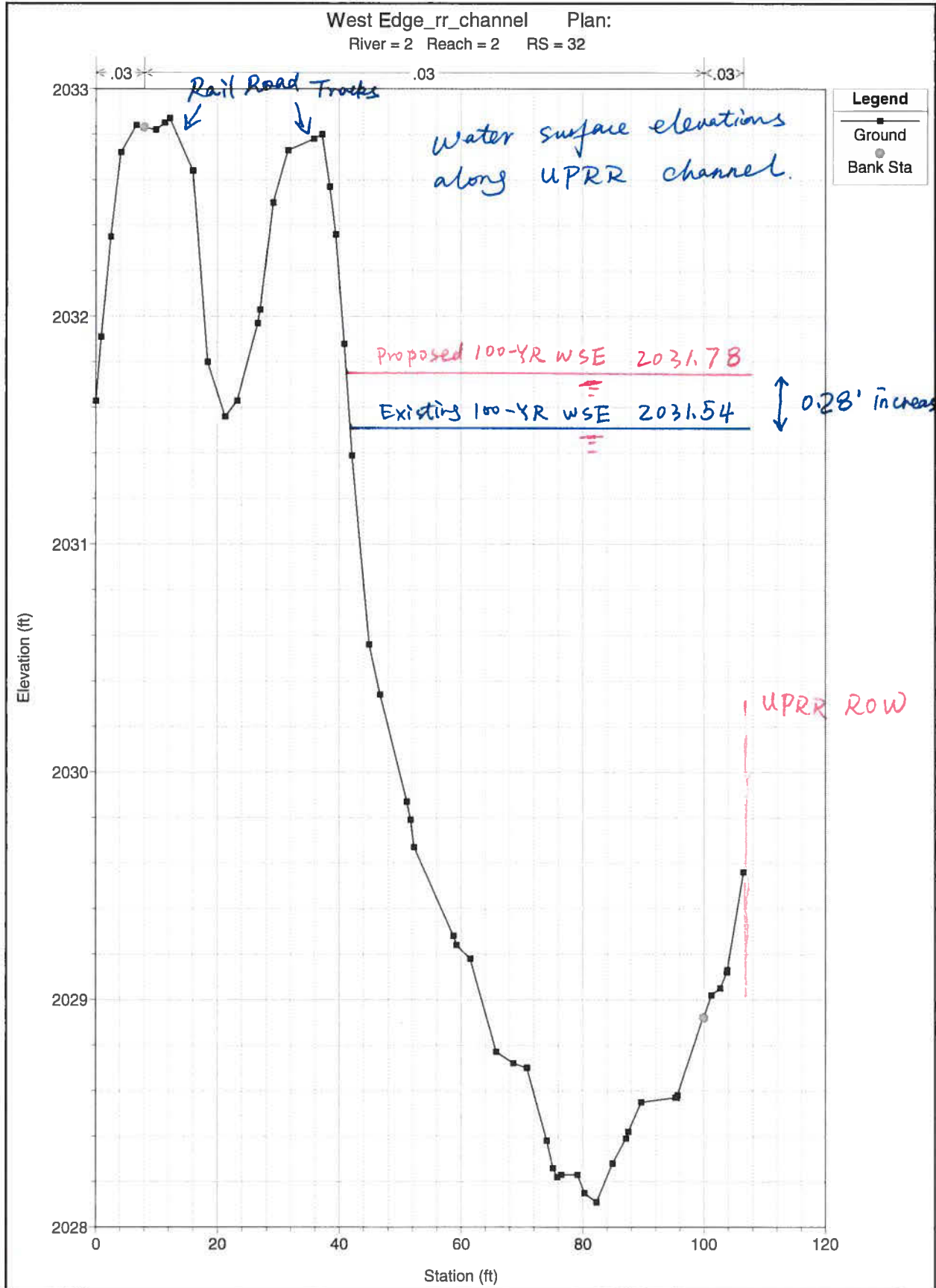


Cross-section B-B [located at about 3250 feet north of Tangerine Rd]



APPENDIX W-G

COST ANALYSES FOR REGIONAL DRAINAGE IMPROVEMENTS

Includes

- Cost analyses for drainage improvements

Cost Analysis for Alternatives for Tangerine Rd West End Regional Drainage Study

Alternative 2, 10-year						
Item	Unit Price	Unit	Quantity of Unit			Total Item Cost
			Quantity per Linear Foot	Total Length (ft)	Volume	
Concrete for Channel Side Slopes and Keyin	\$80	Sq Yd	2.5	6,447		\$1,266,477
Concrete for Channel Toedown and Cutoff wall	\$80	Sq Yd		7,670		\$613,591
Concrete for Channel Bottom	\$80	Sq Yd		3,374		\$269,911
Riprap	\$80	Cu Yd		2,878		\$230,222
Low Flow Outlet Structure	\$5,000	item		1		\$5,000
Five Barrel 10'x4' RCBC	\$1,900	ft		60		\$114,000
Concrete Retaining Wall	\$45	S. F.		192		\$8,640
Training Berm	\$210	ft		350		\$73,500
Drainage Excavation Cost	\$5	Cu Yd		30,919		\$154,596
Borrow Saving	\$5	Cu Yd		30,919		(\$154,596)
Alternative 2 Total:						\$2,581,342

APPENDIX W-H

DRAINAGE STRUCTURE MAINTENANCE PLAN

Includes

- Drainage Structure Maintenance Plan

**OPERATION, MAINTENANCE, AND REPAIR PLAN
FOR
THE TANGERINE ROAD WEST END REGIONAL DRAINAGE SYSTEM
TOWN OF MARANA, ARIZONA**

AUTHORITY AND PURPOSE

Hydraulic structures shall be inspected to ensure their proper functions, per Section 2.3.1.6C of the *Standard Manual for Drainage Design and Floodplain Management in Tucson, AZ*. The operation plans for this regional drainage system includes an interceptor channel, a low flow drainage structure at the downstream end of the interceptor channel, a culvert, and a dip crossing. This regional drainage system is being designed to convey offsite 10-year flood through the project and to keep the Tangerine Road pavement dry in 10-year rainfall event.

LOCATION

The Tangerine Rd West End regional drainage system is located east of the Tangerine Road exit on Interstate 10 in Marana. The interceptor channel is located along the north side of Tangerine Rd; the 5-10'x4' RCBC is located at east Trico driveway; the dip crossing is located at west Trico drive, and the low flow drainage structure is located at the downstream end of the interceptor channel near the Union Pacific Railroad (UPRR) and Tangerine Road intersection.

MAINTENANCE PLAN FOR REGIONAL DRAINAGE SYSTEM IN TANGERINE ROAD WEST END

The Town of Marana will provide the maintenance of the regional drainage system in Tangerine Road West End. Annual inspections of and inspection reports for Tangerine Road West End's regional drainage system, including an interceptor channel, a low flow drainage structure, a culvert and a dip crossing will be provided by the Town. The Town Engineer is to assign an inspector to routinely monitor the condition of the drainage system. These inspections must assess the items listed in Exhibit A.

