SECTION 7

Hydraulic Analysis Results and Drainage Improvements

Limited hydraulic analysis was performed to identify potential problem areas and develop recommended improvements for the City of McMinnville storm drainage system. The analysis results are presented below for each major basin with descriptions of potential projects. These are supported by the Section 7 Hydraulic Analysis Results figures provided at the end of this section. Detailed hydraulic analysis data, calculations, and results for pipes, culverts, and major drainageway profiles can be found in Appendix C.

The Hydraulic Analysis Results figures are organized into an atlas of the City of McMinnville service area. Refer to Figure 7-INDEX (the first figure in the series of Hydraulic Analysis Results figures) to identify which figures to review for any given basin or sub-basin.

Modeled pipelines shown on these figures are color coded to indicate four levels of deficiency risk: very low, low, medium, and high. The figures show the following information for each of these pipe segments: existing 10-year storm event flow, future 10-year storm event flow, existing pipe diameter, and pipe diameter required to meet design criteria for full build-out flow condition. This is referred to as "replacement" pipe diameter, although improvements are not necessarily recommended in every case.

The potential projects described in this section were further evaluated using a risk rating system, which considered additional factors. Areas shown to be at high risk according to the risk rating system were developed into a list of recommended capital improvement projects (shown in bold in the descriptions below). A description of the risk rating methodology is documented in Section 10. A number of additional recommendations are made, by basin, in this section that should be considered during pre-design and design stages of any capital improvements to address drainage problems within the basin. Many of these detailed descriptions are retained from the 1991 plan.

7.1 Cozine Creek Basin

7.1.1 General Description

This area lies along the main stem of Cozine Creek, including the confluence with the South Yamhill River. Its lower reaches are characterized by deep, wide channels that have been cut through the silty soils in excess of the flow requirements of Cozine Creek. This area includes a portion of Linfield College, the south end of City center, the commercial areas near Highway 99W, and residential lands, which are mostly developed. Significant development activities have occurred just south of Fellows Road, along Cozine Creek, to Old Sheridan Road.

FIGURE 7-A3

HYDRAULIC RESULTS & RECOMMENDED IMPROVEMENTS

City of McMinnville
Stormwater Drainage Master Plan

Legend

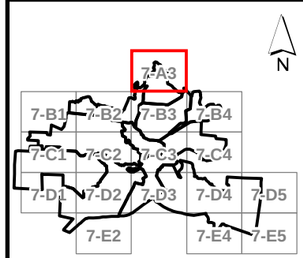
- Manhole
- Major Basin
- Sub-Basin
- Culvert
- Existing Storm Pipe

Deficiency Rating

- Very Low
- Low
- Medium
- High

Example

Existing 10-year Flow (cfs)	--	Future 10-year Flow (cfs)
XX - YY		XX - YY
Exist Pipe Size	--	Future Pipe Size



1 inch = 500 feet

CH2MHILL

Date: 3/25/2009

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FIGURE 7-B1

HYDRAULIC RESULTS & RECOMMENDED IMPROVEMENTS

City of McMinnville Stormwater Drainage Master Plan

Legend

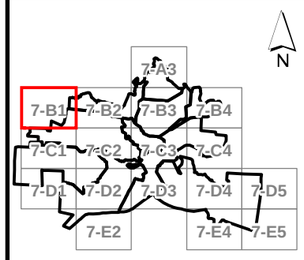
- Manhole
- Major Basin
- Sub-Basin
- Culvert
- Existing Storm Pipe

Deficiency Rating

- Very Low
- Low
- Medium
- High

Example

Existing 10-year Flow (cfs)	--	Future 10-year Flow (cfs)
XX - YY		
XX - YY		
Exist Pipe Size	--	Future Pipe Size



1 inch = 500 feet

CH2MHILL

Date: 3/25/2009

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FIGURE 7-B2

HYDRAULIC RESULTS & RECOMMENDED IMPROVEMENTS

City of McMinnville Stormwater Drainage Master Plan

Legend

- Manhole
- Major Basin
- Sub-Basin
- Culvert
- Existing Storm Pipe

Deficiency Rating

- Very Low
- Low
- Medium
- High

Example

Existing 10-year Flow (cfs)	--	Future 10-year Flow (cfs)
XX - YY		
XX - YY		
Exist Pipe Size	--	Future Pipe Size

N

7-A3
7-B1 7-B2 7-B3 7-B4
7-C1 7-C2 7-C3 7-C4
7-D1 7-D2 7-D3 7-D4 7-D5
7-E2 7-E4 7-E5

1 inch = 500 feet

CH2MHILL

Date: 3/25/2009

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FIGURE 7-B3

HYDRAULIC RESULTS & RECOMMENDED IMPROVEMENTS

City of McMinnville Stormwater Drainage Master Plan

Legend

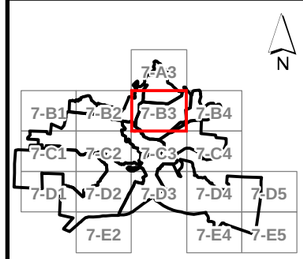
- Manhole
- Major Basin
- Sub-Basin
- Culvert
- Existing Storm Pipe

Deficiency Rating

- Very Low
- Low
- Medium
- High

Example

Existing 10-year Flow (cfs)	--	Future 10-year Flow (cfs)
XX - YY		
XX - YY		
Exist Pipe Size	--	**Future Pipe Size**



1 inch = 500 feet

CH2MHILL

Date: 3/25/2009

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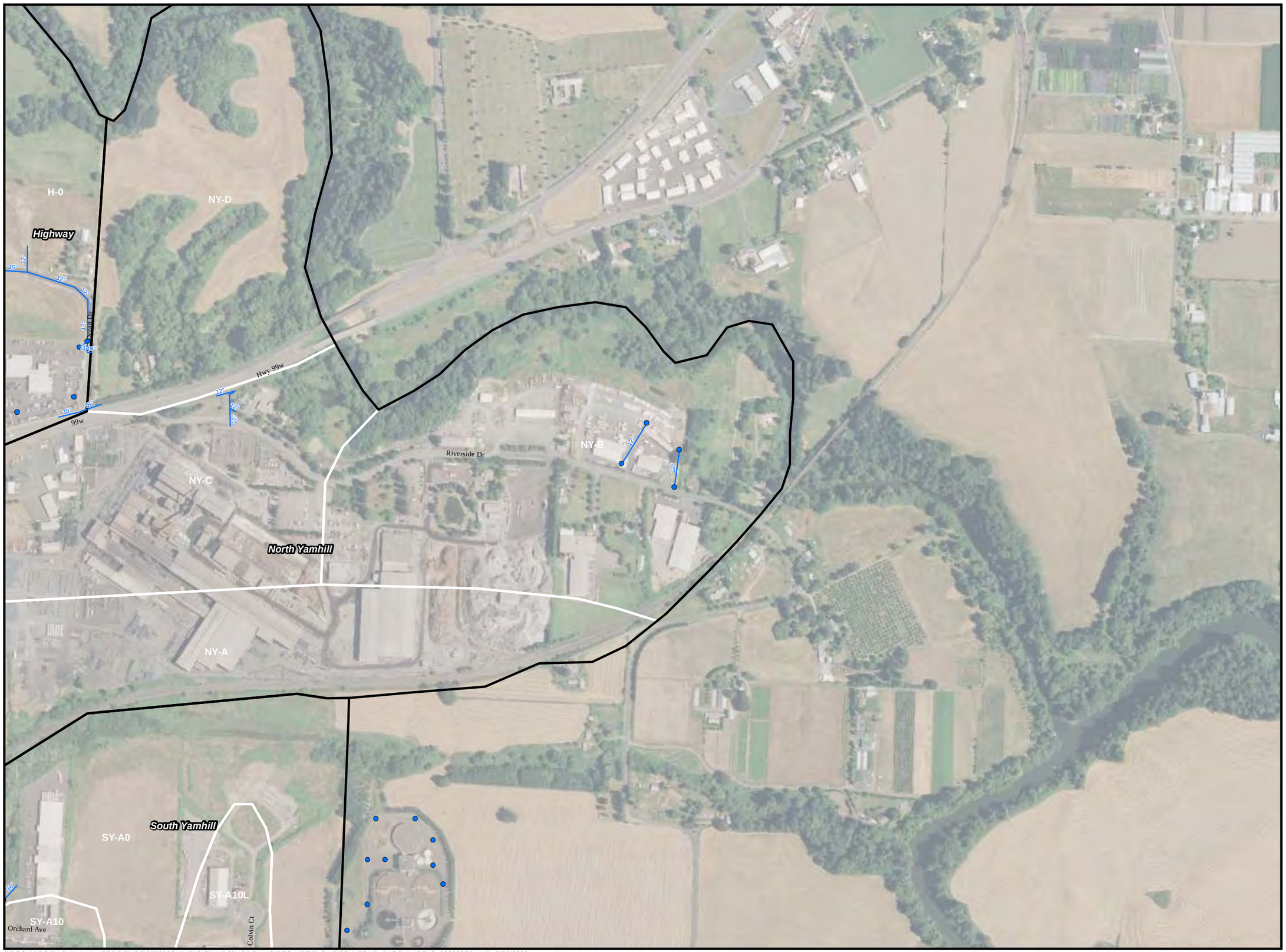
FIGURE 7-B4

HYDRAULIC RESULTS & RECOMMENDED IMPROVEMENTS

City of McMinnville
Stormwater Drainage Master Plan



Legend

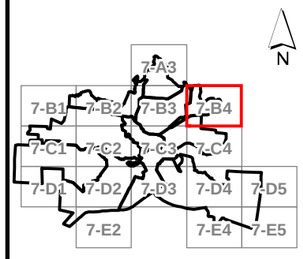
- Manhole
- Major Basin
- Sub-Basin
- Culvert
- Existing Storm Pipe

Deficiency Rating

- Very Low
- Low
- Medium
- High

Example

Existing 10-year Flow (cfs)	--	Future 10-year Flow (cfs)
XX - YY		XX - YY
Exist Pipe Size	--	Future Pipe Size



1 inch = 500 feet

CH2MHILL

Date: 3/25/2009

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FIGURE 7-C1

HYDRAULIC RESULTS & RECOMMENDED IMPROVEMENTS

City of McMinnville Stormwater Drainage Master Plan

Legend

- Manhole
- Major Basin
- Sub-Basin
- Culvert
- Existing Storm Pipe

Deficiency Rating

- Very Low
- Low
- Medium
- High

Example

Existing 10-year Flow (cfs)	--	Future 10-year Flow (cfs)
XX - YY		XX - YY
Exist Pipe Size	--	Future Pipe Size

N

7-A3
7-B1 7-B2 7-B3 7-B4
7-C1 7-C2 7-C3 7-C4
7-D1 7-D2 7-D3 7-D4 7-D5
7-E2 7-E4 7-E5

1 inch = 500 feet

CH2MHILL

Date: 3/25/2009

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FIGURE 7-C2

HYDRAULIC RESULTS & RECOMMENDED IMPROVEMENTS

City of McMinnville Stormwater Drainage Master Plan

Legend

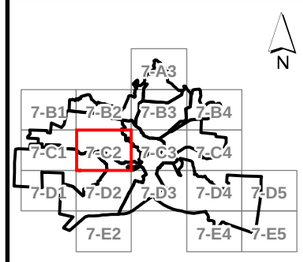
- Manhole
- Major Basin
- Sub-Basin
- Culvert
- Existing Storm Pipe

Deficiency Rating

- Very Low
- Low
- Medium
- High

Example

Existing 10-year Flow (cfs)	--	Future 10-year Flow (cfs)
XX - YY		XX - YY
Exist Pipe Size	--	Future Pipe Size



1 inch = 500 feet

CH2MHILL

Date: 3/25/2009

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FIGURE 7-C3

HYDRAULIC RESULTS & RECOMMENDED IMPROVEMENTS

City of McMinnville Stormwater Drainage Master Plan

Legend

- Manhole
- Major Basin
- Sub-Basin
- Culvert
- Existing Storm Pipe

Deficiency Rating

- Very Low
- Low
- Medium
- High

Example

Existing 10-year Flow (cfs)	--	Future 10-year Flow (cfs)
XX - YY		XX - YY
Exist Pipe Size	--	Future Pipe Size

