will also:

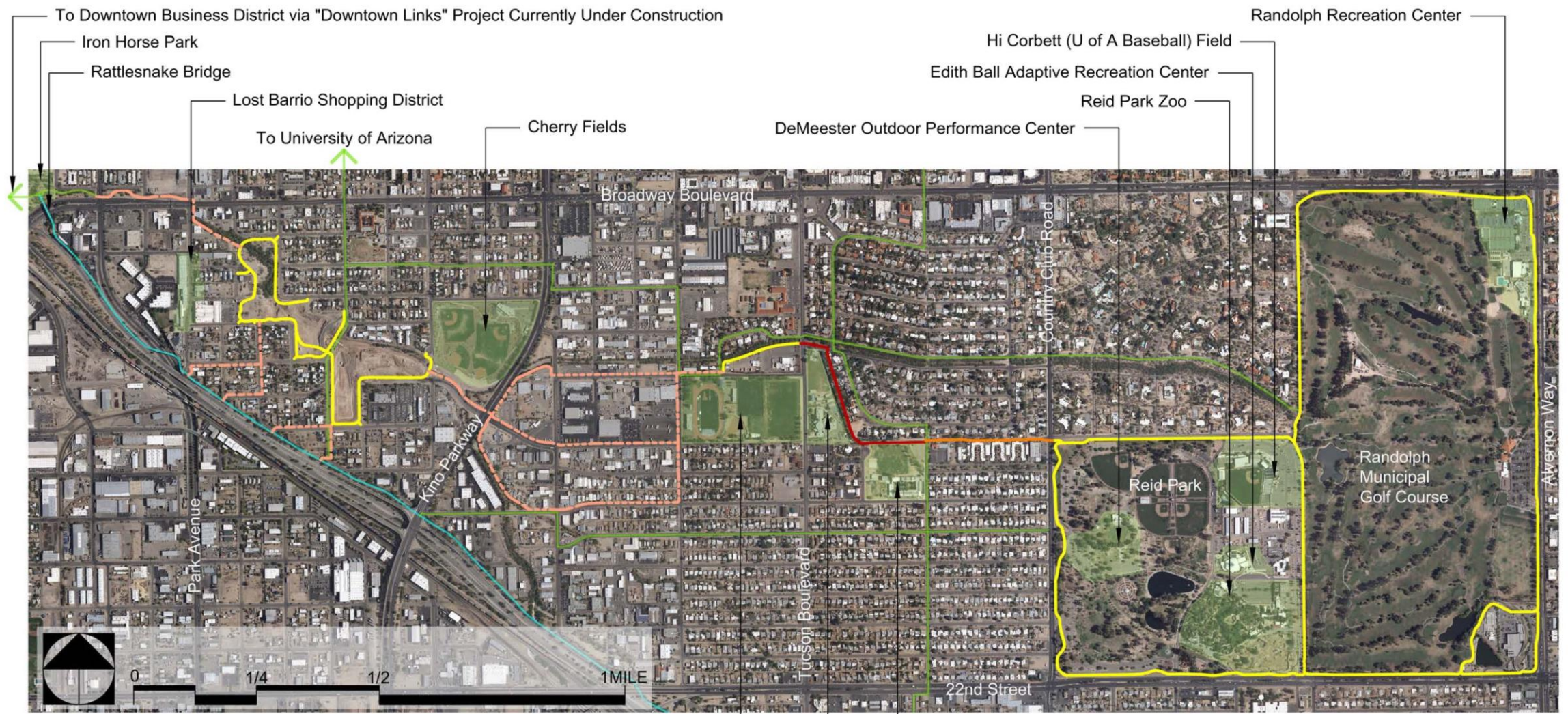
- Relocate the existing HAWK signal from the east side of the E Broadway / S Park Avenue intersection to the west side of the intersection. The new crossing will be redesigned as a bike and pedestrian HAWK signal. An example of this type of treatment is shown in **Figure 8**.
- Construct an extension of the Arroyo-Chico Greenway on the north side of the reconstructed E Broadway from S Park Avenue to the existing Rattlesnake Bridge. The trail will be constructed to a 12-foot wide standard and will cross the N Euclid Avenue and N Tyndall Avenue intersections. N Tyndall Avenue is a fairly minor crossing and should be provided signage and pavement marking. However, N Euclid Avenue is a significant crossing and the introduction of a trail to the north crosswalk of the intersection will also bring moving bicyclists, which create a different expectation dynamic for motorists than pedestrians. This is similar to the crossing at the S Kino Parkway / E 15th Street / E Winsett Street intersection discussed above and the design of this crosswalk should consider options for whether a separate, non-conflicting crosswalk movements can be incorporated into the signal timing. TDOT is currently exploring sensor-based technologies for detecting bicyclists and pedestrians on streets such as Broadway and how that would work with Tucson's existing signal technology. These solutions are not expected to be resolved in the timeline for this design project.



Figure 8: Examples of Bike HAWKs used in Tucson, AZ. ⁴

APPENDIX D

Toole Design Group's – Issues and Opportunities Analysis



Arroyo Chico Greenway Issues and Opportunities Analysis

Tucson Parks and Recreation
October 2015

- Arroyo Chico Greenway Key:**
- Existing Segment
 - Segment Designed, Ready for Construction
 - Segment Currently under Design
 - Greenway Alignment Options to be Studied Under this Contract
- Other Related Facilities Key:**
- Existing Multi-use Path (Golf Links/Aviation Greenway)
 - Proposed Bicycle Boulevards
 - Existing Facilities (Destinations) Along Arroyo Chico Greenway

ARROYO CHICO GREENWAY





Arroyo Chico Crossing at S Tucson Boulevard



The Greenway will cross the north leg of the Arroyo Chico / S Tucson Boulevard intersection to pick up the existing trail. Traffic volumes on this section of Tucson Boulevard are generally low and a median island crossing treatment would be appropriate at this location.

S Treat Avenue to Arroyo Chico



This section of Greenway between S Treat Avenue and Arroyo Chico is in design and will run along the south side of the wash and connect to Stratford Alley via a pedestrian bridge. The trail will continue along the alley and cross Arroyo Chico and run on the north side of the street along the Arroyo Chico Wash to the Tucson Boulevard intersection.



E Winsett Street & S Treat Avenue Crossing



The Greenway will cross the north leg of the Winsett Street / S Treat Avenue intersection. Traffic volumes on this section of S Treat Avenue are generally low and a striped crosswalk would be appropriate at this location.

E Winsett Street



The section of E Winsett Street, between Country Club Road and S Treat Avenue will be redesigned to include an 8-foot wide raised pathway on the south side of the street separated from the 18-foot wide roadway by a 2-foot wedge curb. A concept design prepared by Norris Design is shown on the next page.

Reid Park Pathway



The existing pathway runs on the north side of Reid Park and crosses the southern leg of the Country Club Road / E Camino Campestre / E Winsett Street intersection (photo: looking west along pathway towards Country Club Road).