RESPONSIBLE PARTY

The Town's Engineer is the individual responsible for the oversight and implementation of this drainage system's Maintenance and Operations Plan. The Town Engineer's office is located at:

Town of Marana
Marana Municipal Complex
11555 W. Civic Center Drive
Marana, AZ 85653

FREQUENCY OF INSPECTIONS AND REPORTING

Annual and post-flood drainage system inspections and inspection reports will be conducted under the direction of the Town Engineer. Inspection reports are to be generated with drainage system inspections. Inspections are to be performed annually. Additional inspections may be requested by the Town Engineer in response to storm events. Inspection reports are also required after repairs are made to the drainage system. Inspection reports are to be kept at the Town Engineer's office.

Signed,

Keith Brann P.E., Town Engineer, Floodplain Administrator

EXHIBIT A
Inspection Guide for Flood Control Works
Drainage System

Name of Project: _____	
Date Inspected: _____	
Drainage System Owner: _____	
Owner Phone/ Email: _____	
Inspector: _____	
Type of Inspection (Check One):	<input type="checkbox"/> Routine <input type="checkbox"/> Repair/Maintenance
Overall Project Rating (Check One):	<input type="checkbox"/> Acceptable <input type="checkbox"/> Minimally Acceptable <input type="checkbox"/> (Maintenance is required) <input type="checkbox"/> Unacceptable
INSPECTOR'S OBSERVATIONS:	Contents of this Inspection Report: <input type="checkbox"/> Interceptor Channel <input type="checkbox"/> Riprap <input type="checkbox"/> Culverts
General Rating Comments	

Exhibit A - Drainage System Checklist

For use during all Initial and Continuing Eligibility Inspections of drainage systems

RATED ITEM Regional Drainage	A	M	U	N/A	EVALUATION	LOCATIONS / REMARKS / RECOMMENDATIONS
1. Vegetation and Obstructions					A Minimal, scattered obstructions or vegetation. The flow is not impeded.	
					M Debris, vegetation growth (such as cat tails, bull rushes, bushes, or saplings), starting to impact conveyance.	
					U Debris jams, snags, vegetation growth (such as cat tails, bull rushes, bushes, or saplings), or other obstructions block approximately 50% of the FCW.	
2. Encroachments					A No trash, debris, excavations, structures, or other obstructions present within the project.	
					M Trash, debris, excavations, structures, or other obstructions present, or inappropriate activities that will not inhibit project operations and maintenance or emergency operations.	
					U Trash, debris, excavation, structures, or other obstructions present, or inappropriate activities that will inhibit project operations and maintenance or emergency operations.	
3. Riprap Erosion protection at Inlet/Outlet Structure.					A Existing riprap protection is properly maintained and is undamaged. Riprap clearly visible.	
					M No riprap displacement or scouring activity that could undercut banks, erode embankments, or restrict desired flow. Unwanted vegetation must be cleared and/or treated with an appropriate herbicide.	
					U Dense brush, trees, or grasses hide the rock protection, or meandering and/or scour activity is undercutting banks, eroding embankments, or impairing channel flows by causing turbulence.	
					N/A There is no riprap protecting the drainage system, or the riprap is discussed in another section.	
4. Interceptor Channels					A No active erosion or bank caving observed on the landward or on the riverward side of the bank. Sediment buildup is below sediments monuments on channel bank.	
					M There are areas where active erosion is occurring or has occurred on or near the bank, but bank integrity is not threatened. Sediment buildup is above sediments monuments on channel bank.	
					U Erosion or caving is occurring or has occurred that threatens the stability and integrity of the bank. The erosion or caving has progressed into the bank section or into the extended footprint of the bank foundation and has compromised the bank foundation stability. Severe sediment problems. The sediment has compromised the functionality of the interceptor channel.	
					N/A There are no interceptor channels.	

Key: A = Acceptable. M = Minimally Acceptable; Maintenance is required. U = Unacceptable. N/A = Not Applicable. RODI = Requires Operation During Inspection.

Exhibit A - Drainage System Checklist (continued)

For use during all Initial and Continuing Eligibility Inspections of drainage systems

RATED ITEM	A	M	U	N/A	EVALUATION	LOCATIONS / REMARKS / RECOMMENDATIONS
5. Blockage of Culverts (Inlets, Sump, and Discharge Areas)					A There is little or no debris, sediment, or vegetation blocking the culverts, inlets, sump, or discharge areas. The channel capacity for designed flow is not affected.	
					M Debris, sediment, or vegetation blocks less than 10 percent of the culvert opening, but must be removed.	
					N/A There are no culverts	
6. Culverts					A There are no breaks, holes, cracks in the culvert that would result in significant water leakage. Corrugated metal pipes, if present, are in good condition or have been relined with appropriate material, which is still in good condition.	
					M There are breaks, holes, cracks in the culvert that would result in water leakage and need to be repaired, but do not threaten the integrity of the project. Corrugated metal pipes, if present, are showing deterioration but the entire length of pipe is still structurally sound and is not in danger of collapsing.	
					U Culvert has deterioration and/or has significant leakage such that it threatens the integrity of the FCW. Corrugated metal pipes are in danger of collapsing or have already begun to collapse	
					N/A There are no culverts	
7. Detention Basins					A Basin inlet/outlet structures are intact. No erosion or damage on basin sideslopes. There is little or no sediment at the basin bottom.	
					M Basin inlet/outlet structure has minor damages. Basin sideslopes has minor erosions or damages. 9" ~ 12" thick sediment at the basin bottom	
					U Basin inlet/outlet structures are severely damaged or not functioning. Basin sideslopes has severe erosion and threaten the integrity of the basin berm. Sediments at the basin bottom are more than 12" thick and basin volume is greatly reduced.	
					N/A There are no detention basins.	

Key: A = Acceptable. M = Minimally Acceptable; Maintenance is required. U = Unacceptable. N/A = Not Applicable. RODI = Requires Operation During Inspection.

APPENDIX L

QUALITY CONTROL CERTIFICATE OF COMPLIANCE

Includes

- Signed Quality Control Certificate of Compliance

CERTIFICATE OF COMPLIANCE

DATE: January 31, 2013

TO: Town of Marana
11555 W Civic Center Drive
Marana, AZ 85653-7003

ATTN: Mr. Scott Leska, PE, PTOE
Project Manager

RE: QUALITY CONTROL REVIEW – STAGE II CROSS DRAINAGE REPORT

CONSULTANT: Psomas
333 E Wetmore Road, Suite 450
Tucson, AZ 85705

SUBCONSULTANT: CMG Drainage Engineering, Inc.
3555 N Mountain Ave
Tucson, AZ 85719

CERTIFICATE OF COMPLIANCE

This is to certify that I have monitored the quality control (QC) process during production and review. That I have completed and documented the required QC Review of the production and review quality control documentation for all elements of this submittal. This QC Review was conducted January 31, 2013, after all QC procedures were complete. Submittal plans, associated production and review check prints and quality control documents for the referenced elements have been evaluated, initialed and are available for review upon request.