N

7-A3
7-B1 7-B2 7-B3 7-B4
7-C1 7-C2 7-C3 7-C4
7-D1 7-D2 7-D3 7-D4 7-D5
7-E2 7-E4 7-E5

1 inch = 500 feet

CH2MHILL

Date: 3/25/2009

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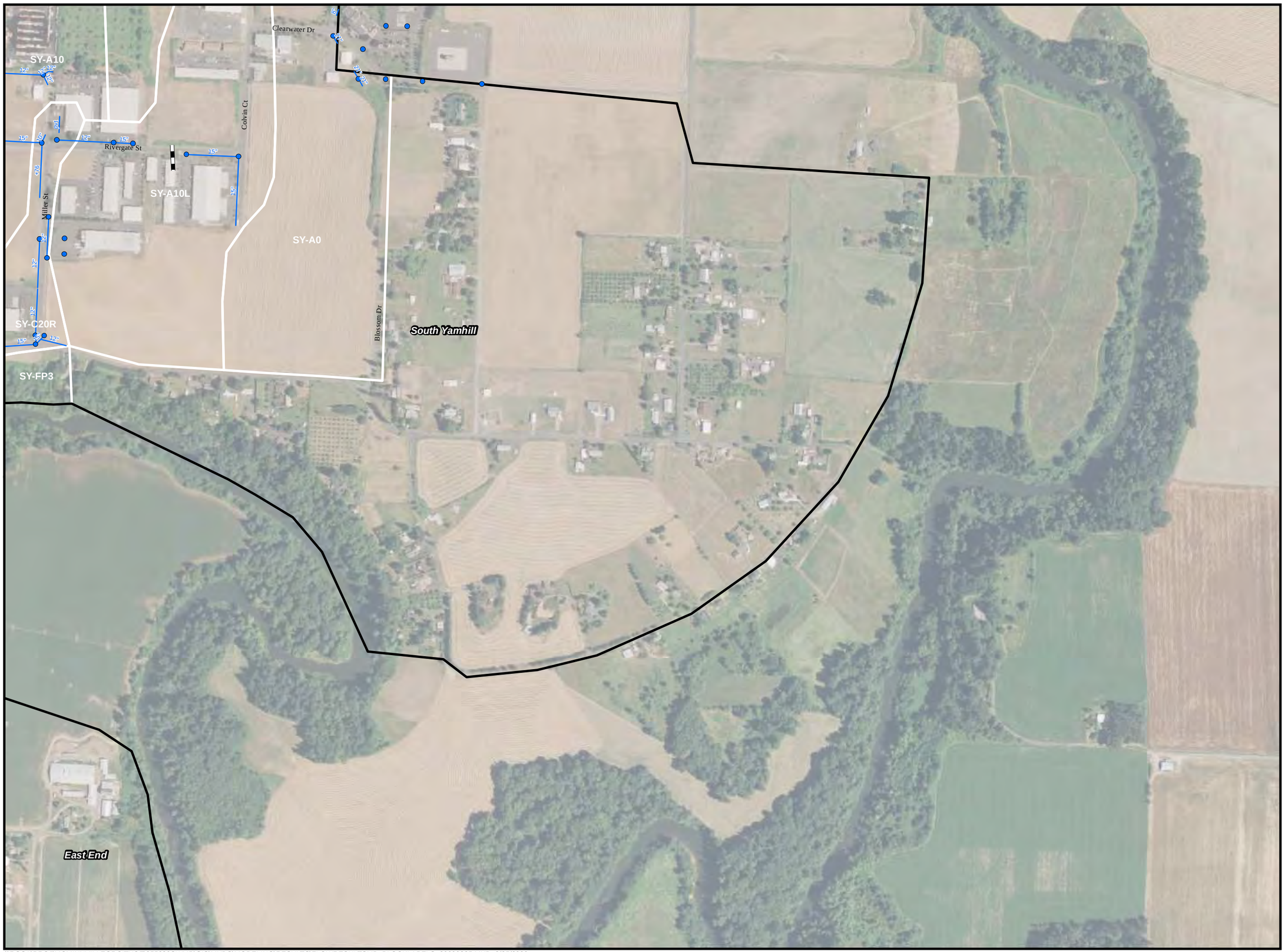
FIGURE 7-C4

HYDRAULIC RESULTS & RECOMMENDED IMPROVEMENTS

City of McMinnville Stormwater Drainage Master Plan



Legend

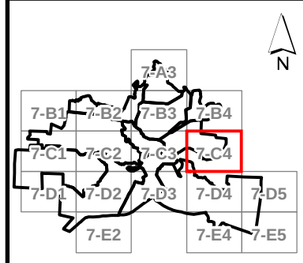
- Manhole
- Major Basin
- Sub-Basin
- Culvert
- Existing Storm Pipe

Deficiency Rating

- Very Low
- Low
- Medium
- High

Example

Existing 10-year Flow (cfs)	--	Future 10-year Flow (cfs)
XX - YY		
XX - YY		
Exist Pipe Size	--	Future Pipe Size



1 inch = 500 feet

CH2MHILL

Date: 3/25/2009

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FIGURE 7-D1

HYDRAULIC RESULTS & RECOMMENDED IMPROVEMENTS

City of McMinnville
Stormwater Drainage Master Plan

C-80R2

West Cozine

W-40L

W-20

W-10L1

C80R

10.9cfs - 10.9cfs
15" - 24"

13.5cfs - 13.5cfs
15" - 24"

13.5cfs - 13.5cfs
15" - 24"

Cozine Creek

Hill Rd

Oleander St

Oleander Ct

Acorn Ct

Filbert St

Songbird St

Sitka Dr

Myrtle Ct

Hawthorne St

Westvale St

Apple Ct

Fellows St

Phyllis Dr

Marie Dr

Emma Dr

Darci Dr

Diane Ct

Louise Dr

Cooper Dr

Nicole Dr

Legend

- Manhole
- Major Basin
- Sub-Basin
- Culvert
- Existing Storm Pipe

Deficiency Rating

- Very Low
- Low
- Medium
- High

Example

Existing 10-year Flow (cfs)	--	Future 10-year Flow (cfs)
XX - YY		
XX - YY		
Exist Pipe Size	--	Future Pipe Size

N

7-A3
7-B1 7-B2 7-B3 7-B4
7-C1 7-C2 7-C3 7-C4
7-D1 7-D2 7-D3 7-D4 7-D5
7-E2 7-E4 7-E5

1 inch = 500 feet

CH2MHILL

Date: 3/25/2009

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FIGURE 7-D2

HYDRAULIC RESULTS & RECOMMENDED IMPROVEMENTS

City of McMinnville Stormwater Drainage Master Plan

Legend

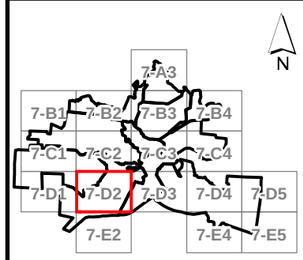
- Manhole
- Major Basin
- Sub-Basin
- Culvert
- Existing Storm Pipe

Deficiency Rating

- Very Low
- Low
- Medium
- High

Example

Existing 10-year Flow (cfs)	--	Future 10-year Flow (cfs)
XX - YY		
Exist Pipe Size	--	Future Pipe Size
XX - YY		



1 inch = 500 feet

CH2MHILL

Date: 3/25/2009

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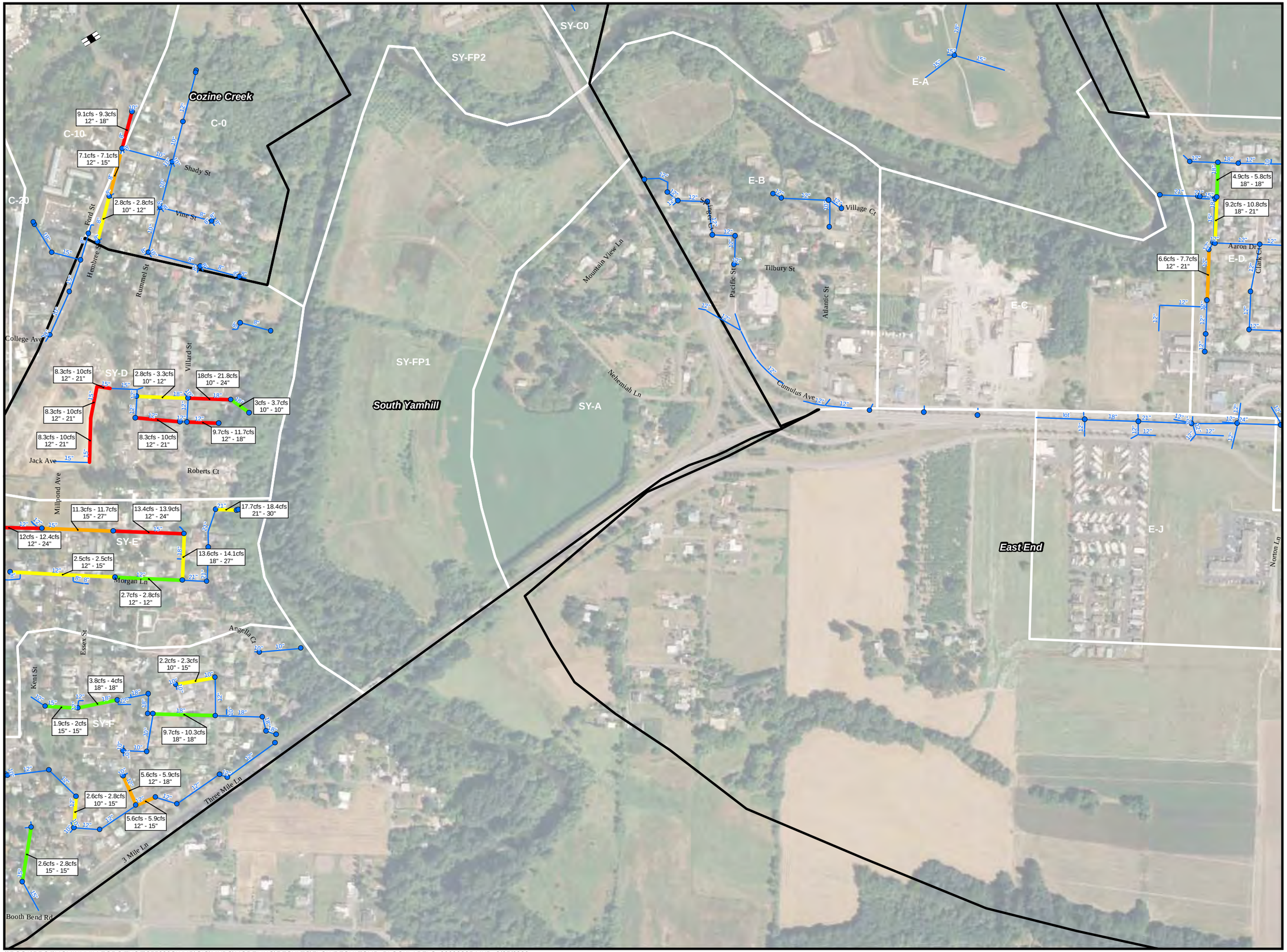
FIGURE 7-D3

HYDRAULIC RESULTS & RECOMMENDED IMPROVEMENTS

City of McMinnville Stormwater Drainage Master Plan



Legend

- Manhole
- Major Basin
- Sub-Basin
- Culvert
- Existing Storm Pipe

Deficiency Rating

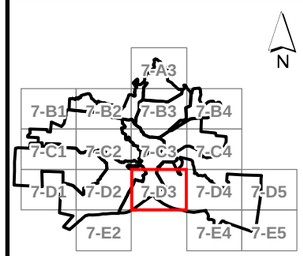
- Very Low
- Low
- Medium
- High

Example

XX - YY
XX - YY

Existing 10-year Flow (cfs) -- Future 10-year Flow (cfs)

