Pendleton Storm Drain Study

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Summary

The existing 42-inch diameter storm drain connecting Linda Creek along Pendleton Drive and Bronson Drive in Granite Bay lacks the capacity required to convey 10-yr storm runoff. As a result, properties along Pendleton Drive have experienced multiple flooding events in the past couple decades. To achieve a level of service accommodating the 10-yr storm runoff, the existing storm drain would need to be upsized to the flow equivalent of a 72-inch diameter concrete pipe. Any upsizing effort, whether it included replacement of the existing storm drain or addition of a parallel storm drain, would necessitate modifications/replacements to three existing stormwater manholes along the route. Further design constraints include inlet structure sizing, existing sanitary sewer lines crossings, manhole modifications as well as gas, cable, and other utilities.

Study Area

The study area is located along a portion of Linda Creek in the Pendleton Drive area of Granite Bay, California beginning at 38°44'28.94"N 121°09'42.70"W at the intersection of Pendleton Drive and Linda Creek and extending to 38°44'26.03"N 121°09'50.33"W at the intersection of Bronson Drive and Linda Creek. The study area consists of the Folsom Lake Terrace Unit 1 subdivision in Western Placer County. The study area is located in the NW1/4 of section 12, Township 10N, Range 7E of Book 47.

Figure 1: Study Area

Historic Damage Information

Preliminary FEMA issued flood maps (Figure 2) show 6 residences along Pendleton Drive which lie within the mapped 100-year floodplain and regulatory floodway. Longtime residents in the area report significant flooding events from 1996 and 2005. The County has utilized the California Conservation Corps to perform channel vegetation and sediment removal near the outfall at Bronson Drive to help alleviate downstream restrictions of flow. Typically, this channel work has been completed every other year since the late 1990s.

The Folsom Lake Terrace subdivision was developed in the 1960s prior to adoption of County drainage standards. If proposed today, the homes along the north side of Pendleton Drive would not be allowed to be constructed since they lie within what used to be the natural floodway of Linda Creek prior to development in the area. Current versions of USGS maps still show the natural Linda Creek centerline (Figure 3).

Figure 2: FEMA Preliminary Map

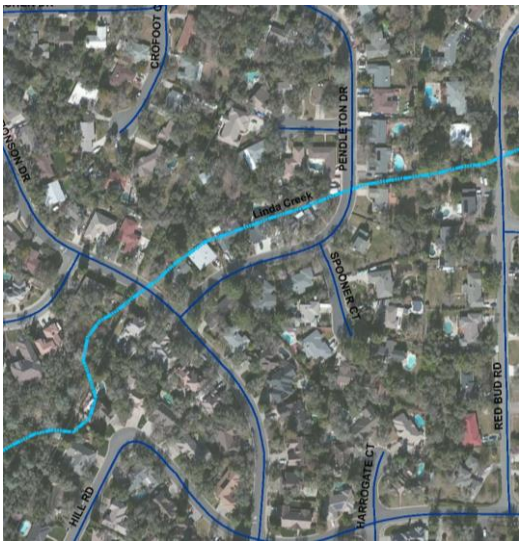

Figure 3: Linda Creek Pre-Development Centerline

HEC-RAS Modeling

Hydrology

FEMA HEC-RAS modeling for Linda Creek utilized the hydrologic data that was developed from a 2005 hydrology study. Placer County completed a 2011 study during the Update to the Dry Creek Watershed Flood Control Plan. Table 1 shows the percent difference between the FEMA modeled flows and the flows from the Dry Creek Watershed Plan. Based on the 2011 study, the FEMA model overestimates peak flows from a 10 year storm runoff event but underestimates peaks flows from a 100 year event. Note: The FEMA model lists the 10 year and 100 year peak discharges at the cross section at Pendleton Drive to be 187 cfs and 346 cfs, respectively. Since the Dry Creek study began reporting peak discharges at Auburn-Folsom Road, no direct comparison was made at the Pendleton Drive section.