This certificate is issued to document my review and to confirm that the standards for professional practice processes were followed in producing the submittal documents. In my professional opinion, these documents meet the standards of the Town of Marana, Department of Public Works and are ready for review.

SIGNED: *Jerald L. Curless*

Jerald L. Curless, PE
Quality Control Manager

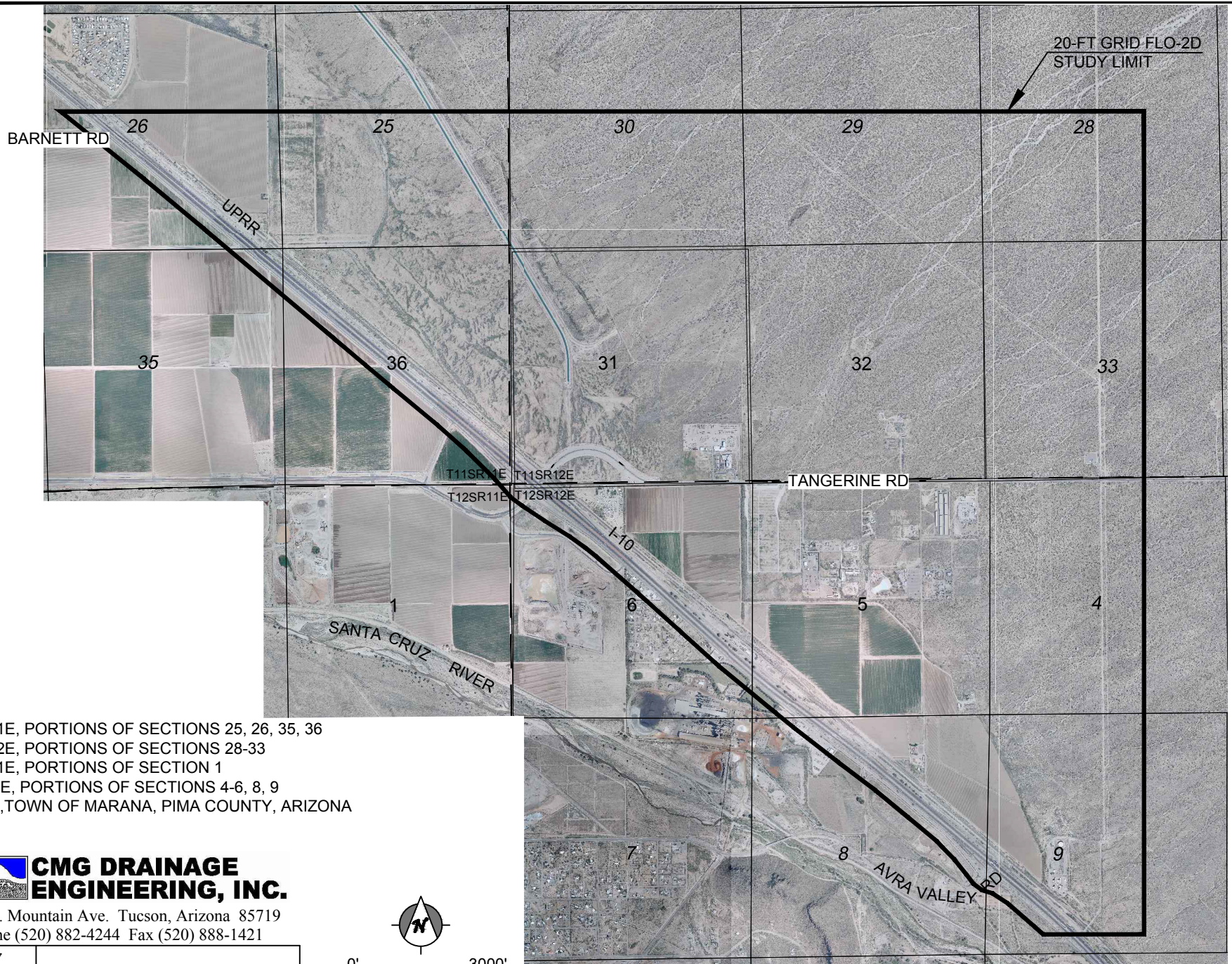
APPENDIX M
ELECTRONIC MEDIA

Enclosed DVD Includes:

Tangerine Road Stage II Cross Drainage Report

- PDF of the Report
- HEC-RAS Computer Hydraulic Model for the Proposed Bridges
- FLO-2D Computer Hydraulic Models

Z:\PROJECTS\2010\10-027 P\scmas-Tangerine Rd I-10 to La Canada\10-027.1 West End Analysis.dwg\Figs 1-2_1-2.dwg, Fig W-2, 12/30/2012 4:09:32 PM



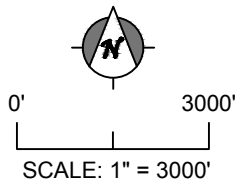
T11S, R 11E, PORTIONS OF SECTIONS 25, 26, 35, 36
 T11S, R 12E, PORTIONS OF SECTIONS 28-33
 T12S, R 11E, PORTIONS OF SECTION 1
 T12S, R12E, PORTIONS OF SECTIONS 4-6, 8, 9
 G.&S.R.M., TOWN OF MARANA, PIMA COUNTY, ARIZONA



