



slo

2035



LAND USE &  
CIRCULATION  
UPDATE

APPENDIX N: SENSITIVITY ANALYSIS

*Please see the next page.*

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## TECHNICAL MEMORANDUM

City of San Luis Obispo

General Plan Update

Sensitivity Analyses of the Roadway Improvements

City of San Luis Obispo, Central Coast Transportation Consulting, Kittelson & Associates Inc.

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Date: June 4, 2014 Project #: 172760  
To: Jake Hudson, City of San Luis Obispo  
From: Jim Damkowitch, Franklin Cai, T.E.  
cc:

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As shown in Section 2.0, of the DEIR Project Description (Tables 2.4-2 and 2.5-1, respectively), the proposed LUCE Update includes sixteen potential development areas (including the South Broad Street Special Planning Area) and seventeen proposed street network changes. The latter entails changes to the physical transportation assets of the City of San Luis Obispo. This includes new roadway connections (new centerline miles of roadway), one-way to two-way conversions, realignments, over-crossings, new interchanges and road/ramp closures. A complete listing of the candidate improvements are provided on the following page.

All the listed improvements are reflected in the General Plan DEIR Maximum Build-Out alternative. Many of these improvements have been included or considered as part of past planning studies performed for or by the City of San Luis Obispo – including the existing General Plan. Given that the cost of implementing these improvements is significant and the operational effects of their implementation to adjacent facilities not fully understood, a sensitivity assessment was performed on each improvement. Using the 2035 Maximum Build-Out condition as the basis, each proposed roadway improvement was analyzed in isolation to determine its operational efficiency and impact to the surrounding street network.

The operational software SYNCHRO was used to evaluate study intersections adjacent to each improvement. Intersection LOS, turn movement LOS and 95<sup>th</sup> percentile queues were analyzed with and without the improvement. Segment LOS was also determined based on the City's daily thresholds.

The results of each assessment informed the City which improvements should be advanced for inclusion in the proposed General Plan.

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### **Circulation Preferred Alternative:**

- Prado Road (Full interchange with phased implementation)
- Bishop Extension
- Orcutt Overpass
- LOVR By-Pass
- Hwy 1/Hwy 101 & Broad ramp closures
- Marsh/Higuera - 2 way
- Mission Plaza Expansion
- Madonna –Realign
- Chorro & Broad – Realign
- Boysen & Santa Rosa (Includes grade-separated crossing for bike/ped. Include turn restrictions)
- Bianchi/Pismo/Higuera Realignment
- New collector – Tank Farm to Buckley
- DT Transit Center
- Calle Joaquin connection to Dalidio Dr
- Vachel Realign
- Victoria Connection
- Broad Street – Consolidate access

See attachment 1 for the configuration diagrams of the above stated improvements.

The following provides the operational summaries of the adjacent facilities when the effect of each improvement is tested:

**a. The Effect of Not Having the Single Point Urban Interchange (SPUI) at SR-1 and SR-101:**

**Intersection Operations of Facilities Adjacent to the SPUI Under Max Build-Out Conditions:**

FULL BUILD									
Intersection	AM Volume	AM Delay	AM LOS	Mov. Failures	PM Volume	PM Delay	PM LOS	Mov. Failures	Mov. Failures
Santa Rosa & Olive	3282	14.3	B	None	4186	23	C	NBL - LOS F	NBL 95% Q at >=282'
Santa Rosa & Walnut	2200	15	B	None	2434	15.6	B	None	
SR-1 & SR-101 SPUI	5667	34.1	C	None	5655	45.9	D	SEL - LOS F	SEL 2 - LOS F
				SBL 95% Q at >=456'				SEL 2 - LOS F	SBL 95% Q at >=187'
				SEL 95% Q at >=253'				SEL 95% Q at >=444'	NEL 2 95% Q at >=759'
				NEL 2 95% Q at >=522'					

**Intersection Operations of Facilities Adjacent to the Proposed SPUI when the Improvement is Removed:**

FULL BUILD MINUS SPUI AT SR-1 AND SR-101 AND NO RAMP CLOSURES									
Intersection	AM Volume	AM Delay	AM LOS	Mov. Failures	PM Volume	PM Delay	PM LOS	Mov. Failures	Mov. Failures
Santa Rosa & Olive	3162	20.9	C	SBL - LOS F	3705	15.4	B	None	None
Santa Rosa & Walnut	2622	42.1	D	WBR - LOS F	2891	43.8	D	WBR - LOS F	WBR 95% Q at >=393'
				WBR 95% Q at >=282'				SBL 95% Q at >=111'	

**Roadway Segment Operations of Facilities Adjacent to the Proposed SPU when the Improvement is Removed:**

Roadway Segment	Location	Roadway Type	Adjusted 2035 Average Daily Traffic	LOS*
Olive	West of Santa Rosa	Local, 2-lanes	2,771	C
Olive	East of Santa Rosa	Local, 2-lanes	4,981	C
Walnut	West of Santa Rosa	Local, 2-lanes	3,179	C
Walnut	East of Santa Rosa	Local, 2-lanes	11,346	D

\*2013 Quality/Level of Service Handbook, Florida Department of Transportation

**Finding**

Based on the operational results – the Hwy 1/Hwy 101 & Broad ramp closures improvement concept should be advanced.

**b. The Effect of Not Having the Two-Way Conversion of Higeura Street and Marsh Street between Santa Rosa Street and Johnson Ave:**

**Operations of Facilities Adjacent to the Two-Way Conversion under Max Build-Out Conditions:**

FULL BUILD									
Intersection	AM Volume	AM Delay	AM LOS	Mov. Failures	PM Volume	PM Delay	PM LOS	Mov. Failures	
Johnson & Mash	831	6.8	A	None	1360	16.6	B	None	
Johnson & Higuera	844	19.7	C	None	1063	32.3	D	None	
Santa Rosa & Mash	1343	12.3	B	None	2289	10.8	B	None	
Santa Rosa & Higuera	831	5.1	A	None	2636	8.1	A	None	
No Queuing Issues Predicted									

**Operations of Facilities Adjacent to the Proposed Two-Way Conversions when the Improvement is Removed:**

FULL BUILD WITHOUT CONVERTING MARSH AND HIGEURA TO TWO WAY									
Intersection	AM Volume	AM Delay	AM LOS	Mov. Failures	PM Volume	PM Delay	PM LOS	Mov. Failures	
Johnson & Mash	849	27.1	C	None	1337	44.6	D	None	
Johnson & Higuera	914	14.6	B	None	1030	17.5	C	None	
Santa Rosa & Mash	1192	10.7	B	None	2062	10.6	B	None	
Santa Rosa & Higuera	1807	5.2	A	None	2382	6.7	A	None	
No Queuing Issues Predicted									

**Roadway Segment Operations of Facilities Adjacent to the Proposed Two-Way Conversions when the Improvement is Removed:**

Roadway Segment	Location	Roadway Type	Adjusted 2035 Average Daily Traffic	LOS*
Marsh	West of Santa Rosa	Arterial, 3-lanes	9,544	B
Higuera	West of Toro	Arterial, 2-lanes	3,895	C
*2013 Quality/Level of Service Handbook, Florida Department of Transportation				

**Finding**

Based on the operational results – the Two-Way Conversion of Higeura Street and Marsh Street concept should be advanced.

**c. The Effect of Not Having the Los Osos Valley Road Extension:**

**Operations of Facilities Adjacent to the LOVR Extension under Max Build-Out Conditions:**

FULL BUILD								
	AM Volume	AM Delay	AM LOS	Mov. Failures	PM Volume	PM Delay	PM LOS	Mov. Failures
Buckley & LOVR Ext	1370	14	B	None	2180	18	B	None
LOVR & Higuera	2229	13	B	None	2627	21	C	SBR 95% Queue >780'
LOVR Ext & LOVR	1860	11	B	None	2770	29	C	None

**Operations of Facilities Adjacent to the Proposed LOVR Extension when the Improvement is removed:**

Full Build Minus LOVR Extension								
	AM Volume	AM Delay	AM LOS	Mov. Failures	PM Volume	PM Delay	PM LOS	Mov. Failures
Buckley & LOVR Ext					Does not exist			
LOVR & Higuera	2549	20	C	None	3658	87	F	NBL
LOVR Ext & LOVR					Does not exist			

**Finding**

Based on the operational results – the Los Osos Valley Road extension concept should be advanced.



**d. The Effect of Not Having the Bishop Street Extension:**

**Operations of Facilities Adjacent to the Proposed Bishop Street Extension under Max Build-Out Conditions:**

FULL BUILD								
	AM Volume	AM Delay	AM LOS	Mov. Failures	PM Volume	PM Delay	PM LOS	Mov. Failures
San Luis Drive & Johnson	2099	3	A	None	2267	3	A	None
Broad & Orcutt	3127	18	B	NBL	3888	27	C	SBL LOS E
Broad & South & Santa Barbara	3868	106	F	All approaches.	3918	52	D	EB, WB approaches

