HDR | ONE COMPANY *Many Solutions*℠

Memo

To:	Michael Shaver, HDR		
From:	Mark Seits, P.E., CFM	Project:	Evaluation of Hydraulic Impact on Bryn Mawr Bridge Alternatives
CC:			
Date:	1/05/2013	Job No:	193026

Document2

Evaluation of Hydraulic Impact on Bryn Mawr Bridge Alternatives

Purpose

The purpose of this memo is to evaluate the hydraulics and potential hydraulic impact for the proposed Mission Zanja Channel grading and Bryn Mawr Bridge alternatives.

Background

Due to urbanization and limited improvements along the Mission Zanja Channel (Channel), runoff from even small storms (i.e. less than 5-year events) has the potential to exceed existing channel capacity, resulting in overflow and flooding of the surrounding areas. The Bryn Mawr bridge area is one of the areas experienced historical flooding and it is considered to have less than adequate flood conveyance capacity. HDR (2012) previously performed hydraulic analysis on the existing Mission Zanja Channel reach which includes Bryn Mawr Bridge. The proposed condition includes the Channel grading and Bryn Mawr Bridge alternatives. Exhibit 1 shows the limits and proposed contour of the Channel grading. The grading is approximately 550-foot long and the centerline was shifted slightly to the south of the existing centerline. The design of Bryn Mawr Bridge is primarily governed by rail and structural needs. The purpose of this analysis is to evaluate the hydraulic impact based on proposed conditions.

Hydrology

A range of flowrates was analyzed to approximate the proposed channel and Bryn Mawr Bridge Alternative capacities. The Comprehensive Storm Drain Plan for the Mission Zanja watershed indicates a future condition 100-year discharge of 7,555 cfs at Bryn Mawr Bridge, but regional detention basins upstream of the Channel are proposed to reduce the peak flow.

Hydraulic Modeling

Hydraulic modeling was conducted using the USACE HEC-RAS (v.4.1) program. Existing FEMA effective modeling was not available for Mission Zanja Channel reach. Therefore, channel geometry was generated based on the topographic map by using HEC-GeoRAS program (v.4.1.1), an extension for support of HEC-RAS using ArcGIS. The topographic map is the one-foot topographic map prepared for RPRP project. An approximate centerline was laid out along the Channel. Cross sections were cut perpendicular to the Channel centerline. Six existing cross sections (from section 11966 to 12507) are within the proposed grading limits. These existing cross sections were revised based on the grading to model the proposed condition. There are two proposed Bryn Mawr bridge alternatives. Alternative 1 is a 27” CIP PS Box Girder and Alternative 2 is a PC/PS I Girder. Both alternatives were modeled and analyzed. The HEC-RAS model developed for the Mission Zanja Channel was used as the base model and existing condition model. The six cross sections

within the grading limits and the two Bryn Mawr Bridge alternatives were modified in the model to reflect the proposed conditions with the following assumptions:

- Manning's n values were based on the aerial imagery. Same values apply to existing and proposed condition.
- Ineffective flow areas were added to cross sections as needed to account for blockage of flow.
- The model was run under subcritical flow conditions.

Hydraulic Results

The results of the channel capacity for the existing and proposed conditions are show in Table 1. Cross sections 12507, 12361 and 12253 are located upstream of Bryn Mawr Bridge, and cross sections 12206, 12158 and 11966 are located downstream of Bryn Mawr Bridge. The hydraulic model results confirm the frequent flooding potential in the area. For the existing condition, the channel upstream of Bryn Mawr Bridge and the Bridge itself has a capacity of approximately 1450 cfs (less than 2-year storm event). For the proposed condition, the proposed Bridge (see table 2) and upstream channel capacity is more than doubled, but is still less than a 5-year storm event capacity for both alternatives. The channel downstream of the Bryn Mawr Bridge has adequate capacity for both existing and proposed conditions. The capacity of the upstream grading reach has increased from existing to proposed condition, but it is still limited by the bridge capacity due to the backwater effect.

Table 1. Channel Capacity

Cross Section	Existing (cfs)	Alternative 1 (cfs)	Alternative 2 (cfs)
12507	3000	4000	4000
12361	1450	3900	3100
12253	1450	3900	3500
12206	>7600	>7600	>7600
12158	>7600	>7600	>7600
11966	>7600	>7600	>7600

Table 2. Bryn Mawr Bridge Capacity

Cross Section	Existing (cfs)	Alternative 1 (cfs)	Alternative 2 (cfs)
12226	1450	3900	3050

For the proposed graded sections, the model results indicate higher velocities for a range of flows. This is likely due to the modified channel sections and corresponding lower water surface elevations. Table 3 shows the channel velocity upstream of Bryn Mawr Bridge and Table 4 shows the channel velocity downstream of Bryn Mawr Bridge. The velocities are erosive and would require armoring, either way, so the increase in velocity may not be significant. The armoring would need to be addressed at the design phase.