3555 N. Mountain Ave. Tucson, Arizona 85719
 Phone (520) 882-4244 Fax (520) 888-1421

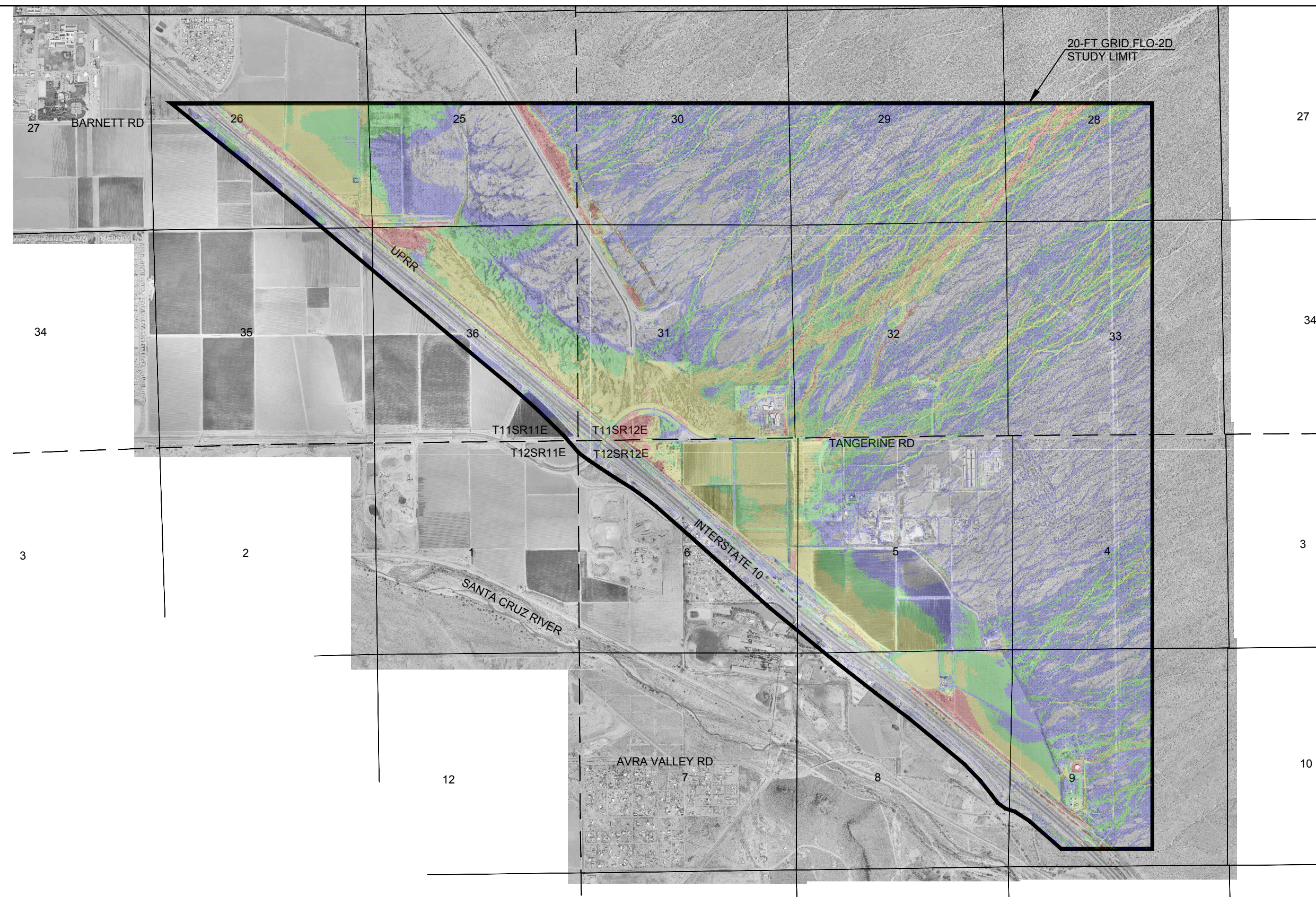
PROJECT NO.:	10-027
DESIGN:	JKW
CHECKED:	JKW
DRAWN:	BJK
DATE:	12/03/2012

FIGURE: C-1
 20-FT GRID FLO-2D STUDY LIMIT



NOTES:
 - AERIAL PHOTOGRAPHY: PIMA ASSOC. OF GOV'S 2008 DATA.

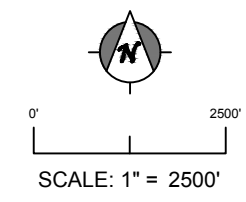
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LEGEND
 100-YR EXT FLOW DEPTH

- FLOW DEPTH 0.1 to 0.5 (ft)
- FLOW DEPTH 0.5 to 1.0 (ft)
- FLOW DEPTH 1.0 to 2.0 (ft)
- FLOW DEPTH 2.0 to MAX (ft)

- NOTES:**
- VERTICAL DATUM = NAVD88
 HORIZONTAL PROJECTION = ARIZONA STATE PLANE CENTRAL, NAD83 HARN
 - AERIAL PHOTO PROVIDED BY PAG, DATED 2008.

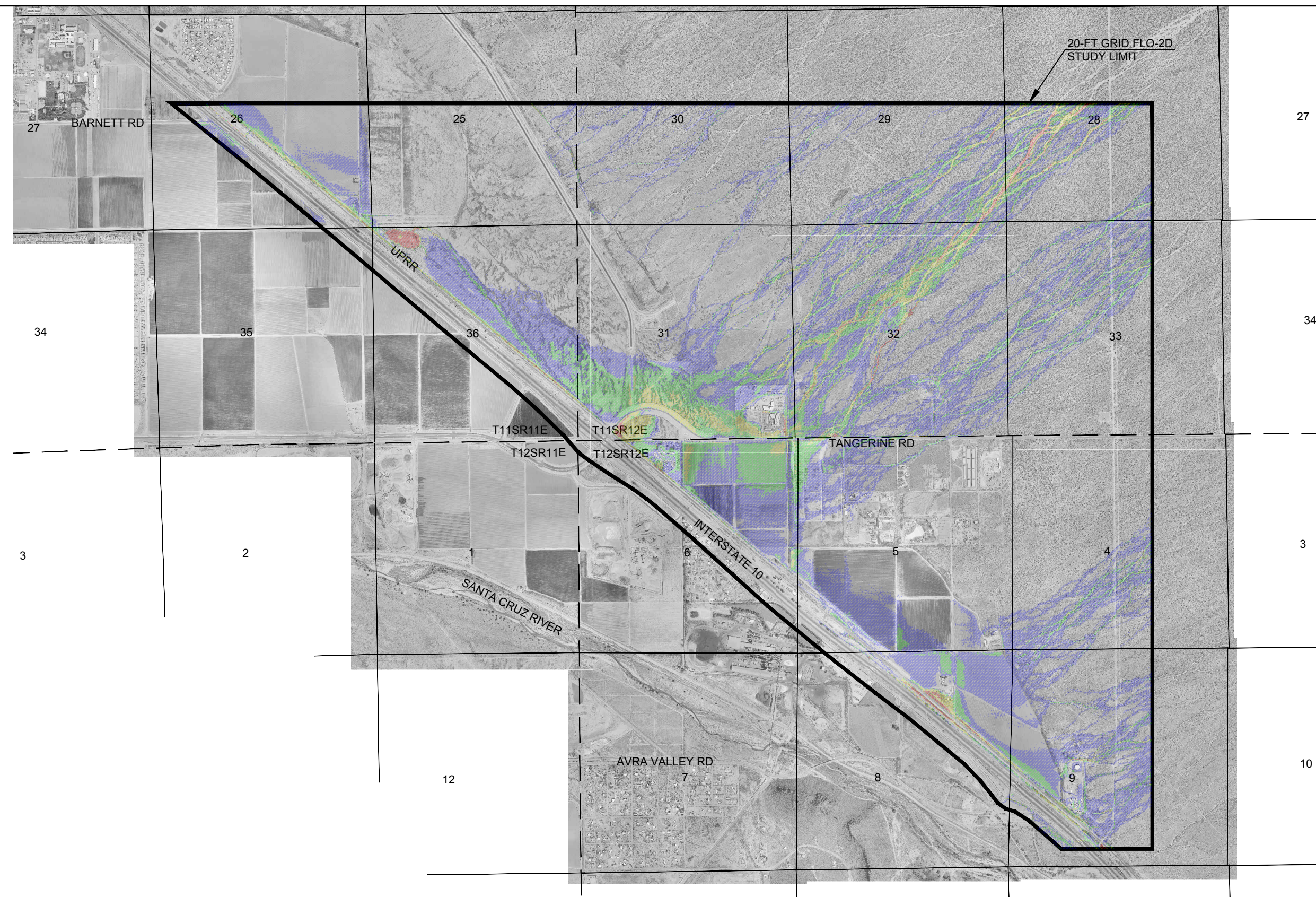


CMG DRAINAGE ENGINEERING, INC.
 3555 N. Mountain Ave. Tucson, Arizona 85719
 Phone (520) 882-4244 Fax (520) 888-1421