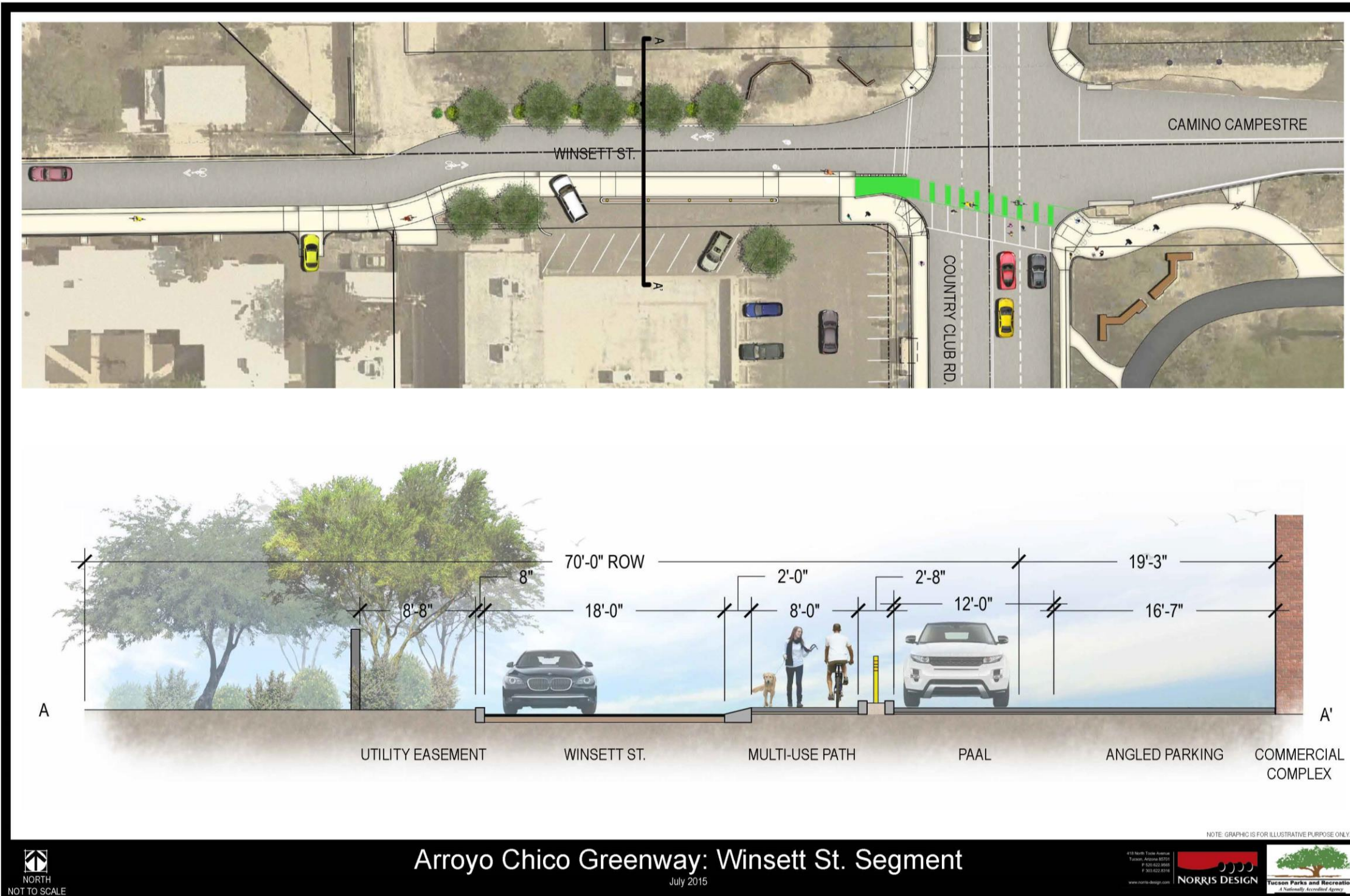
Greenway Crossing at Country Club Road



A HAWK signal will be installed on the south leg of the Country Club Road / E Camino Campestre / E Winsett Street intersection to align with the existing pathway on the east side of the intersection. The HAWK signal is currently in planning.



E Winsett Street Design Concept (Norris Design)





Median Island Crossing Treatment



Example of a median island crossing on a two-lane street with a center turn lane.

Median islands (also referred to as pedestrian refuge islands) are raised areas placed in the center of the street that allow pedestrians to cross traffic one direction at a time. They reduce the amount of time pedestrians are exposed to traffic and make it easier for them to select appropriate gaps in the traffic stream.

They should be installed in conjunction with a marked crosswalk, appropriate signage, and illumination as per the guidelines established in the MUTCD and other design manuals. Curb ramps and pedestrian cut-throughs should be installed in the median crossing.

The refuge island should be the width of the center turn lane minus some shy distance and should be wide enough to fit a bicyclist waiting to cross the street (at least 6-feet).

Visibility of the median island can be enhanced using curb paint, landscaping, and signage.

These treatments should be considered at the Arroyo Chico / Tucson Boulevard and 15th Street / Campbell Avenue intersections, but will remove the southbound left turn lanes at these intersections.



S Treat Avenue Bicycle Boulevard

S Treat Avenue is designated by the Tucson Department of Transportation (TDOT) as a Bicycle Boulevard. This provides an important north-south connection and should connect to the Arroyo Chico Greenway in at least two places - at the S Treat Avenue crossing and where it connects to Arroyo Chico from Stratford Alley. Greenway users can pick up the Treat Avenue bicycle boulevard by turning onto Stratford Drive and crossing the Arroyo Chico Wash.

Arroyo Chico Bicycle Boulevard Designation

TDOT currently has E Arroyo Chico between Stratford Alley and Randolph Way designated as a bicycle boulevard. It runs parallel and close to the proposed Arroyo Chico Greenway alignment. Given this redundancy, the bicycle boulevard designation should be removed.

Eastland Street Crossing at Country Club Road

A HAWK signal will be installed at the Country Club Road / Eastland Street intersection to connect the Eastland bicycle boulevard with Reid Park. The HAWK signal is currently in planning. The Eastland Street bicycle boulevard is particularly important as it provides the most direct connection from Reid Park to the Aviation Bikeway via E 19th Street and the E 18th Street undercrossing of South Kino Parkway.