**Operations of Facilities Adjacent to the Proposed Bishop Street Extension when the Improvement is removed:**

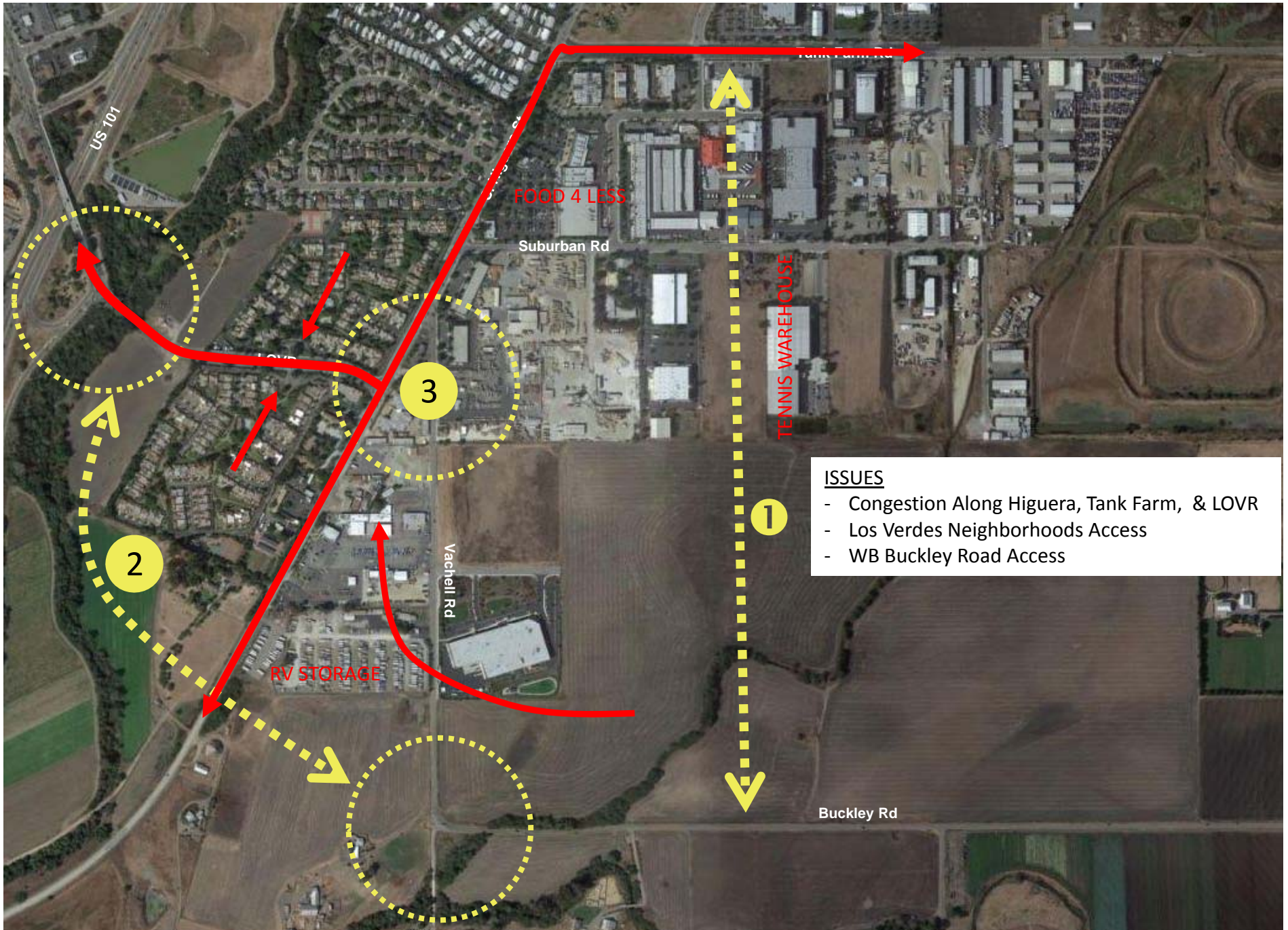
Full Build Minus LOVR Extension								
	AM Volume	AM Delay	AM LOS	Mov. Failures	PM Volume	PM Delay	PM LOS	Mov. Failures
Buckley & LOVR Ext				Does not exist				
LOVR & Higuera	2549	20	C	None	3658	87	F	NBL
LOVR Ext & LOVR				Does not exist				

**Finding**

Based on the operational results – the Bishop Street extension concept should be advanced.

## Appendix 1 Circulation Alternatives

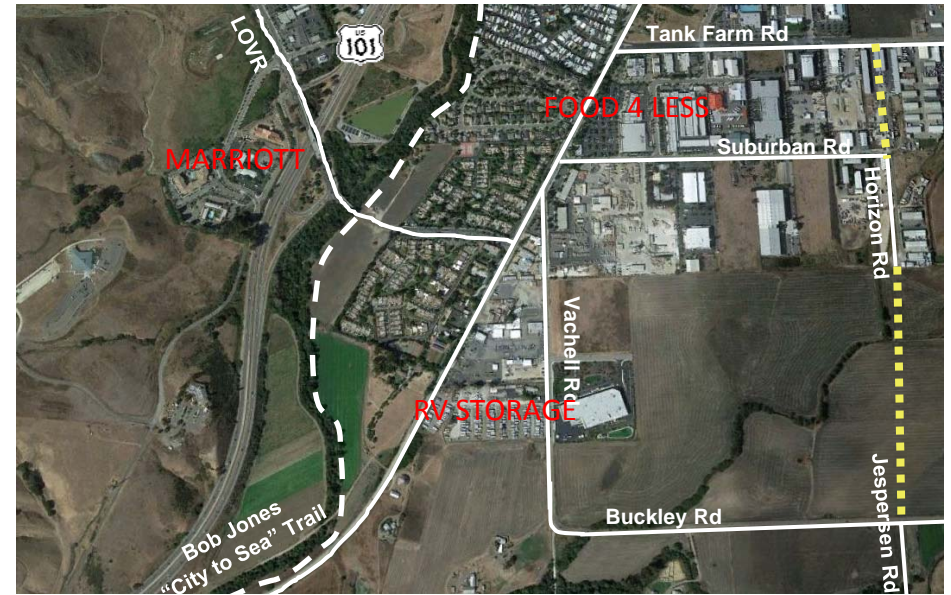
# LOVR & Buckley Road Vicinity



# 1. Tank Farm Road to Buckley Road



1-1. Existing Conditions



1-2. Example Alignment



1-3. Example General Area for Alignment

**Issue:**

- Heavy Congestion Higuera, LOVR, & Tank Farm
- Connectivity between Tank Farm Road and Buckley Road

**Discussion Points on 1-2:**

- Where to intersect with Suburban Road
- Disturbs some existing structures & properties

**Discussion Points on 1-3:**

- Intersection with Suburban Road Tent Tract 2943 (Earthwood)
- May Disturb several existing structures & properties
- Creek crossing

**General Discussion Point:**

- Connection could be made farther east and coordinated with the Chevron Specific Plan

## 2. LOVR to Buckley Road Connection



2-1. Existing Conditions



2-2. Example LOVR Bypass Alignment



2-3. Example Buckley Road Alignment

**Issue:**

- Ease of access entering & exiting Los Verdes
- Volume of traffic passing by Los Verdes
- Future Congestion at LOVR & Higuera
- LOVR Connections to Buckley

**Discussion Points on 2-2:**

- Moving road and noise impacts from one side of Los Verdes to the other.
- Open space and agricultural impacts
- Careful not to disturb Octagon Barn
- Small wetland north of Octagon Barn

**Discussion Points on 2-3:**

- Alignment of LOVR Bypass
- Careful not to disturb Octagon Barn

# 3. Vachell Road to Higuera Road



3-2. Existing Alignment



3-2. Vachel Ln. Realignment



3-3. Vachel Ln. Cul-de-Sac

**Issues:**

- Higuera & LOVR Congestion
- Skew of intersection at S. Higuera and Vachell Road
- LOVR Connections to Buckley

**Discussion Points on 3-2:**

- Impacts buildings & property
- Potential additional traffic on LOVR in front of Los Verdes

**Discussion Points on 3-3:**

- Impacts parking lot for adjacent businesses,
- emergency access issues

# LOVR, Higuera, & Madonna Vicinity



# 4. Prado Overpass / Interchange



4-1. Existing Conditions



4-2. Example Prado Road Extension with Full Interchange



4-3. Example Prado Road Extension with Overpass Only

**Issues:** Limited east-west connectivity throughout city

**Discussion Points on Site 4-2:**

- Relieves intensity and congestion at LOVR & Madonna interchanges.
- Relieves intensity and congestion along Madonna Road & Oceanaire Neighborhoods.
- Elks Lane realignment or cul-de-sac
- Could be combined with Calle Joaquin Extension

**Discussion Points on Site 4-3:**

- Would not relieve traffic at LOVR or Madonna & may drive further expansion of those interchanges.
- Elks Lane realignment or cul-de-sac
- Require closure or access control on Elks Lane.

**General Discussion Points:**

- Contingent on cooperation with Caltrans
- Provides access to proposed Dalidio property development
- Consideration for existing development on east side of US 101



# 5. Oceanaire Neighborhood Connections



5-1. Existing Conditions



5-2. Optional Connection from Neighborhood to Froom



5-3. Optional Connection from Neighborhood to LOVR

**Issues:**

- Limited access from S. Oceanaire neighborhood to the East. LOVR, Madonna Road
- Increased difficulty with Froom Extension & LOVR Volume Increases

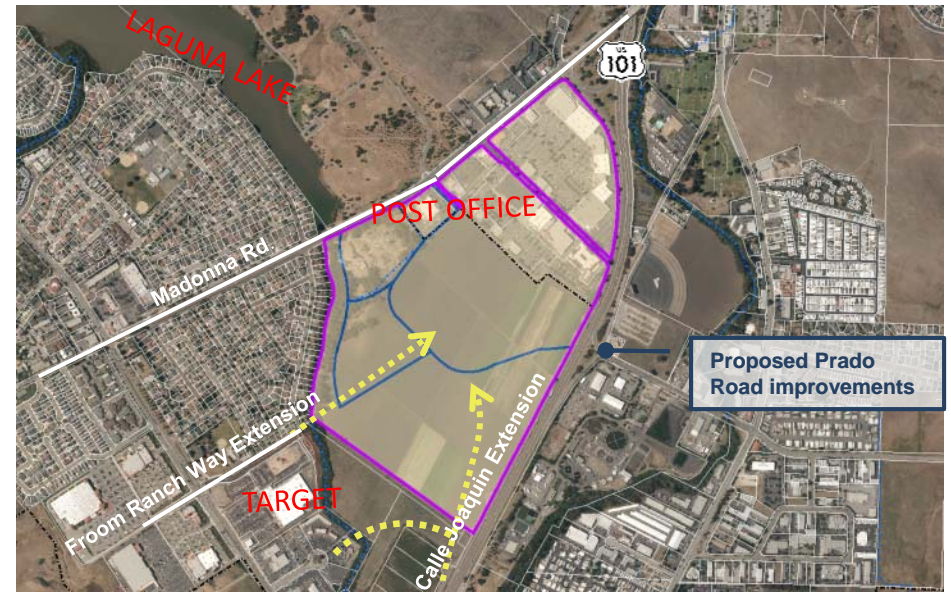
**Discussion Points on LOVR & Madonna Road:**

- Site constraints make roundabout or addition of lanes highly challenging. This likely would require additional right-of-way and disruption of existing buildings.
- Optional connection from neighborhood to Froom & or LOVR to provide alternative exit from neighborhood but may lead to Cut thru traffic.
- Seek input from neighborhood residents as to whether they need different connectivity.