Exist Pipe Size -- Future Pipe Size



1 inch = 500 feet

CH2MHILL

Date: 3/25/2009

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FIGURE 7-D4

HYDRAULIC RESULTS & RECOMMENDED IMPROVEMENTS

City of McMinnville Stormwater Drainage Master Plan

13.9cfs - 16.5cfs
15" - 15"

11.1cfs - 13.2cfs
15" - 24"

5.4cfs - 6.4cfs
12" - 18"

1.5cfs - 1.8cfs
10" - 12"

13.2cfs - 13.5cfs
18" - 27"

114.6cfs - 116.9cfs
30" - 60"

4cfs - 4.1cfs
15" - 18"

4cfs - 4.1cfs
15" - 18"

4cfs - 4.1cfs
15" - 18"

4cfs - 4.1cfs
15" - 18"

Cole Ave
Kingwood Ct
Kingwood St
Kingwood Dr
Mayden
Three Mile Ln
Stratus Ave
Cumulus Ave
3 Mile Ln
Armory Way
Cirrus Ave
Captain Michael King Smith Way
East End

E-D
E-E
E-F
E-G
E-H0
E-H10
E-J
E-K
E-L0
E-L10
E-L20
E-L30
E-M
E-N0

Legend

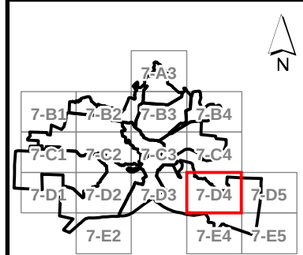
- Manhole
- Major Basin
- Sub-Basin
- Culvert
- Existing Storm Pipe

Deficiency Rating

- Very Low
- Low
- Medium
- High

Example

Existing 10-year Flow (cfs)	--	Future 10-year Flow (cfs)
XX - YY		
XX - YY		
Exist Pipe Size	--	Future Pipe Size



1 inch = 500 feet

CH2MHILL

Date: 3/25/2009

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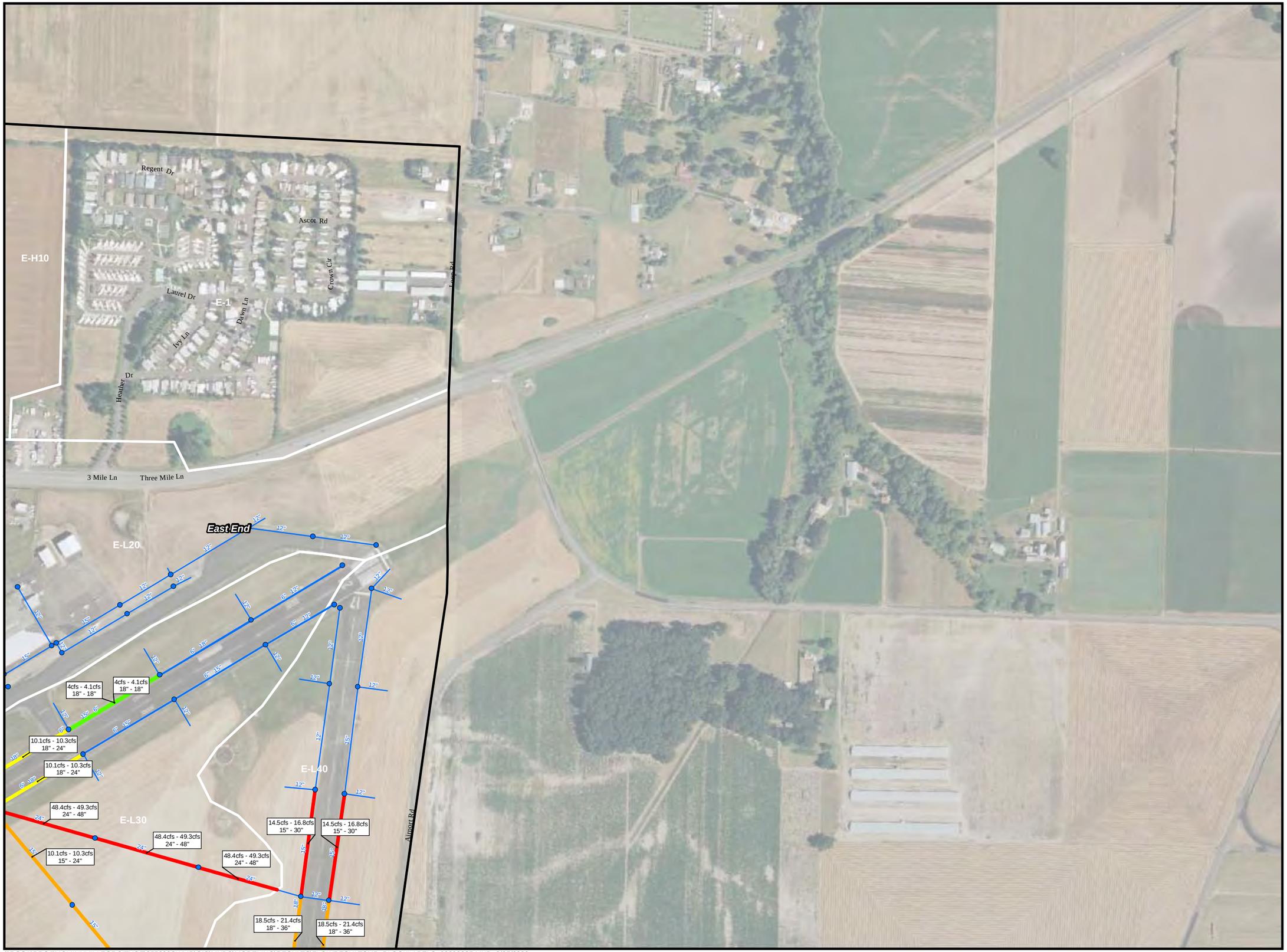
FIGURE 7-D5

HYDRAULIC RESULTS & RECOMMENDED IMPROVEMENTS

City of McMinnville Stormwater Drainage Master Plan



Legend

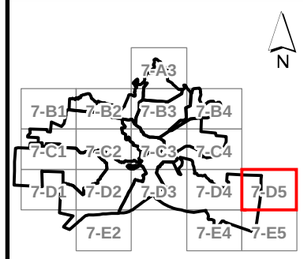
- Manhole
- Major Basin
- Sub-Basin
- Culvert
- Existing Storm Pipe

Deficiency Rating

- Very Low
- Low
- Medium
- High

Example

Existing 10-year Flow (cfs)	--	Future 10-year Flow (cfs)
XX - YY		
XX - YY		
Exist Pipe Size	--	**Future Pipe Size**



1 inch = 500 feet

CH2MHILL

Date: 3/25/2009

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FIGURE 7-E2

HYDRAULIC RESULTS & RECOMMENDED IMPROVEMENTS

City of McMinnville
Stormwater Drainage Master Plan

Legend

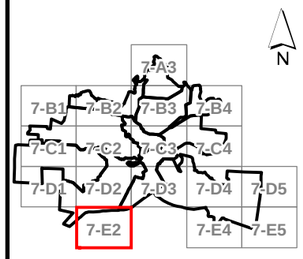
- Manhole
- Major Basin
- Sub-Basin
- Culvert
- Existing Storm Pipe

Deficiency Rating

- Very Low
- Low
- Medium
- High

Example

Existing 10-year Flow (cfs)	--	Future 10-year Flow (cfs)
XX - YY		
XX - YY		
Exist Pipe Size	--	Future Pipe Size



1 inch = 500 feet

CH2MHILL

Date: 3/25/2009

\\ROSA\PROJ\MCMINNVILLEORCITYOF\355230SWMP\GIS\MXDS\MODELING\RESULTS\FLOWRESULTSMB_BLOCKLABELS_20090325.MXD 3/25/2009

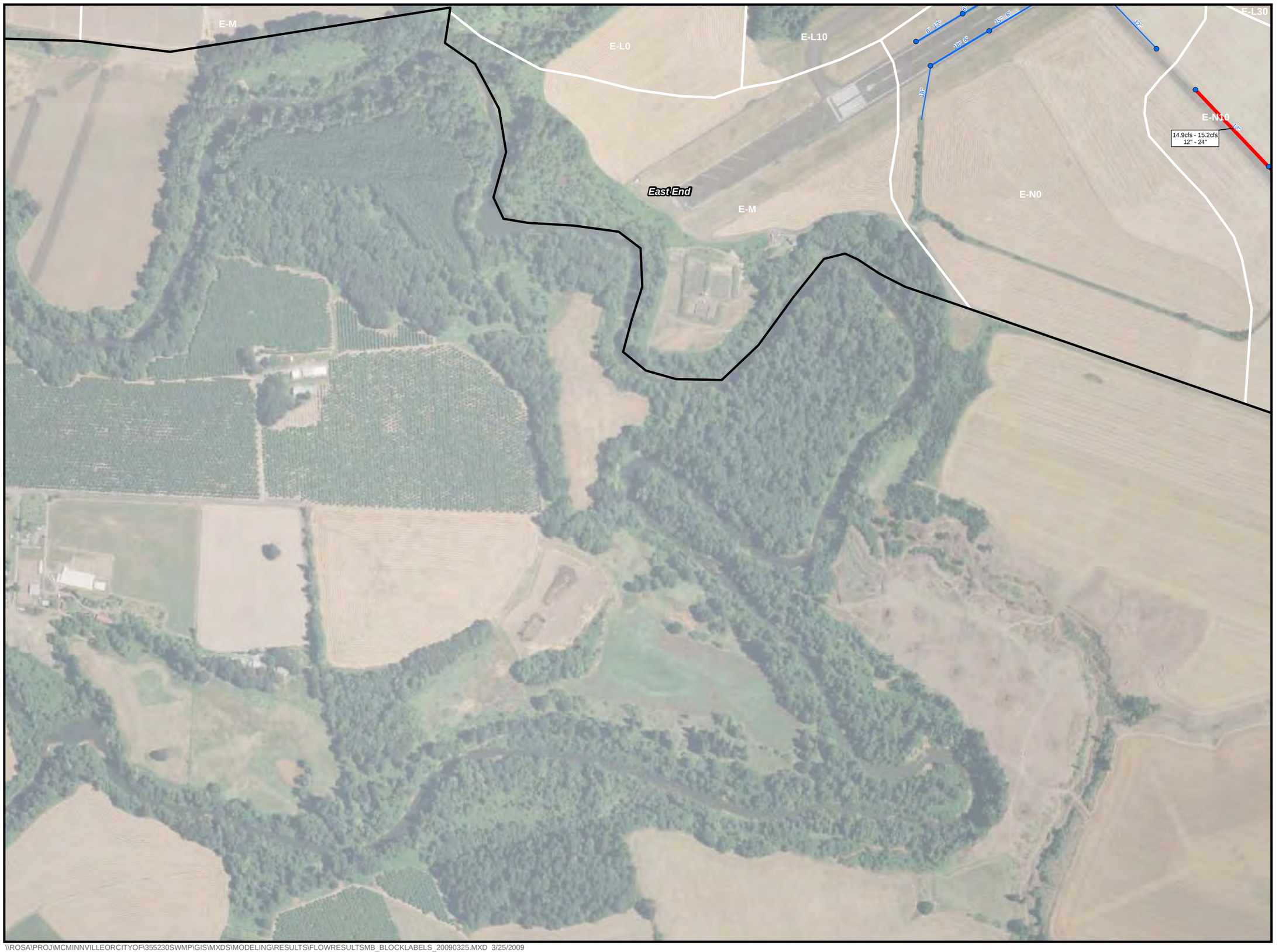


FIGURE 7-E4

HYDRAULIC RESULTS & RECOMMENDED IMPROVEMENTS

City of McMinnville
Stormwater Drainage Master Plan

Legend

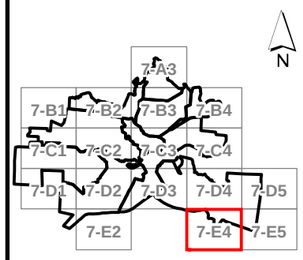
- Manhole
- Major Basin
- Sub-Basin
- Culvert
- Existing Storm Pipe

Deficiency Rating

- Very Low
- Low
- Medium
- High

Example

Existing 10-year Flow (cfs)	--	Future 10-year Flow (cfs)
XX - YY		
XX - YY		
Exist Pipe Size	--	Future Pipe Size



1 inch = 500 feet

CH2MHILL

Date: 3/25/2009

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FIGURE 7-E5

HYDRAULIC RESULTS & RECOMMENDED IMPROVEMENTS

City of McMinnville
Stormwater Drainage Master Plan

Legend

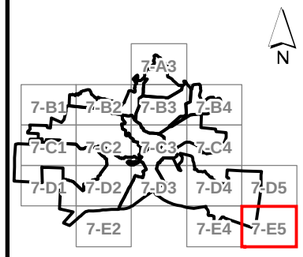
- Manhole
- Major Basin
- Sub-Basin
- Culvert
- Existing Storm Pipe

Deficiency Rating

- Very Low
- Low
- Medium
- High

Example

Existing 10-year Flow (cfs)	--	Future 10-year Flow (cfs)
XX - YY		
Exist Pipe Size	--	Future Pipe Size
XX - YY		



1 inch = 500 feet

CH2MHILL

Date: 3/25/2009

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The Cozine Creek channel forms a well-defined floodplain area with the developed lands lying well above the maximum water surface.