Table 3. Upstream Channel Velocity within the Grading Reach

Flow (cfs)	Existing (ft/s)	Alternative 1(ft/s)	Alternative 2 (ft/s)
2000	5-9	9-11	9-11
3000	7-10	10-12	10-12
4000	8-12	7-10	7-10
5000	8-13	7-11	7-11

Table 4. Downstream Channel Velocity within the Grading Reach

Flow (cfs)	Existing (ft/s)	Alternative 1(ft/s)	Alternative 2 (ft/s)
2000	8-11	11-12	11-12
3000	9-12	12-13	12-13
4000	10-12	12-14	12-13
5000	10-13	13-14	13-14

Figures 1 and 2 show the profiles of the Bryn Mawr Bridge model reach for Alternatives 1 and 2, respectively.

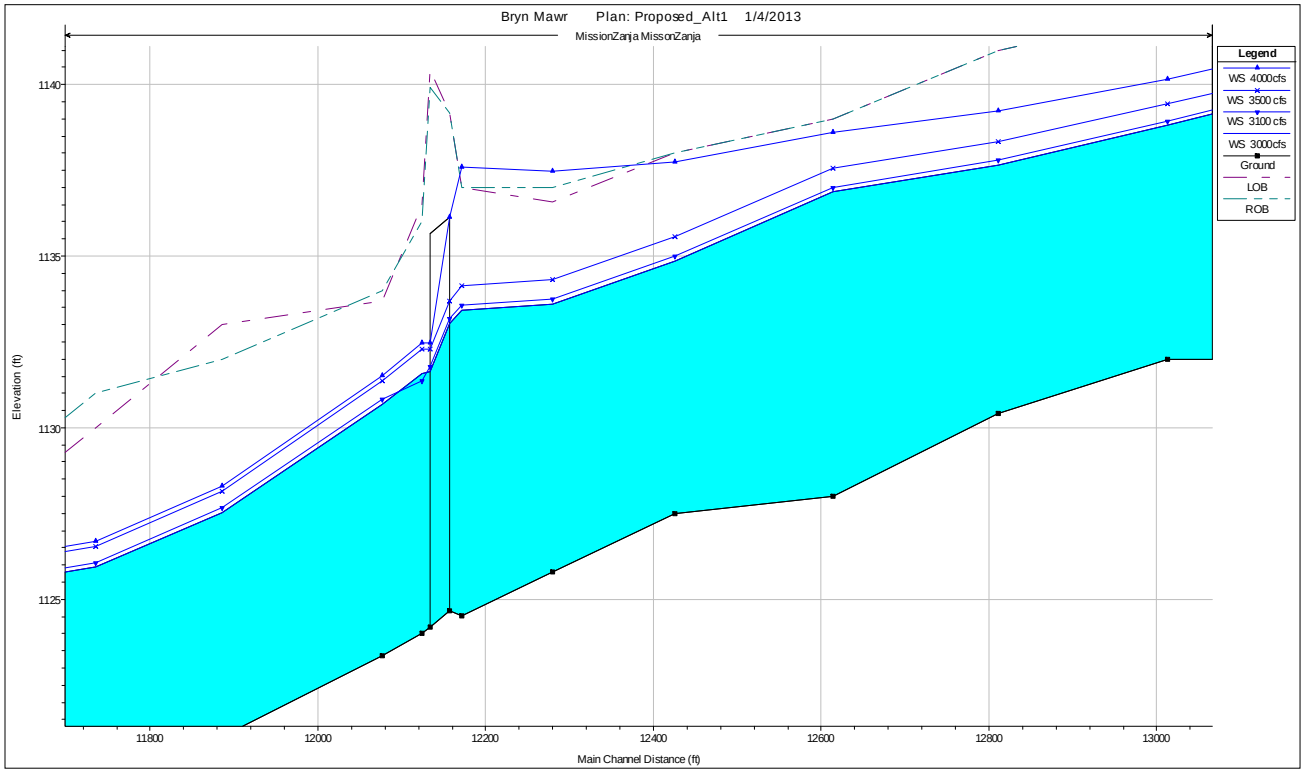


Figure 1. Bryn Mawr Bridge Alternative 1 Profile

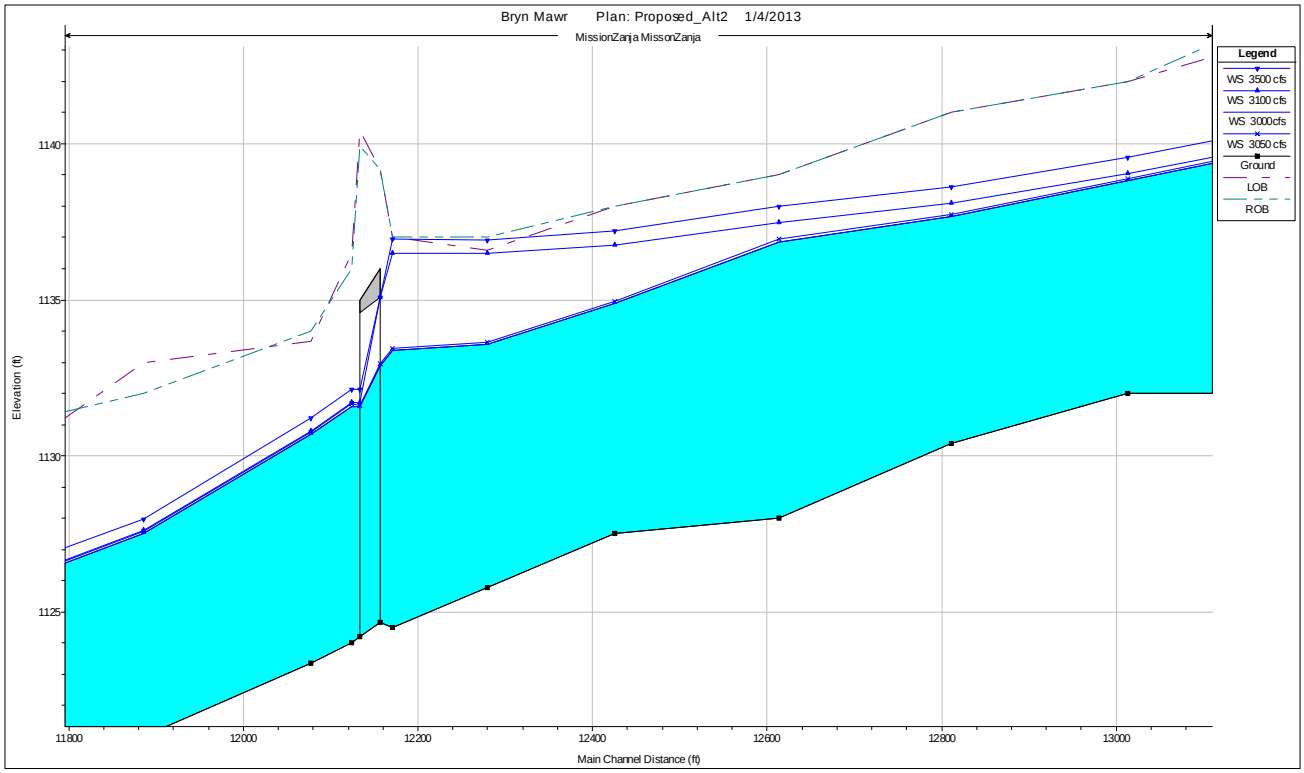


Figure 2. Bryn Mawr Bridge Alternative 2 Profile

Conclusion

The proposed Channel grading and Bryn Mawr Bridge improvements would increase the channel capacity upstream of the Bryn Mawr Bridge. Alternatives 1 and 2 would increase the existing capacity of 1450 cfs, to a minimum capacity of 3,900 cfs and 3,000 cfs, respectively. The downstream channel capacity is not significantly impacted by the proposed improvements. The capacity increase still can't meet the future condition 100-year flow of 7,600 cfs upstream of the bridge. The upstream master planned detention basin(s) would be required to prevent the overflow and flooding in the surrounding area (assuming the flow could get to the study reach). The proposed grading would result in slightly higher velocities for a range of flows. The velocities are erosive and would require armoring. The armoring needs would need to be addressed in the design phase.

Attachments:

- Attachment 1 - HEC-RAS Models (digital)
- Exhibit 1

References:

FEMA (2008). San Bernardino County Flood Insurance Study.

