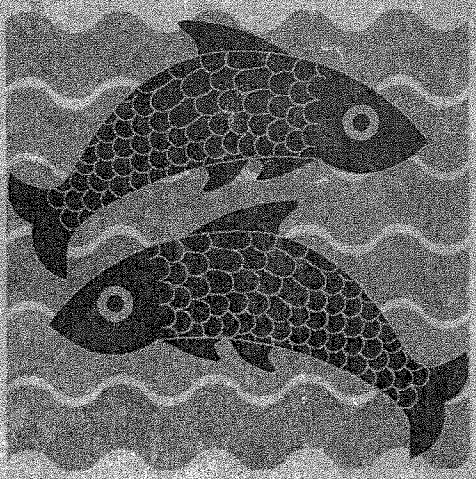

CITY OF WILLAMINA
STORMWATER MASTER PLAN

PREPARED FOR:

CITY OF WILLAMINA
411 C Street
PO Box 629
Willamina, Oregon 97396

IN COOPERATION WITH:

Mid-Willamette Valley Council of Governments
105 High Street
Salem, Oregon 97301

PREPARED BY:

H B H
Consulting Engineers

11535 SW Durham Road, Suite C6
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June 1999

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City of Willamina

Stormwater Master Plan

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City of Willamina
Stormwater Master Plan

CHAPTER 1

City of Willamina
Stormwater Master Plan
INTRODUCTION

1

1.1 SCOPE

The purpose of this study effort is to prepare a comprehensive document to be used for directing the City of Willamina's stormwater management efforts within its Urban Growth Boundary. The plan should be considered as a technical resource document to be used by City staff in their efforts to make wise stormwater management decisions.

The following scope of work was followed in the preparation of this stormwater master plan:

1. INFORMATION GATHERING

   Existing maps and field inspections were used to determine the current drainage system, including any existing problem areas.

2. EVALUATE THE EXISTING SYSTEM WITH A FOCUS ON PROBLEM AREAS IDENTIFIED BY THE CITY

   Seven existing problem areas were identified by city staff. These areas were investigated in depth. Solutions and implementation costs were developed for each of the problem areas. In addition to these seven projects, the entire city was evaluated.

3. ANALYZE AND PROJECT FUTURE STORM DRAINAGE NEEDS

   The existing stormwater system was analyzed based on the development of the current Urban Growth Boundary. Improvement projects that will allow the city to meet future needs were identified. Water quality issues were also discussed.

4. DEVELOP MAPS OF EXISTING SYSTEM AND PROPOSED IMPROVEMENTS

   Maps of the existing stormwater system were developed and are included as inserts to this study. Detailed maps were also developed for proposed drainage improvements. These figures are bound in this plan.

5. DEVELOP DESIGN STANDARDS

   Stormwater design standards were developed for the City of Willamina. These standards deal with both design and construction of stormwater drainage facilities. The design standards will act as a supplement to the City's current standards.

6. RESEARCH AND DEVELOP A CITY SYSTEMS DEVELOPMENT CHARGE ORDINANCE FOR STORM DRAINAGE

A Systems Development Charge (SDC) methodology was developed for the City of Willamina. The Capital Improvements Projects list was applied to this methodology to determine the maximum SDC which can be levied by the City of Willamina. As the existing SDC Ordinance (previously authored by HBH, Inc.) contains provisions for the addition of storm drainage, it has been included in Appendix B.

1.2 ACKNOWLEDGEMENT

On March 15, 1999, the City of Willamina retained HBH Consulting Engineers, Inc. to prepare a stormwater master plan. This study was funded by a grant administered through Mid-Willamette Valley Council of Governments. HBH wishes to thank the City Public Works staff for their effort in field identification of problems and the locating of existing piping. Without their help, this study would not have been possible.

1.3 STUDY AREA CHARACTERISTICS

The City of Willamina is located in both Yamhill and Polk Counties, approximately 15 miles west of McMinnville on the Hwy 18 Business Loop. The study area for this Stormwater Master Plan is the Urban Growth Boundary (UGB) for the City of Willamina. Drainage basins which begin outside of the UGB, but affect stormwater in the city, were also included as in the study area.