Table 1: Modeled Peak Discharges

Location	10 YR - FEMA Modeled Peak Discharge (cfs)	10 Yr - Dry Creek Wtrshd Plan Peak Discharge (cfs)	% Difference	100 Yr - FEMA Modeled Peak Discharge (cfs)	100 Yr - Dry Creek Wtrshd Plan Peak Discharge (cfs)	% Difference
Linda Creek @ Auburn-Folsom Road	199	181	9.5%	370	499	29.7%
Linda Creek @ Country Court	199	180	10.0%	370	488	27.5%
Linda Creek @ Muir Way	211	179	16.4%	404	508	22.8%

FEMA Preliminary HEC-RAS Model

In December of 2015, FEMA issued a preliminary flood insurance study along Linda Creek (Figure 2). The preliminary FEMA model for the area showed Linda Creek entering a 36-inch diameter concrete culvert on the east side of Pendleton Drive which then discharges back into a natural channel on the west side of Pendleton Drive until it reaches Bronson Drive where the FEMA model shows the creek entering a 24-inch diameter corrugated metal pipe culvert to cross under Bronson Drive.

In actuality, Linda Creek enters a 42-inch diameter concrete pipe on the east side of Pendleton Drive and is piped underneath Pendleton Drive to the south and Bronson Drive to the west before discharging back into a natural channel on the south side of Bronson Drive.

FEMA Updated HEC-RAS Model

In February of 2017, Placer County provided FEMA with certified measurements of the storm drain system between Pendleton and Bronson Drive to include the 42-inch concrete pipe and associated storm drain manholes which extends from the east side of Pendleton Drive to the south side of Bronson Drive. While the preliminary FEMA model overestimated weir runoff (due to inaccurate storm drain sizes), it is still apparent from the updated model results (shown in Figure 4), as well as historic flooding, that the 42-inch storm drain under Pendleton Drive lacks capacity to accommodate 10-yr storm runoff.

Figure 4: 10 Year Floodplain with Existing Infrastructure

Figure 5: 10 Year Floodplain with Upsized Storm Drain

Potential Improvements

The ideal solution to reduce the strain on the Pendleton Drive storm drain system would be to reduce peak flows approaching the storm drain either by detention or retention. Typically peak flow reductions are accommodated through detention projects. All of the parcels along Linda Creek upstream of the Pendleton storm drain system are privately owned and have been developed which limits the feasibility of detention/retention type projects without purchase of easements.

Since a detention project does not appear to be feasible upstream of Pendleton Drive, alternate options include upsizing the storm drainage system along Pendleton and Bronson to accommodate peak flows. To limit the inundation of private property during a 10-yr storm event, multiple culvert types were analyzed.

Based on model results, a 72-inch diameter concrete pipe (or flow equivalent) is the only standalone improvement that could provide enough capacity to handle the flows of a FEMA 10-yr storm event. If it is desired to keep the existing 42-inch pipe in service, a 60-inch diameter concrete pipe could be added in parallel to the existing 42-inch diameter concrete pipe. The combination of 42-inch and 60-inch concrete pipes would provide enough capacity to handle 10-yr storm runoff flows. While an upsized storm drain will handle creek flows from a FEMA 10-yr storm, houses on the north side of Pendleton Drive would still experience some water flow in the backyards due to the natural drainage path in the area (shown in Figure 5). Additionally, during a 100-yr event, flows from the creek would still overtop the roadway and inundate the area on the north side of Pendleton Drive as seen in Figure 6.

Figure 6: 100 Year Floodplain with Upsized Storm Drain

Design Constraints

Ground Cover

Based on spot elevations near the inlet of Linda Creek into the storm drain system, the existing 42-inch storm drain maintains a depth of cover of approximately 24 inches below the road surface. The minimum required depth of cover for a Class III reinforced concrete pipe is 18 inches (Placer County Plate 435). If a 60-inch diameter concrete pipe was added in parallel to the existing 42-inch pipe, the invert of the 60-inch pipe would need to be approximately 1 foot below that of the existing pipe and creek invert bed in order to maintain minimum ground cover requirements. Similarly, if the 42-inch pipe were replaced with a 72-inch diameter pipe, the invert of the pipe would need to be approximately 2 feet below that of the existing pipe and creek invert bed. Such modifications to the natural creek bed are typically avoided in order to prevent excessive erosion and sedimentation. To match existing invert elevations, rectangular box culverts could be used.

Inlet/Outlet Structures

Due to development on either side of the creek, the maximum channel width at the existing inlet into the storm drain system, shown in Figure 8, is approximately 8 feet. A standard inlet structure for a single 60-inch pipe requires 8 feet 10 inches in width (Placer County Plate 440). Therefore, if a 60-inch pipe were to be installed in parallel to the existing pipe, a modified inlet design or encroachment onto adjacent property would be necessary in addition to excavation within the natural creek channel.

