

## 5.0 EXISTING SYSTEM CONDITIONS

Field investigations were performed to assess conditions of existing facilities and determine details necessary to create the computer model. This chapter summarizes the existing hydraulic conditions and identifies existing deficiencies. Figures 8A through 8D in Appendix A show the existing system.

### 5.1 FIELD EVALUATIONS SUMMARY

During field investigations, physical conditions of detention basins, river outfalls, and irrigation canal spills were evaluated to determine condition and determine if any improvements are needed. Appendix E contains the rating system used for the field investigations and contains maps of the various assets that were evaluated. Field notes recorded for each facility have been provided to City staff as a separate document for reference.

### 5.2 MODEL EVALUATIONS

The computer model described in section 4 was used to evaluate the existing system conditions for flooding areas, bottlenecks, and undersized pipes. The results are presented in the following sections.

#### 5.2.1 Flooding Areas and Alternative Analysis

The models were run at storm event return intervals of 2, 5, 10, 25, 50, and 100 years. The nodes that flood during each time frame are shown in Figures 9A through 9D of Appendix A. Each flooding node has been assigned to a geographic or hydraulically connected group. The alphabetic labels for the areas are solely to provide a unique identifier, and do not have any significance relative to priority of improvements. Each of the 48 areas is shown in Figures 10A through 10D in Appendix A and described briefly below, with each individual issue and possible alternatives to mitigate flooding. Some alternatives are presented as a concept only; once it was determined that an approach was not feasible or another alternative was thought to be better for the overall system, that alternative was not developed further or evaluated in the model.

The overall outcome of the proposed improvements is very dependent on all improvements working together, and an overall recommended system solution is presented in section 6. The stormwater network has been modeled with all of these improvements working together to meet the design criteria. These planning level solutions should be further refined (and in some cases additional evaluation of alternatives completed) as part of predesign. Any deviations from the current concept should be evaluated in the system-wide computer model to ensure improvements are consistent with the overall master plan.

In the flooding area summaries presented in this section, a brief description of the areas and problems are presented in the following format:

- **Title Bar:** Area identifier and general location
- **First line below title:** description of the area affected by the flooding, and the basin name.
- **Second line below title:**

- *First floods at:* This identifies the smallest storm event (e.g. 2-, 5-, 10-, 25-year) at which the area first begins flooding.
- *25-year flood time:* This is the predicted time the area would remain flooded if all of the flood water ponds at the location where flooding occurs. In reality, the time flooded may be greater or less, depending on overland flow patterns during flooding. This value provides a basis of comparison for the severity of the flooding.
- *25-year flood volume:* This is the predicted volume of floodwater resulting in the flooded area. Similar to the flood time, it is provided as a reference for comparing severity of flooding at different locations. Values are reported in cubic feet (cf).
- **Deficiencies:** Summary of issues
- **Potential solutions:** Alternatives to address identified issues

<b>Area A: Pond Upstream of 7<sup>th</sup> Street and Outlook Avenue</b>		
<i>Potential flooded area: 7th Street and the field surrounding the pond</i>	<i>Basin: Skunk Creek</i>	
<i>First floods at: 5-year</i>	<i>25-year flood time: 55 min.</i>	<i>25-year flood volume: 12,845 cf</i>

**Deficiencies:**

1. This area is downstream of a pond with an outfall pipe crown above the top of pond. This does not allow for 1 ft. of freeboard in the pond. Currently, the water overtops the pond before the top of the outfall flows full. The field around the pond may flood.
2. Further downstream, pipes are undersized to carry design flows. 7<sup>th</sup> Street may flood.



**Potential solutions:**

1. Pond Solutions
  - a. Construct a berm around pond to allow for 1 ft. freeboard above top of outfall pipe.
  - b. Lower outfall pipe
2. Downstream pipes
  - a. Upsizing and regrading pipes
  - b. Adding a parallel pipe

**Area B: 9th Street by High School to F Street**

<i>Potential flooded area: 7th Street and the field surrounding the pond</i>		<i>Basin: Skunk Creek</i>
<i>Smallest event flooding: 25-year</i>	<i>25-year flood time: 56 min.</i>	<i>25-year flood volume: 33,378 cf</i>



**Deficiencies:**

1. There is a large portion of the Skunk Creek Basin that flows to the pipe downstream of this area, causing water to back up into this area. There is an existing 48-inch pipe that currently is not connected to the system, but runs nearly parallel to the problem area. This area floods Madrone Street for approximately 83 minutes during the 25-year storm event, (with potential impacts to the surrounding houses), and floods the canal between D Street and E Street near businesses for approximately 91 minutes.



2. While not contributing to the model's prediction of flooding in this area, there are some maintenance and cleaning needs noticed in the field (as seen above) that need to be addressed.

**Potential solutions:**

1. Upsize the entire line in this area from Madrone Street to the river.
2. Redirect flow from this area down the existing 48-inch line that is currently not being used to a new outfall at Skunk Creek. This effort should be coordinated with redirection of flows in Areas E, F, and I presented later.