# 6. Froom Ranch and Calle Joaquin Connections to and within Dalidio Property



6-1. Existing Conditions



6-2. Example with One Internal Intersection



6-3. Example with Several Internal Intersections

**Issues:**

- Connectivity for Froom Ranch Road and Calle Joaquin
- Heavy Congestion on Madonna & LOVR Roads
- Cut Thru Traffic In N. Oceanaire Neighborhood

**Discussion Points on 6-2:**

- Connect Calle Joaquin to Madonna Road
- Connect Froom Ranch Way to Calle Joaquin at one (1) location

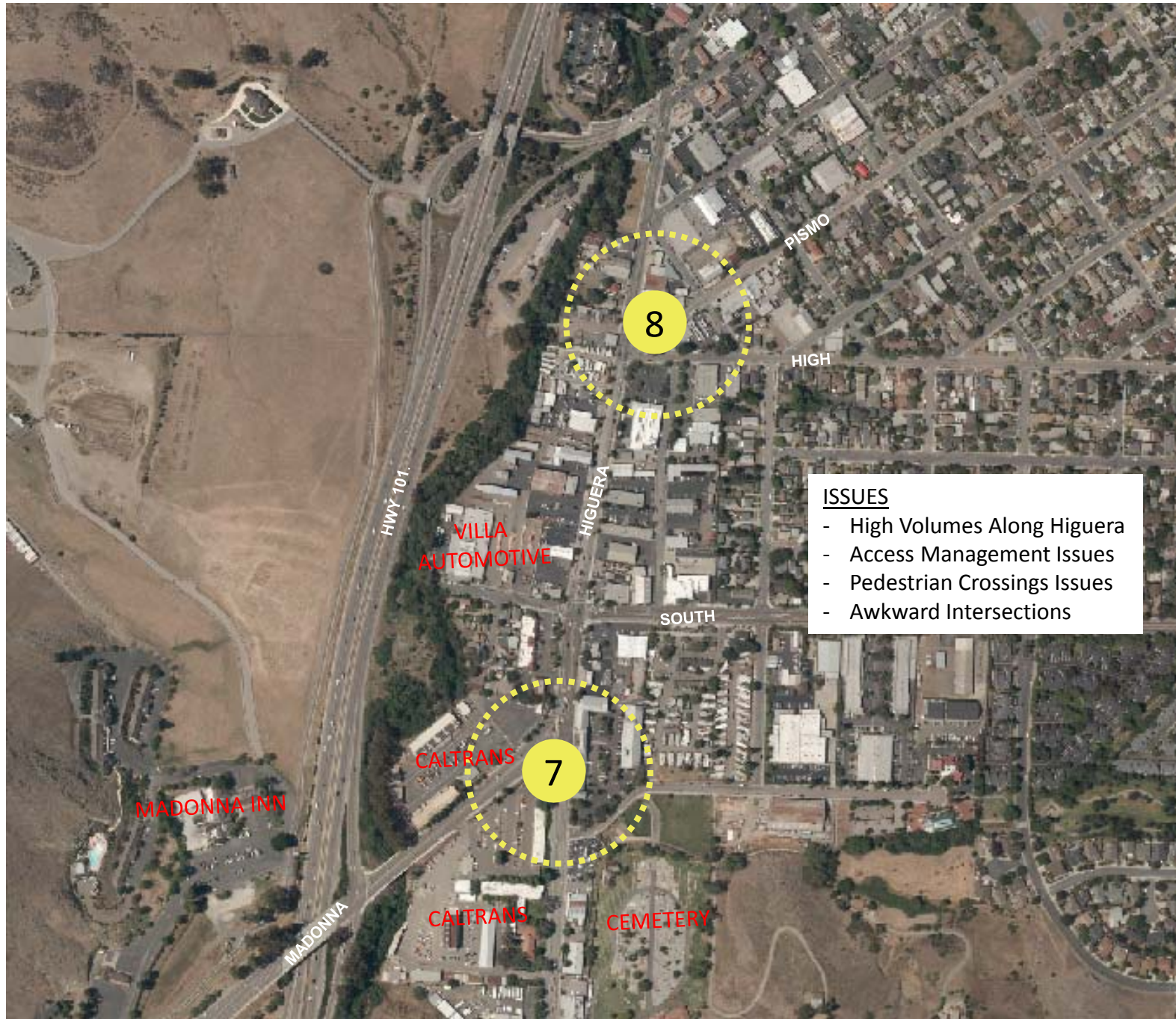
**Discussion Points on 6-3:**

- Connect Calle Joaquin to Madonna Road
- Connect Froom Ranch Way to Calle Joaquin at two (2) or more locations

**General Discussion Points:**

- Calle Joaquin Extension with Prado Road connection can enhance circulation and alleviate traffic at LOVR interchange and LOVR & Madonna Road
- Reduce traffic impacts on existing neighborhoods.
- Active street edge / parking behind buildings
- Trail connectivity
- Bicycle access between Dalidio property and commercial areas