1.3.1 Topography and Landforms

The terrain within the planning area alternates between flat bottomlands to steeply sloped hillsides. There are two areas with substantial hills. In the southwest portion of the city, the Hill Drive and Pioneer Heights areas are located on the downslope of a large hilly area. The north side of the city is dominated by a large hill. The slopes in the city fall toward the South Yamhill River and Willamina Creek. Elevations range from 220 feet along the creek and river to over 400 feet in the extreme southwest corner of the city. Slopes are predominately under 10 percent, but areas of excessive slopes (over 20%) are scattered throughout the planning area.

1.3.2 Natural Drainages

The major natural drainages in the City of Willamina are Willamina Creek, which runs in an easterly direction through the center of town, and the South Yamhill River, which forms the eastern city limits.

In addition to the South Yamhill River and Willamina Creek, there are two minor natural drainages in the city. One of these runs at the west end of Pioneer and Hill Drives. The small stream runs through the new Pioneer Heights Subdivision then into Willamina Creek. The other drainage runs along Oaken Hills Drive. This crosses the state highway and runs into the South Yamhill River.

City of Willamina
Stormwater Master Plan

CHAPTER 2

City of Willamina
Stormwater Master Plan
EXISTING SYSTEM

2

2.1 HISTORY OF DRAINAGE SYSTEM

Willamina was incorporated in 1879 as a mill town. There was steady growth in the downtown corridor up to the 1950's. Many of the storm outfalls were constructed during this period. In the following years growth pushed up the surrounding slopes. Concrete circular pipe began to be used during this period. The upper reaches has pipe from 8-inch to 12-inch diameter, which was connected to pipe of similar size on the downstream portions. As development occurred, the impermeable area increased and the capacity of the trunk lines were used up in the lower portions of the system.

2.2 DESCRIPTION AND CONDITION OF EXISTING SYSTEM

The northern downtown corridor is developed with catch basins and small piping. This pipe size ranges from 8 to 12 inches in diameter. A majority of the pipe is concrete, with a mixture of bell-and-spigot and tongue-and-groove construction. The condition of the pipe in this area is fair.

Development in the vicinity of Willamina Drive installed high-density polyethylene (HDPE) in the 1990's. This pipe is in excellent condition. The drainage system along Churchman consists of concrete pipe. Cover over this bell-and-spigot pipe is not sufficient to keep the concrete from being damaged. The condition of pipe in this area is poor. When the opportunity presents itself, such as during a road reconstruction, the pipe should be lowered.

Drainage in the area of Pioneer and Hill Drives is constituted primarily of ditches with driveway culverts. Flows are routed east in ditches to James Street then to the State Highway. Ditches along the State Highway break at a grade change just east of James Street, where they are ultimately piped to Willamina Creek through 12-inch diameter pipe. The drainage facilities in this area are in adequate condition.

There is a mix of concrete and HDPE pipe north of the highway and east of Willamina High School. After the pipes cross the railroad tracks, the exact routes and pipe sizes are not known. However, the grade is flat and sediment drops out of the stormwater system in this area, causing reduced capacity. The largest pipe in the area is 24 inches at the intersection of Washington and Adams Streets. Currently, there is only one-third of the capacity remaining in this pipe due to sediment buildup.

The surface drainage in the vicinity of Yamhill Street, Water Street, and Main Street is collected in ditches along the railroad tracks. When the water levels in the river rise, the ditches back-up and are unable to take any flow. There is an 18-inch storm pipe at the north end of town, east

of the highway that discharges to a ditch close to the river. This ditch backs up into the drainage along the railroad tracks, causing some flooding in the area.

In the drainage basin west of the highway, near Oaken Hills Drive, the larger rain events result in ponding due to a restriction in the tailwater of the culvert crossing Highway 18. The pipe immediately downstream of the culvert is routed under the foundation of a residence 80 feet downstream. This pipe is undersized and cannot be accessed for maintenance.