**Area C: Canal North of Freeway near Beacon Drive**

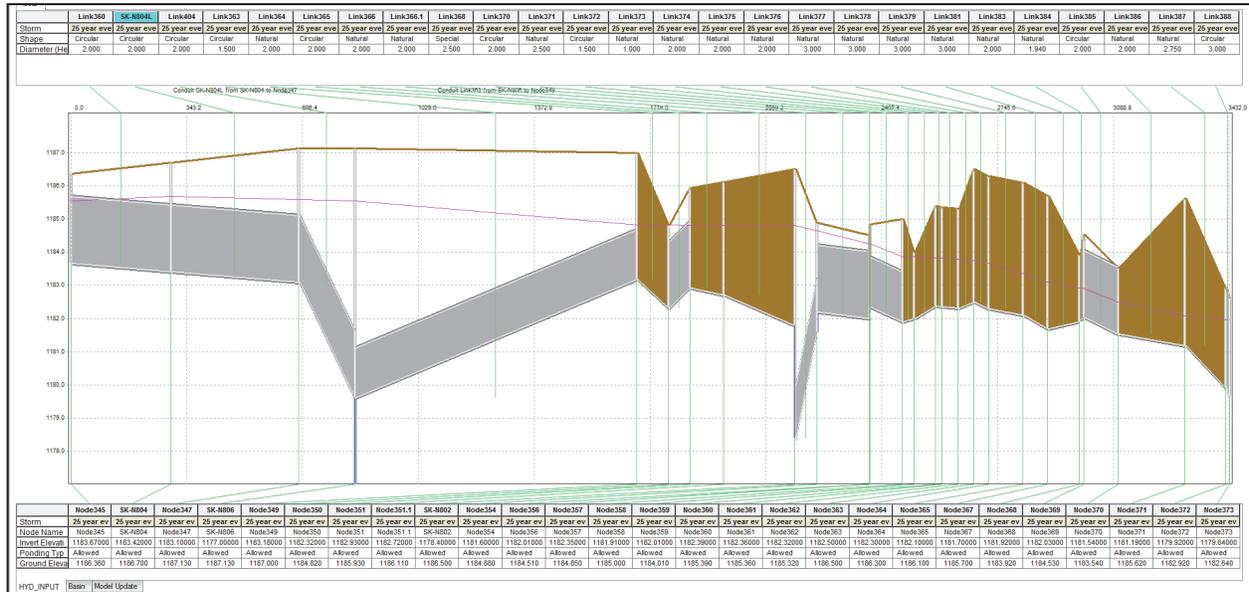
<i>Potential flooded area: residential area and fields</i>		<i>Basin: Skunk Creek</i>
<i>First floods at: 5-year</i>	<i>25-year flood time: 98 min.</i>	<i>25-year flood volume: 11,982 cf</i>



**Deficiencies:**

1. This area floods due to low spots in the channel walls, and an inconsistent channel slope with adverse grades as shown in the following profile. The channel meanders around yards, houses, and fields.
2. The irrigation spill, which crosses under I-5, is

also a potential flooding area. The county recently completed some improvements in this area, but it is unknown to the City what these improvements were. A survey could find that this pipe is now adequately sized.



Grey = piped segments; Brown = open channel segments; Brown line = ground surface or top of bank; Red line = hydraulic grade, or maximum water surface elevation

**Potential solutions:**

1. Channel solutions
  - a. Create a uniform cross-section channel with a uniform slope that varies in depth with ground elevation.
  - b. Pipe canal
2. Spillway solutions
  - a. Do nothing; it is in the middle of a field and only floods in the 5+ year events
  - b. Increase culvert diameter downstream of outfall

Area D: N Street and Rose Place		
Potential flooded area: N Street and the surrounding residences		Basin: Skunk Creek
First floods at: 25-year	25-year flood time: 4 min.	25-year flood volume: 2 cf



**Deficiencies:**

This area floods in the model due to an undersized outlet. However, this area may have unmapped stormwater pipelines that are capable of conveying local runoff without flooding.

**Potential solutions:**

1. Survey the pipes in N Street and re-delineate the basins with more detail. Add the additional information to the

- model. This may reveal that there is no flooding problem in this area.
- 2. Replace pipes downstream. This may be difficult since the outfall daylights at a cliff.
- 3. Create new spill of N Street pipes to irrigation siphon. This would require an adverse grade overflow, because the siphon is higher than the storm pipe.

<b>Area E: M Street</b>		
<i>Potential flooded area: businesses and residences surrounding M Street</i>	<i>Basin: Skunk Creek</i>	
<i>First floods at: 2-year</i>	<i>25-year flood time: 305 min.</i>	<i>25-year flood volume: 36,974 cf</i>



**Deficiencies:**

The pipeline in M Street is undersized.

**Potential solutions:**

- 1. Upsize the entire line along M Street, and create a new outfall to the river
- 2. Construct an overflow to Rogue Drive that allows the surcharged pipe to flow in reverse. This should be done in coordination with fixing Areas B, F and I.

<b>Area F: F Street and Industry Drive</b>		
<i>Potential flooded area: roads and adjacent businesses</i>	<i>Basin: Skunk Creek/Jones Creek</i>	
<i>First floods at: 2-year</i>	<i>25-year flood time: 408 min.</i>	<i>25-year flood volume: 287,225 cf</i>



**Deficiencies:**

- 1. The pipelines in F Street/Industry Drive are undersized.
- 2. There is insufficient detention storage
- 3. Water backs up from downstream pipes, causing flooding along the entire line

**Potential solutions:**

- 1. Reroute flows along Rogue Drive, and Agness Avenue to River; create an overflow for the east end to Jones Creek; and construct a detention pond to slow flows from running offsite. This should be done in coordination with fixing Areas B, E and I.
- 2. Upsize lines all the way from upstream end of Industry Drive to the river. Detention will be needed.

**Area G: Dewey Drive and 10<sup>th</sup> Street**

<i>Potential flooded area: field and surrounding residences</i>		<i>Basin: Skunk Creek</i>
<i>First floods at: 2-year</i>	<i>25-year flood time: 108 min.</i>	<i>25-year flood volume: 2,223 cf</i>



**Deficiencies:**  
 The channel is undersized to carry the design flows.

- Potential solutions:**
1. Widen and deepen channel
  2. Add localized detention

**Area H: Hillcrest Drive**

<i>Potential flooded area: Hillcrest Drive, 9<sup>th</sup> Street and surrounding residences and businesses</i>		<i>Basin: Skunk Creek</i>
<i>First floods at: 2-year</i>	<i>25-year flood time: 89 min.</i>	<i>25-year flood volume: 16,677 cf</i>



- Deficiencies:**
1. The pipe on Hillcrest Drive is undersized, causing a bottleneck.
  2. The flow split on 9<sup>th</sup> and Hill crest sends too much flow down 9<sup>th</sup> Street.
  3. The survey of this area was not able to be completed during field investigations,

due to a large blackberry grove covering land in front of the pipe.