ARROYO CHICO GREENWAY





Alignment Options to South Kino Parkway

Alignment Option 1

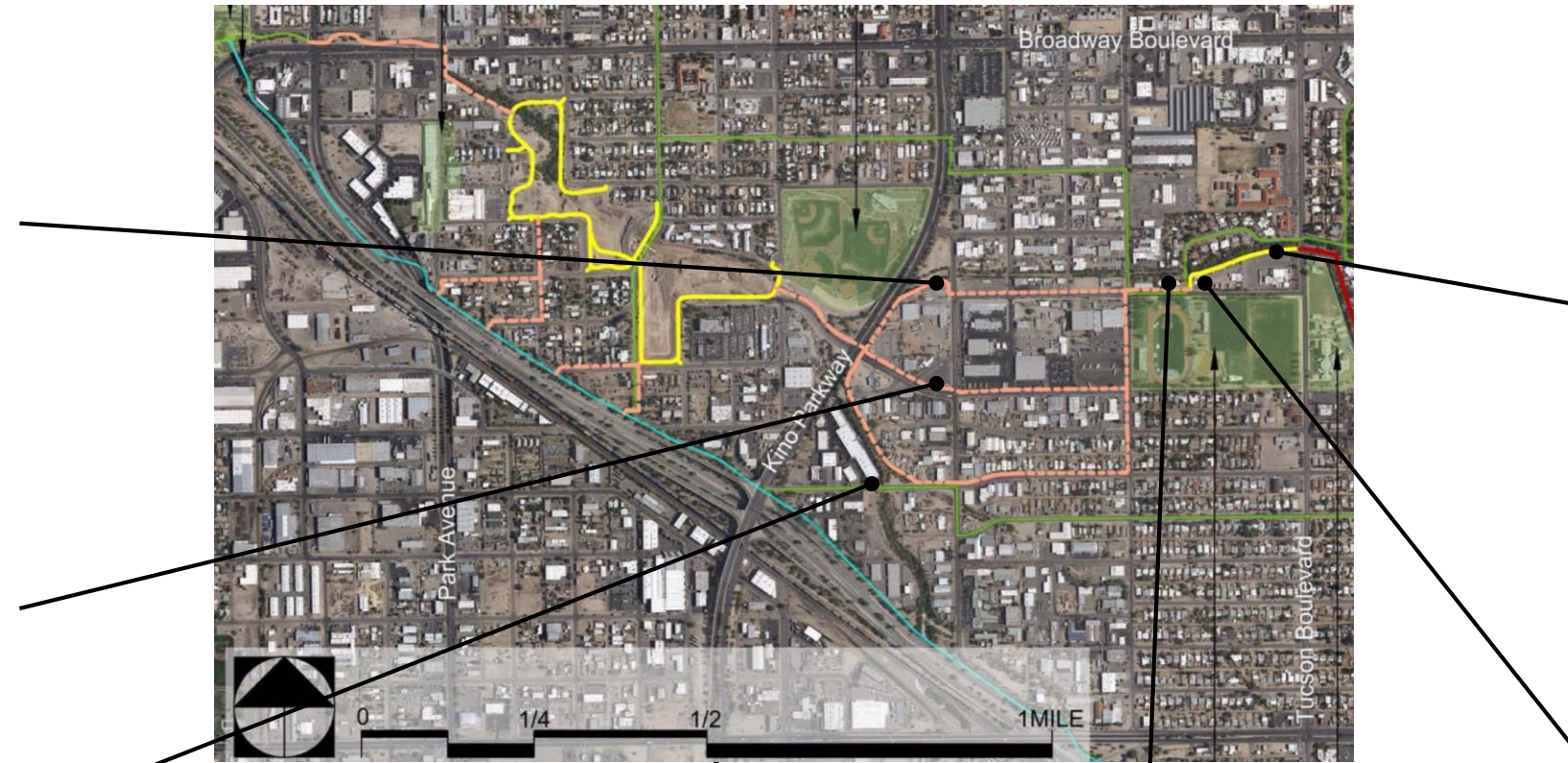
From the Plumer Avenue intersection, Alignment Option 1 would run along the north side of E 15th Street past the Bethel Community Baptist Church, the Spray Master Auto Body & Paint shop, and the Tucson Unified School District (TUSD) property to S Campbell Avenue. There is also an option to divert the Greenway behind the TUSD property (see below). The Greenway would cross S Campbell Avenue and run on the south side of the Arroyo Chico Wash and the southeast side of South Kino Parkway to the intersection with E Winsett Street

Alignment Option 2

From the Plumer Avenue intersection, Alignment Option 2 would run south along the east side of Plumer Avenue past the Rincon Vista Sports Complex to the E Winsett Street intersection. It would cross Plumer Avenue and continue along the north side of E Winsett Street past several TUSD properties including the main TUSD operations center and a body shop to the South Kino Parkway intersection.

Alignment Option 3

From the Plumer Avenue intersection, Alignment Option 3 would run south along the east side of Plumer Avenue past the Rincon Vista Sports Complex to the E 18th Street intersection. It would cross Plumer Avenue and continue along the north side of E 18th Street through a residential neighborhood before crossing S Campbell Avenue. From there, users would have the option to continue along E 18th Street and use the undercrossing at South Kino Parkway to access the Aviation Bikeway or connect to a new section of the Greenway that would run along the Railroad Wash to the South Kino Parkway intersection with E Winsett Street.



Crossing at Plumer Avenue



The pathway would cross either the north or east legs of the E 15th Street / Plumer Avenue intersection (depending on the alignment option chosen). Given traffic volumes are low at this intersection, a marked crosswalk is sufficient (similar to the crossing at the E 15th Street / Parkway Terrace intersection).

Parkway Terrace to Plumer Avenue



There is sufficient right-of-way to extend the pathway on the north side of E 15th Street to Plumer Avenue. The pathway would cross three residential driveways.

S Tucson Boulevard to Parkway Terrace



This section of pathway is constructed and runs on the south side of the Arroyo Chico Wash to the intersection with Parkway Terrace. The cross-section consists of a 12-foot wide pathway within a 20-foot wide right-of-way.

Crossing at Parkway Terrace



The existing pathway crosses the north leg of the E 15th Street / Parkway Terrace intersection. Traffic volumes are low and a marked crosswalk is sufficient at this location.



Alignment Option I



Figure 1: Alignment Option 1

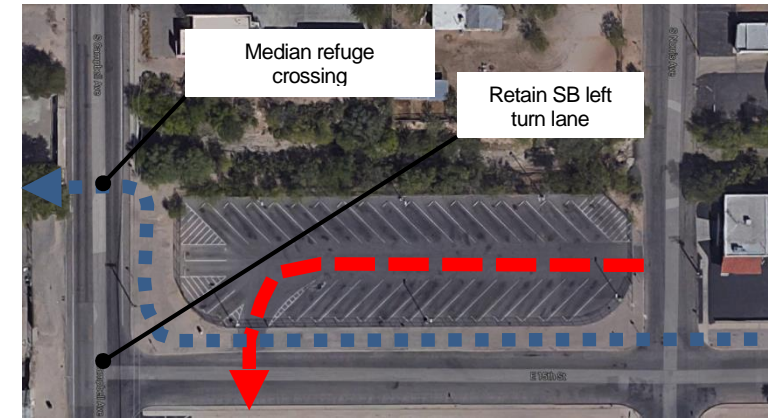


The Greenway would utilize sidewalk right-of-way in front of the Spray Master Auto Body & Paint shop. There is one main driveway and a secondary driveway that the Greenway will need to cross. The shop currently parks overflow vehicles in the sidewalk right-of-way. However, there is ample space on the street to park overflow vehicles and offset the impact of taking the sidewalk right-of-way.



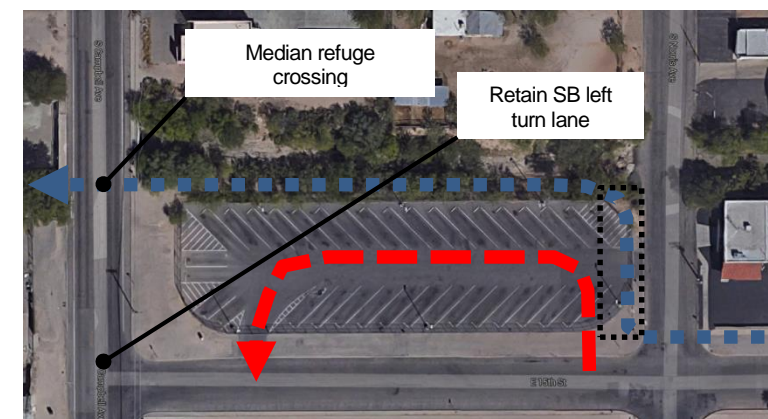
The Greenway would utilize sidewalk right-of-way in front of the Bethel Community Baptist Church that is currently used for head-in parking. However, there is ample space at the west end (Olsen Avenue end) of the block to create a parking lot for the church as well as on-street parking.

TUSD Property



Above: continuing the Greenway along E 15th Street will introduce a conflict at the existing driveway location of the TUSD property. An alternative would be to divert the Greenway behind the TUSD property (see below).