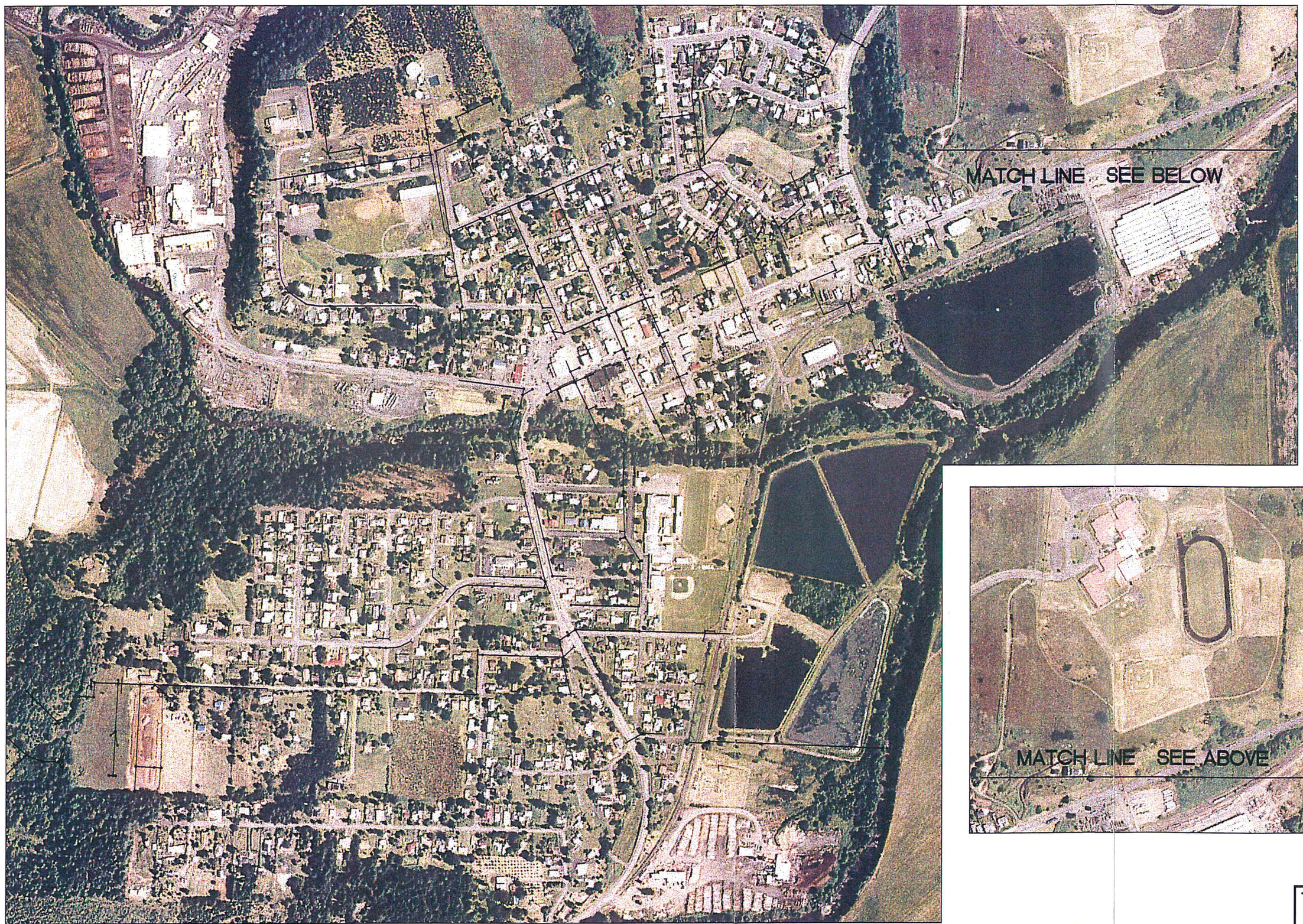
There are a number of springs located in the northwest portion of the city, primarily above Fourth Street. These enter the existing piping system, often taking up a significant portion of the pipe capacity. Springs are also a problem near Bronson and Baker Streets. These springs cause problems for the local residents.