- Potential solutions:**
1. Upsize pipes down Hillcrest Drive, and reconfigure flow split to send more flow down Hillcrest Drive.
  2. Increase capacity of 9<sup>th</sup> Street overflow and canal downstream.

**Area I: D Street, Staples, Alley between Anderson Street and Baker Drive**

<i>Potential flooded area: D Street and surrounding residences and businesses, alley</i>	<i>Basin: Skunk Creek</i>
<i>First floods at: 10-year</i>	<i>25-year flood time: 125 min.      25-year flood volume: 11,794 cf</i>



**Deficiencies:**

1. Water from downstream pipes backs up in this pipeline, due to much of the Skunk Creek basin draining to the same line.
2. Some of the pipes are undersized (some have smaller diameters than upstream pipelines) and have inadequate grades.

3. the main drain runs under the large building as shown

**Potential solutions:**

1. Upsize pipes and channels all the way to the river. This would include approximately 1950 feet of pipe and 2075 feet of open channel.
2. Locally upsize pipes (provide adequate cover). Redirect flows from Areas B, E, and F away from the outfall of this area as described in their respective sections. Pipeline rerouting may need to be considered instead of pipeline upsizing for a portion of the pipeline, if the pipeline goes under Staples as shown in some of the mapping.

**Area J: Between Hefley Drive and Savage Street**

<i>Potential flooded area: residences</i>	<i>Basin: Skunk Creek</i>
<i>First floods at: 25-year</i>	<i>25-year flood time: 16 min.      25-year flood volume: 474 cf</i>

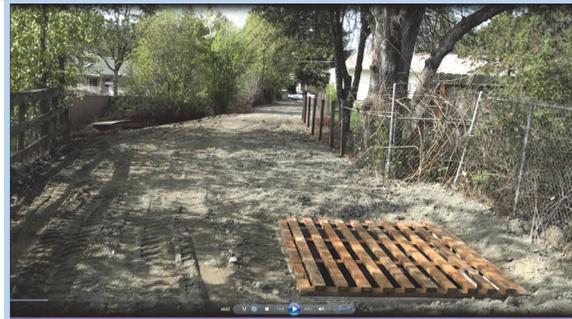


**Deficiencies:**

Shallow pipes in this area flood.

**Potential solutions:**

1. Further survey definition of this spill could decrease or increase the modelled flooding in this area.
2. Completing alternatives in other areas removes modeled flooding here.



**Area K: South Highline Canal – Southern Flowing Portion near Allen Creek**

Potential flooded area: Residences and businesses around canal

Basin: Allen Creek

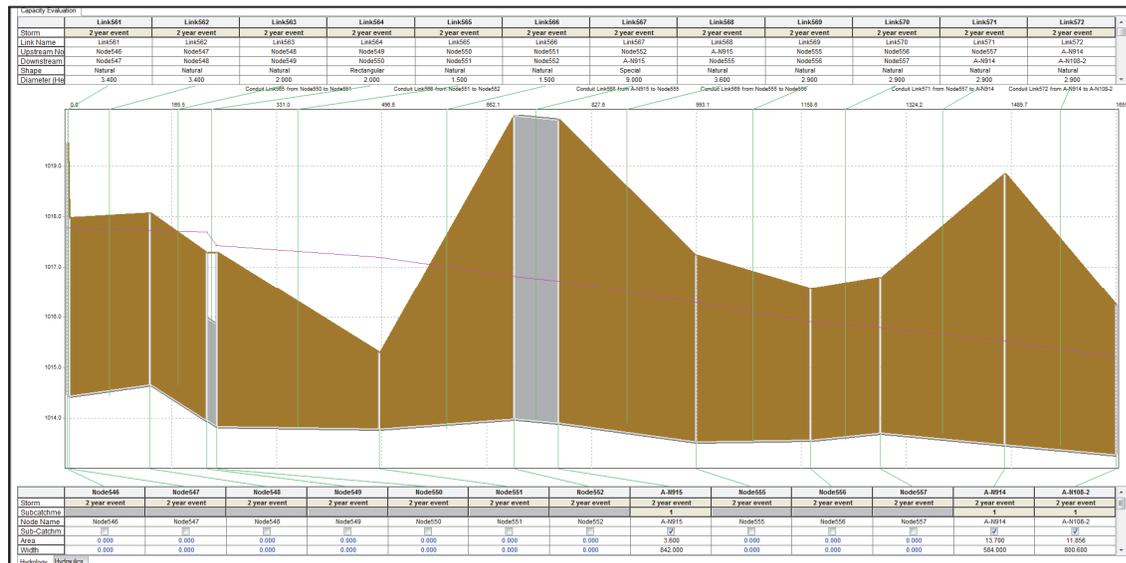
First floods at: 2-year

25-year flood time: 1408 min.

25-year flood volume: 329,330 cf

**Deficiencies:**

The canal has many areas where the berms have eroded, or were never constructed as high as the surrounding area. There are adverse grades in the channel bottom, slowing the flow of water through the undersized canals.



**Potential solutions:**

All alternatives assume the eroded berms have been repaired.

1. Widen canal substantially to allow enough flow through
2. Construct a parallel pipe that will convey overflow from the canal
3. Replace the canal with a pipe

**Area L: County Yard**

<i>Potential flooded area: County yard and surrounding businesses</i>	<i>Basin: Allen Creek</i>	
<i>First floods at: 2-year</i>	<i>25-year flood time: 1752 min.</i>	<i>25-year flood volume: 6,303,146 cf</i>



**Deficiencies:**

The outlet pipe from the structure shown above is too small to pass design flows, and water backs up through the siphon into the ditch upstream where it overtops.