PROJECT NO.:	10-027.1
DESIGN:	JKW
CHECKED:	JKW
DRAWN:	CRB
DATE:	12/20/2012
REV. DATE:	
REV. DATE:	
REV. DATE:	

FIGURE C-2
EXISTING 100-YR
MAXIMUM FLOW DEPTHS
TANGERINE WEST END FLO-2D
 SHEET 1 OF 1

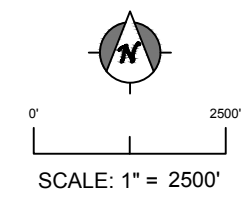
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LEGEND
 10-YR EXT FLOW DEPTH

- FLOW DEPTH 0.1 to 0.5 (ft)
- FLOW DEPTH 0.5 to 1.0 (ft)
- FLOW DEPTH 1.0 to 2.0 (ft)
- FLOW DEPTH 2.0 to MAX (ft)

- NOTES:**
- VERTICAL DATUM = NAVD88
 HORIZONTAL PROJECTION = ARIZONA STATE PLANE CENTRAL, NAD83 HARN
 - AERIAL PHOTO PROVIDED BY PAG, DATED 2008.

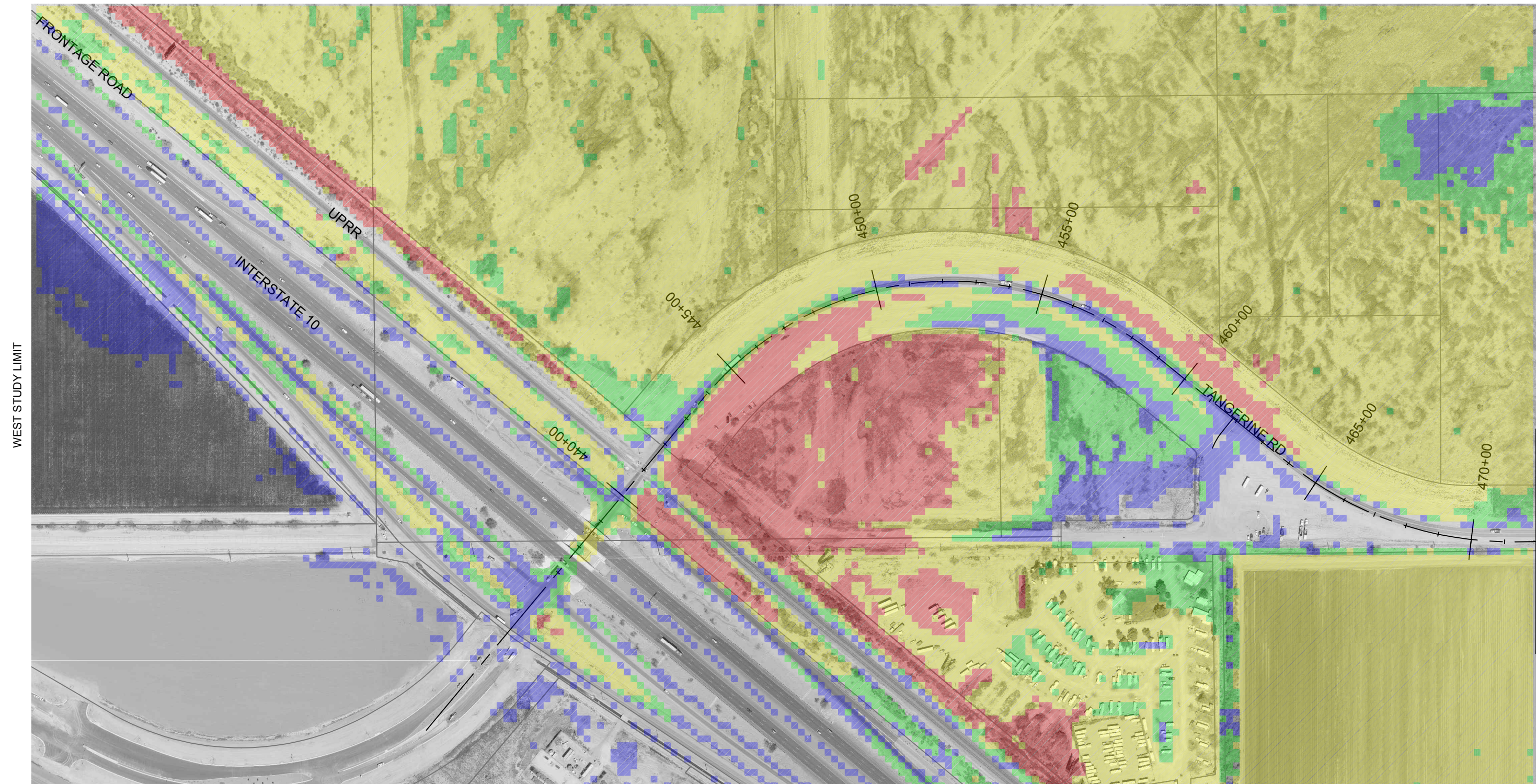


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REV. DATE:	
REV. DATE:	

FIGURE C-3
 EXISTING 10-YR
 MAXIMUM FLOW DEPTHS
 TANGERINE WEST END FLO-2D
 SHEET 1 OF 1

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WEST STUDY LIMIT

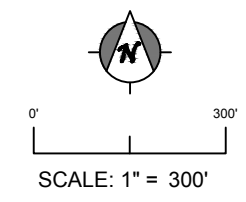
MATCH STA. 472+00 - SHEET 2 OF 2

- NOTES:**
1. VERTICAL DATUM = NAVD88
HORIZONTAL PROJECTION = ARIZONA STATE PLANE CENTRAL, NAD83 HARN
 2. AERIAL PHOTO PROVIDED BY PAG, DATED 2008.