Under either option, the Greenway should cross S Campbell Avenue at the Arroyo Chico Wash to separate the crossing from the E 15th Street intersection. This will provide a more obvious mid-block crossing location for the Greenway and allow the southbound left turn from S Campbell Avenue onto E 15th Street to be retained. This is a well-used left turn, particularly for TUSD vehicles.



Diverting the Greenway behind the TUSD property will likely require some property acquisition from TUSD. Under this scenario, it is recommended that the driveway locations and internal parking circulation be reconfigured to remove conflicts with the Greenway.

Grade Change at TUSD Property



There is a significant grade change at the existing TUSD driveway on S Norris Avenue and some property acquisition will be likely to transition the Greenway to the Arroyo Chico Wash without damaging the bank.

Arroyo Chico Wash / Kino Parkway Right-of-Way



Further study is needed to determine if there is sufficient right-of-way between the north side of the TUSD property and the Arroyo Chico Wash to fit the Greenway. A few feet of acquisition may be required from TUSD. There appears to be sufficient existing right-of-way along the southeast side of Kino Parkway to fit the Greenway to the E Winsett Street intersection.



Alignment Option 2



Figure 2: Alignment Option 2

Alignment Option 3

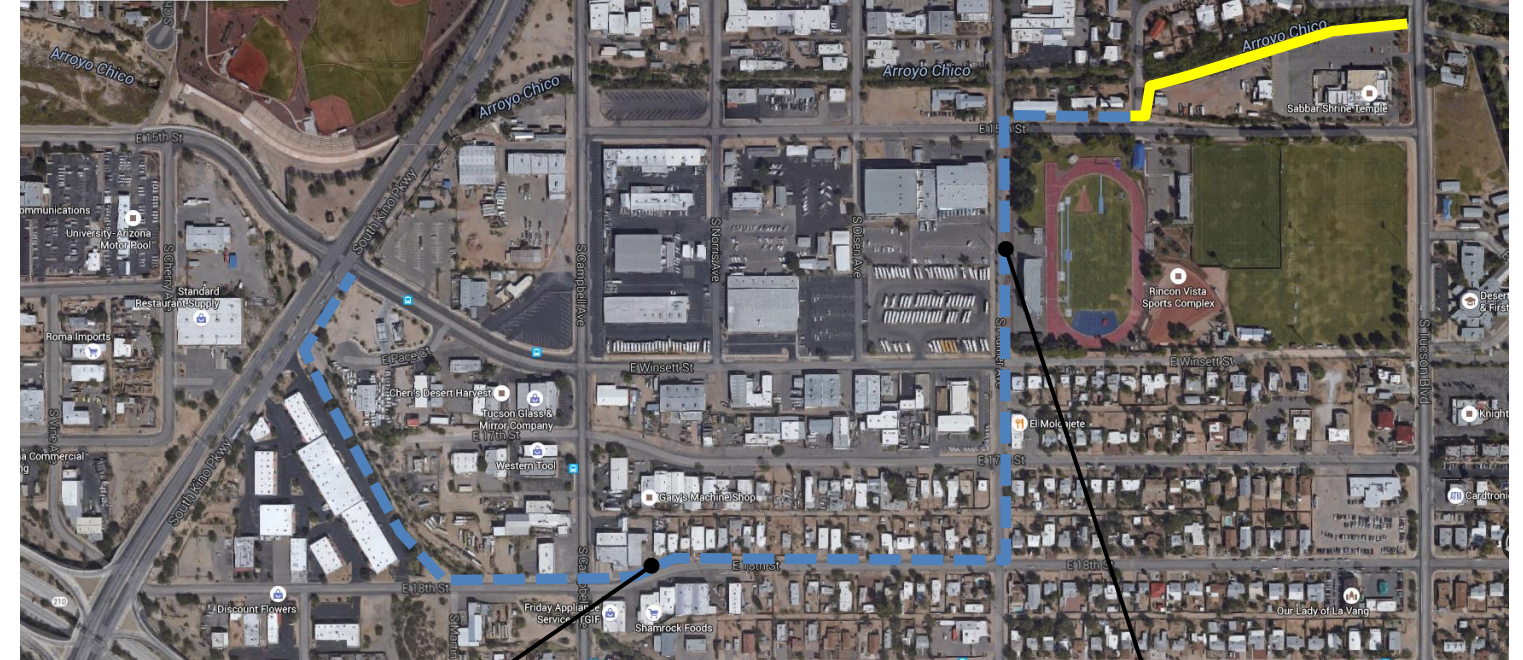
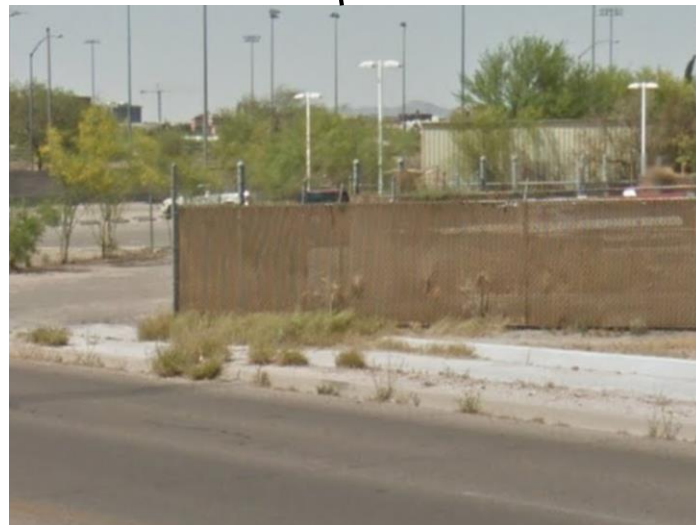


Figure 3: Alignment Option 3



A fence and annex that is part of the Winsett Alignment Specialists' business encroaches into the proposed Greenway right-of-way. Analysis is needed to determine if this encroaches into City right-of-way or whether property acquisition would be required.



E Winsett Street is a much busier street than E 15th Street and in particular there are numerous heavy vehicle movements including school buses moving in and out of the TUSD properties at several locations along the street. There are at least five major TUSD driveways that the Greenway would cross using this alignment.



There is less available sidewalk right-of-way along Plumer Avenue between E Winsett Street and E 18th Street, where the street changes to a residential character. To avoid impacts to businesses and residences, the street would need to be reconstructed to take space from the travel way. Along these sections there are also a significant number of residential driveways.