**Potential solutions:**

1. Upsize the outlet pipe. This will require connecting to the existing pipe further downstream than the existing intersection, due to cover requirements for the county's large trucks.
2. Bypass this structure and create a parallel pipe system.

**Area M: Harbeck Road, Colorado Lane, Nebraska Avenue**

<i>Potential flooded area: residences, a church, streets</i>	<i>Basin: Allen Creek</i>	
<i>First floods at: 2-year</i>	<i>25-year flood time: 102 min.</i>	<i>25-year flood volume: 52,248 cf</i>



**Deficiencies:**

The pipes are undersized to carry the design flows.

**Potential solutions:**

Upsize pipes to appropriate sizes as described in further detail in Section 6 and shown in Figure 11A of Appendix A.

**Area N: South Highline Canal – Southern Flowing Portion near Fruitdale Creek- Southern Half**

<i>Potential flooded area: fields, residences, forest</i>		<i>Basin: Fruitdale Creek</i>
<i>First floods at: 10-year</i>	<i>25-year flood time: 103 min.</i>	<i>25-year flood volume: 109,499 cf</i>



**Deficiencies:**  
 The canal receives upland flow and flow coming from areas upstream outside of the city limits that exceeds its capacity. This causes the canal to overtop.

- Potential solutions:**
1. Widen channel from City limits to Fruitdale Creek.
  2. Create a new spill to river at the start of City limits to reroute flows

originating from outside the City. This solution will also fix area X.

**Area O: Parkdale Drive and Main Gravity Canal - Poplar Drive to Cloverlawn Drive**

<i>Potential flooded area: residences and businesses along canal and Parkdale Drive</i>		<i>Basin: Allen Creek</i>
<i>First floods at: 2-year</i>	<i>25-year flood time: 166 min.</i>	<i>25-year flood volume: 163,789 cf</i>

- Deficiencies:**
1. The main gravity canal is undersized through this portion, causing water to overtop and flood surrounding areas.
  2. Pipes down Parkdale Drive are undersized.

- Potential solutions:**
1. Create a new corridor for flow to exit canal to river down Parkdale Drive.
  2. Add detention to the system and upsize pipe in Parkdale Drive.



**Area P: Haviland Drive**

<i>Potential flooded area: Haviland Drive and surrounding residences</i>	<i>Basin: Allen Creek</i>
<i>First floods at: 25-year</i>	<i>25-year flood time: 9 min.      25-year flood volume: 706 cf</i>



**Deficiencies:**  
The pipes are undersized to carry the design flows.

**Potential solutions:**  
Upsize pipes to appropriate sizes as described in further detail in Section 6 and shown in Figure 11A of Appendix A.

**Area Q: Gaffney Way and Idle Court**

<i>Potential flooded area: Gaffney Way, Idle court and surrounding residences</i>	<i>Basin: Allen Creek</i>
<i>First floods at: 2-year</i>	<i>25-year flood time: 143 min.      25-year flood volume: 41,330 cf</i>



**Deficiencies:**  
The pipes are undersized to carry the design flows.

**Potential solutions:**  
Upsize pipes to appropriate sizes as described in further detail in Section 6 and shown in Figure 11A of Appendix A.

**Area R: Near Virginia Lane**

<i>Potential flooded area: Virginia Lane and surrounding residences</i>	<i>Basin: Allen Creek</i>
<i>First floods at: 10-year</i>	<i>25-year flood time: 32 min.      25-year flood volume: 3,079 cf</i>



**Deficiencies:**  
The pipes are undersized to carry the design flows.

**Potential solutions:**  
Upsize pipes to appropriate sizes as described in further detail in Section 6 and shown in Figure 11A of Appendix A.

**Area S: Harbeck Road and Southridge Way**

<i>Potential flooded area: residences, businesses, field, streets</i>		<i>Basin: Allen Creek</i>
<i>First floods at: 2-year</i>	<i>25-year flood time: 318 min.</i>	<i>25-year flood volume: 41,470 cf</i>



**Deficiencies:**

The pipes are undersized to carry the design flows.

**Potential solutions:**

Upsize pipes to appropriate sizes as described further detail in Section 6 and shown in Figure 11A of Appendix A.

**Area T: Northern Improvements to Allen Creek Basin**

<i>Potential flooded area: residences, businesses, park, streets, State highway</i>		<i>Basin: Allen Creek</i>
<i>First floods at: 2-year</i>	<i>25-year flood time: 165 min.</i>	<i>25-year flood volume: 99,435 cf</i>



**Deficiencies:**

1. Many of the pipes are undersized to carry design flows.
2. The City reports that the sugar beet line may be blocked. Minor storm lines are connected to this line at several locations.
3. Water potentially floods the State highways 238, 199, and 99.

**Potential solutions:**

All improvements include adding detention, and rehabilitating the sugar beet line.

1. Upsize most of the pipes in this area, even those in highway ROW.
2. Upsize selected pipes and redirect flows to connect into the proposed alternative improvements in Area O.
3. Coordinate with State agencies to remove flooding on their highways.

**Area U: West Park Street to River**

<i>Potential flooded area: residences around canal, West Park street</i>		<i>Basin: Allen Creek</i>
<i>First floods at: 25-year</i>	<i>25-year flood time: 6 min.</i>	<i>25-year flood volume: 121 cf</i>



**Deficiencies:**  
The canal is undersized to carry the design flows.

**Potential solutions:**  
Upsize pipes to appropriate sizes as described in further detail in Section 6 and shown in Figure 11A of Appendix A.