There are seven culvert crossings and one bridge at Old Sheridan Road. The FEMA profiles show that backwater from the South Yamhill River extends up as far as Fellows Road.

Figure 7-1 provides an outline of the Cozine Creek Basin.

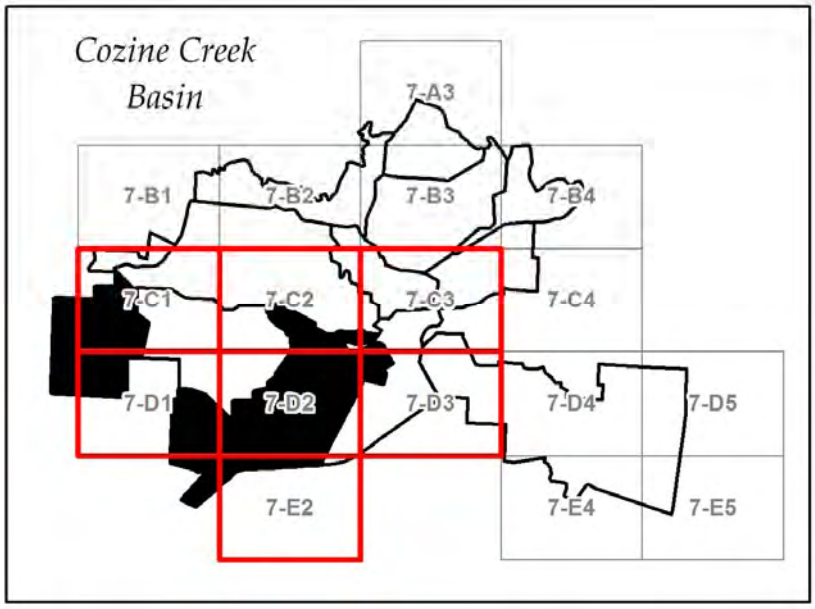


FIGURE 7-1
Cozine Creek Basin

7.1.2 Problem Areas

The stage of the South Yamhill River has a significant influence on the hydraulic conditions (i.e., water surface profile) in the lower reach of Cozine Creek because it creates a backwater condition that can extend for several miles upstream. This backwater effect reduces storage capacity in lower Cozine Creek, which makes flooding problems worse than they otherwise would be if the South Yamhill stage were lower. The Cozine Creek system was evaluated over a wide range of possible backwater conditions to bracket the range of possible conditions.

Results from dynamic (unsteady) modeling indicate that the effects of storage and timing are critical factors that must be considered when evaluating hydraulic capacity of infrastructure in lower Cozine Creek. The resulting water surface profiles are considerably lower than the profiles computed using steady-state assumptions. The profile plots in Figures 7-2 and 7-3 illustrate the difference between the dynamic and steady-state model results for the 10-year event.

All culverts have adequate capacity to pass the 10-year storm without over topping, even under extreme condition where the South Yamhill River is assumed to have a 10-year peak stage coincident with the 10-year event in Cozine Creek. Ford Avenue overtops as a result of backwater from the South Yamhill but the problem is unrelated to capacity of the culverts.

Results from the 50-year event show that Cozine Creek overtops the road at Edmunston (private road) and Ford Avenue; all other roads remain dry. These results indicate that all culverts in the Cozine Creek system have adequate capacity. Therefore, no improvements are required beyond standard maintenance.

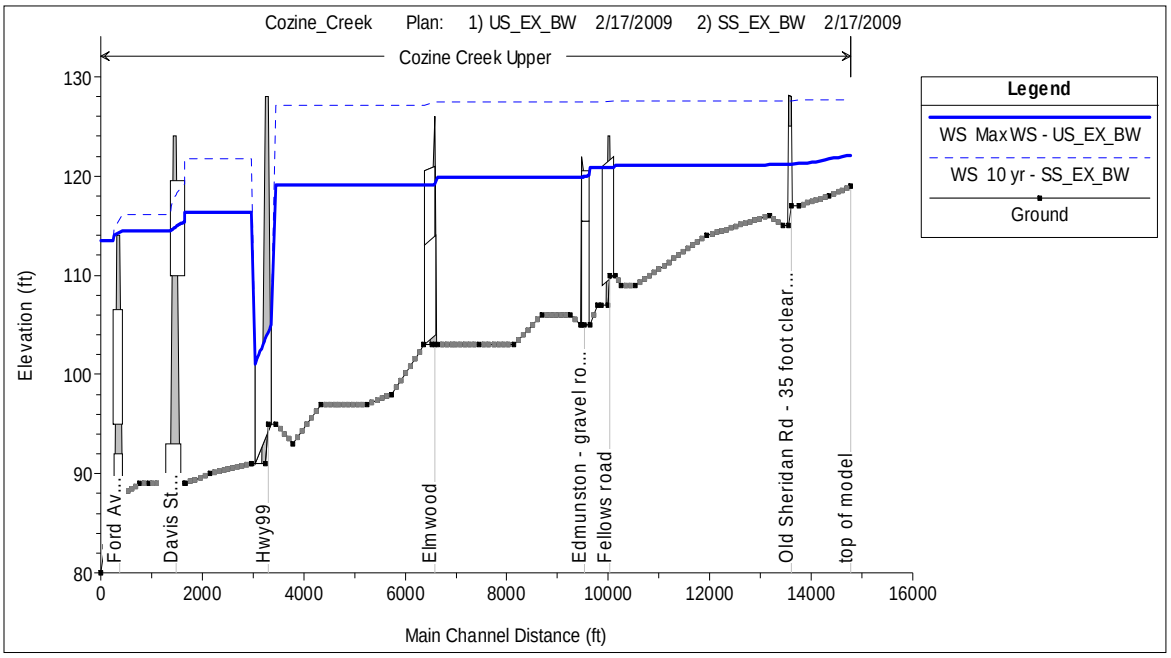


FIGURE 7-2
Comparison of 10-Year Maximum Water Surface Elevation Profiles Between Steady-State and Dynamic
The blue dashed line represents the steady-state 10-year water surface profile and the solid blue line represents the 10-year maximum water surface profile from the dynamic (unsteady) model.

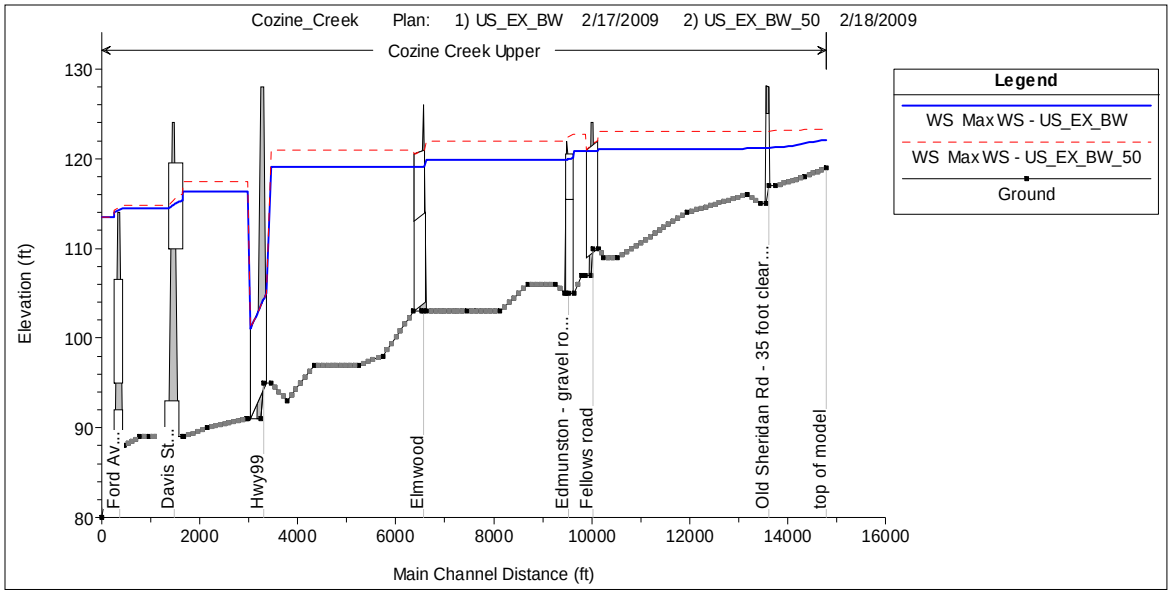


FIGURE 7-3
Comparison Between 10-Year and 50-Year Maximum Water Surface Profiles
The red dashed line represents the 50-year water-surface elevation profile and the blue solid line represents the 10-year water-surface elevation profile from the dynamic (unsteady) model.

Hydraulic analysis of the storm drainage system in the Cozine Basin shows several problem areas and one that is recommended as a capital improvement project based on additional risk factors.

The 12-inch storm drain system on Linfield Avenue from Baker Street to Melrose Avenue has a hydraulic deficiency risk level of medium to high during the 10-year design event for both the existing and future condition.

Results from the hydraulic analysis also show that the 24-inch pipe system running down Brockwood Avenue to Edmunston Street and down Drumwood Avenue to have a high deficiency rating.

The 12-inch storm drain system in Hilary Street from Clifton Court to Hilary Court was identified as having a high risk of hydraulic deficiency during the 10-year design event for both the existing and future condition.

The 12-inch storm system in Davis is likely deficient. This small pipe system drains a relatively large area and flooding could be further impacted due to elevated river levels at the outlet. Any additional development in the Linfield College area that would discharge through either of these storm drains would increase the potential for flooding in this area.

7.1.3 Potential Projects

There are no obvious opportunities for diverting flow to relieve the above listed capacity problems. Therefore, only pipe upsizing solutions are recommended for this basin.

- **Linfield Avenue from Baker St. to Melrose Ave.:** This is a small drainage system that appears to drain a relatively large area. The system is composed of 650 feet of 12-inch

storm drain. Any additional development in the Linfield College area that increases runoff to the local drainage basin will aggravate the potential for flooding in this area.

7.1.4 Additional Requirements and Comments

Much of the land near Cozine Creek lies within the regulatory floodplain. Fills below the regulatory floodplain should not be permitted and native vegetation along Cozine Creek should be protected below this elevation. These low-lying areas will provide natural detention for future upstream development and the non-disturbance of natural vegetation will minimize the potential for bank erosion. Where fills below this elevation are essential for the economic development of a site, compensating excavation should be required to provide for equivalent stormwater storage.