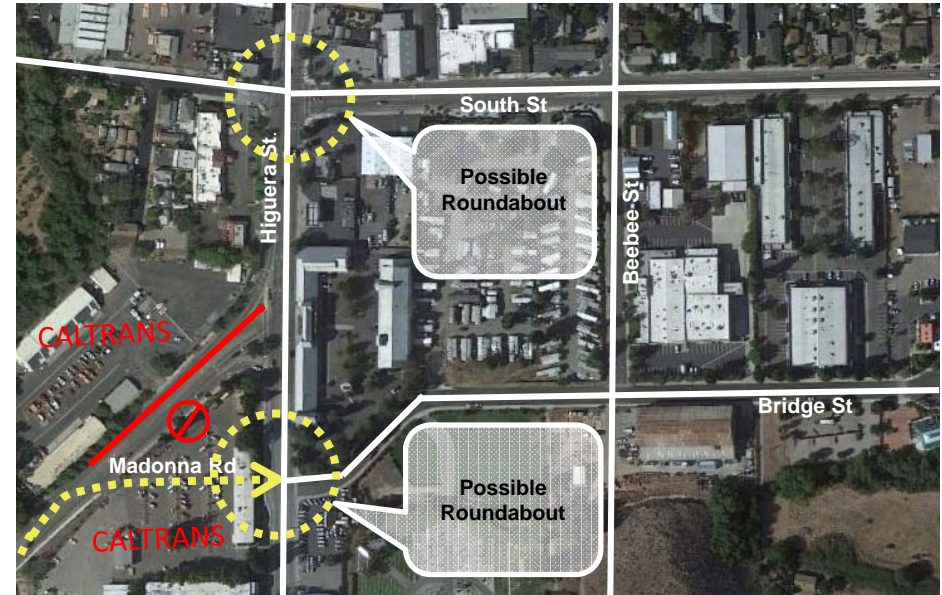
# Mid Higuera Vicinity



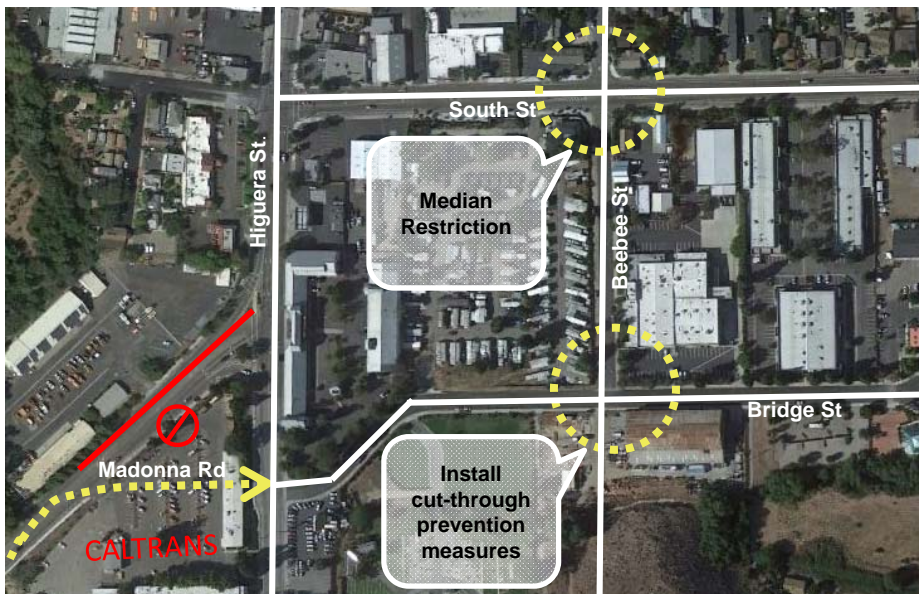
# 7. Madonna / Higuera Intersection



7-1. Existing Conditions



7-2. Example Realignment and Intersection Improvements



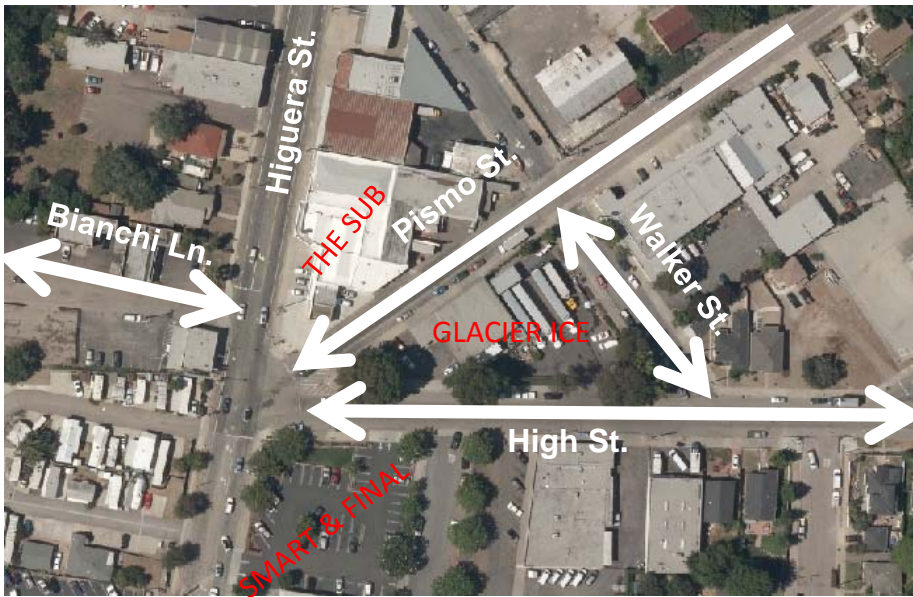
Example Cut Through Prevention Measures

**Issue: Sharp turns and difficult sightlines at skewed intersection**

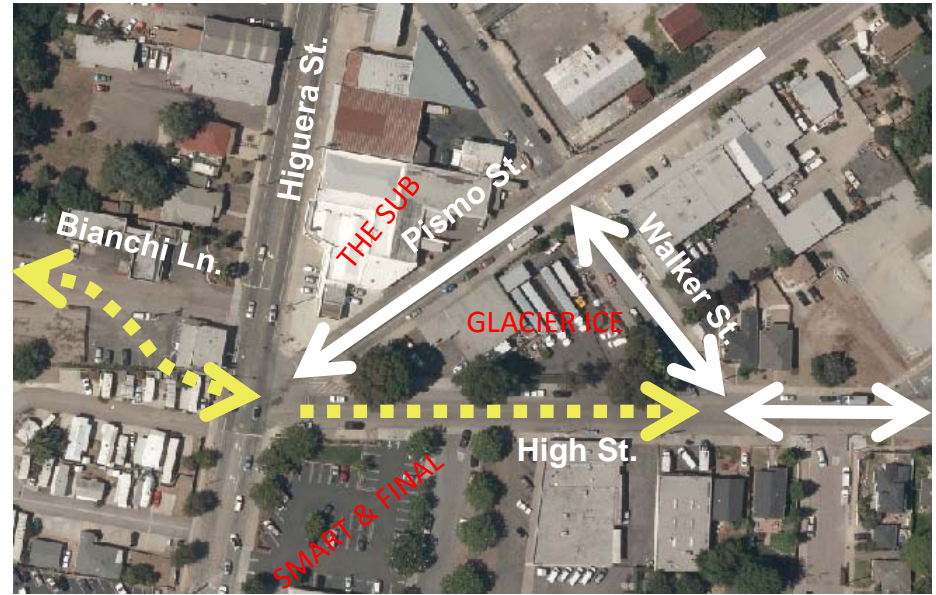
**Discussion Points on 7-2:**

- Impacts Caltrans building
- Possible locations for roundabouts or other intersection improvements
- Potential to increase cut-through traffic on Bridge Street Without Additional measures.
- Options for preventing cut-through traffic:
  - Half-street closure
  - Full-street
  - Median diverter
- Safety enhancement for bikes and pedestrians
- Contingent on cooperation with CalTrans

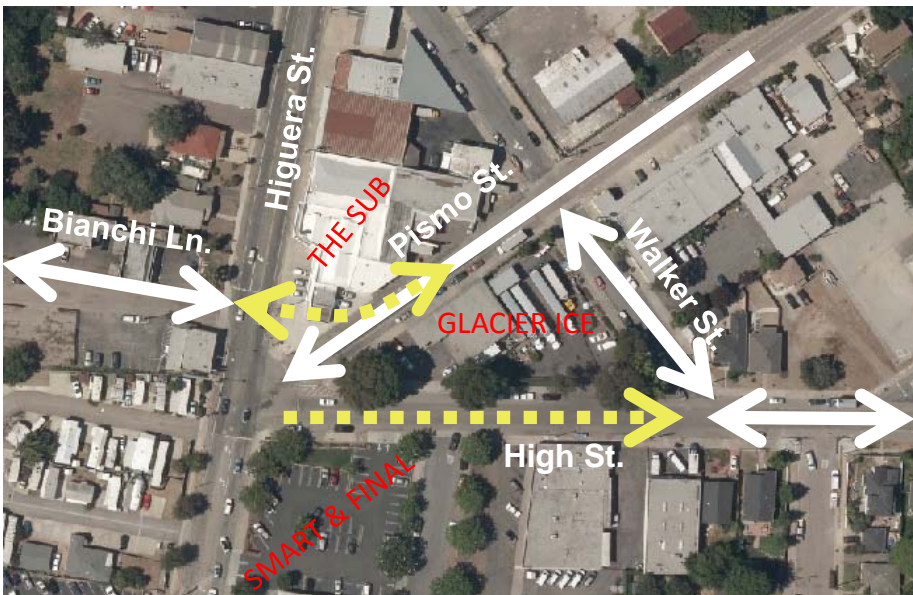
# 8. High & Pismo / Higuera Intersection



8-1. Existing Conditions



8-2. Example Conversion of High St. to One Way



8-3. Realignment of Bianchi Ln

**Issue:**

- Heavy Congestion in Intersection
- Awkward Intersection alignment affects safety
- Long pedestrian crossings

**Discussion Points on 8-2:**

- One way couplet system between High St. Pismo & Beach St.
- Impacts Drum Circuit building
- May allow additional on-street parking on High between Higuera and Walker
- Modify truck routes & reduces impact on neighborhood

**Discussion Points on 8-3:**

- One way couplet system between High St. Pismo & Beach St.
- Realigns Pismo St. to align with Bianchi Ln.
- Impacts The Sub building
- Intersection control evaluation necessary
- Improves intersection operations and pedestrian crossings

# Broad Street & Johnson Avenue Vicinity

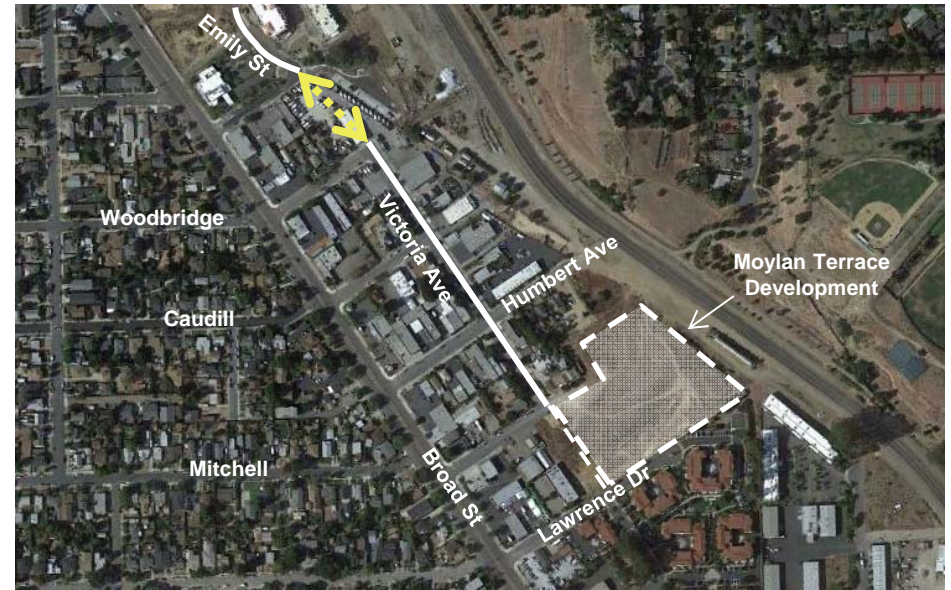


- Issues:**
- High volumes on Broad & Johnson
  - Neighborhood cut thru traffic
  - Pedestrian connections across Broad Street
  - Victoria Avenue connections

# 9. Victoria Ave Connection



9-1. Existing Conditions



9-2. Example Connection of Victoria Avenue and Emily St



9-3. Example Consolidated Access W/ Access Management (Turn Restrictions)

**Issues:**

- Heavy Broad Street Congestion
- Local Access limitations
- Pedestrian Connections Across Broad

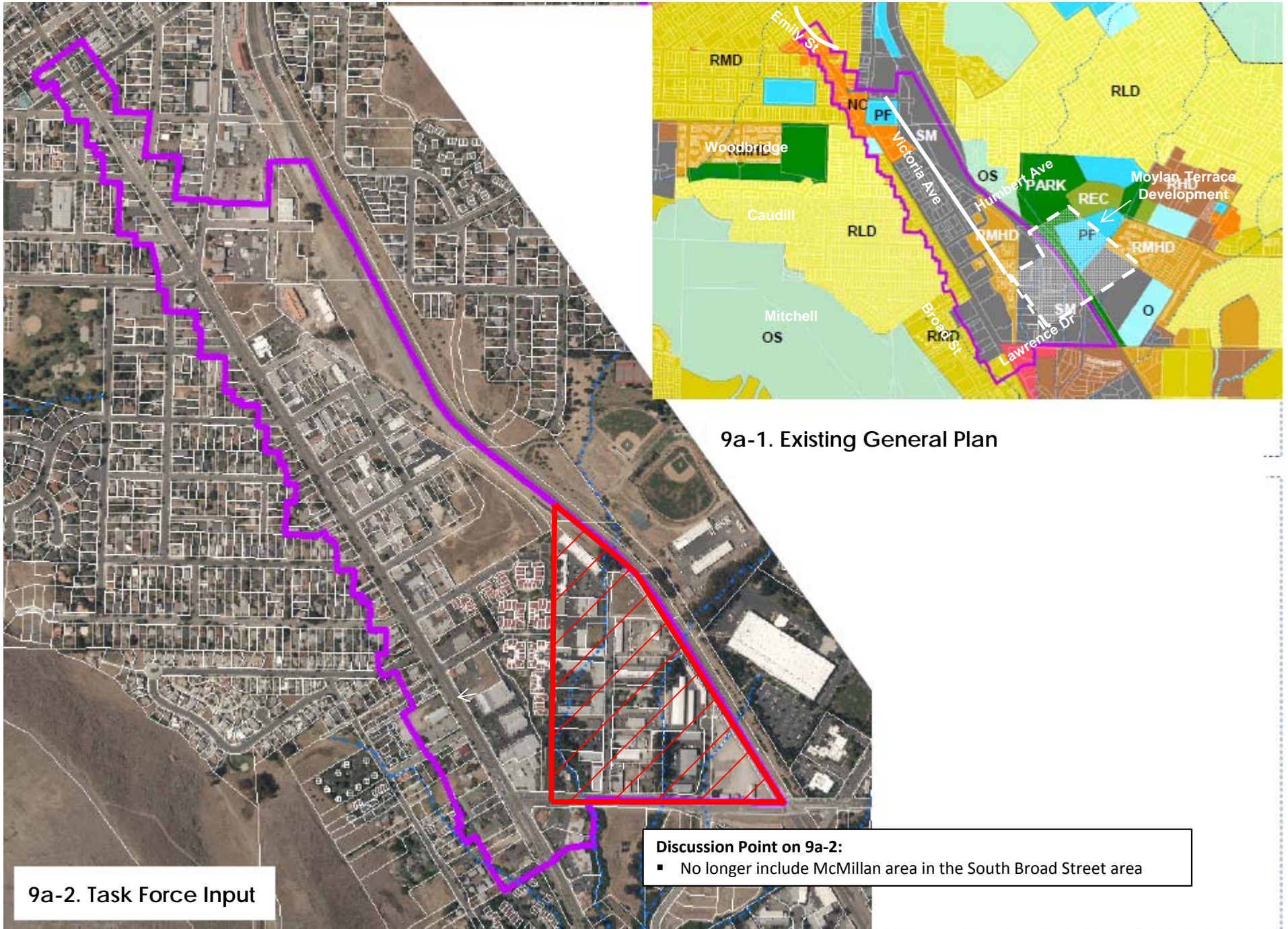
**Discussion Points on 9-2:**

- Complete Victoria Ave. Connection

**Discussion Points on 9-3:**

- Consolidate access points into enhanced crossings
- Reclassify Broad Street From Highway/Regional Route to Parkway Arterial

# 9a. Broad Street Area



9a-1. Existing General Plan

9a-2. Task Force Input

**Discussion Point on 9a-2:**

- No longer include McMillan area in the South Broad Street area



# 10. Bishop St Extension



10-1. Existing Conditions



10-2. Planned Crossing

**Issue:**

- No East/West Connections between Broad & Johnson
- Heavy Congestion along Broad & Johnson
- Cut Thru Impacts to Pismo/Buchon Neighborhood
- Limited emergency response routes

**Discussion Points on 10-2:**

- Must coordinate with Union Pacific Railroad
- Reduces cut thru traffic in other neighborhoods
- Impacts to existing neighborhood on Bishop

# 11. Marsh/ Higuera & Pismo / Buchon Two-way Roads and Couplets



11-1. Existing Conditions



11-2. Convert Buchon to One-Way



11-3. Convert Marsh & Higuera to Two-Way (California to SR)

**Issue:**

- First point of E/W connection is neighborhood leading to cut thru traffic
- One way street system make next point of E/W connection further
- Heavy School Time Cut-thru traffic on Buchon Street.