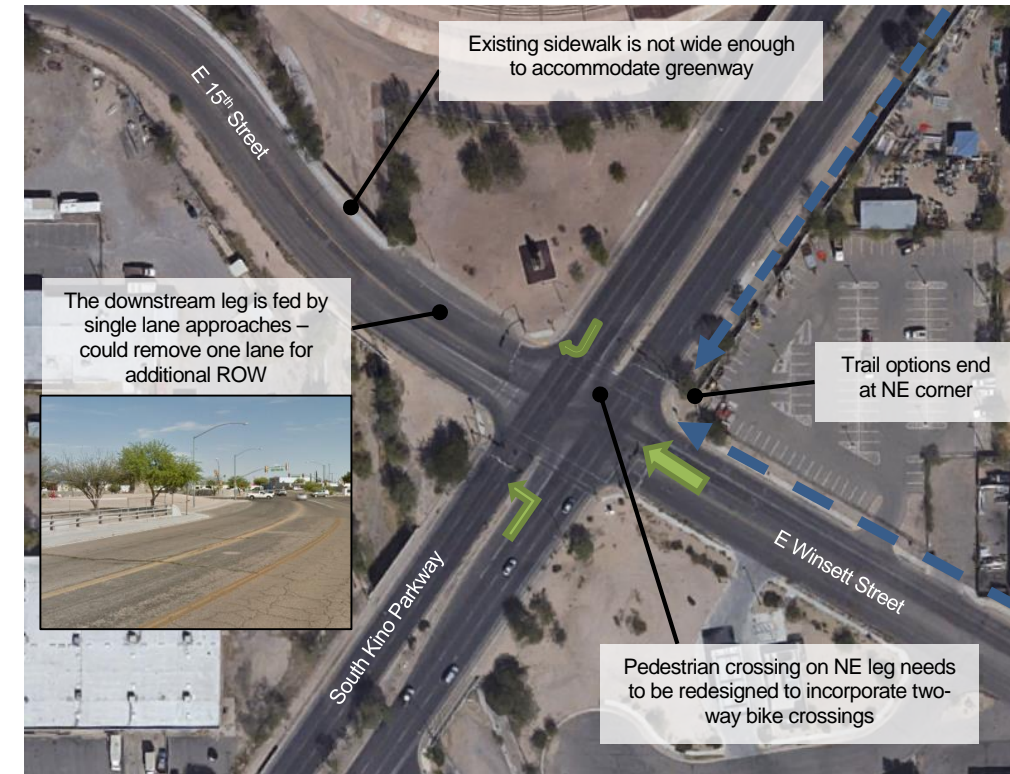
There is sufficient sidewalk right-of-way available on the east side of Plumer Avenue in front of the Rincon Vista Sports Complex to fit the Greenway.



Alignment Evaluation

| | Alignment Option 1 | Alignment Option 2 | Alignment Option 3 |
|---------------------------------|--|---|--|
| Distance | The most direct option – it also represents a logical continuation of the existing Greenway along the Arroyo Chico Wash. Distance: 0.53 miles | This option is longer than Option 1 and some users may feel that they are heading “out of the way” by having to go south from the existing Greenway section. Distance: 0.63 miles | This option is the longest and requires a user to go significantly out of their way to get back to the Winsett intersection. Distance: 0.90 miles |
| Intersection Crossings | There are four roadway crossings along this alignment – three low volume marked crosswalks and one median refuge crossing of S Campbell Avenue. | There are five roadway crossings along this alignment – four low volume marked crosswalks and one median refuge crossing of S Campbell Avenue. | There are five roadway crossings along this alignment – four low volume marked crosswalks and one median refuge crossing of S Campbell Avenue. |
| Driveway Crossings | Driveway crossings can be limited to three driveways by diverting the Greenway behind the TUSD property. | There are five major driveway crossings along this alignment that will put Greenway users in conflict with TUSD school buses at different times of the day. | There are numerous driveways on the east side of Plumer Avenue, south of E Winsett Street, and along E 18 th Street. Most are low turnover residential driveways. |
| Right-of-Way (ROW) Availability | ROW is available along E 15 th Street, however some additional property acquisition may be necessary to divert the Greenway behind the TUSC property. | ROW is available along both Plumer Avenue and E Winsett Street, however there is a fence that encroaches on the required right-of-way. Further analysis would be required to determine if property acquisition is required. | ROW can be obtained by reconstructing the street and narrowing the travel lanes on the east side of Plumer Avenue and along the north side of E 18 th Street. |
| Summary | Option 1 is the preferred alignment given it is the most direct connection and minimizes the number of conflicts with intersections and driveways. For the most part, right-of-way is available for the Greenway, however, some property may need to be acquired from TUSD. | Option 2 is a viable alternative and is a reasonably direct connection. However, it would expose Greenway users to more conflict with TUSD bus operations and driveways. | Option 3 is the least direct option and would send Greenway users well out of their way. This option would provide a direct connection to the Aviation Bikeway via the undercrossing of South Kino Parkway and as such it should still be considered as part of the City’s Bicycle Boulevard proposal for Eastland Street and E 19 th Street. |

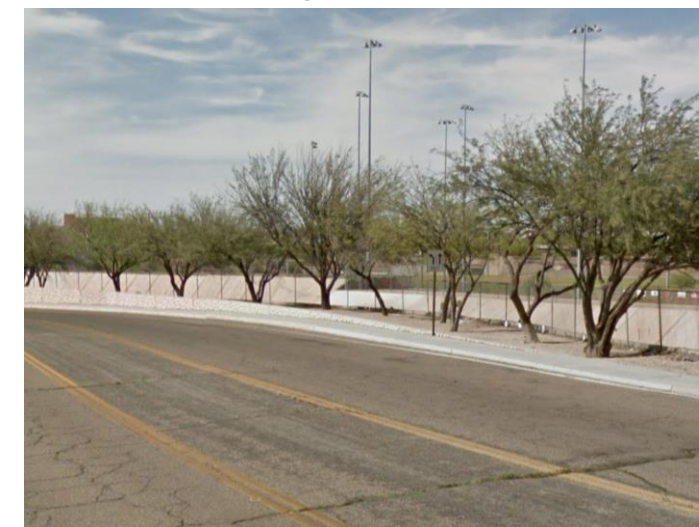
South Kino Parkway / E Winsett Street Intersection



Under either of the preferred alignment options (1 or 2), the trail will arrive at the NE corner of the South Kino Parkway / E Winsett Street intersection. The design of the intersection and signal timing will need to be modified to accommodate a two-way bicycle crossing on the northeast leg of the intersection.

The NW leg of the intersection on E 15th Street has a bridge crossing of the Railroad Wash. The bridge sidewalk is not wide enough to fit the Greenway. In order to avoid widening the bridge or building a separate structure, the Greenway could take the outside lane on the north side of E 15th Street to fit a curb-separated pathway. Currently, there are two receiving lanes on the NW leg, one of which is redundant as all movements at the intersection that feed this leg are single lane approaches.

Connection to Existing Detention Basin Trail



Once across the bridge, the Greenway could stay curbside using the outside travel lane on the north side of E 15th Street, or could transition to a pathway that runs behind the retaining wall on the north side of E 15th Street.



If the Greenway stays along the road right-of-way, it can be connected to the existing detention basin trail system. If the Greenway is diverted to the top of the retaining wall, there is a grade transition created by the detention basin headwall that will need to be overcome to transition the trail back to level.