LEGEND

100-YR EXT FLOW DEPTH

■	FLOW DEPTH 0.1 to 0.5 (ft)
■	FLOW DEPTH 0.5 to 1.0 (ft)
■	FLOW DEPTH 1.0 to 2.0 (ft)
■	FLOW DEPTH 2.0 to MAX (ft)

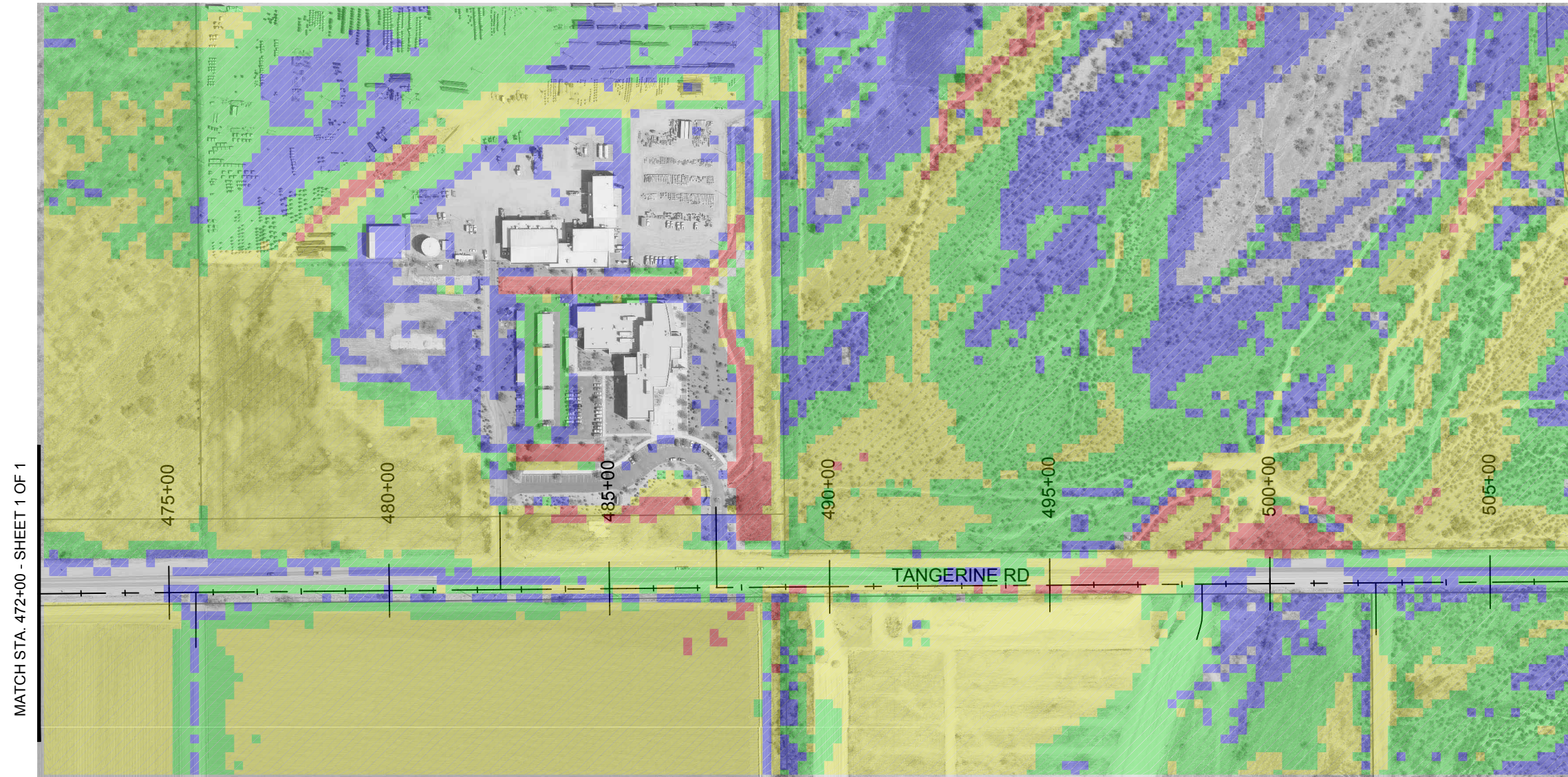


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REV. DATE:	
REV. DATE:	

FIGURE C-4
EXISTING 100-YR FLOW DEPTHS AT TANGERINE RD.
 TANGERINE WEST END FLO-2D
 SHEET 1 OF 2

Z:\PROJECTS\2010\10-027 Psomas-Tangerine Rd I-10 to La Canada\10-027.1 West End Analysis\dwgs\FLO2D Depths_M3D 2013.dwg, C4 EXT 100-YR RDWY DEPTHS, 12/20/12



MATCH STA. 472+00 - SHEET 1 OF 1

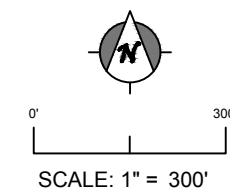
STA. 507+00 - EAST STUDY LIMIT

NOTES:

1. VERTICAL DATUM = NAVD88
HORIZONTAL PROJECTION = ARIZONA STATE PLANE CENTRAL, NAD83 HARN
2. AERIAL PHOTO PROVIDED BY PAG, DATED 2008.

LEGEND
100-YR EXT FLOW DEPTH

	FLOW DEPTH 0.1 to 0.5 (ft)
	FLOW DEPTH 0.5 to 1.0 (ft)
	FLOW DEPTH 1.0 to 2.0 (ft)
	FLOW DEPTH 2.0 to MAX (ft)