**Area V: Ramsey Avenue, Grandview Avenue, Williams Highway, Union Avenue, G I Lane Ringuette Street, Liberty Drive, Independence Drive, Harbeck Avenue**

<i>Potential flooded area: streets, hospital, businesses, fields</i>		<i>Basin: Allen Creek</i>
<i>First floods at: 2-year</i>	<i>25-year flood time: 403 min.</i>	<i>25-year flood volume: 332,367 cf</i>



- Deficiencies:**
1. The canals and pipes in this area are undersized to carry the design flows.
  2. The canal and pipe entering the canal need to be maintained.



**Potential solutions:**  
The alternatives for this project include any number of choices for which pipes to upsize. Most of the pipes need to be upsized in any case. A connection between the canals is also part of this alternative. Flow splits should be adjusted to redirect flow as needed.

**Area W: Meadow Glen**

<i>Potential flooded area: residences, field, Meadow Glen</i>		<i>Basin: Allen Creek</i>
<i>First floods at: 2-year</i>	<i>25-year flood time: 127 min.</i>	<i>25-year flood volume: 9,479 cf</i>



**Deficiencies:**  
The pipes are undersized to carry the design flows.

**Potential solutions:**  
Upsize pipes to appropriate sizes as described further detail in Section 6 and shown in Figure 11A of Appendix A.

**Area X: South Highline Canal – Southern Flowing Portion near Fruitdale Creek- Southern Half**

<i>Potential flooded area: forest, residences</i>		<i>Basin: Fruitdale Creek</i>
<i>First floods at: 25-year</i>	<i>25-year flood time: 88 min.</i>	<i>25-year flood volume: 120,303 cf</i>



**Deficiencies:**  
The canal receives more upland flow and flow coming from areas upstream outside of the city limits than its capacity. This causes the canal to overtop.

**Potential solutions:**

1. Widen channel from City limits to Fruitdale Creek
2. Create a new spill to the river at

the start of City limits to reroute flows originating from outside the City. This solution will also fix area N.

**Area Y: South Highline Canal – Towne Street to Gaffney Way**

<i>Potential flooded area: residences, field</i>	<i>Basin: Allen Creek</i>	
<i>First floods at: 5-year</i>	<i>25-year flood time: 128 min. 2</i>	<i>5-year flood volume: 50,797 cf</i>



**Deficiencies:**  
 There are numerous flows entering the canal from upland areas within and outside the City limits. This makes the canal overtop.

- Potential solutions:**
1. Upsize canal
  2. Create detention upstream to decrease flow attenuation in canal

**Area Z: Streets near Golf Course**

<i>Potential flooded area:</i>	<i>Basin: Allen Creek</i>	
<i>First floods at: 2-year</i>	<i>25-year flood time: 101 min.</i>	<i>25-year flood volume: 18,922 cf</i>



- Deficiencies:**
1. The pipes are undersized to carry the design flows.
  2. Residents are blocking culverts with bricks, reportedly to keep the skunks out.

- Potential solutions:**
1. Upsize pipes to appropriate sizes.
  2. Install grates on driveway culverts to keep animals out, and keep homeowners from plugging them with paving stones.

<b>Area AA: 9<sup>th</sup> Street</b>		
<i>Potential flooded area: 9<sup>th</sup> Street and surrounding businesses and residences</i>	<i>Basin: Gilbert Creek</i>	
<i>First floods at: 5-year</i>	<i>25-year flood time: 81 min.</i>	<i>25-year flood volume: 4,054 cf</i>



**Deficiencies:**  
The pipes are undersized to carry the design flows.

**Potential solutions:**  
Upsize pipes to appropriate sizes as described in further detail in Section 6 and shown in Figure 11B of Appendix A.

<b>Area AB: 5<sup>th</sup> Street</b>		
<i>Potential flooded area: 5<sup>th</sup> Street and surrounding businesses and residences</i>	<i>Basin: Gilbert Creek</i>	
<i>First floods at: 2-year</i>	<i>25-year flood time: 998 min.</i>	<i>25-year flood volume: 97,318 cf</i>



**Deficiencies:**  
The pipes are undersized to carry the design flows.

**Potential solutions:**  
Upsize pipes to appropriate sizes as described in further detail in Section 6 and shown in Figure 11B of Appendix A.

<b>Area AC: G Street and Oak Street</b>		
<i>Potential flooded area: streets and surrounding residences</i>	<i>Basin: Gilbert Creek</i>	
<i>First floods at: 10-year</i>	<i>25-year flood time: 32 min.</i>	<i>25-year flood volume: 673 cf</i>



**Deficiencies:**  
The pipes are undersized to carry the design flows.

**Potential solutions:**  
Upsize pipes to appropriate sizes as described further detail in Section 6 and shown in Figure 11B of Appendix A.

**Area AD: Highland Heights Estates**

<i>Potential flooded area: streets and surrounding residences</i>	<i>Basin: Gilbert Creek</i>	
<i>First floods at: 2-year</i>	<i>25-year flood time: 950 min.</i>	<i>25-year flood volume: 221,010 cf</i>



**Deficiencies:**

1. A portion of this network consists of a canal constructed with a wall about 3 bricks tall on one side. This is insufficient to convey design flows.
2. The private channel and associated culverts in Highland Estates are too small to pass design flows.

**Potential solutions:**

1. Canal
  - a. Replace brick channel with pipe
  - b. Widen/deepen existing channel
2. Private channel
  - a. Widen channel and upsize culverts
  - b. Create a parallel pipe next to the canal

**Area AE: Diamond Hardware**

<i>Potential flooded area: businesses, residences, streets</i>	<i>Basin: Gilbert Creek</i>	
<i>First floods at: 2-year</i>	<i>25-year flood time: 52 min.</i>	<i>25-year flood volume: 27,338 cf</i>



**Deficiencies:**

The canal receives upland flow and flow coming from areas upstream outside of the

city limits that exceeds its capacity. This causes the canal to overtop.