**Discussion Points on 11-2:**

- Reduces neighborhood traffic by eliminating SB movements
- Limits access for neighborhood residents.

**Discussion Points on 11-3:**

- Reduces neighborhood traffic by providing shorter routes.
- Changes access and impacts on-street parking for business along these sections of Higuera & Marsh.

# 12. Orcutt Rd. Overpass Railroad Crossing



12-1. Existing Overpass Railroad Crossing



12-2. Example Overpass Railroad Crossing



Example Overpass alignment

**Issue: Limited east-west connectivity city-wide**

**Discussion Points on 12-2:**

- Enhanced safety over existing overpass crossing
- Must coordinate with Union Pacific Railroad
- Other locations for overpass crossings may be considered
- Impacts to RR safety trail.

# Downtown

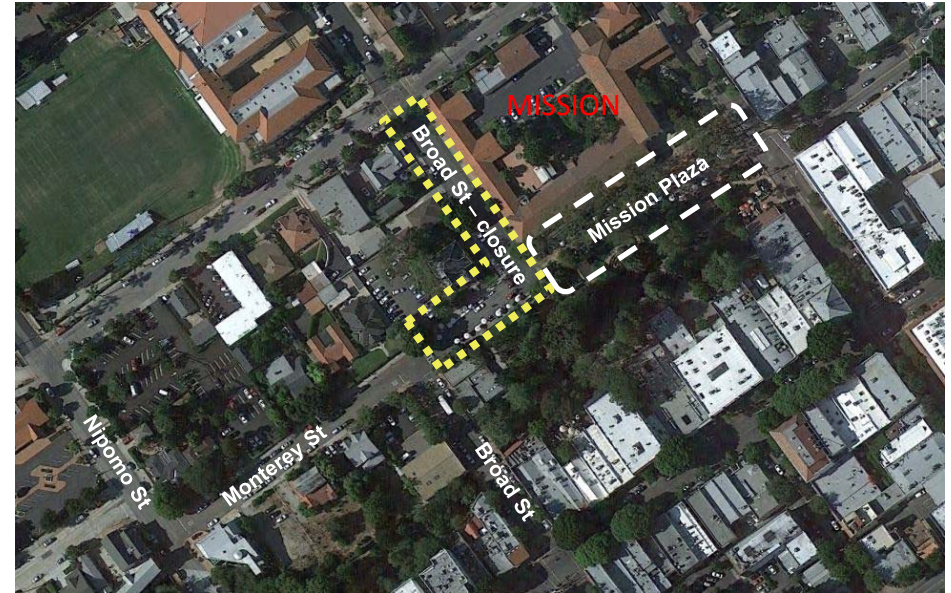


- ISSUES
- Hwy 101 Hook Ramps: Tight Spacing & Neighborhoods
  - Heavy Congestion at 1 and 101 Interchange
  - Downtown Transit Center
  - Mission Plaza Dogleg

# 13. Broad St Dog Leg (Mission Plaza Expansion)



13-1. Existing Conditions



13-2. Example Extension of Pedestrian Plaza



13-3. Example Expansion of Pedestrian Plaza

**Issue:** Confusion regarding pass-through along Broad Street

**Discussion Point on 13-2:**

- Potential for pedestrian streetscape enhancement

**Discussion Point on 13-3:**

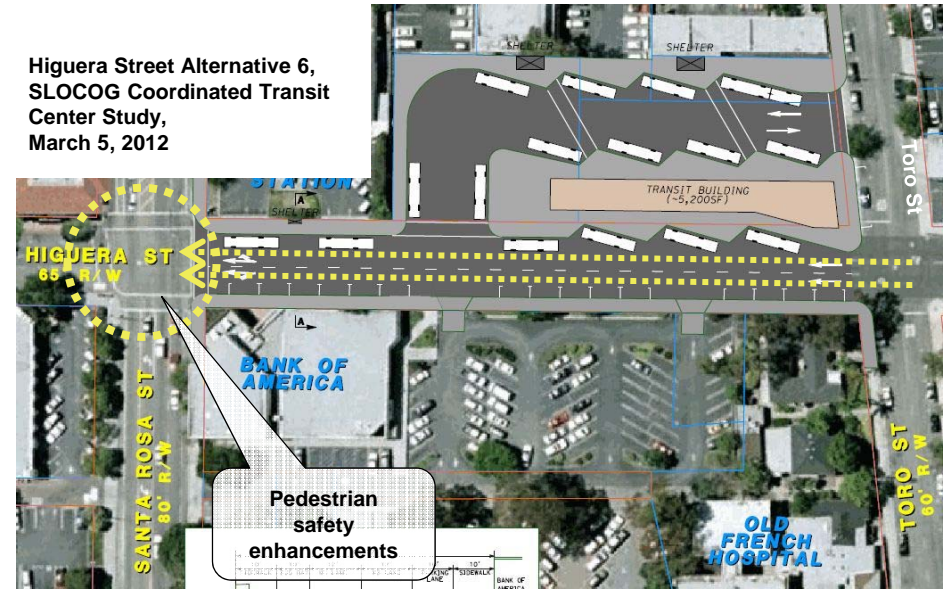
- Benefits to and impact on Monterey Street residences west of Broad Street
- Full Closure vs. Woonerf, or a mix of closure and Woonerf



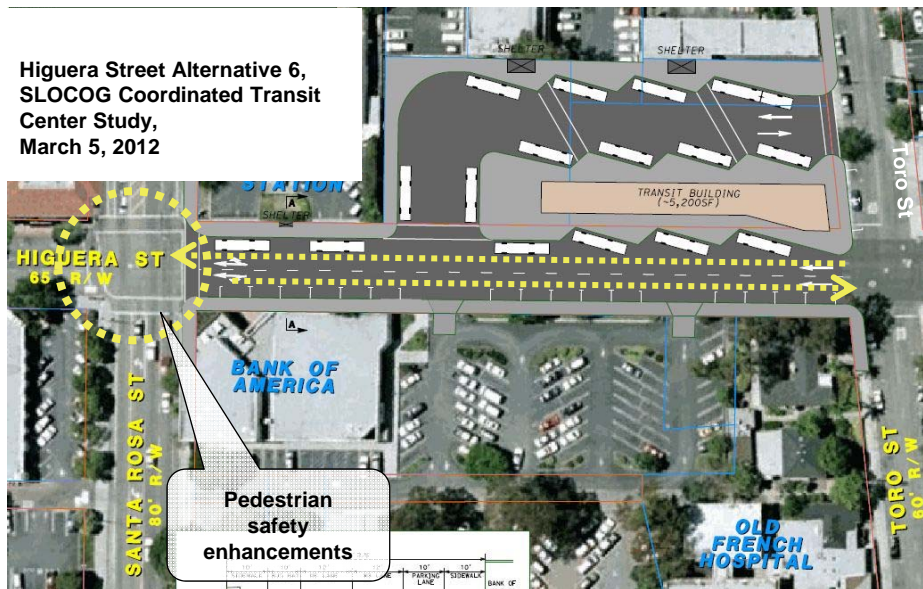
# 14. Transit Center Relocation



14-1. Existing Conditions



14-2. Example Site Layout on Higuera Street



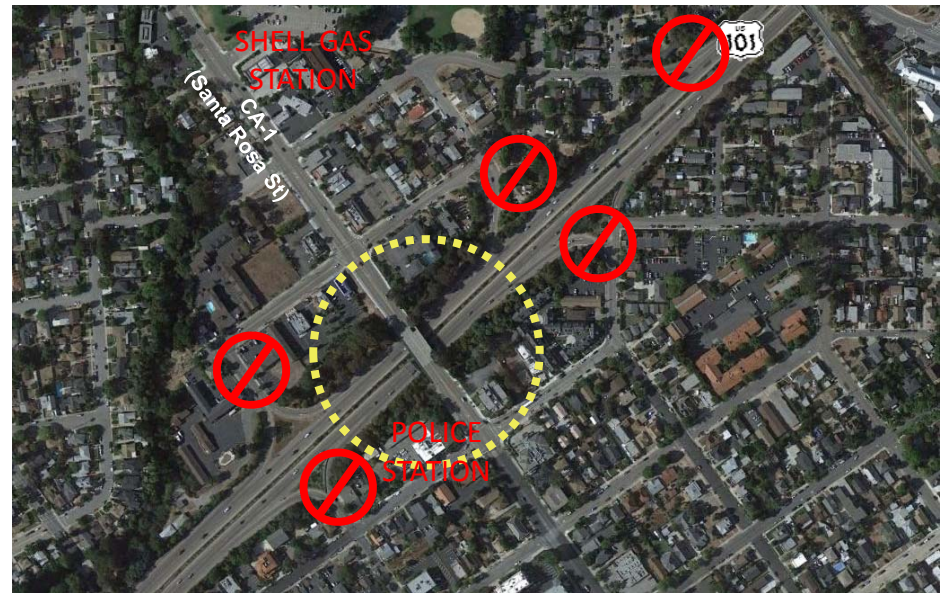
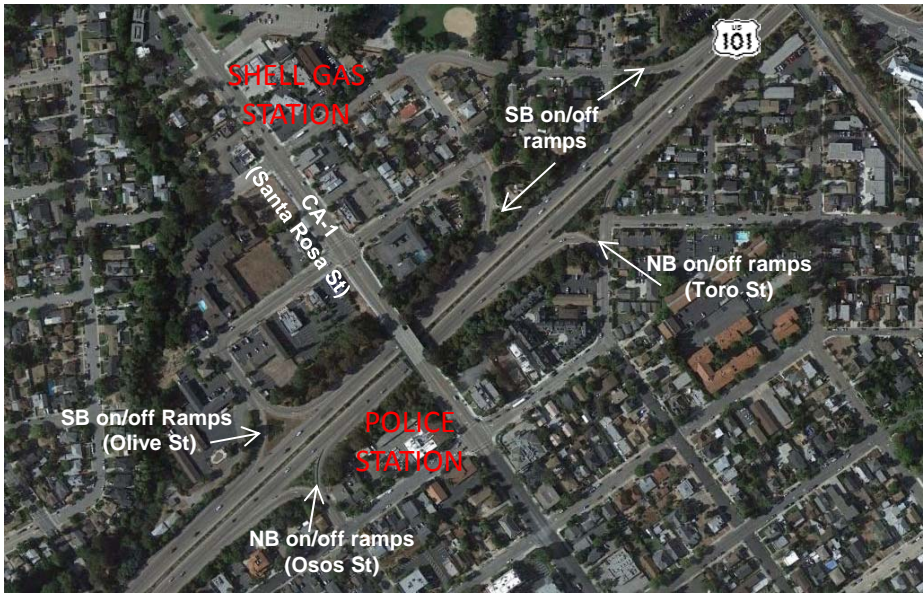
Example Site Layout W/ Two-Way Traffic

