



## TECHNICAL MEMORANDUM #1 Revised

To: Ms. Nanette Slusser, Assistant County Administrator

From: Benjamin H. Goff, P.E., Deputy Director, Transportation

Date: June 25, 2009

Subject: Revised Cost Estimates for SWIP Roadway Capacity Improvement Projects and Roadway Life Cycle Costs

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This memorandum is a revision of the original Technical Memorandum #1 dated January 20, 2009. Based on written comments and meetings with stakeholders, Department of Transportation staff believes some revisions are warranted to the original information.

In this memorandum, CLA and County staff sets forth the methods used to make two fundamental estimates for SWIP roadway projects:

1. Total costs of the roadway capacity improvements that have been determined necessary to meet demand associated with population growth in the Southwest Infrastructure Project (SWIP) area;
2. Average annual life cycle costs for each roadway project.

The SWIP planning process identified twelve separate roadway capacity improvement projects for the study area. One of the projects, however, envisions adding an additional two lanes of capacity to Ajo Highway between Sandario Road and Kinney Road. Ajo Highway is a state route and Pima County is prohibited from expending development impact fee revenues on a state route. Therefore, this memorandum will only address the eleven roadway projects that are eligible for impact fee funding. The recommended improvements to Ajo Highway (\$36.6 million) are still needed, but they will have to be funded by means other than impact fees.

### ESTIMATING TOTAL COSTS OF SWIP ROADWAY PROJECTS

CLA and County staff defined total projects costs as the sum of four components: construction costs, design costs, construction administration costs, and right-of-way costs. CLA and County staff developed estimates of the costs of each of the SWIP roadway capacity improvement projects by (A) developing estimates of construction costs per lane mile and then multiplying the per lane mile cost by the number of lane miles to be constructed; (B) by calculating design at 17.6 percent of construction costs;

(C) calculating construction administration costs at 14.2 percent of construction costs; and (D) working with Pima County Real Property staff to estimate right-of-way costs for each project.

### **Estimating Construction Costs**

CLA and County staff developed estimated construction costs based on calculating a base unit cost of construction per lane mile to which we added estimated costs for extraordinary (i.e., atypical) drainage structures associated with constructing roadway projects in the SWIP area.

### **Estimating Construction Costs per Lane Mile**

In estimating a construction cost per lane mile, staff reviewed eleven arterial roadway improvements completed by Pima County between 2002 and 2006. Staff used the final construction costs for each of these eleven projects, adjusted three projects by removing bridge costs and then inflated the final costs to 2008 dollars. Based on this methodology, construction costs per lane mile are estimated at \$1,509,000 in 2008 dollars.

### Inflating Final Construction Costs to 2008 Dollars

Exhibit 1 identifies the eleven projects used in cost estimation, with the effective dates of their construction contract (column 1). Pima County staff used the final construction cost (original contract award amount plus change orders) for each project as reported in County's e-contract data base (column 2) and inflated them to 2008 dollars using annual increases reported by the Engineering News Record – Construction Costs Index for each year between the date of the original award and 2008 (column 3). The bridge costs for three projects were removed prior to inflating the costs to 2008 dollars. The SWIP project cost estimates include an increase for "extraordinary" drainage costs for wash crossings with a peak 100 year discharge greater than 1,000 cfs (exhibit 4). However, three of the baseline projects used for the cost analysis also included some large drainage structures. For consistency, the bridge costs for these three projects were deducted from the final construction cost, as noted in Exhibit 1.

**Exhibit 1 Final Construction Costs Inflated to 2008 Dollars**

Project	Column 1 Effective Date of Construction Contract	Column 2 Final Construction Cost	Column 3 % Increase	Column 4 Inflated Final Construction Costs(2008 Dollars)
La Cholla Blvd: Omar Drive to Magee Road - 45a	3/19/02	\$6,805,483	25.8%	\$8,561,298
S. 12th Ave: Los Reales Road to Lerdo Road	5/8/02	\$4,516,401	25.8%	\$5,681,632
Skyline Drive: Chula Vista to Campbell	5/21/02	\$16,865,541	25.8%	\$21,216,851
Wetmore/Ruthrauff Rd: La Cholla-Fairview	9/9/03	\$11,079,497	22.9%	\$13,616,702
La Cholla Blvd: River Road to Omar Drive - 45b	11/18/03	<sup>1</sup> \$10,346,375	22.9%	\$12,715,695
Catalina Hwy: Tanque Verde Rd. to Houghton Rd.	8/16/04	\$4,897,772	15.4%	\$5,652,029
River Road: Campbell Ave to Alvernon Way/ Alvernon, River Rd to Fort Lowell	5/5/05	<sup>2</sup> \$16,270,844	10.6%	\$17,995,553
So. 12th Avenue: 44th Street Gateway Intersection (10th Ave. & 44th Street)	3/8/06	\$2,701,368	6.2%	\$2,868,853
Valencia Road / Mission Rd. to I-19	8/1/06	\$9,016,868	6.2%	\$9,575,914
Country Club, 36th St to Milber	8/21/06	<sup>3</sup> \$7,007,776	6.2%	\$7,442,258
Valencia, Mark to Camino de la Tierra	12/12/06	\$13,841,629	6.2%	\$14,699,810
				<b>\$120,026,594</b>