**Potential solutions:**

1. Widen channel from City limits to Fruitdale Creek
2. Create a new spill to river at the start of City limits to reroute flows originating from outside the City. This solution will also fix area N.

**Area AF: Tokay - Gilbert Creek spill to Pleasantview Drive**

<i>Potential flooded area: Canal and surrounding houses and school</i>	<i>Basin: Gilbert Creek</i>	
<i>First floods at: 2-year</i>	<i>25-year flood time: 121 min.</i>	<i>25-year flood volume: 18,113 cf</i>



**Deficiencies:**

1. The spill to Gilbert Creek is not large enough to pass the design flows to the creek, so water backs up and spills over the top of the control structure.
2. The gate on the spill to Valleyview Drive is much smaller than the receiving pipe, and too small to pass the design flows.

**Potential solutions:**

1. Expand the spill diameter to Gilbert Creek.
2. Expand the spill gate size to Valleyview Drive.
3. In addition, riprap should be added along Gilbert Creek to reduce erosion.

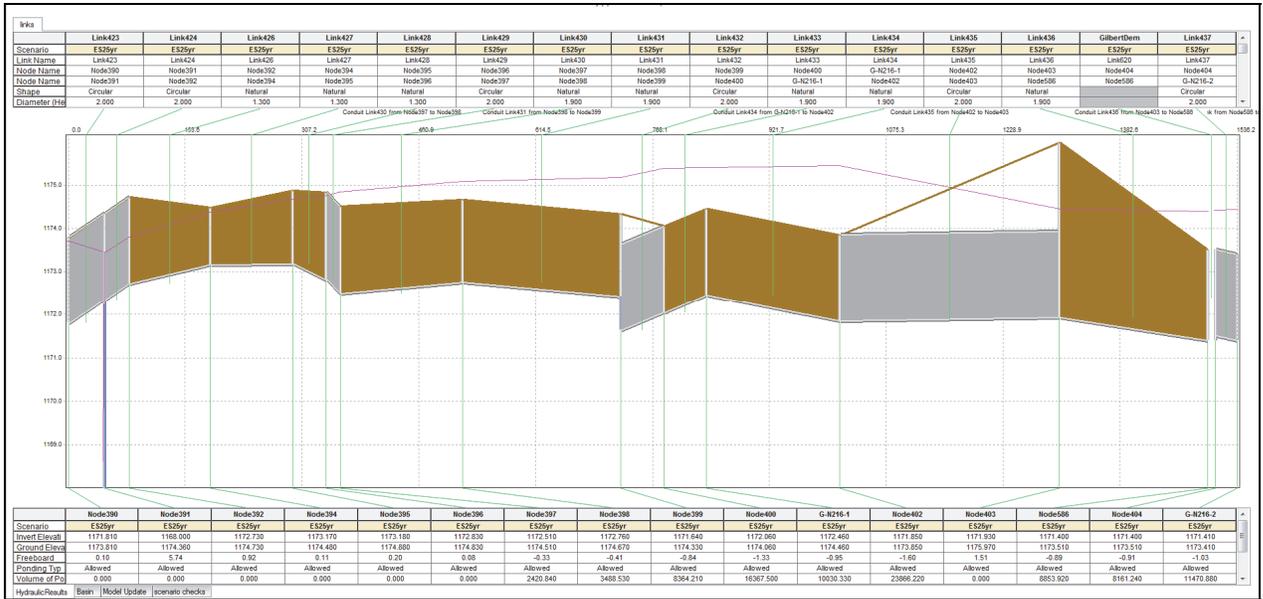
**Area AG: Demoray Canal - Vine Street to Greenfield Drive**

<i>Potential flooded area: canal and surrounding fields, residences, and businesses</i>	<i>Basin: Gilbert Creek</i>	
<i>First floods at: 2-year</i>	<i>25-year flood time: 742 min.</i>	<i>25-year flood volume: 258,298 cf</i>



**Deficiencies:**

1. The canal receives upland flow and flow coming from areas upstream outside of the City limits that exceeds its capacity, causing the canal to overtop.
2. There are adverse grades in multiple different sections of the canal



- The pipe at the downstream end of this section of canal is undersized.
- The orifice for the pond on North Hill drive is too small to pass the design flows.

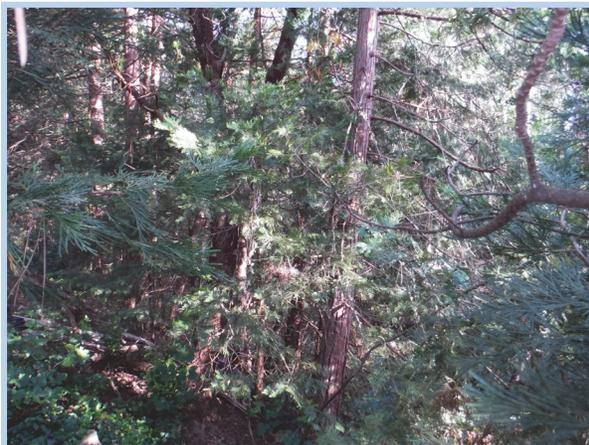
**Potential solutions:**

- Widen channel from City limits to Gilbert Creek
- Create a new spill to river at the start of City limits to reroute flows originating from outside the City. This solution will also fix area N.



**Area AH: Demoray Canal – Regent Drive to Valleyview Drive**

Potential flooded area: canal and surrounding houses	Basin: Gilbert Creek
First floods at: 2-year	25-year flood time: 276 min.      25-year flood volume: 12,077 cf



**Deficiencies:**

The canal is rather shallow in this area, causing the canal to overtop into surrounding yards.

**Potential solutions:**

- Expand channel capacity.
- Create a new spill to the existing drainage ditch that crosses Shelly Circle.