Issue: Transit center could be a “self-contained” hub

**Discussion Points on 14-2:**

- Pedestrian safety enhancements at Santa Rosa Street and Higuera Street
- Other proposed alternatives require riders to cross Higuera Street to access some bus bays
- Acquisition of private property
- Impacts on adjacent properties
- Potential benefits to adjacent properties
- Potential shifts in traffic flow and routes drivers choose
- Coordination with transit agencies
- Potential conversion of Higuera St. to Two Way.

# 15. CA-1 & US 101 Interchange



15-1. Existing Freeway Access Through Neighborhoods

15-2. Potential for Enhancement of Interchange



15-2. Example Impact to Surround Properties

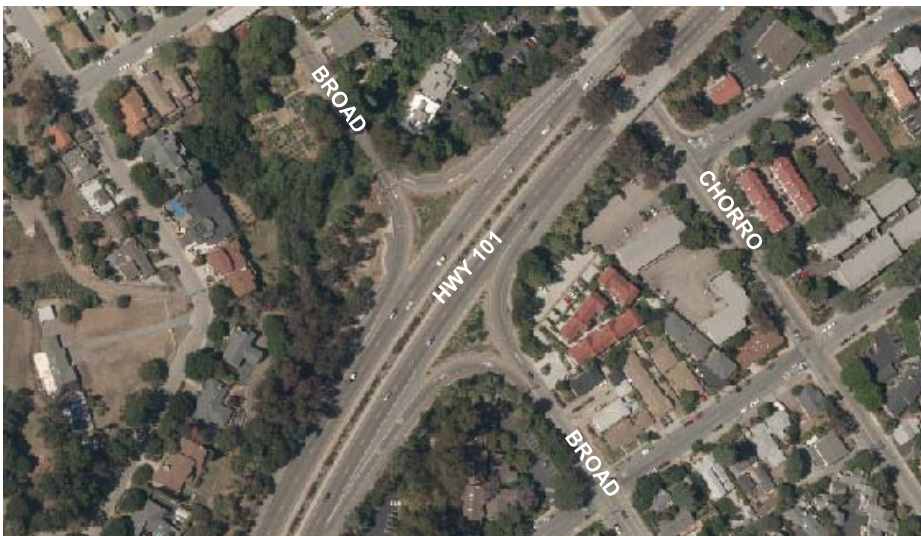
**Issues:**

- Does Not Meet Modern Design Standards
- Heavy Congestion on Santa Rosa
- Ramp system routes traffic thru surrounding neighborhoods

**Discussion Points on 15-2:**

- Redesign interchange to alleviate traffic on neighborhood streets
- Impacts to adjacent businesses and properties
- Potential Access Restrictions at adjacent intersections (Olive & Walnut)
- Closure of existing ramps to neighborhood streets
  - Osos Street and Olive Street
  - Toro Street and Olive Street
  - Broad Street

# 16. Broad St. & US 101 Interchange



16-1. Existing Freeway Access Through Neighborhoods



16-2. Potential for Ramp Closure

#### Issues:

- Does Not Meet Modern Design Standards
- Ramp system routes traffic thru surrounding neighborhoods

#### Discussion Points on 16-2:

- Redesign interchange to alleviate traffic on neighborhood streets
- Increased traffic volume at Santa Rosa



# Santa Rosa & Foothill Vicinity



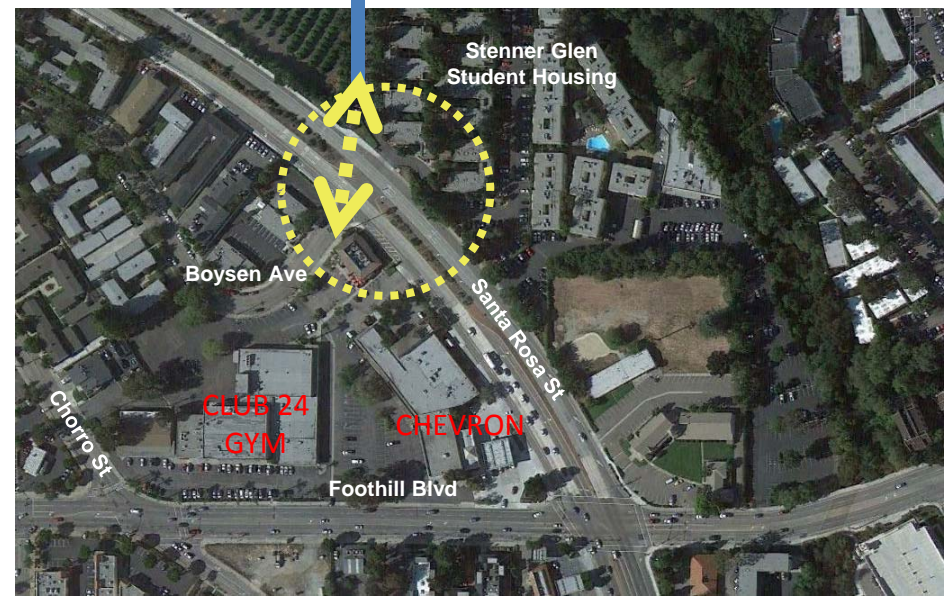
ISSUES

- Boysen Ave. Pedestrian Crossings
- Awkward Intersections

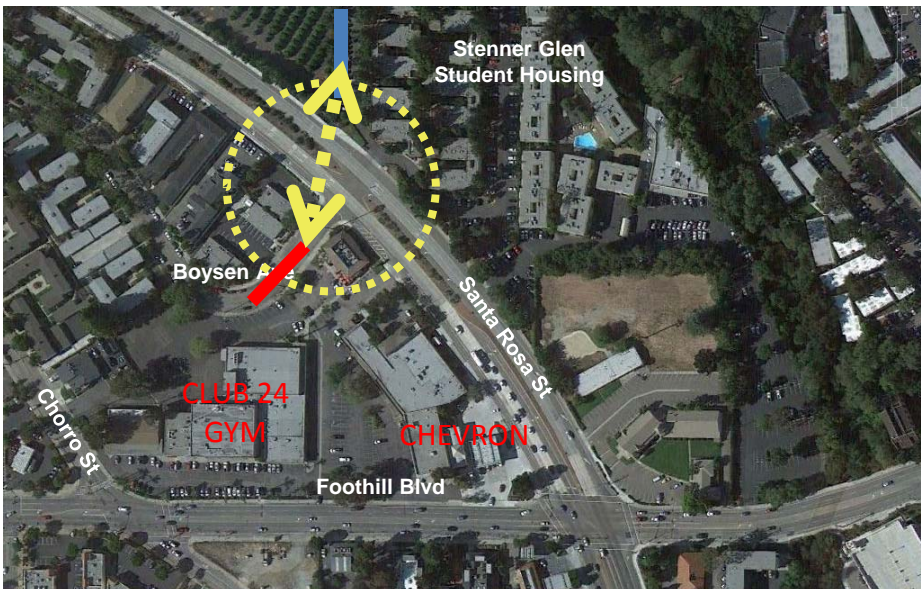
# 17. Pedestrian Access Near Foothill Blvd



17-1. Existing Conditions



17-2. Over/Under Pass Crossing



17-3. Boysen Access Closure – Bikes & Ped Access Only

**Issues:**

- Pedestrians jaywalk across Santa Rosa Street north of Foothill Blvd
- Future CalPoly Master Plan Pedestrian & Bike Connections

**Discussion Points on 17-2:**

- Enhance safety for all modes
- Follows existing pathway preferred by pedestrians
- Could provide natural daylight in tunnel with opening along median

**Discussion Points on Site 17-3:**

- Potential closure of Boysen at Santa Rosa to further enhance or provide for over or under pass crossing.

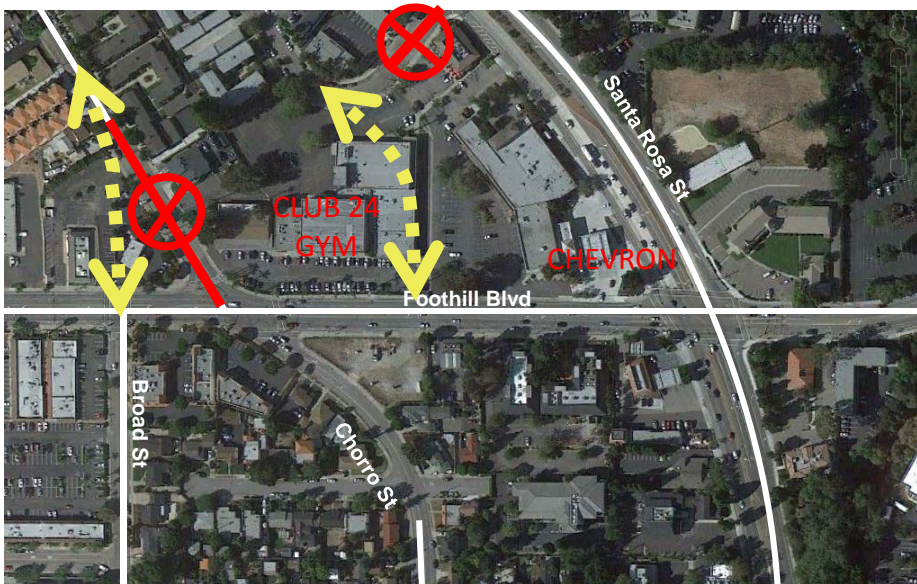
# 18. Vehicular Access Near Foothill Blvd