U.S. Army Corps of Engineers (USACE) (2010). HEC-RAS v.4.1 User's Manual and Technical Reference Manual

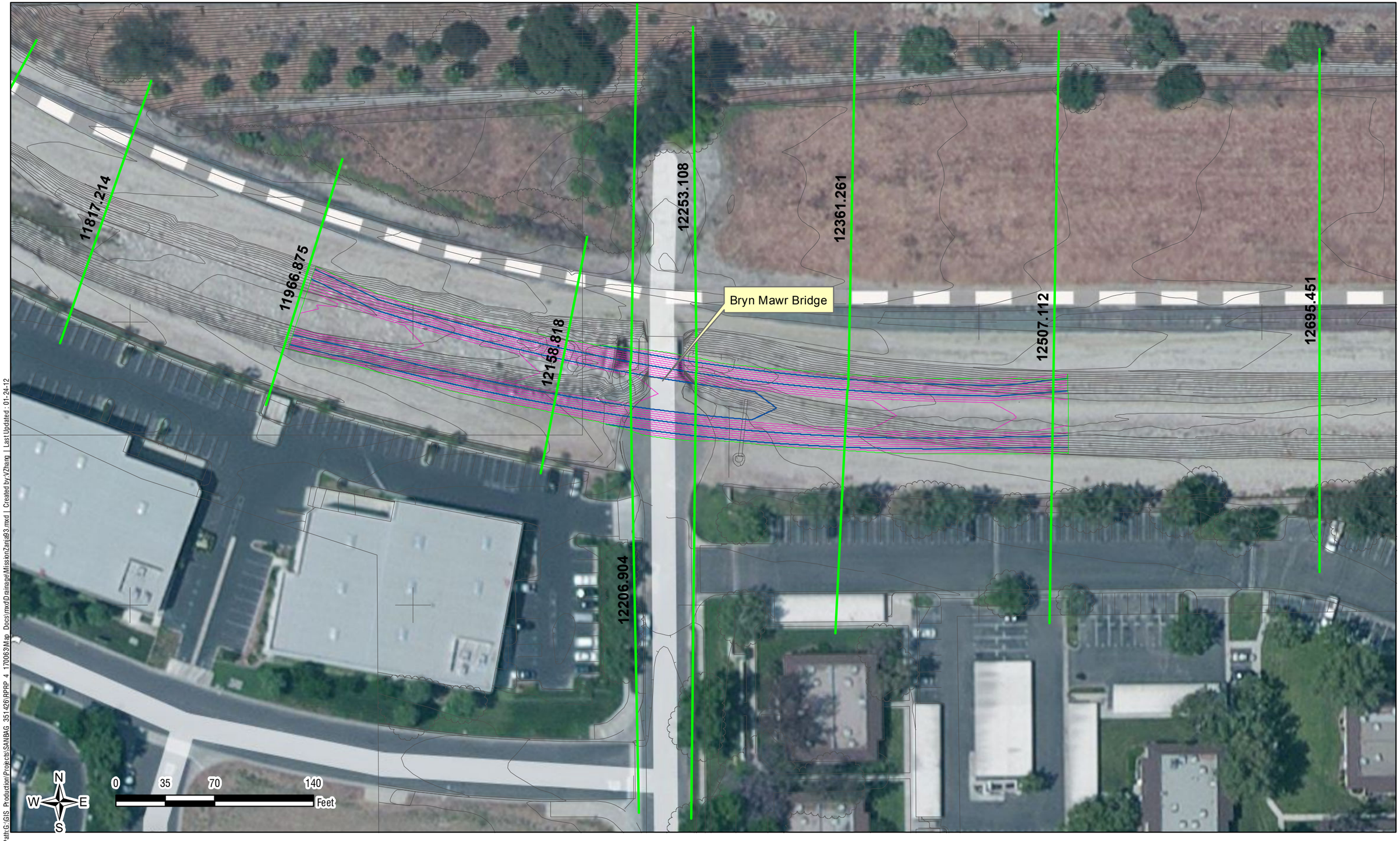
Federal Emergency Management Agency (FEMA) (2008). Flood Insurance Study, San Bernardino County, California.

U.S. Army Corps of Engineers (USACE) (2004). Corpscon 6.0.1

Parsons (2009), Concept Drainage Report, Interstate 10 High Occupancy Vehicle Lane Addition Project.

Metcalf & Eddy (1987), Mission Zanja Creek Channel Improvement Study.

HDR (2012), Hydraulic Evaluation of Mission Zanja Channel.



| PathG:\GIS_Production\Projects\SANBAG_351426\RPRP_4_170063\Map_Docs\mxd\Drainage\MissionZanija93.mxd | Created by:VZhang | Last Updated: 01-24-12

HDR
ONE COMPANY | *Many Solutions*™

Bryn Mawr Bridge

EXHIBIT 1

SANBAG | Redlands Passenger Rail Project | Hydraulic Report