There is a problem with a lack of storm piping downstream of Willamina Drive, prior to Main Street. This results in flooding during even smaller storms. The City of Willamina has repeatedly attempted to obtain easements to remedy the situation.

A complete map of the system is shown as the COLOR INSERT. A more detailed map has been prepared for use by City staff, and has also been included as an insert for this study. These larger maps are presented as Exhibits 1 and 2.

City of Willamina
Stormwater Master Plan

CHAPTER 3



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City of Willamina
Stormwater Master Plan
DRAINAGE SYSTEM ANALYSIS

3

3.1 OREGON DRAINAGE LAW

Oregon has adopted the civil law doctrine of drainage. Under this doctrine, adjoining landowners are entitled to have the normal course of natural drainage maintained. The lower owner must accept water that naturally comes to his land from above, but he is entitled not to have the normal drainage changed or substantially increased. The lower landowner may not obstruct the run-off from the upper land, if the upper landowner is properly discharging the water.

For a landowner to drain water onto lands of another in the State of Oregon, two conditions must be satisfied initially:

1. The lands must contain a natural drainage course, and;

2. The Landowner must have acquired the right of drainage supported by consideration.

In addition, because Oregon has adopted the civil law doctrine of drainage, three basic elements must be followed:

1. A landowner may not divert water onto adjoining land that would not otherwise have flowed there. Diverting water includes, but is not necessarily limited to:

   - Water diverted from one drainage area to another
   - Water collected and discharged which normally would infiltrate into the ground, pond, and/or evaporate.

2. The upper landowner may not change the place where the water flows onto the lower owner's land. (Most of the diversions not in compliance with this element result from grading and paving work, and/or improvements to water collection systems.)

3. The upper landowner may not accumulate large quantities of water, then release it, greatly accelerating the flow onto the lower owner's land. This does not mean that the upper landowner cannot accelerate the flow of water at all. Experience has found drainage to be improper only when acceleration and concentration of the water was substantially increased.

   Percolating waters can be intercepted and diverted for the protection of the highway without regard for the loss of these waters to the adjacent landowners. In those cases where wells and springs are involved, the right-of-way liaison engineer should contact the affected owner(s) to prevent any misunderstanding over damage that could be claimed. Drainage designs should satisfy Oregon Drainage Law to avoid claims or litigation resulting from improper drainage design. When it is apparent that the drainage

design will not satisfy the law, then drainage easements should be obtained from the affected property owners. The legal staff should be consulted in those situations that appear to be unique and could result in litigation. Most records of flooding or problem areas come from discussions with Public Works staff, local residents, or by field investigations.

3.2 SPECIFIC PROBLEM AREAS IN THE CITY OF WILLAMINA

Seventeen sub-basins have been identified within the city. Our work identifies basins No. 2, 5, 7, 10, 11 and 17 as problem areas. The following sections describe and analyze the problems in each basin. An improvement plan is then developed and a cost to fix the problem is given.

3.2.1 West Main Street (Basin 11)

Description of Basin

The first portion of the drainageway under review lies above West Main Street/Willamina Creek Rd. and is bound by flows reaching as far as the city water treatment plant, to the north and Willamina Drive to the west, and Churchman Street to the east.

The second Portion of the basin under review is adjacent to the intersection of Hwy 18 Bypass and West Main Street. A railroad track and a concrete island are located in this vicinity. There is limited storm drainage in this area. The storm drainage belongs to the city, but is on a state highway. The state has over-laid the roadway over the years, causing isolated areas that do not drain. There are inadequately sized and quantity of curb inlets in this area. Flows from Willamina Drive Basin discharge overland onto private property prior to Main Street.

Drainage Problem

At the intersection of Churchman Street and Willamina Drive, stormwater is piped south in a 15-inch storm drain, which discharges into a shallow ditch approximately 100 feet south. A second line, 12 inches in diameter, discharges similarly 150 feet to the east. A portion of the stormwater is collected in a 6-inch pipe that terminates at Main Street. Stormwater bubbles out of the ground at this location while the remaining volume floods the properties approximately 100 feet north. There are no storm pipes which cross Main Street to discharge into the river.