7.2 West Cozine Creek Basin

7.2.1 General Description

The original drainage patterns of this basin are indistinct and developed flows have tended to follow pipe networks rather than any small differences in original ground slope. As a result, the recent developments in this area have directed their flows northward and eastward into West Cozine Creek.

This land is zoned for residential development. Residential developments in this basin have progressed rapidly over recent years. Many of the associated private stormwater systems include stormwater detention facilities that serve to attenuate peak flows when properly maintained.

This basin includes several rapidly growing residential areas in the vicinity of Cypress Street. These areas included the mobile home park along Hickory Street, the residential areas along the northern end of Fleishauer Lane, and the residentially zoned meadows and other open lands including the flat meadow land south of Tamarack Street.

The West Tributary of Cozine Creek runs through this area. The West Tributary is a shallow, free-flowing stream that deepens east of Fleishauer Lane towards its confluence with the main stem of Cozine Creek. West Cozine Creek originates in the higher ground west of Hill Road, flows through a 30-inch pipe in West 2nd Street, which discharges into the low meadow lands near Westvale Street. This open channel flow is collected into a 24-inch pipe, which runs under a series of detention ponds. When the 24-inch pipe reaches capacity, excess flow fills the series of detention ponds and reportedly frequently overtops Cypress Street. Overtopping flows combine with flows from the 24-inch pipe just east of Cypress Street, then flow through an open channel which flows through the Russ Lane and Dorothy Street neighborhood before crossing Fleishauer Lane and then discharging to Cozine Creek. The area south of West 2nd Street, and east of Hill Road, is flat and low-lying relative to the creek. Fills have been placed to raise the residential developments and achieve drainage.

The mobile home park along Hickory Street and the surrounding areas drain to a recently installed 36-inch pipe that runs from 2nd Street to Wright Street and eventually discharges to West Cozine Creek. An overflow diversion to the Hickory Street area storm drains has

recently been constructed. It diverts some water from the intersection of Fenton Street and West 2nd Streets to Fleishauer Lane.

Figure 7-4 provides an outline of the West Cozine Creek Basin.

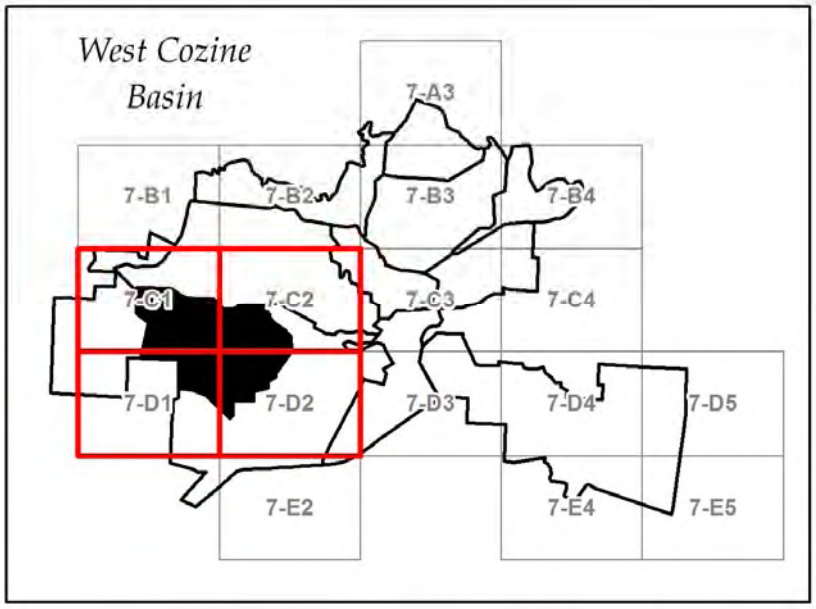


FIGURE 7-4
West Cozine Creek Basin

7.2.2 Problem Areas

A number of problem areas in the West Cozine Basin have been identified. The problems are expected to become more serious as lands continue to develop and if the network of detention facilities (mostly private) in this basin is not adequately maintained.

Cypress Street is reported to flood several times per year. Descriptions of past flooding indicate that water from upstream detention ponds overtop and flow across Cypress Street. Flooding conditions are compounded by the thick vegetation in the channel downstream of Cypress Street, which reduces the hydraulic capacity. The constructed channel is nearly half full with sediment from years of accumulation and is clogged with thick vegetation (primarily grass). The accumulation of sediment has created a pond that holds water nearly year-round; the ponded water nearly submerges the inlet at all times, even when there is little to no flow in the channel. Maintenance staff have reported frequent flooding at this location. The location should be considered high priority.

Another problem area exists where West Cozine Creek flows through residential yards in the Russ Lane and Dorothy Street vicinity. Two houses (one midway on the north side of Russ Lane, the other on the southwest corner of Dorothy Street and Fleishauer Lane) are situated on particularly low ground. These residences are expected to be substantially flooded by the existing 25-year and future 10-year events. Heavy vegetative growth and encroaching fills in the creek through this residential areas further raises the water surface elevation. It would be difficult for the City to maintain the vegetation in this creek segment because of lack of access.

Further upstream, west of Cypress Street, the storm drains in both Sesame and Tamarack Streets will carry the existing 5-year event but only the future 2-year event. In general, as additional development takes place in these meadow areas, the resulting reduction in flood storage area will further impact the Russ Lane area.

The sloping areas west of Hill Road drain to a ditch along the west side of Hill Road and enter a 30-inch storm drain that runs eastward along West 2nd Street and discharges into the meadow area west of Filbert Street. This existing pipe is adequate for the existing 2-year event but very inadequate for the future 2-year event.

Another problem area is along the lower end on Hickory Street through the trailer park where the existing storm drain is inadequate for the existing 2-year event.

The 30-inch to 36-inch drainage line in West 2nd from Hill Road to Meadow Dr. is likely deficient. This project was previously identified as a capital improvement project.

Hydraulic analysis shows that the 15-inch storm pipe in Tamarack from Filbert St. downstream is deficient during the design storm. Only several pipes were evaluated in this portion of the system but the deficiencies were quite large which indicates that the rest of the system downstream may also be hydraulically deficient.

The 12-inch drainage system in Sesame St. between Filbert St. and Cypress St. is shown to be hydraulically deficient during the existing 10-year design storm, although, stormwater detention facilities likely relieve flooding in this area.

7.2.3 Potential Projects

- **West Cozine Channel Maintenance from Cypress Street to Agee Street**: The accumulated sediment should be removed and the channel reconstructed with a low flow channel to maintain higher flow velocities to discourage sediment deposition. The 24-inch storm line that feeds into this channel on the upstream side of Cypress Street should be upsized to reduce the frequency of flooding at Cypress Street. Upstream sediment traps may also alleviate some of the problem.

- Install a West 2nd Street Parallel Storm Drain. The intent of this system is to supplement the existing, deficient 30-inch storm drain in West 2nd Street. The existing storm drain is located outside the curb on the north side of West 2nd Street. With the church, residential landscaping, and other utilities along this corridor, it appears that the south side of the road offers a better alignment.

  To minimize costs it is recommended that the existing storm drain be left in place and that a new parallel storm drain be installed to assist in draining the ditch along the west side of Hill Street. The new storm drain would run outside the curb along the south side of West 2nd Street to Westvale, then south on Westvale, and discharge into an existing stream channel at the east end of Manzanita Street.

  As part of this project, the existing pipes in Tamarack Lane and in Sesame Street would be off-loaded by the addition of bypass pipes into the greenway swale. From Sesame Street, the alignment would be down Ponderosa Court and then along an existing walking trail to the greenway. From Tamarack, the alignment would be in the vicinity of

Dogwood Lane northward to the greenway. Both pipes would connect to the existing 24-inch storm drain that runs under the greenway area.

7.2.4 Additional Requirements

- The flow through the Russ Lane area could be improved by vegetative maintenance on the part of adjacent property owners and by not extending fill into the creek channel.
- Any development in the W-10R Sub-Basin west of the existing development in Donahoo Street should discharge stormwater directly to West 2nd Street rather than into the Donahoo Street pipe. The West 2nd Street storm drain west of Donahoo Street will need to be replaced when this additional development occurs.
- Any further development west of Westvale should be discharged directly into the creek/greenway system rather than into the Tamarack Lane storm drain.
- Any further development along the south side of West 2nd Street between Westvale Lane and Hill Road and at the end on Manzanita Street should provide for the granting of easement or right-of-way for the future parallel storm drain.
- Where possible, storm drainage flows should be directed southward into the main stern of Cozine Creek rather than northward along Cypress Street.
- All future development in this basin should include detention facilities to ensure those downstream flooding problems do not become worse. If retention facilities are not included in future developments or existing detention facilities are not properly maintained, and become non-functional, downstream flooding conditions will become more severe and occur more frequently.

7.3 North Cozine Creek Basin

7.3.1 General Description

North Cozine Creek is the largest basin and includes the downtown core area. This area is quite flat with some general sloping towards the west and southwest. The discharge from the storm sewers in this sub-basin is to the North Tributary of Cozine Creek or to Cozine Creek itself in the lower portions of this basin.

The lower portion of this basin is completely developed with the downtown commercial areas along Adams and Baker Streets and from 1st to 5th Streets. The drainage within this area is almost entirely piped. Some additional development is expected as sites are upgraded from residential to commercial and as some in-filling takes place.

The land to the north of the North Cozine Creek and north of downtown is existing residential development. The flow direction in this area is generally from Baker Road southward towards North Cozine Creek. Most of this area is quite flat with ground slopes being mostly less than 1 percent. The existing storm drain that serves Michelbook Lane north of 17th Street leaves the public right-of-way to flow by storm drain through the Michelbook County Club, then across 11th Street and through a landscaped multi-family residential development before discharging into a small tributary of North Cozine Creek.

The institutional center of McMinnville lies at the southwest corner of this sub-basin group with City Hall, the Fire Station, Library, Park and Aquatic Center all located in this area.

To the east, the Elm Street storm drain collects piped flows from adjacent streets and flows southward. Elm Street terminates at 10th Street, but the storm drain continues southward, apparently under the garage located at the south end of Elm Street and under the garage on the north side of 9th Street. This pipe is shown to continue southward through private properties to an outfall into North Cozine Creek.

The upper sub-basins drain the Michelbook Golf Course, the Doral Street area north of the golf course, and the Wallace Road area west of the 11th Street intersection. North Cozine Creek runs through the golf course from northwest to southeast. North Cozine Creek flows through a weir-controlled pond within the golf course. The size of the circular weir and the discharge pipe downstream from the outflow weir are too large to force detention in the pond; they act simply to maintain constant water elevations in the pond.

Residential development has been occurring around the edges of the golf course over recent years, and the rate of development in this area is expected to continue. A significant amount of undeveloped land upstream of the golf course could be developed in the near future. Stormwater detention implemented on future development projects in this area will help maintain peak flows at their current level.

Figure 7-5 provides an outline of the North Cozine Creek Basin.

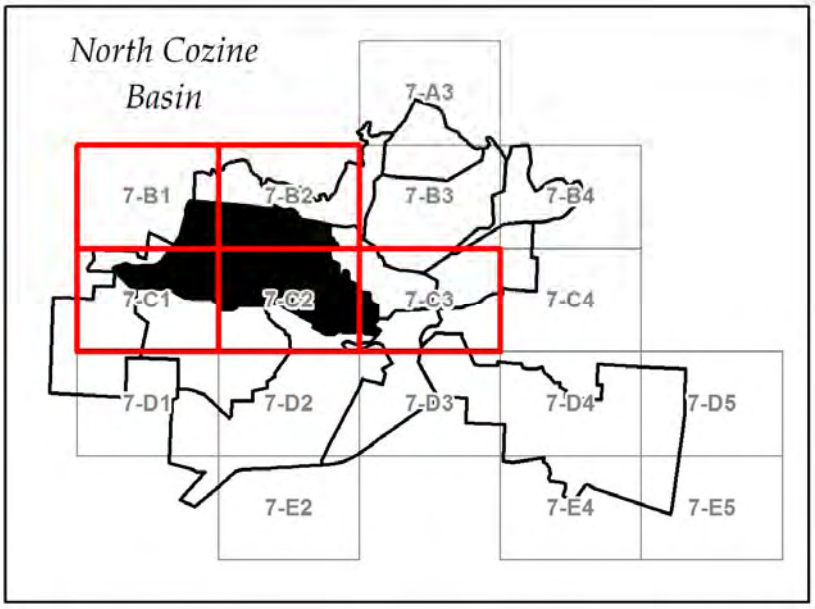


FIGURE 7-5
North Cozine Creek Basin

7.3.2 Problem Areas

Hydraulic analysis shows that a number of storm drain pipes are undersized in the downtown and urban residential areas that they serve. There are three capital improvement projects recommended in this basin.