Figure 7: Existing Outlet Structure

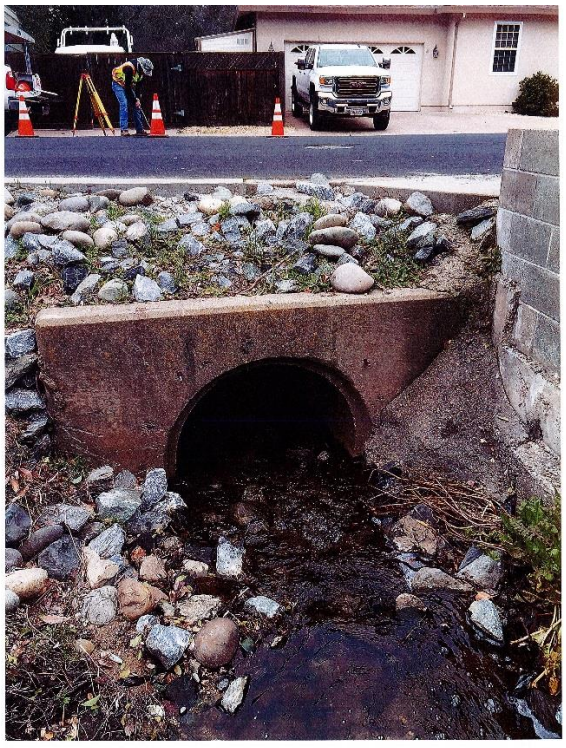

Figure 8: Existing Inlet Structure with 42-inch Pipe

Existing Utilities

The storm drainage system in the Pendleton/Bronson area includes the following three manholes (shown in Figure 9) which would require modifications or replacement if storm drain improvements were to be made:

- Manhole 1 - in center of Pendleton Drive near creek inlet to culvert
  - 42-inch in (e) – invert elev. = 420.85 ft
  - 18-inch in (n)
  - (2) storm inlets in (sw, se)
  - 42-inch out (s)
- Manhole 2 - at intersection of Pendleton Drive and Bronson Drive
  - 42-inch in (ne) – invert elev. = 418.27 ft
  - 18-inch in (se)
  - (3) storm inlets in (n, e, sw)
  - 42-inch out (nw)
- Manhole 3 - in center of Bronson Drive at intersection with creek
  - 42-inch in (se) – invert elevation = 417.5 ft
  - 12-inch in (nw)
  - (1) storm inlet (ne)
  - 42-inch out (ssw)

Due to the size of the potential upsized storm drains, standard precast manholes (Placer County Plate 409) would not be of adequate size to accommodate either the 60-inch or 72-inch storm drains. Due to the number of incoming lines and size of potential new lines, either alternative would necessitate junction boxes rather than standard manholes.

Figure 9: Existing Pendleton Storm Drain

Other utilities exist in the area which would have to be evaluated prior to storm drain improvements. According to system maps, an 8-inch gravity sanitary sewer line runs parallel to the existing 42-inch storm drain along the segment from the inlet to Manhole 1. A separate 8-inch gravity sanitary sewer line runs parallel to the existing 42-inch storm drain from Spooner Court to Bronson Drive. A crossing with an 8-inch gravity sanitary sewer line exists at the intersection of Bronson/Pendleton. An 8-inch gravity sanitary sewer line then runs parallel to the existing 42-inch storm drain along Bronson Drive until the storm drain turns to the south. Additional surveying would be necessary to ensure that any proposed storm drain infrastructure could be installed while maintaining proper separation distances at crossings with the existing gravity sanitary sewer lines.

Other utilities such as gas, cable, electricity, and telephone services undoubtedly exist within the study area and would necessitate coordination with their respective owners.

Cost Estimate

The total design and construction costs of the described storm drain improvements is estimated at between $3 – 3.5 million. The costs for removing and replacing the existing storm drain with a larger pipe are estimated to be slightly higher than installing a parallel pipe due to the removal of existing manholes and modifying connections with existing drain inlets. The described improvements are estimated to provide a level of service for a 10-year storm; hence, larger storm events would continue to result in flooding and stress on the storm drain system within the study area.