Connection Options to the Aviation Bikeway

Connection at E 16th Street



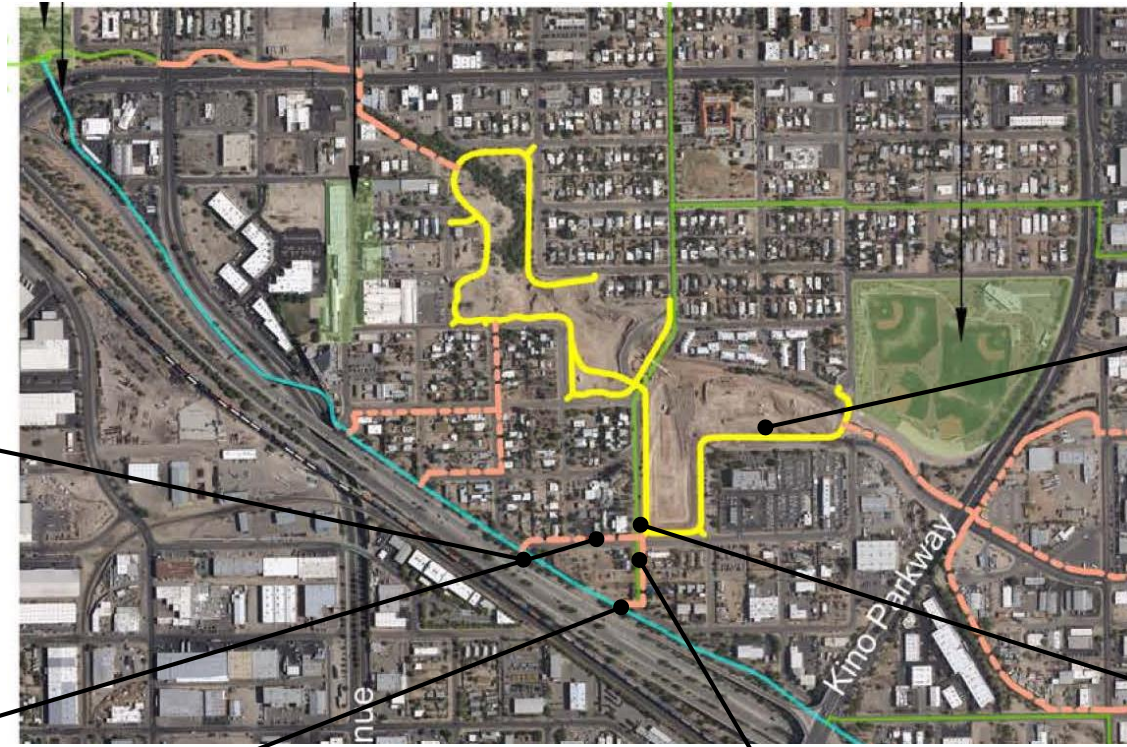
The photo above shows the existing Aviation bikeway connection at the west end of E 16th Street. This could be connected via E 16th Street to the Arroyo Chico Greenway.

E 16th Avenue



The section of E 16th Avenue, between S Highland Avenue and the Aviation Bikeway is a low volume street. The roll curb on the south side of the street could be extended to provide a two-way pathway on the south side of the street to connect to the Aviation Bikeway. The pathway would cross just a few residential driveways.

Arroyo Chico Greenway



Connection at S Highland Avenue



The photo above shows the existing Aviation bikeway connection at the south end of S Highland Avenue. This could be connected via Highland Avenue to the Arroyo Chico Greenway. **This is the preferred alignment** because it creates a connection to the Highland Bicycle Boulevard, is a low volume street, and results in the fewest driveway conflicts.

S Highland Avenue



The section of S Highland Avenue, between E 16th Street and the Aviation Bikeway is a low volume street. The roll curb on the west side of the street could be extended to provide a two-way pathway on the west side of the street to connect to the Aviation Bikeway. The pathway would cross a few residential driveways.

Cherry Field Trail



The existing detention basin trail system is a two way separated multi-use pathway that goes around the southern periphery of the U.S. Army Corps' Arroyo Chico Detention Basin. There are connections to the north via crossings at S Cherry Avenue, S Highland Avenue, and Santa Rita Avenue.

S Highland Avenue & E 16th Street



The pathway rounds the corner at the S Highland Avenue / E 16th Street intersection, where it is at its closest to the Aviation Bikeway. A ramp access has been provided at the northeast corner of the intersection. It is a low traffic volume intersection.



Arroyo Chico Wash at Park Avenue

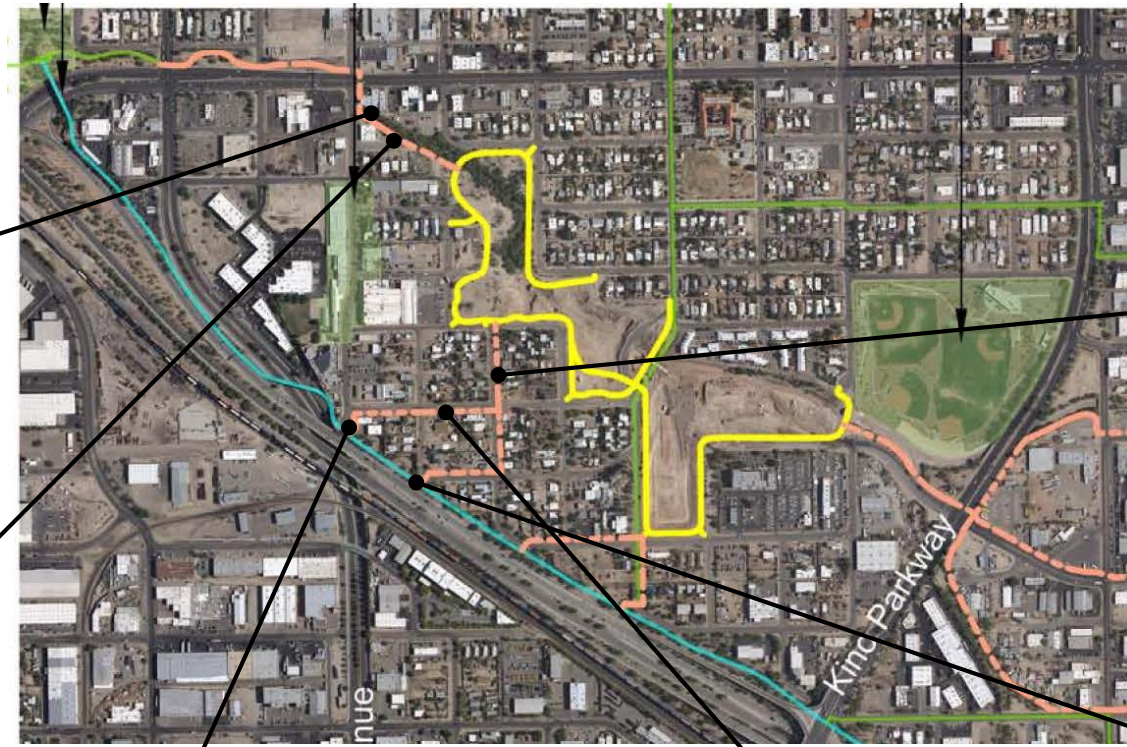


Where the Arroyo Chico Wash meets S Park Avenue, there is very limited space and buildings are constructed almost up to the bank. Without property acquisition, there is no space to construct the Greenway.

E 12th Street



The section of E 12th Street between S Park Avenue and the Arroyo Chico Greenway is a low volume street with only a few minor driveways. The Greenway could connect to facilities on S Park Avenue via a short section of shared street.



E 14th Street Connection



At the west end of E 14th Street, the Greenway would need to cross S Park Avenue, just north of the turnaround to connect to the Aviation Bikeway. The turnaround is used by all types of vehicles including service vehicles from Lost Barrio that could introduce conflicts with Greenway users. **Remove from consideration.**

E 14th Street



The section of E 14th Street between S Star Street and S Park Avenue is a low volume street but has numerous residential driveways and several curb extensions that appear to be recently constructed to visually narrow the street. The street would need to be reconstructed to include the Greenway. **Remove from consideration.**

S Star Avenue



The existing trail runs along the north side of E Manlove Street and has connections to the street opposite S Star Street. This street could be used to connect to the Aviation Bikeway via E 15th Street or E 14th Street. S Star Street would be more circuitous than other connections and has numerous driveway crossings. **Remove from consideration.**

E 15th Street Connection



The west end of E 15th Street is separated from the Aviation Bikeway by a large wall. It would be expensive to make a connection through this wall. **Remove from consideration.**



Connection from S Euclid Avenue to Arroyo Chico



Euclid Avenue Crossing at E Broadway

The Greenway will cross the north leg of the intersection and redesign of the intersection and signal timing should be considered to allow two-way bicycle traffic to cross the north leg of the intersection.