18-1. Existing Conditions



18-2. Chorro Realignment



18-3. Eroad & Boysen Realignment

**Issue:** Foothill Blvd and Chorro Street intersection is skewed; volumes at Foothill Blvd and Santa Rosa Street intersection eventually will exceed capacity of current geometry

**General Discussion Points:**

- Better sightlines for drivers at right intersection than at skewed intersection
- Realignment of Chorro Street would reduce pedestrian crossing time along Foothill Blvd
- Coordination with Caltrans at Foothill Blvd and Santa Rosa Street
- Increase capacity of intersection at Foothill Blvd and Santa Rosa Street
- Costs for intersection improvements and maintenance

**Discussion Points on 18-2:**

- Roundabouts can be designed safely to accommodate all modes, including pedestrians and bicyclists
- Right-of-way appears to be adequate for roundabout design
- Roundabout precludes vehicular traffic from speeding through intersection

**Discussion Points on 18-3:**

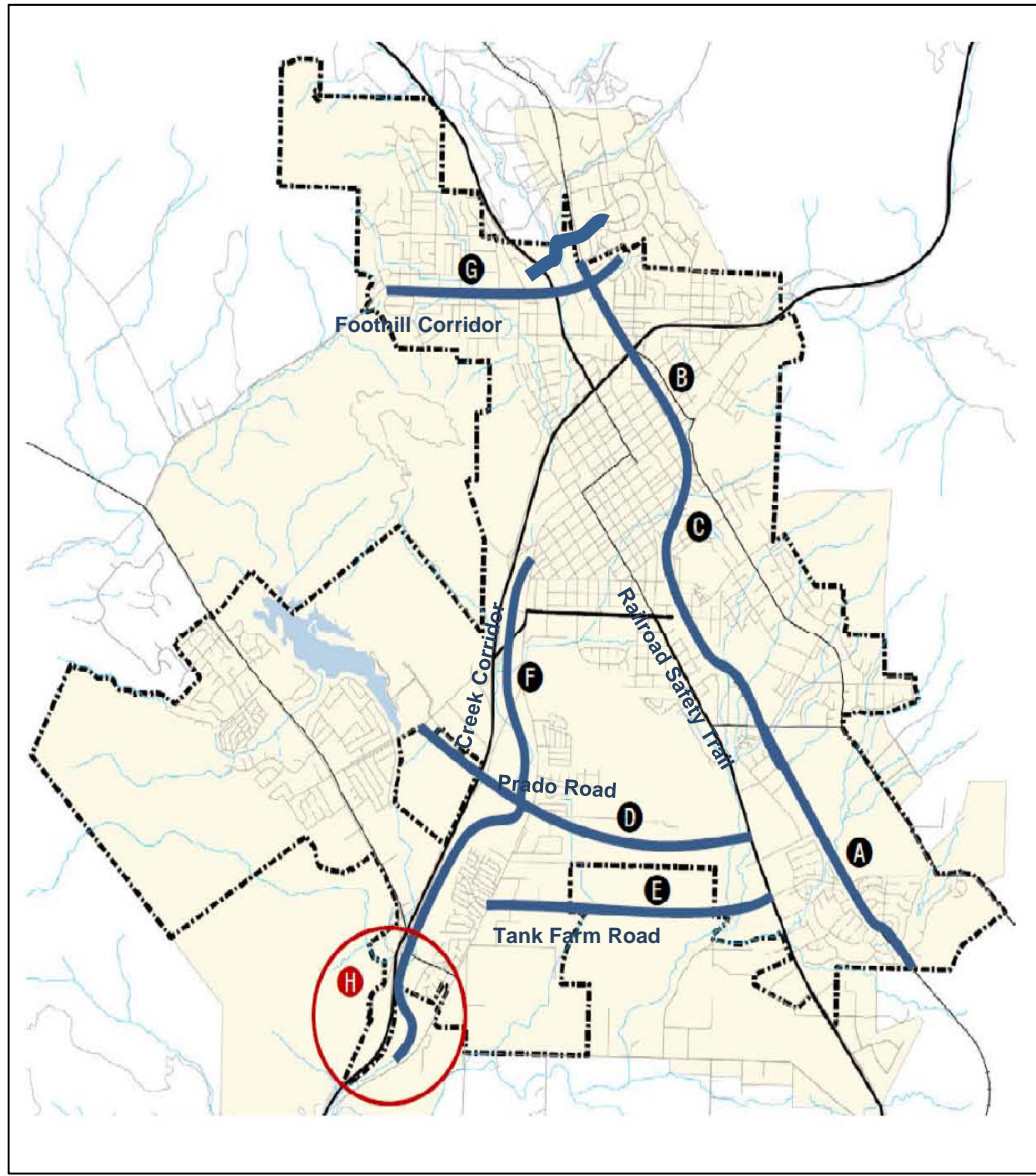
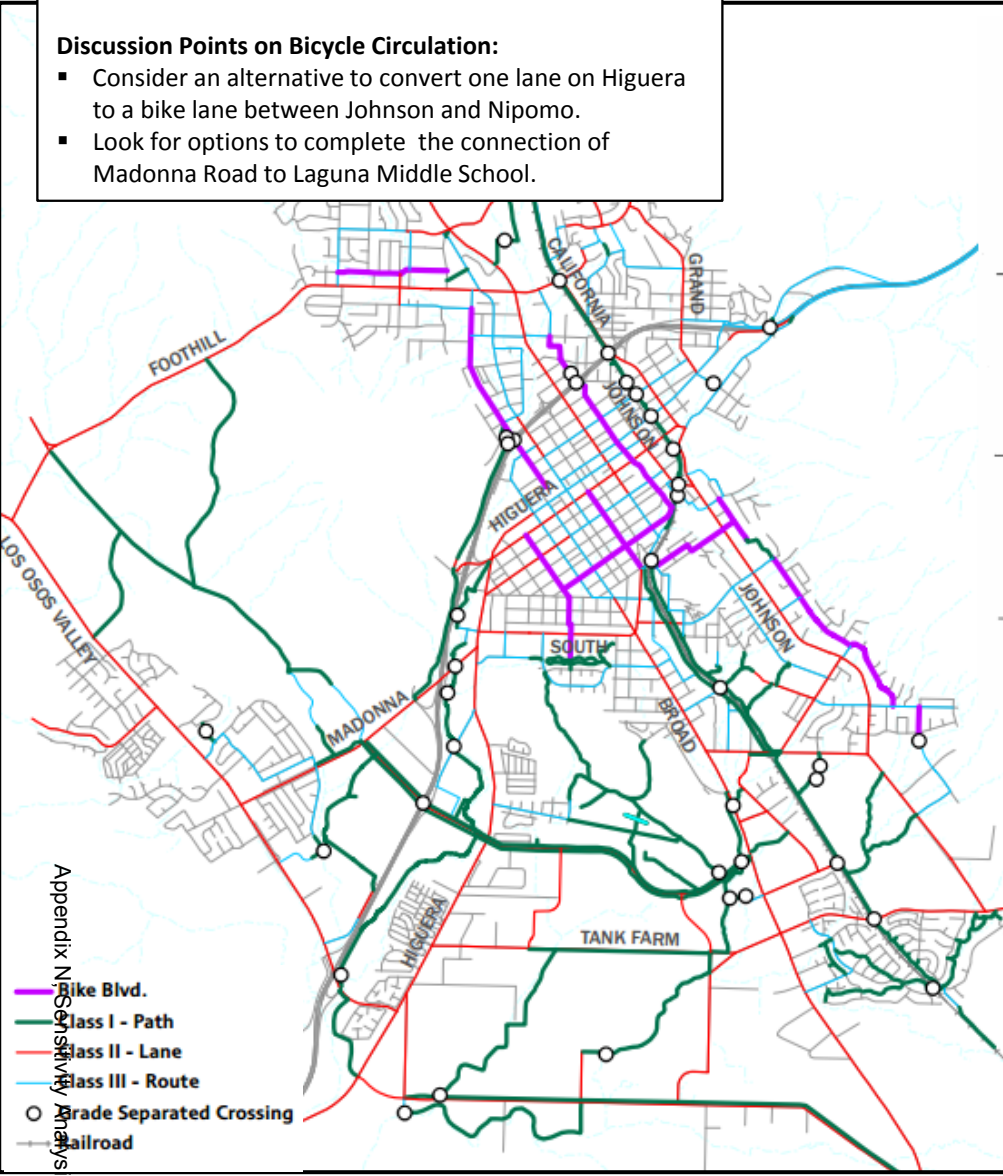
- Impacts to buildings and properties
- Impact to adjacent fire station