<sup>1</sup>Final Construction Cost minus bridge cost of \$1,433,751

<sup>2</sup>Final Construction Cost minus bridge cost of \$2,667,084

<sup>3</sup>Final Construction Cost minus bridge cost of \$991,644

Estimating Construction Costs per Lane Mile

Exhibit 2 converts the inflated final construction cost estimates into construction costs per lane mile. The construction cost per lane mile for these projects was \$1,509,000 (rounded), in 2008 dollars.

**Exhibit 2 Estimated Construction Costs per Lane Mile (2008 dollars)**

	Column 1	Column 2
Project	Inflated Final Construction Costs (Column 4, Exhibit 1)	Total Lane Miles
La Cholla Blvd: River to Omar Drive	\$8,561,298	12.00
S. 12th Ave: Los Reales Road to Lerdo Road	\$5,681,632	3.60
Skyline Drive: Chula Vista to Campbell	\$21,216,851	12.00
Wetmore/Ruthrauff Rd: La Cholla-Fairview	\$13,616,702	7.20
La Cholla Blvd: Omar Drive to Magee Road	\$12,715,695	6.00
Catalina Hwy: Tanque Verde Rd. to Houghton Rd.	\$5,652,029	6.40
River Road: Campbell Ave to Alvernon Way/ Alvernon, River Rd to Fort Lowell	\$17,995,553	14.24
So. 12th Avenue: 44th Street Gateway Intersection (10th Ave. & 44th Street)	\$2,868,853	1.40
Valencia Road / Mission Rd. to I-19	\$9,575,914	3.20
Country Club, 36th St to Milber	\$7,442,258	3.10
Valencia, Mark to Camino de la Tierra	\$14,699,810	10.40
	<b>Inflated Final Construction Costs Total</b>	<b>Total Lane Miles</b>
	\$120,026,595	79.54

<b>Construction Costs per Lane Mile</b>	\$1,509,009
<b>Rounded Construction Costs per Lane Mile</b>	<b>\$1,509,000</b>

Base Construction Cost for SWIP Projects

Exhibit 3 applies the base cost per lane mile of \$1.509 million to each of the identified SWIP roadway capacity improvement projects, based on the current project configurations. The three grade separated intersections along Ajo Highway were estimated at \$20 million each, for a total estimated cost of \$60 million. Based on this methodology, total estimated base construction costs for the eleven SWIP transportation projects are \$290.5 million



**Exhibit 3      Estimated Base Construction Costs for SWIP Roadway Capacity Improvement Projects**

Map I.D.	Project Description	Project Length (miles)	SWIP Lane Additions	SWIP Added Lane Miles	Base Construction Cost Estimate
TR - 1b	Ajo Highway; three grade separated intersections				\$60,000,000
TR - 2	Joseph Road/Mark Road, widen to 4-lanes from Ajo Highway to Los Reales	3.70	4	14.80	\$22,333,200
TR - 3	Irvington Road extension and widening; Ajo Highway to Mission Road			20.20	\$30,481,800
	<i>Irvington Road, Ajo to Sunset</i>	0.90	2	1.80	
	<i>Irvington Road, Sunset to Mission</i>	4.60	4	18.40	
TR - 4	Drexel Road extension; Ajo Highway to Mark Rd	3.43	4	13.72	\$20,703,480
TR - 5	Valhalla Road extension; Valencia Road to Drexel Road	1.00	4	4.00	\$6,036,000
TR - 6	Valencia Road, widen to 6-lanes from Ajo Highway to Mission Road			31.20	\$47,080,800
	<i>Valencia Road, Ajo to Airline Road 4-lanes (as programmed)</i>	0.75	0	0.00	
	<i>Valencia, Airline Road to Vahalla (4 to six lanes)</i>	2.00	2	4.00	
	<i>Valencia Road, Vahalla to Mission</i>	6.80	4	27.20	
TR - 7	Wade Road, Ajo Highway to Los Reales Road			8.40	\$12,675,600
	<i>Wade Road, Ajo - Valencia</i>	1.45	4	5.80	
	<i>Wade Road - Valencia - Los Reales</i>	1.30	2	2.60	
TR-8	San Joaquin, Ajo to Sandario			16.00	\$24,144,000
	<i>San Joaquin Road, widen to 4-lanes from Ajo Highway north to Bopp Road</i>	2.40	2	4.80	
	<i>San Joaquin Road, Bopp Road north to Sandario</i>	5.60	2	11.20	
TR -9	Los Reales, Ajo Highway to Mark Rd			32.72	\$49,374,480
	<i>Los Reales, Ajo - Yedra</i>	5.73	4	22.92	
	<i>Los Reales, Yedra to Camino Verde</i>	1.50	2	3.00	
	<i>Los Reales, Camino Verde - Mark</i>	1.70	4	6.80	
TR - 10	Airline Road, Los Reales to Valencia	1.00	4	4.00	\$6,036,000
TR-11	Bopp Road, San Joaquin to Kinney	3.85	2	7.70	\$11,619,300
<b>Grand Total</b>				<b>152.74</b>	<b>\$290,484,660</b>