**Area AI: Demoray Canal- at Wrightwood Circle**

<i>Potential flooded area: canal and surrounding residences</i>	<i>Basin: Gilbert Creek</i>
<i>First floods at: 2-year</i>	<i>25-year flood time: 1364 min.      25-year flood volume: 29,222 cf</i>



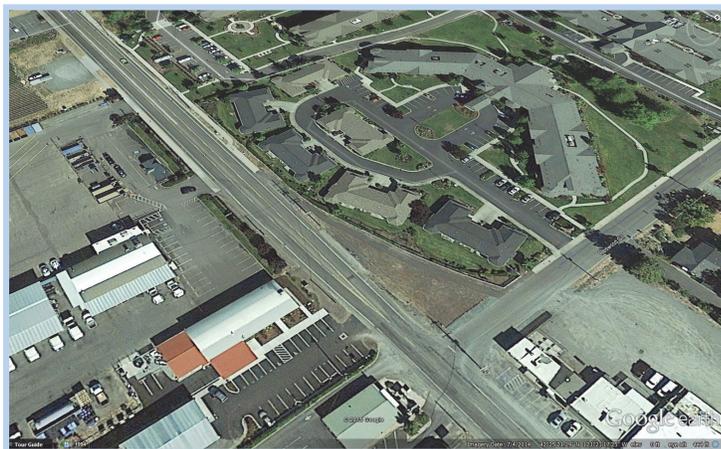
**Deficiencies:**  
 The canal is rather shallow in this area, causing the canal to overtop into surrounding yards.

**Potential solutions:**

1. Widen channel
2. Create a new spill through Highland Heights Estates.

**Area AJ: Redwood Circle and Redwood Avenue**

<i>Potential flooded area: streets, businesses, nursing home</i>	<i>Basin: Sand Creek</i>
<i>First floods at: 2-year</i>	<i>25-year flood time: 62 min.      25-year flood volume: 6,543 cf</i>



**Deficiencies:**  
 Flat pipes limit flow passing through

**Potential solutions:**

1. Upsize pipes
2. Regrade existing pipes

**Area AK: South Main Canal**

<i>Potential flooded area: canal and surrounding businesses, homes, and fields</i>	<i>Basin: Sand Creek</i>
<i>First floods at: 2-year</i>	<i>25-year flood time: 2,569 min.      25-year flood volume: 209,775 cf</i>



**Deficiencies:**

1. The canal receives more upland flow and flow coming from areas upstream outside of the city limits than its capacity, causing overtopping.
2. There are many adverse grades throughout the canal reach.

**Potential solutions:**

1. Widen and regrade channel

2. Pipe flows through existing canal alignment

3. Increase spills and redirect flow

**Area AL: Dowell Road and Surrounding Branches**

<i>Potential flooded area: Streets, canal, residences, businesses, park</i>		<i>Basin: Sand Creek</i>
<i>First floods at: 2-year</i>	<i>25-year flood time: 2,389 min.</i>	<i>25-year flood volume: 1,247,866 cf</i>



**Deficiencies:**

1. Some sections of the canal are very shallow and undersized.
2. There is a pipe within the canal.
3. Pipes are undersized.

**Potential solutions:**

1. Expand all the pipes out to the river from the canal spill.
2. Add detention.

3. Permanently close the spill that was closed during flow monitoring, to prevent flows from entering the smaller pipe. Also partially close the one that was open.

**Area AM: Kellenbeck Avenue and Redwood Avenue**

<i>Potential flooded area: streets and surrounding residences and nursing home</i>		<i>Basin: Sand Creek</i>
<i>First floods at: 2-year</i>	<i>25-year flood time: 89 min.</i>	<i>25-year flood volume: 15,242 cf</i>





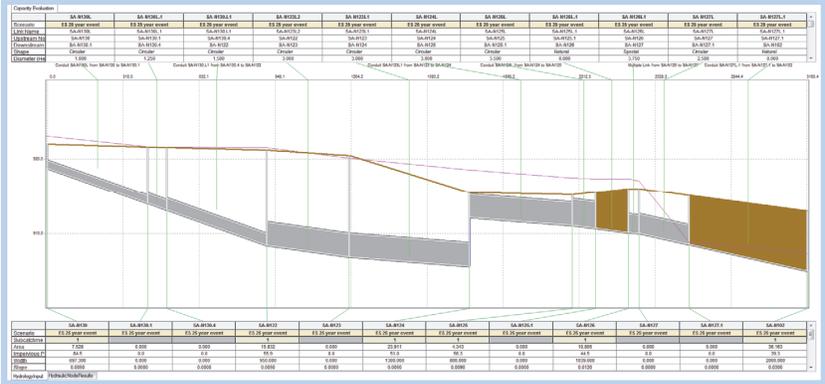
**Deficiencies:**

1. The pipes installed in the recent Redwood Avenue Improvements project were too small to pass the 25-year event.
2. Other utilities limited the size of the newly installed pipes.

**Potential solutions:**

1. Expand pipes and reroute other utilities.
2. Add a parallel pipe to increase capacity.

Area AN: Willow Lane		
Potential flooded area: streets and surrounding residences	Basin: Sand Creek	
First floods at: 2-year	25-year flood time: 121 min.	25-year flood volume: 52,564 cf



**Deficiencies:**

1. Undersized pipe
2. Downstream pipe exits manhole 6.5 feet higher than upstream inlet pipe. Since upstream system must surcharge to this depth before flow can pass through, it will eventually fill with sediment.