# Bicycle Circulation – Bicycle Transportation Plan

**Issue:** Bicycle connectivity could be improved citywide

**Discussion Points on Bicycle Circulation:**

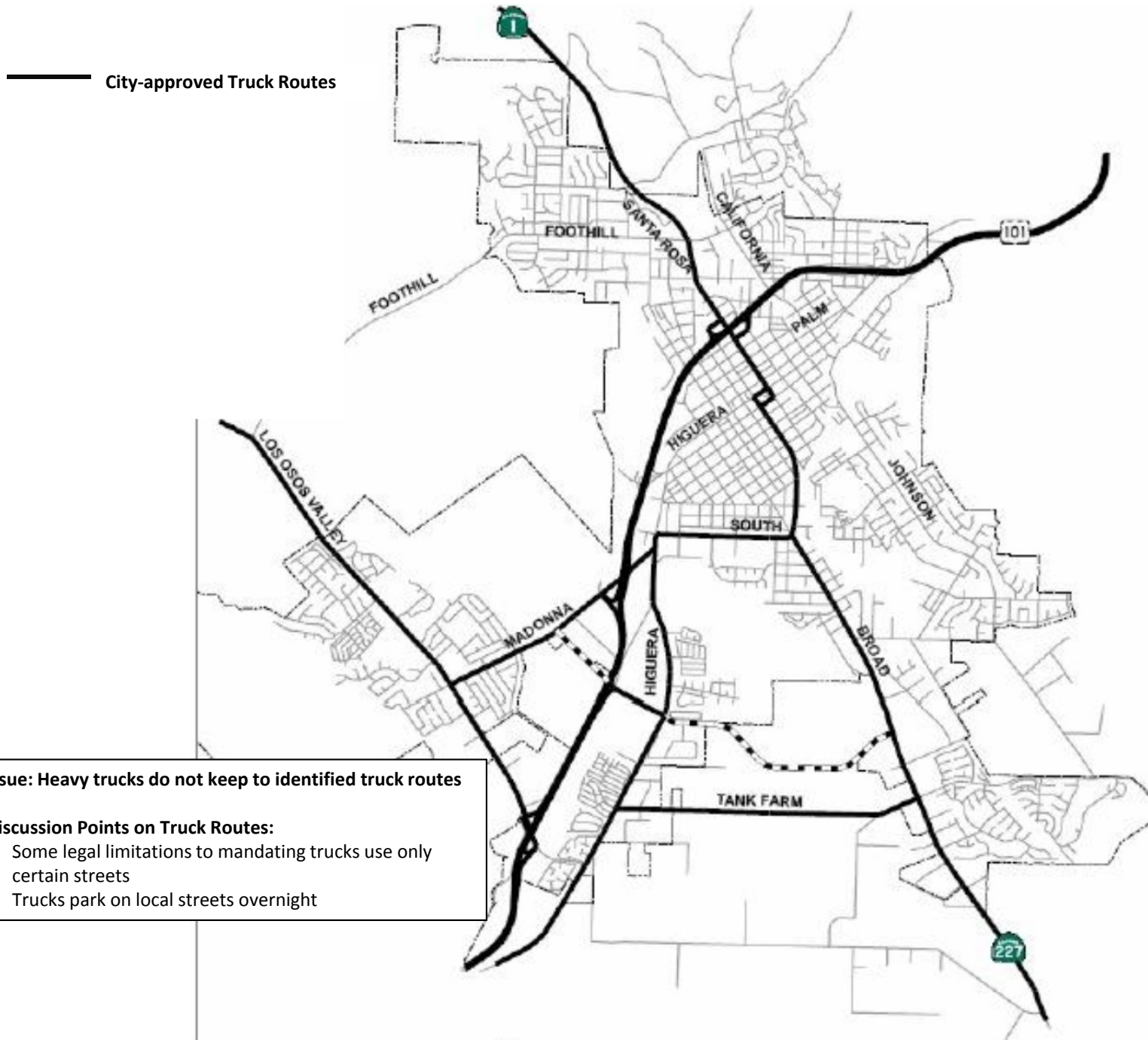
- Consider an alternative to convert one lane on Higuera to a bike lane between Johnson and Nipomo.
- Look for options to complete the connection of Madonna Road to Laguna Middle School.



City Bike Plan

Routes indicated as high priority at Future Fair

# City Wide Issue: Truck Routes continued



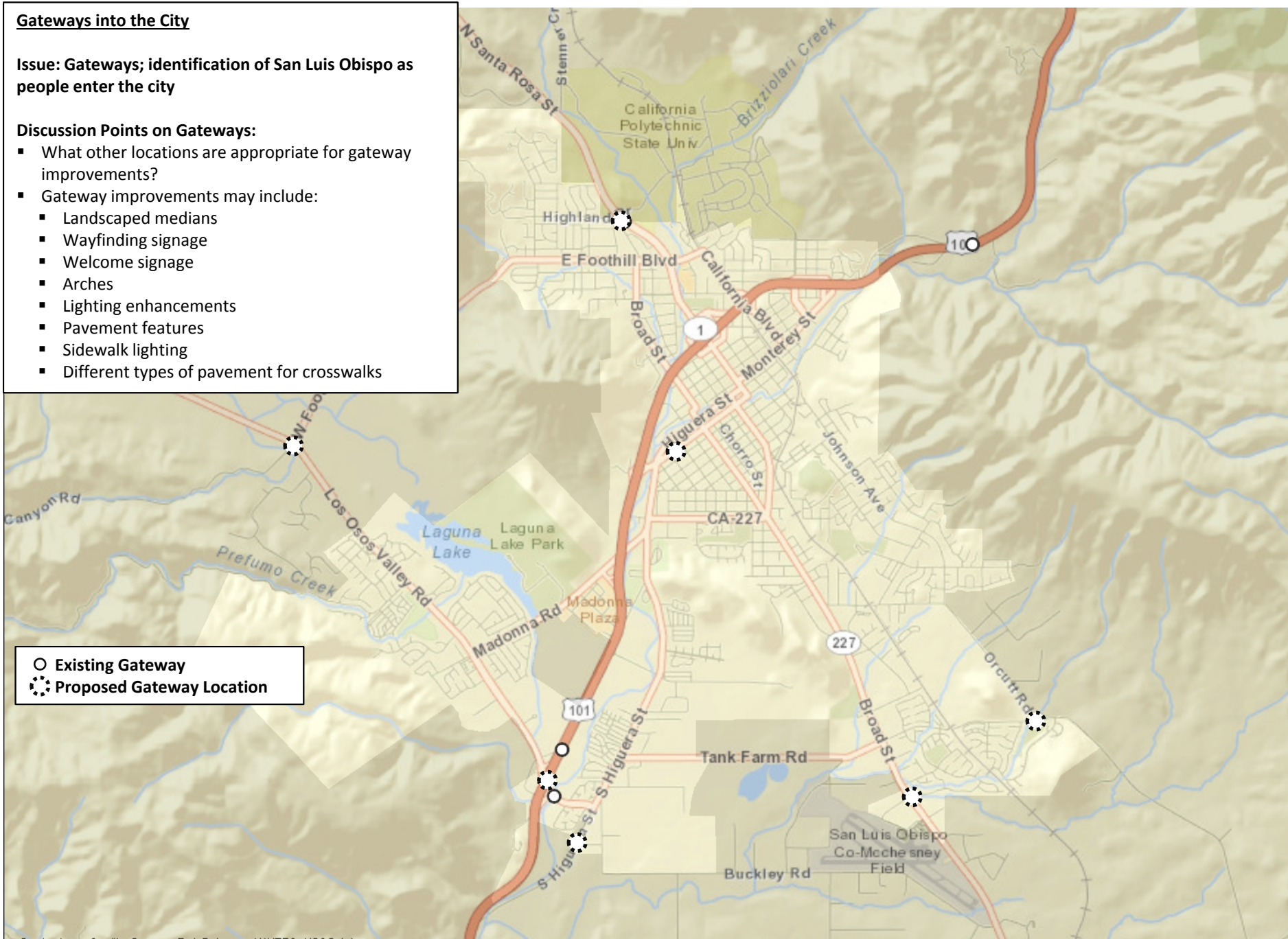
# City Wide Issue: Gateways

## Gateways into the City

**Issue: Gateways; identification of San Luis Obispo as people enter the city**

### **Discussion Points on Gateways:**

- What other locations are appropriate for gateway improvements?
- Gateway improvements may include:
  - Landscaped medians
  - Wayfinding signage
  - Welcome signage
  - Arches
  - Lighting enhancements
  - Pavement features
  - Sidewalk lighting
  - Different types of pavement for crosswalks



- Existing Gateway
- ⊙ Proposed Gateway Location

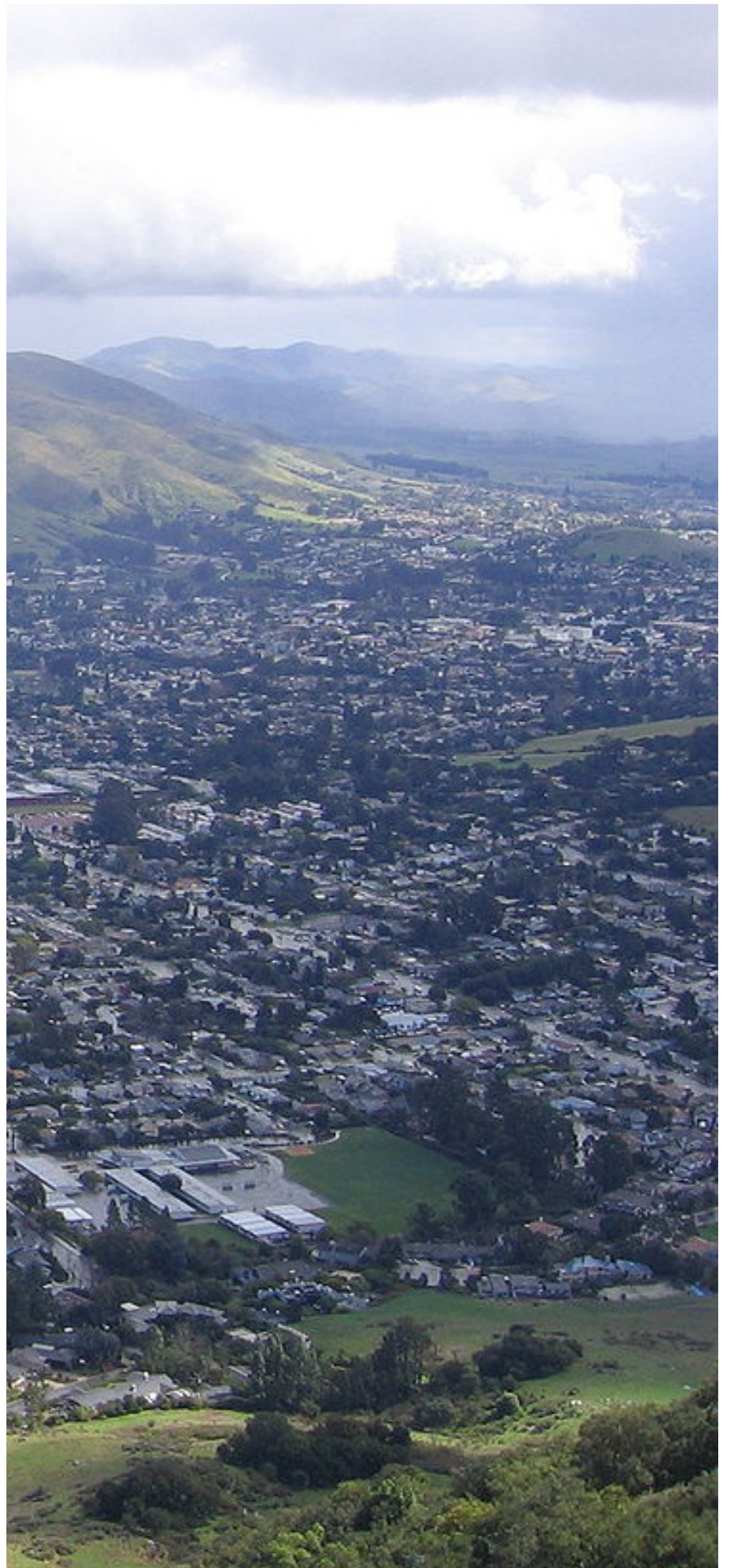
# S. Oceanaire Neighborhood Connection to Froom (Prior location)







*Please see the next page.*



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General Plan Update  
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