### Estimated Costs of Extraordinary Drainage Needs in SWIP Area

A complex drainage network consisting of braided channels and large areas of sheet flooding results in frequent road closures. Providing all weather access on the major transportation corridors is a critical element of the SWIP plan. The SWIP study identified forty-two roadway crossings that needed either new or improved box culverts or bridges to handle flows exceeding 1,000 c.f.s (Table H-4). These locations require drainage structures larger than the typical roadway widening.

The costs of these larger structures are considered extraordinary, in that they would not be captured in the \$1.509 million per lane mile construction cost estimate. Therefore, the additional drainage structure costs identified in the SWIP report are included in the construction cost estimate.

The estimated drainage costs were added to the estimated base construction costs from Exhibit 3 to produce estimated total construction costs for each SWIP project, as shown in Exhibit 4.

Exhibit 4 Estimated Total Construction Costs for SWIP Roadway Development Impact Fee Projects

Map I.D.	Project Description	Estimated Construction Costs		
		Base Construction Estimate	Drainage Cost Estimates	Revised Construction Cost Estimates
TR - 1b	Ajo Highway; three grade separated intersections	\$60,000,000		\$60,000,000
TR - 2	Joseph Road/Mark Road, widen to 4-lanes from Ajo Highway to Los Reales	\$22,333,200	\$1,300,300	\$23,633,500
TR - 3	Irvington Road extension and widening; Ajo Highway to Mission Road	\$30,481,800	\$1,618,900	\$32,100,700
TR - 4	Drexel Road extension; Ajo Highway to Mark Rd	\$20,703,480	\$1,733,700	\$22,437,180
TR - 5	Vahalla Road extension; Valencia Road to Drexel Road	\$6,036,000	\$7,145,000	\$13,181,000
TR - 6	Valencia Road, widen to 6-lanes from Ajo Highway to Mission Road	\$47,080,800	\$16,517,900	\$63,598,700
TR - 7	Wade Road, Ajo Highway to Los Reales Road	\$12,675,600		\$12,675,600
TR-8	San Joaquin, Ajo to Sandario	\$24,144,000	\$10,763,900	\$34,907,900
TR -9	Los Reales, Ajo Highway to Mark Rd	\$49,374,480	\$14,427,600	\$63,802,080
TR - 10	Airline Road, Los Reales to Valencia	\$6,036,000		\$6,036,000
TR-11	Bopp Road, San Joaquin to Kinney	\$11,619,300	\$1,500,000	\$13,119,300
<b>Grand Total</b>		\$290,484,660	\$55,007,300	\$345,491,960

### **Estimating Preconstruction and Construction Administration Costs of SWIP Roadway Capacity Improvement Projects**

Design costs and construction administration costs estimates derive from the Arizona Benchmarking Study (Study). The Study notes that “While construction costs represent a significant expenditure, they do not represent the entire cost of the projects. There are additional, significant costs – over and above construction costs - to deliver these projects. The costs associated with the project delivery process – planning, design, environmental remediation and documentation, value engineering, permits, construction management, closeout and startup – are influenced by many factors...” The Study refers to these as “project delivery costs” or “soft costs.” The costs are related to (a) the Pre-Construction or Design Phase – from the time a project budget was approved to the construction Notice to Proceed and (b) the Construction Management Phase – from the construction Notice to Proceed to the Notice of Completion.”

The Study calculated Design Costs at 17.6 percent of direct construction costs and Construction Administration costs as 14.2 percent of direct construction costs. CLA applied these percentages to the construction cost estimates described above.

### **Estimating Right-of-Way Costs**

Right-of-way costs were estimated by the Pima County Real Property Division, on a project-by-project basis, based on both the existing and proposed rights of way superimposed on aerial photographs where all parcels were identified, with their current zoning and development.