The storm drain pipe in 1st Street appears to be undersized from Ford Street westward.

The storm drain pipe in 4th Street is also inadequate for both the existing and future 2-year events for the reach west of Davis Street. This storm drain is routed through the roadway located just north of the Aquatic Center.

Another problem area is caused by the storm drain in 7th Street, which appears to follow an old drainageway through backyards lying southwestward of the corner at Birch and 6th Streets and also through the yards to the southwest of the intersection of 6th and Birch. This storm drain, which originates in 7th Street, is adequate, westward of Davis Street, for only the existing and future 2-year events.

The storm drain in 9th Street between Davis and Baker Streets is adequate for the existing 5-year event, but only adequate for the future 2-year event. There may be sufficient slope along Cedar Street to allow gutter flow to carry the runoff that cannot enter the storm drain.

Finally, the storm drain in Cedar Street is undersized southward from 10th Street to its outfall into the North Fork of Cozine Creek.

Michelbook Lane suffers from regular ponding of runoff. The capacity of the Michelbook storm drain above 17th Street is insufficient for the existing 2-year event. This fact, when combined with an elevated hydraulic grade line in the downstream storm drain through the golf course and the very flat street grades, creates these frequent ponding problems. The presence of root damage in this pipe has also contributed to the frequency of flooding. Maintenance staff have cleared the root obstructions in this pipe and report that flooding has been reduced as a result. Continued maintenance may be sufficient to maintain capacity through this system. The reconstruction of the downstream storm drain through the golf course would disturb golf course operations. South of 11th Street, the pipe slopes increase enough that the capacity is adequate for the 10-year event.

Many of the storm drains in the Elm Street area are sufficient only for the existing 2-year event. Some do not even have a 2-year capacity. More specifically, Elm Street south of 18th Street is capable of carrying only the existing and future 2-year events. The storm drainage system across the Memorial Playground between Elm Street and Birch Street is undersized for the existing 2-year event. Birch Street drainage between 19th and 16th Streets is also not capable of conveying the existing 2-year event. Another problem is that the Elm Street storm drain south of 10th Street is inaccessible for maintenance.

Storm drainage for 12th Street between Thompson Lane and Cedar Street is inadequate for the 2-year event, but slopes sufficiently from both directions towards Elm Street that excess gutter flow over these short reaches is probably tolerable.

The Wallace Road storm drain is placed outside the curb lines of the road and is elevated to the extent that the crown of the pipe can be seen above ground level. The creek that discharges into this pipe is directed into the pipe by a berm at the end of Wallace Road. If this storm drain is surcharged by heavy inflows from the creek, water will flow out of the catch basins in Wallace Road because the catch basins lie at a lower elevation than the pipe itself. When the pipe flows only partially full, then this problem is not evident. City staff have not observed flooding at this location so no action is recommended at this time although continued monitoring may be prudent.

The storm drains in 8th Street for one block east of Hickory Street and in 9th Court between Hickory Street and Wallace Road are inadequate for the existing or future 2-year events.

The sub-basins (N-50, N-30L1, and N-30L2), which lie west of and upstream of the golf course and Wallace Road, are zoned for residential uses and will substantially impact downstream drainage facilities unless detention is provided in these upstream areas.

The 12- to 14-inch pipe system draining 1st Avenue from Adams to Evans appears deficient and likely causes frequent flooding in this high use commercial area adjacent to downtown. This system was also previously identified as a recommended capital improvement. (See Figure 7-C2 in the Hydraulic Analysis figure series at the end of this section.)

7.3.3 Potential Projects

- **4th St. from Birch St. to Davis St.**: Downtown, there are few alternatives for system improvements besides increasing the pipe diameter. To accommodate the 10-year future event, the 4th Street storm drain should be enlarged west of Davis Street.
- **1st St. from Adams St. to Evans St.:** Hydraulic analysis indicates that the existing 12- to 14-inch storm drain in 1st Street is severely deficient. Since this is a high use public area in the vicinity of downtown, this project should be considered a high priority.
- **Elm Street System Improvements**: The residential area north of downtown includes the largest concentration of problem spots
- Hydraulic analysis shows a number of deficient pipes in Wallace Road and Oakmont Court, although, City staff have not observed the predicting flooding problems at this location. If continued monitoring confirms that this is not a problem site, then no action is needed. If problems are confirmed by field observation, the solution required to eliminate the surcharge problem in Wallace Road is to install a new pipe at a deeper elevation with the pipe crown at least 2.5 feet below adjacent Wallace Road catch basin rims. There is a sharp increase in the slope of the existing pipe near 11th Street. The pipe will need to be replaced from the west end of Wallace Road to a point near 11th Street where the existing pipe can be intercepted at a sufficiently deep elevation. The existing alignment would remain the same. The parallel 15-inch pipe would be abandoned since the reinstalled pipe would be deep enough to pick up the flow from 9th Court at Wallace Road.
- To off-load the pipe system near 9th Court south of Wallace Road, a bypass pipe along Hickory Street between 8th Street and 9th Court would be constructed and the existing pipe in 9th Court between Hickory Street and Wallace Road would be replaced.

7.3.4 Additional Requirements

If any of the above roads are re-surfaced or reconstructed before the suggested phasing schedule, the pipe replacement should be considered.

The catch basins at the intersection of Elm and 12th Streets should be designed with sufficient additional capacity to accommodate the excess gutter flow approaching from both directions on 12th Street.

Development projects in sub-basins N-50, N-30L1, and N-30L2, which are larger than 4 acres and which will create impervious areas greater than 20 percent as measured at full build-out of the constructed phase, should provide for detention of stormwater. Detention facilities should detain peak flows so that the peak flow from the 10-year storm after development is not more than the peak runoff from the 10-year existing flow from the site.

7.4 Midtown Basin

7.4.1 General Description

This basin drains through the treatment plant in a 48-inch pipe that discharges directly into the South Yamhill River. It drains an area that includes the mobile home park just upstream of the treatment plant, the industrial Alpine Avenue area, the residential areas south of the High School, most of the high school, and the Highway 99W area between 14th and 20th Streets.

Nearly all of this area is developed, although there is some potential for infilling and intensification of land use. Most of the area is quite flat with only the southeast of the railroad tracks showing increasing slope through the mobile home park and the treatment plant.

Figure 7-6 provides an outline of the Midtown Basin.

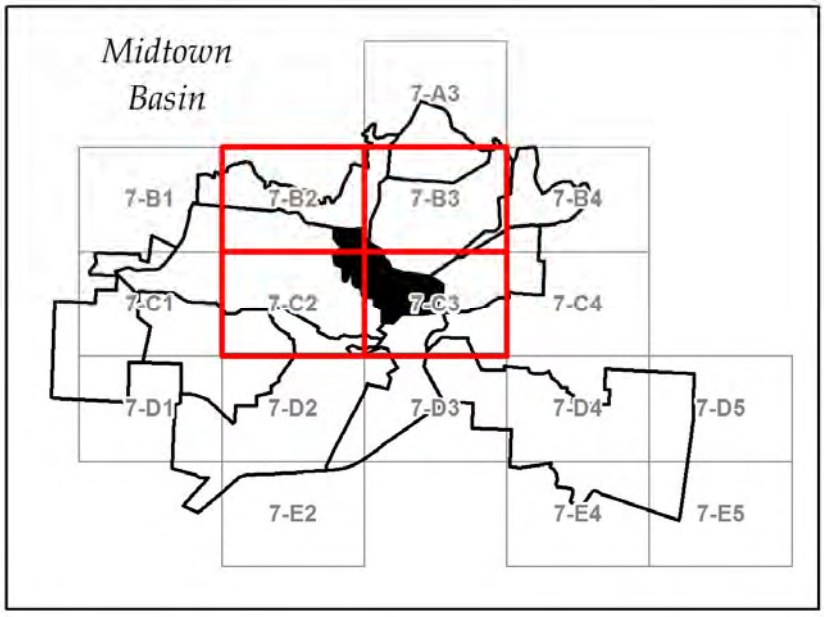


FIGURE 7-6
Midtown Basin

7.4.2 Problem Areas

The storm drain in Adams Street between 16th and 19th Streets is inadequate for the existing 10-year event.

The storm drain along Galloway Street that drains the main high school area is hydraulically deficient for the existing 2-year event. Routine flooding currently occurs in the vicinity of 15th Street, and the depressed intersection at 17th Street and Galloway Street will be periodically flooded. The current storm drain alignment through the high school appears to have been built over with some temporary structures on the east side of the high school.

The storm drain along 12th Street is very flat and is estimated to have the capacity to carry only the existing but not the future 2-year event. This storm drain is a problem between Galloway Street and Alpine Avenue. Its replacement would be complicated by the alignment through private property near Kirby Street, by the railroad tracks, and by the cost to replace such a long length of large diameter pipe.

The storm drain in Alpine Avenue is inadequate to handle the existing 5-year or future 2-year events between 7th and 12th Streets.

The existing 48-inch pipe through the treatment plant is inadequate to handle the existing 2-year event and periodic flooding results from the combination of stormwater from the Midtown Basin and from the effluent discharge, which is also carried by this pipe. This pipe may have been replaced when Lafayette Avenue was improved. This size and condition of this pipe should be verified.

7.4.3 Potential Projects

- **Galloway Street from 13th to 17th:** The storm drain along Galloway Street between 17th and 12th Streets will need to be replaced. A suggested alignment through the high school area is from 17th Street southward through the playing fields just east of the developed area, past the northeast corner of the tennis courts, through the student parking lot, and then southward along Galloway Street. The increased pipe capacity when combined with the reduced flow in the 12th Street storm drain due to the Adams and Baker Street diversion will significantly reduce the flooding potential near the high school. City staff believe a parallel system may have been installed which is not shown on the current mapping. If a parallel system has been installed, the above-mentioned flooding problems may have been relieved. Field investigation at this location could confirm whether a parallel system has been installed.

- **Alpine Street from 7th to 12th:** This industrial area may continue to add impervious surfaces. Currently, many of the-yards are gravel. The existing pipe is inadequate for future 2-year event and will require replacement between 8th and 12th Avenues.

- The treatment plant storm drain is currently inadequate. It may be possible to solve the problem by diverting upstream flows from sub-basin M-40 (Adams and Baker Street) to North Cozine but the grades need to be verified. Continued stormwater separation in the area of combined sewers will also help relieve this line. Since this pipe is an old brick pipe, its condition could be quite poor and could reduce its capacity. If this conduit is irregular because of sidewall failure, or is otherwise less than 48 inches in effective diameter, replacement is warranted.

- The problems with the storm drain capacity in the Adams and Baker Street areas can be corrected by upsizing deficient pipes. There may be an opportunity to divert flow into the North Cozine Basin at 19th Street. This would help to relieve the downstream

capacity problems along 12th Street between Galloway and Alpine Streets; however, the Elm Street storm system would need to be sized to handle these additional flows.

7.4.4 Additional Requirements

None.

7.5 Baker Creek Basin

7.5.1 General Description

This basin drains the area from Baker Creek Road north to Baker Creek between Michelbook Lane and Evans Street approximately. This area is residential and is largely developed.

The drainage system consists of storm drains running down to the creek along road alignments with the major system discharging into Baker Creek from Baker Street between 25th and 27th Streets.