E Broadway

This section of E Broadway is currently being redesigned for widening as part of the Downtown Links project. Even with road widening there is sufficient right-of-way to build the Greenway on the north side of E Broadway. Right-of-way ownership boundaries will need to be confirmed to understand the City and ADOT's respective rights-of-way.

Arroyo Chico Greenway

S Park Avenue / E McKey Street / E 12th Street

Further analysis will be needed to design a safe and comfortable crossing from the west side of S Park Avenue to the shared street connection to the Greenway on E 12th Street. The offset intersection with E McKey Street may introduce some challenges.

E 12th Street

This street is a low volume traffic street and could be provided as a short section of shared street to connect S Park Avenue to the Arroyo Chico Greenway. The street would be marked with sharrow and should be reconstructed to include sidewalks.

Connection to Arroyo Chico Greenway

There appears to be space to construct a connection between the existing Arroyo Chico Greenway and the east end of E 12th Street. One thing that will need to be considered is the grade transition of the trail to meet the height of the detention basin headwall.

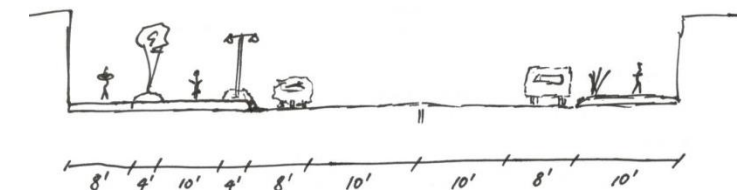
E Broadway Crossing



The east leg of the E Broadway / S Park Avenue intersection currently has a HAWK signal. This will be converted to a BikeHAWK and relocated to the west side of the street as part of the Broadway expansion and the Downtown Links project.

S Park Avenue

A separated two-way bike facility could be constructed on the west side of Park Avenue to provide a Greenway-style bike facility to accompany the sidewalk for pedestrians. A possible cross-section is shown below.



The 72' right-of-way could be distributed to provide an 8' sidewalk and a 10' two-way bikeway on the west side of the street. The existing four head-in parking spaces on the east side of the street would be reconfigured to parallel parking on both sides of the street to ensure no loss of on-street vehicle parking.



Next Steps

A number of actions are currently underway or could be undertaken to complete the greenway section from Reid Park to S Plumer Avenue. These include:

- Completing the design of the HAWK signal crossing of Country Club Road at E Winsett Street (currently underway).
- Completing the redesign of E Winsett Street between Country Club Road and S Treat Avenue (currently underway).
- Completing the design of the pathway section between S Treat Avenue and S Tucson Boulevard (currently underway).
- The general design standard for the Greenway is a 12-foot wide pathway in a 20-foot right-of-way based on already constructed sections and the standards outlined in the Pima Regional Trail System Master Plan.
- **Action:** Conduct traffic surveys at the S Tucson Boulevard / Arroyo Chico intersection to determine the impact of providing a median crossing island on the north leg of the intersections. This may limit the ability to provide a southbound left turn lane.
- **Action:** Move forward with design of the section of the Greenway on the north side of E 15th Street between Parkway Terrace and Plumer Avenue.

This report considered several alignment alternatives for different sections of the trail and came up with the following recommendations:

- **Recommendation:** It is recommended that Trail Alignment Option I be pursued as the preferred Greenway alignment between S Plumer Avenue and S Kino Parkway. This option is the shortest section and minimizes the number of intersection and driveway crossings.
- **Recommendation:** It is recommended that S Highland Avenue be pursued as the preferred Greenway alignment to connect the existing US Army Corp trail network to the Aviation Bikeway. S Highland Avenue provides a direct link to the Highland Avenue Bicycle Boulevard that extends north to the University of Arizona campus and beyond. It also is a low volume street with minimal driveway crossings.

Assuming there is agreement to move forward with these alignment options, the following actions will be required to design the section of the Greenway from Parkway Terrace to the existing US Army Corp trail network:

- **Action:** Reach out to the Bethel Community Baptist Church, Spray Master Auto, and TUSD to inform them about the project and work with them to develop design solutions that integrate their operations.
- **Action:** undertake an assessment to determine whether additional right-of-way is required to run the Greenway along the Arroyo-Chico Wash and behind the TUSD properties between S Norris Avenue and S Kino Parkway. Work with TUSD to understand the feasibility of property acquisition or easement rights being granted and the possibility of reconfiguring the driveway and internal circulation of the TUSD property at S Norris Avenue.
- **Action:** prepare a design concept that shows how the South Kino Parkway / E Winsett Street / E 15th Street intersection could be modified to provide a two-way Greenway crossing across the north leg of the intersection.
- **Action:** prepare a design concept that shows how the Greenway would transition from the South Kino Parkway / E Winsett Street / E 15th Street intersection to the existing US Army Corp trail network. This would include concepts for how to redesign E 15th Street west of South Kino Parkway to avoid bridge expansion and options for using the street right-of-way or the space behind the retaining wall to connect to the existing trail network.

Connecting the existing US Army Corp trail network to S Park Avenue via the Arroyo Chico Wash is not feasible without significant property acquisition. As an alternative, it is recommended that a connection be established to the east end of E 12th Street and then using S Park Avenue to connect to the Greenway section that will be constructed on the north side of E Broadway as part of the Downtown Links project. Action items required to further this design include:

- **Action:** prepare a design for the section of the Greenway that would connect the existing US Army Corp trail network past the detention basin headwall to the east end of E 12th Street.
- **Action:** prepare a design concept that shows how sidewalks and a protected bikeway would be provided from the S Park Avenue intersection with E 12th Street to E Broadway. This would include concepts for the E 12th Street and E McKey Street intersections with S Park Avenue.
- **Action:** integrate the redesign of S Park Avenue with the redesign of the E Broadway / S Park Avenue intersection that will occur as part of the Downtown Links project. This will include relocating the HAWK signal from the east side to the west side of the intersection and upgrading it to a BikeHAWK.
- **Action:** review the proposed design for the Greenway on the north side of E Broadway to be provided as part of the Downtown Links Project. This includes reviewing the design proposal for the E Broadway / Euclid Avenue intersection and determining if there is an option for providing a two-way crossing across the north leg of the intersection.

APPENDIX E

Probable Construction Quantities and Cost Estimates

ARROYO CHICO URBAN GREENWAY
 PARKWAY TERRACE TO KINO PARKWAY
 Probable Construction Quantities and Cost Estimate