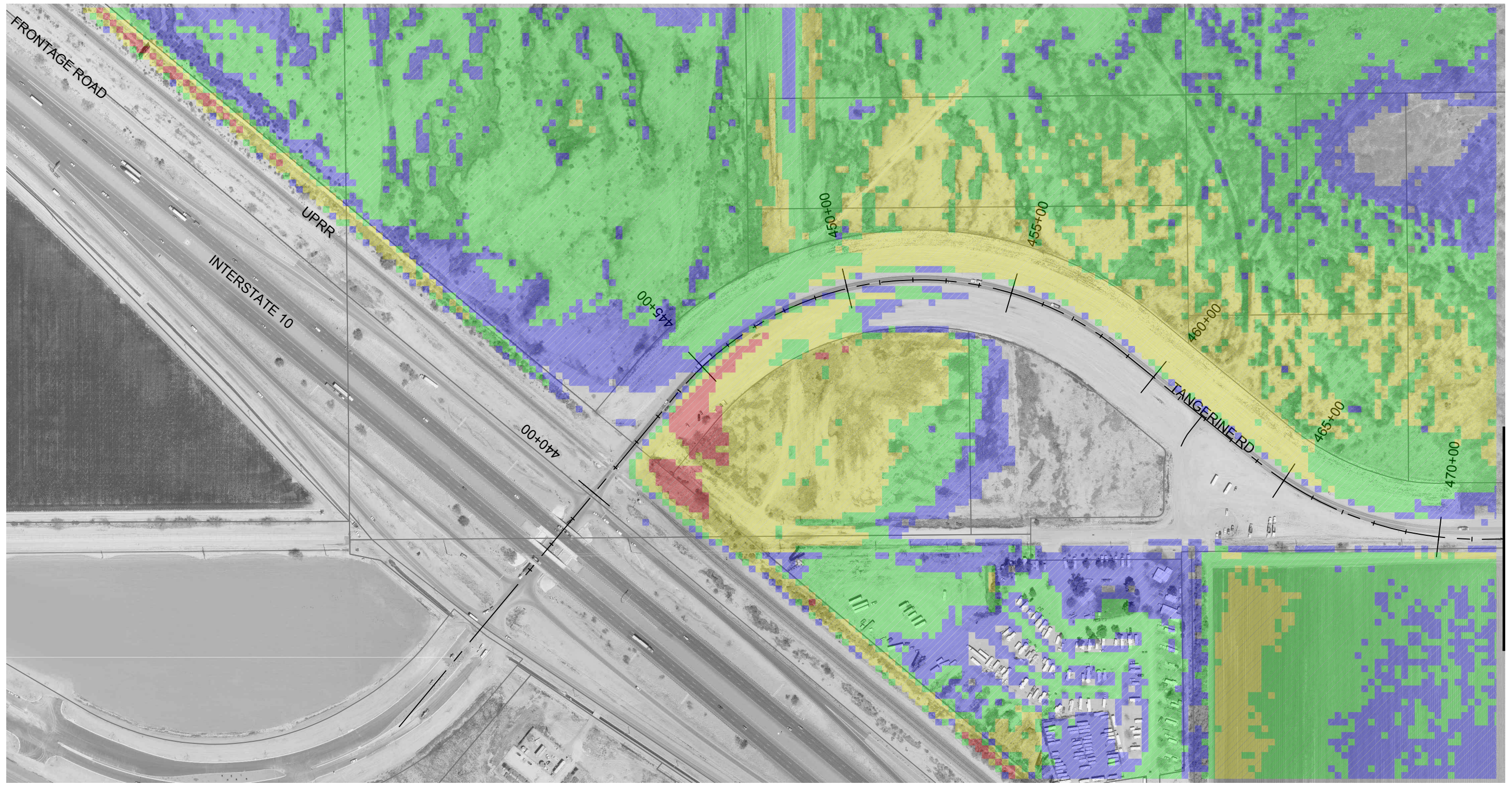



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DRAWN:	CRB
DATE:	12/20/2012
REV. DATE:	
REV. DATE:	
REV. DATE:	

FIGURE C-4
EXISTING 100-YR FLOW DEPTHS AT TANGERINE RD.
 TANGERINE WEST END FLO-2D
 SHEET 2 OF 2

Z:\PROJECTS\2010\10-027 Psomas-Tangerine Rd I-10 to La Canada\10-027.1 West End Analysis\dwgs\FLO2D Depths_M3D 2013.dwg, C5 EXT 10-YR RDWY DEPTHS, 12/2



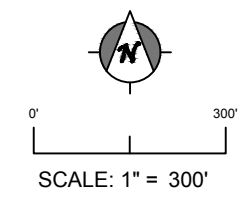
NOTES:

1. VERTICAL DATUM = NAVD88
HORIZONTAL PROJECTION = ARIZONA STATE PLANE CENTRAL, NAD83 HARN
2. AERIAL PHOTO PROVIDED BY PAG, DATED 2008.

LEGEND

10-YR EXT FLOW DEPTH

	FLOW DEPTH 0.1 to 0.5 (ft)
	FLOW DEPTH 0.5 to 1.0 (ft)
	FLOW DEPTH 1.0 to 2.0 (ft)
	FLOW DEPTH 2.0 to MAX (ft)

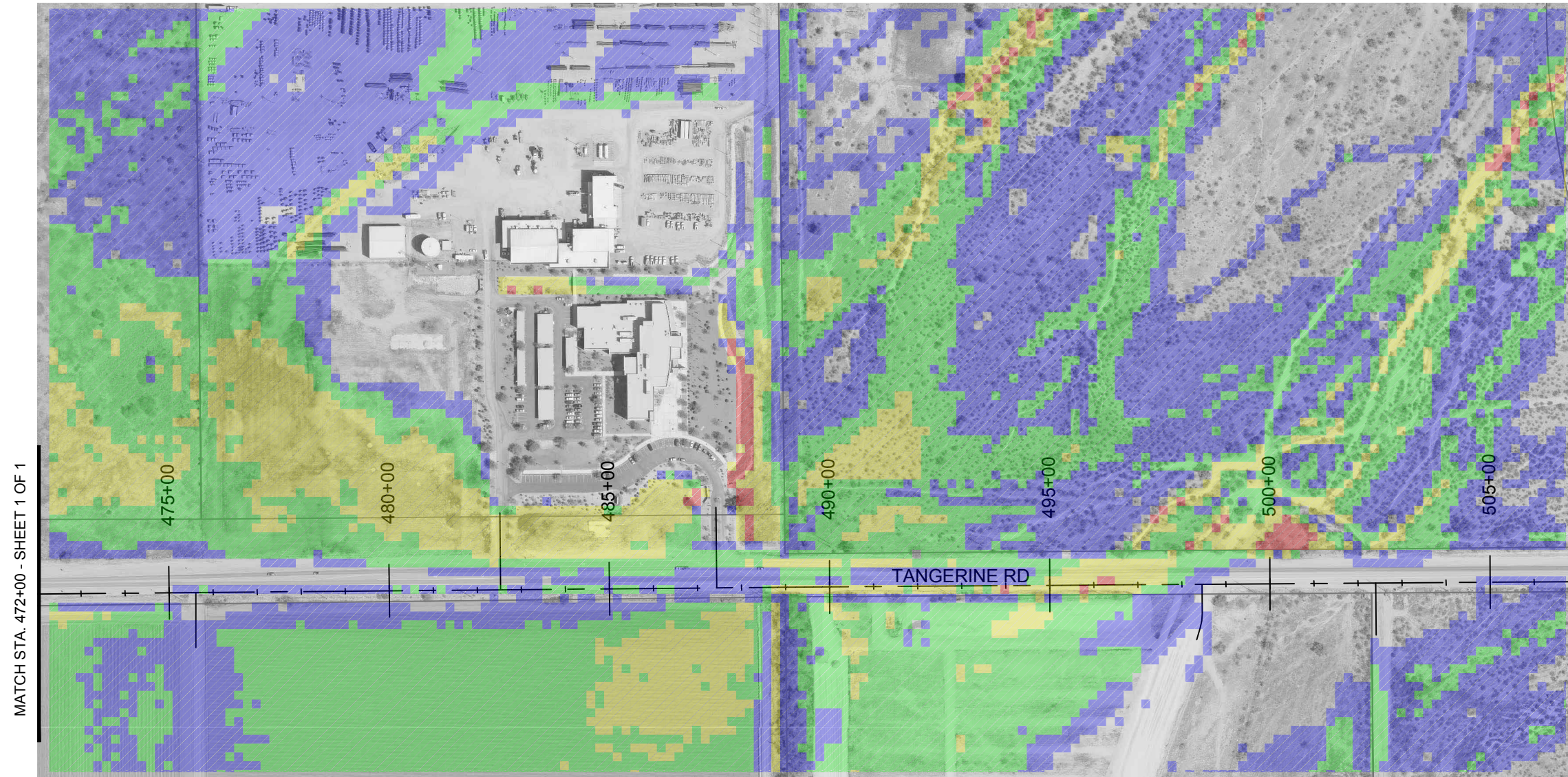


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CHECKED:	JKW
DRAWN:	CRB
DATE:	12/20/2012
REV. DATE:	
REV. DATE:	
REV. DATE:	