Figure 7-7 provides an outline of the Baker Creek Basin.

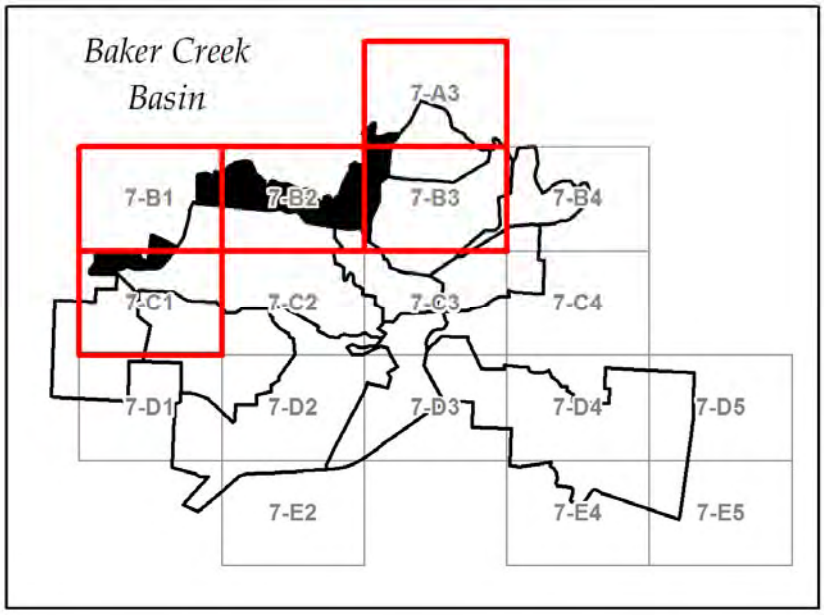


FIGURE 7-7
Baker Creek Basin

7.5.2 Problem Areas

Hydraulic analysis shows only minor deficiencies in the Baker Creek basin. The only potential problem area is the storm drain in Baker Creek Road between Birch and Baker Streets and in Baker Street between Baker Creek Road and the discharge point into Baker Creek. This piped system is adequate for the existing 10-year storm but Baker Street outfall is shown to be highly deficient which could cause flow to back-up and lead to surface street flooding.

7.5.3 Potential Projects

No projects are recommended in this basin.

7.5.4 Additional Requirements

Monitor the low point in Baker Street where overflow to the creek will occur to a somewhat greater degree over the years. Check for excessive erosion along the overflow path from Baker Street to the creek.

7.6 Highway Basin

7.6.1 General Description

This sub-basin drains the Highway 99W areas east of Evans to Doran. This area includes extensive commercial areas on the south side of the highway and parts of the County Fairgrounds. Recent residential development has occurred and is expected to continue in the areas to the north of Highway 99W. The creek that drains this sub-basin discharges directly to the North Yamhill River.

North of 27th Street, the flow is routed by pipe to a creek that flows eastward. This system is adequate for both existing and future flows.

All basins upstream of Sub-Basin H-30 flow through Wortman Park and through the landscaped areas of the Hollow Brook Apartments.

There is a private driveway at the outfall of sub-basin H-10 which may be inundated during heavier storm events, but the capacity of this crossing will have no effect on upstream drainageway hydraulics because even the water elevation required to top the private drive is lower than that which will impact development south of Highway 99W.

The creek is well defined through this sub-basin group and there are no apparent capacity problems.

Figure 7-8 provides an outline of the Highway Basin.

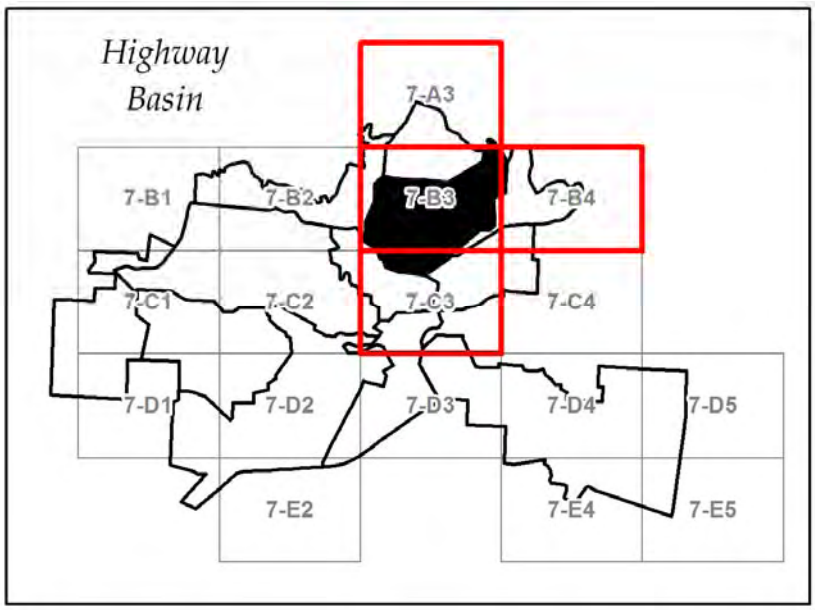


FIGURE 7-8
Highway Basin

7.6.2 Problem Areas

The hydraulic analysis shows the storm drain in McDaniel Street between 19th Street and its outfall into Wortman Park to be deficient, although, City staff reported that a diversion was constructed at 18th Street in 1999, which has likely relived the flooding problem at this location.

The pipe segments along McDonald Street between 17th and 18th Streets and then along 18th Street between McDonald and McDaniel Lane are adequate for the existing 5-year but only the future 2-year events.

7.6.3 Potential Projects

- The existing pipes in McDonald Street between 17th and 18th Streets and between 21st Street and the "tee" manhole south of Highway 99W would be replaced.

7.6.4 Additional Requirements

Verify that a diversion has been constructed to relieve flooding in McDaniel Street storm system between 19th Street and its outfall into Wortman Park.

7.7 South Yamhill Basin

7.7.1 General Description

This area includes the emerging industrial land in the Riverside Drive area southeast of the railroad. The area is predominately open space at this time and is generally quite flat. The SY-A basins discharge eastward to the South Yamhill River. The SY-C basins flow southwestward and discharge through the treatment plant area to the adjacent creek. The South Yamhill River to the south borders most of the area.

Linfield College and Hewlett Packard are also included in this basin. It is bounded on the south by Salmon River Highway, on the north by Storey Street, and on the east by the South Yamhill River. This area discharges directly to the river. The area is generally residential in areas closer to the river and generally undeveloped along the west and southwest portions of the sub-basin group. Some of these undeveloped lands are owned by the college and may remain open for the indefinite future.

The area around Naomi Street drains through a storm drain along an alignment that runs parallel to Naomi Street through private parcels. This pipe is inadequate for the existing and future 5-year events. East of Villard Street this alignment is inaccessible.

The storm drain serving the SY-E sub-basin flows northward in the newly reconstructed Cleveland Avenue and then ultimately discharges into the South Yamhill River.

The residential area further to the east is served by a storm drain system that discharges to a ditch running northeastward along the Salmon River Highway

There is a combined sewer area between 5th and Brooks Streets in the east side of the downtown area. The main area of combined sewers lies between Irvine and Macy Streets with a smaller section extending westward along Washington Street. This area is mostly developed with downtown commercial and older residential neighborhoods. The sanitary component of flow was not included in the updated hydrologic analysis. Recommendations to address combined sewer capacity needs, if any, are addressed in the Water Reclamation Facility Plan (October 2008).

Figure 7-9 provides an outline of the South Yamhill Basin.

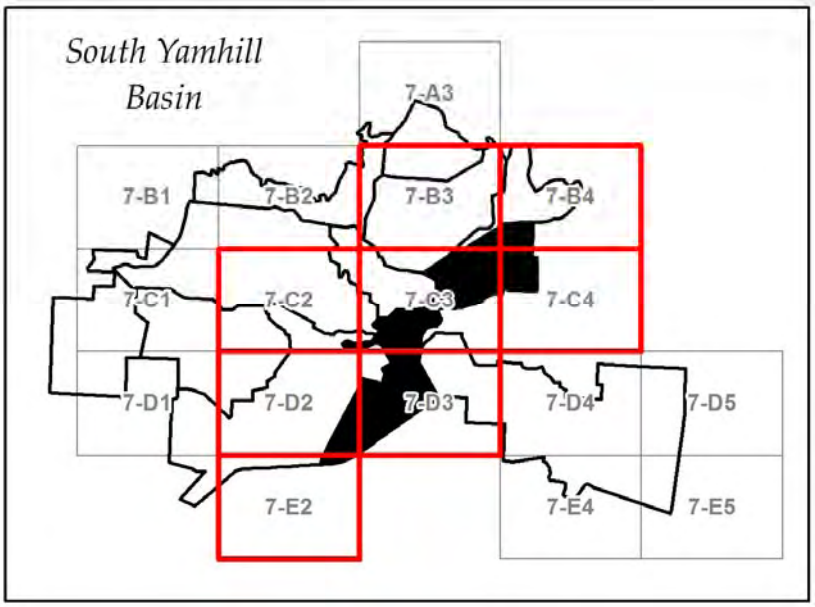


FIGURE 7-9
South Yamhill Basin

7.7.2 Problem Areas

The storm drain in the easterly end of Riverside Drive has moderate deficiencies during the 10-year event and could benefit from a diversion into the South Yamhill River.

The sewer in Washington Street is adequate for stormwater flows. The sewer in Irvine Street is inadequate for 2-year existing flows, and the sewer in Macy Street is inadequate for 5-year events.

The Naomi Street area experiences regular ponding on Villard Street just south of Naomi Street. This is caused by insufficient capacity in the pipe, particularly east of Villard Street. This undersized segment runs through heavily landscaped private property and is considered inaccessible. The pipe segment in Rummel Street is undersized for the 5-year event.

The Cleveland Street storm drain is sized only for the existing 5-year and is undersized for the future 2-year event. Since this street was recently re-constructed, other alternatives to relieve this problem area would be attractive.

Hydraulic analysis shows a number of deficiencies between Rummel Street and Villard Street during the 10-year design event.

7.7.3 Potential Projects

- The storm drain in Riverside Drive could be diverted from a point about 600 feet west of Miller Street directly into the South Yamhill River. The intent of this improvement would be to offload the existing storm drain in Riverside Drive to the extent that the remainder of the pipe would be adequate for both existing and future flows.
- Replace Naomi Street Bypass and Storm Drain. This storm drain would relieve the flows between Rummel Street and Villard Street and would drain the low area on Villard Street just south of Naomi Street. A pipe would be constructed along Naomi Street between Rummel Street and the outfall at the east end on Naomi Street. The existing alignment through the private development at the east end of Naomi Street is suitable for construction. A bypass pipe from the low spot where the existing storm drain crosses Villard Street would connect this spot to the proposed storm drain in Naomi Street. Grades should be reviewed to ensure this is a feasible project.
- One option that would help relieve the flooding in Cleveland St. would be to replace the Morgan Lane storm drain. This storm drain would be constructed along Morgan Lane between Davis and Villard Streets to accommodate flows generated along Morgan Lane and to relieve future flows in Cleveland Street. There is potential for a bypass in Morgan Lane, which would relieve the storm drain in Cleveland Street.

7.7.4 Additional Requirements

An easement for the new outfall from Riverside Drive will be required. An easement for the new outfall for the Logan and Macy Street storm drainage alignment will be required.

Storm runoff from the currently undeveloped lands at the southwest corner of the sub-basin group, i.e., west of Davis Street and south of Border Lane, should be directed to the ditch

along the Salmon River Highway and not into the existing storm drainage system in the Alethea Way area.

7.8 North Yamhill Basin

7.8.1 General Description

This is a relatively small basin with very little public infrastructure. The basin drains the northeast corner of the City split by Highway 99. The area south of Highway 99 is developed industrial land, which is assumed to have a private stormwater system that is not shown on the current mapping. The land to the north of Highway 99 is currently undeveloped farm land.