### **Estimated Total Project Costs for Development Impact Fee Roadway Projects Only**

Exhibit 5 presents the total estimated project costs for all eleven SWIP roadway projects eligible for impact fee funding. Based on the method described above, the total estimated cost of SWIP roadway projects is \$503.9 million. Direct construction costs are estimated at \$345.5 million (70 percent). The design costs, construction administration costs, and right-of-way costs total to an additional \$158 million (30 percent).

**Exhibit 5 Estimated Total Project Costs**

Map I.D.	Project Description	Revised Construction Cost Estimates	Other Estimated Costs			Total Project Costs	Total Project Costs (Rounded)
			Design Costs	Construction Administration Costs	Estimated Right-of-Way Costs		
TR - 1b	Ajo Highway; three grade separated intersections	\$60,000,000	\$10,560,000	\$8,520,000		\$79,080,000	\$79,100,000
TR - 2	Joseph Road/Mark Road, widen to 4-lanes from Ajo Highway to Los Reales	\$23,633,500	\$4,159,496	\$3,355,957	\$12,300,000	\$43,448,953	\$43,400,000
TR - 3	Irvington Road extension and widening; Ajo Highway to Mission Road	\$32,100,700	\$5,649,723	\$4,558,299	\$5,800,000	\$48,108,723	\$48,100,000
TR - 4	Drexel Road extension; Ajo Highway to Mark Rd	\$22,437,180	\$3,948,944	\$3,186,080	\$8,000,000	\$37,572,203	\$37,600,000
TR - 5	Vahalla Road extension; Valencia Road to Drexel Road	\$13,181,000	\$2,319,856	\$1,871,702	\$300,000	\$17,672,558	\$17,700,000
TR - 6	Valencia Road, widen to 6-lanes from Ajo Highway to Mission Road	\$63,598,700	\$11,193,371	\$9,031,015	\$10,700,000	\$94,523,087	\$94,500,000
TR - 7	Wade Road, Ajo Highway to Los Reales Road	\$12,675,600	\$2,230,906	\$1,799,935	\$1,600,000	\$18,306,441	\$18,300,000
TR - 8	San Joaquin, Ajo to Sandario	\$34,907,900	\$6,143,790	\$4,956,922	\$2,300,000	\$48,308,612	\$48,300,000
TR - 9	Los Reales, Ajo Highway to Mark Rd	\$63,802,080	\$11,229,166	\$9,059,895	\$4,000,000	\$88,091,141	\$88,100,000
TR - 10	Airline Road, Los Reales to Valencia	\$6,036,000	\$1,062,336	\$857,112	\$500,000	\$8,455,448	\$8,500,000
TR - 11	Bopp Road, San Joaquin to Kinney	\$13,119,300	\$2,308,997	\$1,862,941	\$3,000,000	\$20,291,237	\$20,300,000
<b>Grand Total</b>		\$345,491,960	\$60,806,585	\$49,059,858	\$48,500,000	\$503,858,403	\$503,900,000

## ESTIMATING AVERAGE ANNUAL LIFE CYCLE COSTS

Based on information provided by staff, CLA estimates annual life cycle costs for the arterial roadway improvements in SWIP to be 25 percent of total construction costs averaged out over a twenty year project useful life. Exhibit 6 below presents the estimated average annual life cycle costs for each SWIP project.

**Exhibit 6 Average Annual Life Cycle Costs for SWIP Roadway Improvements**

### Life Cycle Cost Estimates

Project	Total Construction Costs	25% of Construction Costs	Average Annual Life Cycle Costs	Average Annual Life Cycle Costs (Rounded)
Ajo Highway GSIs	\$60,000,000	\$15,000,000	\$750,000	\$750,000
Joseph/Mark	\$23,633,500	\$5,908,375	\$295,419	\$295,000
Irvington	\$32,100,700	\$8,025,175	\$401,259	\$401,000
Drexel	\$22,437,180	\$5,609,295	\$280,465	\$280,000
Valhalla	\$13,181,000	\$3,295,250	\$164,763	\$165,000
Valencia	\$63,598,700	\$15,899,675	\$794,984	\$795,000
Wade	\$12,675,600	\$3,168,900	\$158,445	\$158,000
San Joaquin	\$34,907,900	\$8,726,975	\$436,349	\$436,000
Los Reales	\$63,802,080	\$15,950,520	\$797,526	\$798,000
Airline	\$6,036,000	\$1,509,000	\$75,450	\$75,000
Bopp	\$13,119,300	\$3,279,825	\$163,991	\$164,000
Total	\$345,491,960	\$86,372,990	\$4,318,650	\$4,319,000