FIGURE C-5
EXISTING 10-YR FLOW
DEPTHS AT TANGERINE RD.
TANGERINE WEST END FLO-2D
SHEET 1 OF 2

MATCH STA. 472+00 - SHEET 2 OF 2



MATCH STA. 472+00 - SHEET 1 OF 1

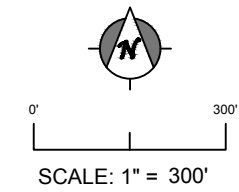
STA. 507+00 - EAST STUDY LIMIT

NOTES:

1. VERTICAL DATUM = NAVD88
HORIZONTAL PROJECTION = ARIZONA STATE PLANE CENTRAL, NAD83 HARN
2. AERIAL PHOTO PROVIDED BY PAG, DATED 2008.

LEGEND
10-YR EXT FLOW DEPTH

	FLOW DEPTH 0.1 to 0.5 (ft)
	FLOW DEPTH 0.5 to 1.0 (ft)
	FLOW DEPTH 1.0 to 2.0 (ft)
	FLOW DEPTH 2.0 to MAX (ft)

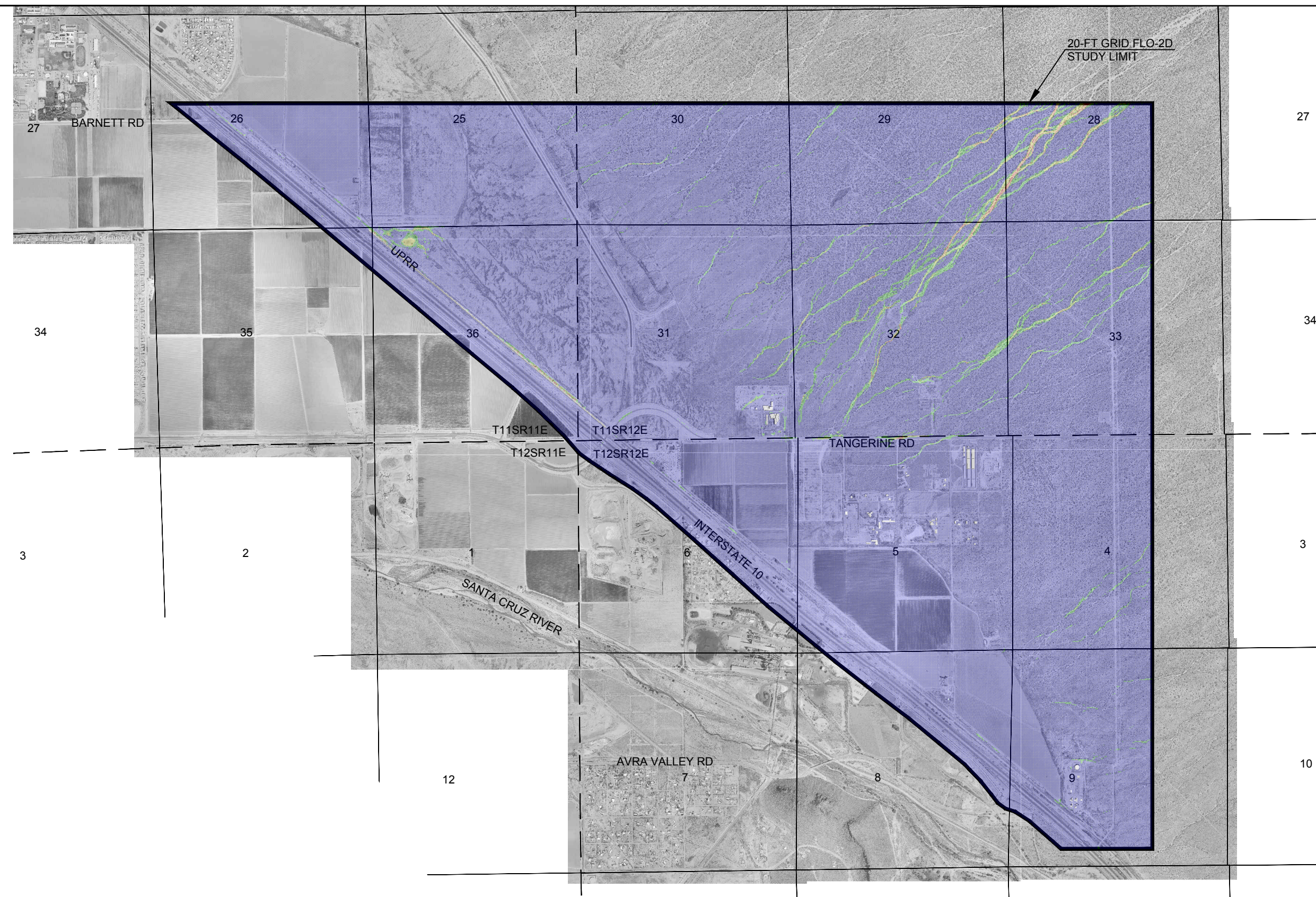



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REV. DATE:	
REV. DATE:	

FIGURE C-5
EXISTING 10-YR FLOW DEPTHS AT TANGERINE RD.
 TANGERINE WEST END FLO-2D
 SHEET 2 OF 2

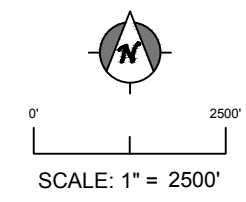
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LEGEND
 100-YR EXT VELOCITY

- VELOCITIES 0 to 3 (fps)
- VELOCITIES 3 to 5 (fps)
- VELOCITIES 5 to 7 (fps)
- VELOCITIES 7 to MAX (fps)

- NOTES:**
- VERTICAL DATUM = NAVD88
 HORIZONTAL PROJECTION = ARIZONA STATE PLANE CENTRAL, NAD83 HARN
 - AERIAL PHOTO PROVIDED BY PAG, DATED 2008.



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DRAWN:	CRB
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REV. DATE:	
REV. DATE:	
REV. DATE:	

FIGURE C-6
EXISTING 100-YR MAXIMUM
FLOW VELOCITIES
 TANGERINE WEST END FLO-2D
 SHEET 1 OF 1