Figure 7-10 provides an outline of the North Yamhill Basin.

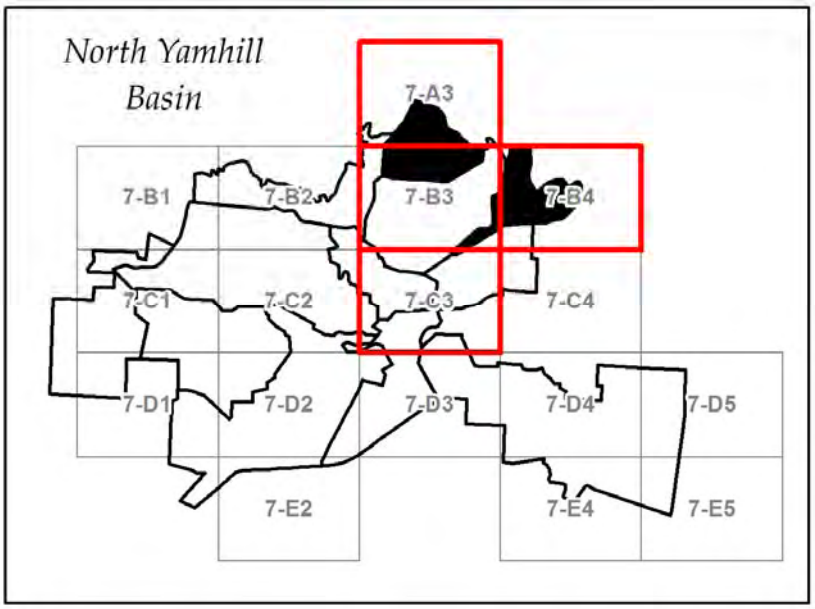


FIGURE 7-10
North Yamhill Basin

7.8.2 Problem Areas

There are no current problems in this basin. If development occurs on the undeveloped farmland, flows should be detained to the extent practical before discharging to the North Yamhill River.

7.8.3 Potential Projects

None needed.

7.8.4 Additional Requirements

Do not allow fill in the North Yamhill regulatory floodplain.

7.9 East End Basin

7.9.1 General Description

This basin includes the generally open lands within the UGB between Dunn Place and the McMinnville Airport. These lands are mostly flat with some gentle relief for drainage-ways. The area is currently farmed or open space, except for three developments on the north side of Three Mile Lane. These developments have piped storm drainage systems, which flow north and discharge into the South Yamhill River.

This basin includes the McMinnville Municipal Airport. The area is largely established, but some additional development is expected. The existing drainage system for the runway and taxiway areas is insufficient for the 10-year event, but adequate for both the existing and future 2-year event. The southwest portion of the airfields discharges directly to the South Yamhill River via a creek (Sub-basins E-N0 and E-N10). The remainder of the area discharges to a creek or ditch that flows westward from the main terminal area.

Figure 7-11 provides an outline of the East End Basin.

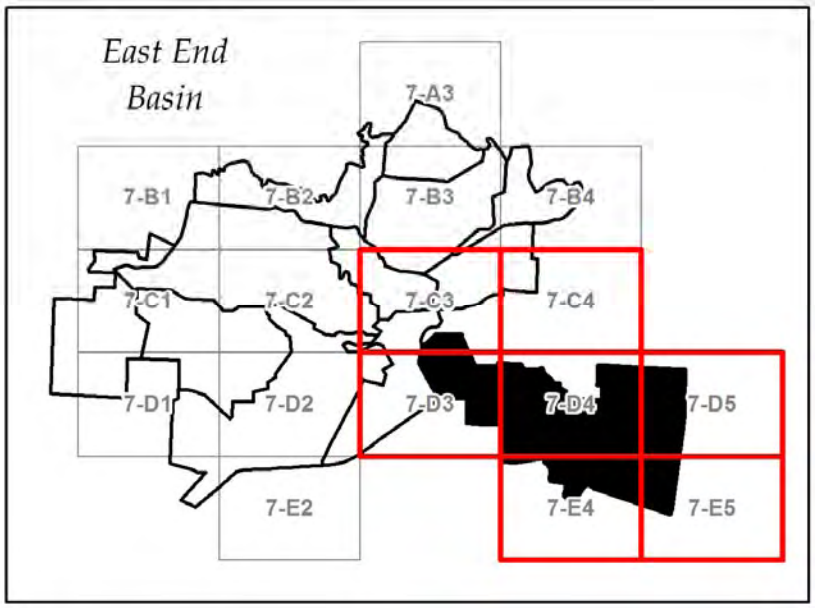


FIGURE 7-11
East End Basin

7.9.2 Problem Areas

Both existing piped systems are adequate only for the existing 5-year and future 2-year events.

The 2-year capacity of the airfield pipes is considered adequate because of the low risk of flooding. Any excess water would tend to accumulate within the infield areas between the runways until the storm subsides. The piped system through the apron area adjacent to the main terminal is only barely adequate for the 5-year future event even with the downstream improvement recommended below.

The existing 30-inch outlet, lying at the west end of the terminal through which most of the airport runoff passes, is inadequate for the existing 5-year and future 2-year events. Without improvement, this pipe will cause flooding both in the main terminal area and on the runway.

7.9.3 Potential Projects

- Monitor the existing 30-inch pipe leaving the main terminal area. If frequent flooding is observed, this pipe would need to be upsized (approximately length of 250 linear feet).

7.9.4 Additional Requirements

No additional flows should be permitted to be directed into the existing storm drainage systems in the two development areas north of Three Mile Lane. Any additional flows in these areas should be routed in another pipe or open channel system.

Monitor the ponding during heavy storms around the apron areas of the airport.

7.10 Private Development Drainage Facilities

Other drainage facilities will be needed within developments that occur on the fringes of existing development. These additional facilities are typically provided by the developer as part of the development's infrastructure and are either kept as private drainage facilities or are constructed to City standards and turned over to the City upon acceptance of the construction by the City. It is not the intent of this plan to place restrictions on the alignment of drainage facilities within these currently undeveloped lands, except as specifically provided for in this plan.

Section 6 provides a methodology to estimate the peak flows of catchment areas that are smaller than sub-basins. Drainage facilities will be planned for these outlying areas as part of the City's normal site design review process. These facilities should have the capacities necessary to handle the flows estimated by this master plan and should provide for continuity of existing drainageways. In some areas, some additional restrictions are imposed; these are described above in each basin's Additional Requirements subsection.

7.11 Stormwater Detention Considerations

Stormwater detention is an effective tool for limiting the increase in peak runoff resulting from continued urbanization. The location of these facilities within a watershed has a significant impact on their effectiveness at reducing peak flows in the receiving waters. The impact of detention facilities within a system is dependant on the timing of peak flows in relation to the timing of adjacent and downstream systems. Therefore, a routing and storage model is needed to assess the impacts and benefits of detention. However, there are applications where the benefit is clear. For example, detention facilities located high in the basin can provide peak flow relief for the entire downstream system, ensuring that peak flooding conditions are not worsened as a result of upstream development. Whereas a detention facility located in the middle or lower reaches of a basin may actually compound the peak runoff of adjacent or downstream systems, causing worsened flood conditions in

the receiving waters. Because of the backwater effects from the Yamhill River and Cozine Creek (and its tributaries), this negative impact is a real concern for the City. A more detailed look at timing effects is recommended before pursuing detention storage as a strategy to reduce capital improvement cost.

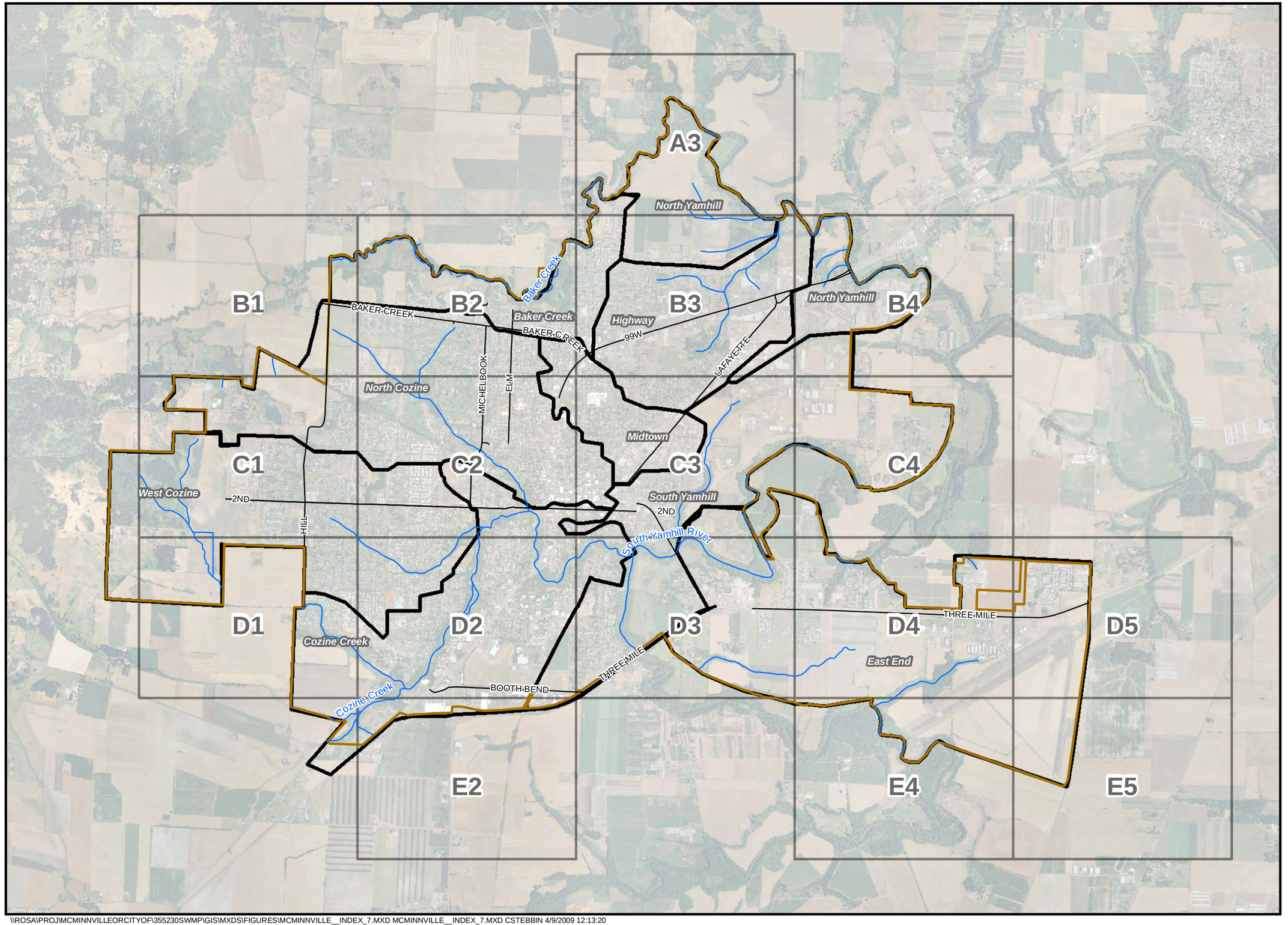
For the purpose of the master planning analysis, the effects of future stormwater detention were ignored in the hydrologic and hydraulic analysis.

Stormwater detention is most critical in the currently undeveloped headlands of West and North Cozine Creek where increased peak flows from these sub-basins would further aggravate existing downstream flooding problems. Limiting future flows by not allowing future 10-year peak flow rates to exceed existing 10-year peak flow rates would be prudent in the following sub-basins: N-30L2, N-50, and C-80R2.

FIGURE 7 - INDEX

HYDRAULIC ANALYSIS RESULTS

City of McMinnville
Stormwater Drainage Master Plan



Legend

- Major Roads
- Creek\River
- Proposed UGB
- Major Basin
- Index
- Sub-Basins

N

1 inch = 3,000 feet

Source:
City of McMinnville

CH2MHILL

Date: 4/10/2009

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