**Potential solutions:**

1. Regrade and upsize pipes

**Area AO: Rainwood Lane and Sprinkle Way**

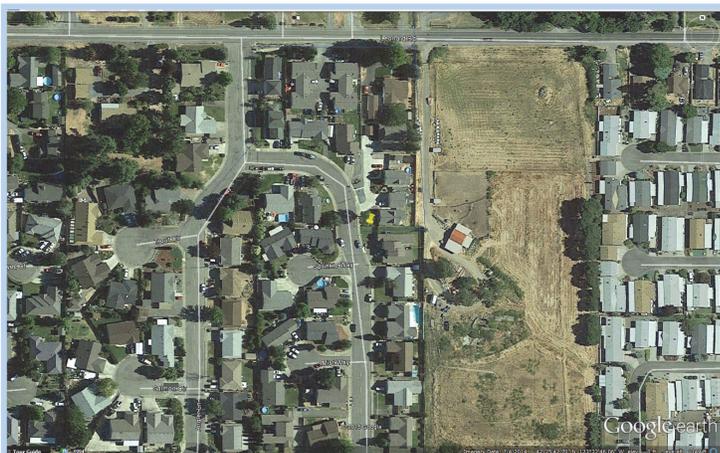
Potential flooded area: streets and surrounding residences

Basin: Sand Creek

First floods at: 2-year

25-year flood time: 89 min.

25-year flood volume: 5,876 cf



**Deficiencies:**

1. Undersized pipe
2. Downstream pipe exits manhole 2.2 feet above inlet pipe, causing surcharging and sedimentation in upstream network.

**Potential solutions:**

1. Regrade and upsize pipes (Section 6 and Figure 11C of Appendix A).

**Area AP: Summerfield Estates Ponds**

Potential flooded area: Ponds, streets, and surrounding residences and fields

Basin: Sand Creek

First floods at: 2-year

25-year flood time: 1,063 min. 25-year flood volume: 113,561 cf



**Deficiencies:**

1. The ponds receive more upland flow and flow coming from areas upstream outside of the city limits than their capacity, causing the ponds to overtop.
2. The ponds were designed only for the neighborhood in which they reside and not for the external inflows.

**Potential solutions:**

1. Route external flows to bypass ponds.
2. Expand ponds.

Area AQ: Redwood Avenue		
Potential flooded area: residences		Basin: Sand Creek
First floods at: 25-year	25-year flood time: 406 min.	25-year flood volume: 15,195 cf



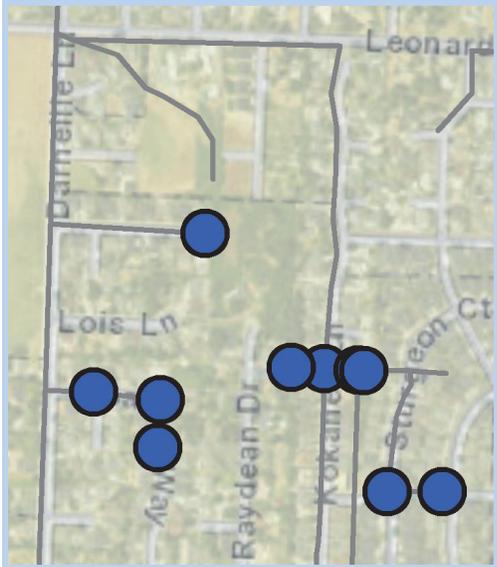
**Deficiencies:**

1. The pipes are not large enough to pass the 25 year flow.
2. Conflicts with other existing utilities limited the size of the newly installed pipes.
3. The wetlands upstream do not detain sufficient amounts of water, and are in need of maintenance.

**Potential solutions:**

1. Expand pipes and reroute other utilities.
2. Add a parallel pipe to increase capacity.
3. Expand wetland into a detention capacity.
4. The spill on the east side of Dowell Road that was closed during flow monitoring should remain closed during the winter drainage season. Also, partially close the one that was open (between Kokanee Lane and Yucca Drive).

Area AR: Areas Upstream of Darnelle Lane Bottle Neck		
Potential flooded area: streets and surrounding residences and fields		Basin: Sand Creek
First floods at: 2-year	25-year flood time: 270 min.	25-year flood volume: 19,070 cf



**Deficiencies:**

1. Undersized pipe

**Potential solutions:**

1. Increase pipe size

**Area AS: Demoray Canal-West Side**

<i>Potential flooded area: forest and surrounding residences</i>		<i>Basin: Gilbert Creek</i>
<i>First floods at: 10-year</i>	<i>25-year flood time: 389 min.</i>	<i>25-year flood volume: 59,388 cf</i>



**Deficiencies:**

The canal receives more upland flow and flow coming from areas upstream outside of the city limits than than its capacity, causing the flow to overtop the canal and flood the surrounding areas.

**Potential solutions:**

1. Widen channel
2. Expand the existing spill to Gilbert Creek upstream of the problem area, to divert flow.
3. Redirect flow upstream of this area.

**Area AT: 6<sup>th</sup> Street**

<i>Potential flooded area: streets and surrounding businesses</i>		<i>Basin: Gilbert Creek</i>
<i>First floods at: 10-year</i>	<i>25-year flood time: 46 min.</i>	<i>25-year flood volume: 2,174 cf</i>



**Deficiencies:**

The pipes are undersized to carry the design flows.

**Potential solutions:**

Upsize pipes to appropriate sizes

**Area AU: MoonGlo Drive and Leonard Road**

<i>Potential flooded area: streets and surrounding residences and fields</i>	<i>Basin: Sand Creek</i>	
<i>First floods at: 25-year</i>	<i>25-year flood time: 15 min.</i>	<i>25-year flood volume: 1,014 cf</i>



**Deficiencies:**

The pipes are undersized to carry the design flows.

**Potential solutions:**

1. Upsize pipes to appropriate sizes
2. Connect to area AV and expand spill to river.

**Area AV: Delsie Drive and Mesman Drive**

<i>Potential flooded area: streets and surrounding residences</i>	<i>Basin: Sand Creek</i>	
<i>First floods at: 25-year</i>	<i>25-year flood time: 9 min.</i>	<i>25-year flood volume: 870 cf</i>



**Deficiencies:**

The pipes are undersized to carry the design flows.

**Potential solutions:**

1. Upsize pipes to appropriate sizes
2. Expand spill to river.