3/24/2017

| Item | Unit | Quantity | Unit Price | Amount |
|---|-------|----------|--------------|---------------------|
| Clearing and Grubbing | L.SUM | 1 | \$5,000.00 | \$5,000 |
| Removal of Concrete Sidewalks, Driveways and Slabs | S.FT. | 11,130 | \$5.00 | \$55,650 |
| Removal of Concrete Curb | L.FT. | 1,550 | \$5.00 | \$7,750 |
| Removal of Asphaltic Concrete Pavement | S.FT. | 11,970 | \$7.00 | \$83,790 |
| Aggregate Base | C.YD | 440 | \$50.00 | \$22,000 |
| Asphaltic Concrete (COT Mix No. 2) | TON | 430 | \$120.00 | \$51,600 |
| Drainage Modifications | L.SUM | 1 | \$22,000.00 | \$22,000 |
| Concrete Curb (Std. Dtl. 209) (Type 2) | L.FT. | 2,100 | \$25.00 | \$52,500 |
| Concrete Sidewalk | S.FT. | 40 | \$25.00 | \$1,000 |
| Curb Access Ramp (Std. Dtl. 207) | EACH | 9 | \$3,000.00 | \$27,000 |
| Concrete Driveway Apron | S.FT. | 4,860 | \$15.00 | \$72,900 |
| Handrail | L.FT. | 20 | \$60.00 | \$1,200 |
| Traffic Signal Modifications | L.SUM | 1 | \$75,000.00 | \$75,000 |
| Pavement Markings and Signing | L.SUM | 1 | \$15,000.00 | \$15,000 |
| Landscape/Irrigation | L.SUM | 1 | \$100,500.00 | \$100,500 |
| AZPDES/NPDES (Original) | L.SUM | 1 | \$10,000.00 | \$10,000 |
| Subtotal - Construction Costs | | | | \$602,890.00 |
| Mobilization | L.SUM | 3% | \$18,100.00 | \$18,100.00 |
| Maintenance and Protection of Traffic | L.SUM | 6% | \$36,200.00 | \$36,200.00 |
| Contractor Quality Control | L.SUM | 2% | \$12,100.00 | \$12,100.00 |
| Construction Survey and Layout | L.SUM | 2% | \$12,100.00 | \$12,100.00 |
| Utility Relocations/Adjustments | L.SUM | 1% | \$6,100.00 | \$6,100.00 |
| Contingencies | L.SUM | 15% | \$90,500.00 | \$90,500.00 |
| Engineering Administration | L.SUM | 5% | \$30,200.00 | \$30,200.00 |
| Construction Management | L.SUM | 10% | \$60,300.00 | \$60,300.00 |
| Subtotal - Mobilization & Administration Costs | | | | \$265,600.00 |
| Total Construction Cost | | | | \$868,490.00 |

ARROYO CHICO URBAN GREENWAY
 HIGHLAND, 16TH STREET TO BARRAZA-AVIATION SHARED-USE PATH
 Probable Construction Quantities and Cost Estimate

3/24/2017

| Item | Unit | Quantity | Unit Price | Amount |
|---|-------|----------|-------------|---------------------|
| Clearing and Grubbing | L.SUM | 1 | \$2,000.00 | \$2,000 |
| Removal of Concrete Sidewalks, Driveways and Slabs | S.FT. | 400 | \$5.00 | \$2,000 |
| Removal of Concrete Curb | L.FT. | 280 | \$5.00 | \$1,400 |
| Removal of Asphaltic Concrete Pavement | S.FT. | 280 | \$7.00 | \$1,960 |
| Remove and Relocate Mail Box | EACH | 1 | \$500.00 | \$500 |
| Aggregate Base | C.YD | 4 | \$50.00 | \$200 |
| Asphaltic Concrete (COT Mix No. 2) | TON | 3 | \$120.00 | \$360 |
| Concrete Curb (Std. Dtl. 209) (Type 2) | L.FT. | 240 | \$25.00 | \$6,000 |
| Concrete Sidewalk | S.FT. | 1,470 | \$25.00 | \$36,750 |
| Concrete Driveway Apron | S.FT. | 220 | \$15.00 | \$3,300 |
| Pavement Markings and Signs | L.SUM | 1 | \$4,000.00 | \$4,000 |
| Landscape/Irrigation | L.SUM | 1 | \$13,500.00 | \$13,500 |
| AZPDES/NPDES (Original) | L.SUM | 1 | \$2,000.00 | \$2,000 |
| Subtotal - Construction Costs | | | | \$73,970.00 |
| Mobilization | L.SUM | 2% | \$1,500.00 | \$1,500.00 |
| Maintenance and Protection of Traffic | L.SUM | 3% | \$2,300.00 | \$2,300.00 |
| Contractor Quality Control | L.SUM | 1% | \$800.00 | \$800.00 |
| Construction Survey and Layout | L.SUM | 1% | \$800.00 | \$800.00 |
| Utility Relocations/Adjustments | L.SUM | 25% | \$18,500.00 | \$18,500.00 |
| Contingencies | L.SUM | 15% | \$11,100.00 | \$11,100.00 |
| Engineering Administration | L.SUM | 5% | \$3,700.00 | \$3,700.00 |
| Construction Management | L.SUM | 10% | \$7,400.00 | \$7,400.00 |
| Subtotal - Mobilization & Administration Costs | | | | \$46,100.00 |
| Total Construction Cost | | | | \$120,070.00 |

ARROYO CHICO URBAN GREENWAY
 ARROYO CHICO DETENTION BASIN PATH TO BROADWAY BOULEVARD
 Probable Construction Quantities and Cost Estimate

3/24/2017

| Item | Unit | Quantity | Unit Price | Amount |
|---|-------|----------|-------------|---------------------|
| Clearing and Grubbing | L.SUM | 1 | \$1,000.00 | \$1,000 |
| Removal of Structures and Obstructions | L.SUM | 1 | \$2,000.00 | \$2,000 |
| Removal of Concrete Sidewalks, Driveways and Slabs | S.FT. | 2,100 | \$5.00 | \$10,500 |
| Removal of Concrete Curb | L.FT. | 1,430 | \$5.00 | \$7,150 |
| Removal of Asphaltic Concrete Pavement | S.FT. | 8,120 | \$7.00 | \$56,840 |
| Aggregate Base | C.YD | 77 | \$50.00 | \$3,850 |
| Asphaltic Concrete (COT Mix No. 2) | TON | 75 | \$120.00 | \$9,000 |
| Drainage Modifications | L.SUM | 1 | \$16,000.00 | \$16,000 |
| Concrete Curb (Std. Dtl. 209) (Type 2) | L.FT. | 1,000 | \$25.00 | \$25,000 |
| Concrete Sidewalk | S.FT. | 6,270 | \$25.00 | \$156,750 |
| Curb Access Ramp (Std. Dtl. 207) | EACH | 7 | \$2,500.00 | \$17,500 |
| Concrete Driveway Apron | S.FT. | 740 | \$15.00 | \$11,100 |
| Brick Pavers | S.FT. | 400 | \$15.00 | \$6,000 |
| Replace Post & Cable Barrier & Fencing | L.SUM | 1 | \$6,000.00 | \$6,000 |
| Pavement Markings and Signing | L.SUM | 1 | \$6,000.00 | \$6,000 |
| Landscape/Irrigation | L.SUM | 1 | \$34,000.00 | \$34,000 |
| AZPDES/NPDES (Original) | L.SUM | 1 | \$2,000.00 | \$2,000 |
| Subtotal - Construction Costs | | | | \$370,690.00 |
| Mobilization | L.SUM | 2% | \$7,500.00 | \$7,500.00 |
| Maintenance and Protection of Traffic | L.SUM | 6% | \$22,300.00 | \$22,300.00 |
| Contractor Quality Control | L.SUM | 2% | \$7,500.00 | \$7,500.00 |
| Construction Survey and Layout | L.SUM | 2% | \$7,500.00 | \$7,500.00 |
| Utility Relocations/Adjustments | L.SUM | 4% | \$14,900.00 | \$14,900.00 |
| Contingencies | L.SUM | 15% | \$55,700.00 | \$55,700.00 |
| Engineering Administration | L.SUM | 5% | \$18,600.00 | \$18,600.00 |
| Construction Management | L.SUM | 10% | \$37,100.00 | \$37,100.00 |
| Subtotal - Mobilization & Administration Costs | | | | \$171,100.00 |
| Total Construction Cost | | | | \$541,790.00 |