A second problem exists directly to the east near the concrete island. There is a curb inlet near this location, which has too small of an opening to avoid plugging from debris or to intake stormwater. In addition, there are a couple of areas, which are poorly graded and trap stormwater.

Problem Solution

There is currently a 12-inch and a 15-inch storm drain outfalling from Willamina Drive onto private property. These need to be tied together and routed east 250 feet with an 18-inch pipe, then south 100 feet to Main Street. At Main Street the pipe should cross private property for 150 feet and outfall at the river.

There are low points along the State Highway plus existing catch basins, which are barely functioning. To correct this requires 75 feet of 12-inch pipe and two new catch basins.

If the grade of the pipe does not allow construction on Willamina Drive, then the easement will be needed for 18-inch storm piping across private property. This easement may be easier obtained running perpendicular with the highway as the lower property owner has previously denied past attempts by the city to obtain an easement running parallel to the highway.

Table 3-1 Cost Estimate for West Main Street Storm Improvements

Item	Length/Number	Unit Cost	Total Cost
12" Storm Laterals	70 ft	$40/ft	$2,800
12" Storm Piping	260 ft	$40/ft	$10,400
18" Storm Piping (Rock B.F.)	365 ft	$70/ft	$25,550
18" Storm Piping (Native B.F.)	380 ft	$50/ft	$19,000
Construct 48" Manhole over Exist. S.D.	1	$3,400/ls	$3,400
Construct 60" Manhole over Exist. S.D.	1	$4,000/ls	$4,000
48" Manholes	2	$2,800/ea	$5,600
Connect to Existing Manhole	1	$3,800/ea	$3,800
Catch Basins	2	$2,200/ea	$4,400
Traffic Control	1	$10,000/ls	$10,000
Subtotal			$88,950
Contractor Profit and Overhead (15%)			*$13,876*
Construction Total			$102,826
PROJECT TOTAL (with 30% for contingency, engineering and inspection)			**$133,674**

Notes: 1. Easement cost not included.
2. Landscaping cost through easement not included.
3. State highway inspection and permit not included.

3.2.2 NW 5th Street and Churchman Street (Basin No. 10)

Description of Basin

The basin receives flows from two directions. The first is from Churchman Street. There is a 12-inch tongue-and-groove pipe, which is within 1 or 2 inches of the surface about 50 feet south of Fifth Street along the west side of the paved roadway. This drain is connected to the city sedimentation basin at the water treatment plant and, also, to the Highlands of Willamina Subdivision, located 100 feet upstream. There is a second pipe on the east side of the street, which is routed east toward the center of town. The exact pipe route is unknown. Fifth Street drainage consists of a series of ditches and driveway culverts directing flows toward the east. The flows are interrupted at some driveways where culverts were not installed. The south side of Fifth Street drops abruptly to property described as the "Old School Property". The site contains an outdated building, which needs demolishing. The property is scheduled for a residential subdivision. Flows from the subdivision need to tie into the 12-inch line in Churchman Street.

Drainage Problem

The 12-inch, tongue-and-groove concrete pipe in Churchman Street is shallow and needs to be lowered and replaced with a watertight pipe. When the sediment basin is drained it bubbles out through a broken pipe onto Churchman Street. The remaining flow either travels downstream or enters the road sub-grade, thereby damaging the integrity of the pavement section. Churchman Street is a combination of oil-mat and asphalt pavement section. Due to the lack of piping and proper ditching on Fifth Street, the pavement section is severely damaged.

There is inadequate piping downstream to handle flows from this basin and a large amount of development scheduled upstream.

There are no catch basins at the intersection of Fifth and Churchman Streets. As a result, flows travel across the "Old School Property".

Problem Solution

Fifth Street should be reconstructed to shed to the south side of the intersection. An extruded curb could be constructed to direct stormwater east and west to existing storm piping. At Fifth and Churchman a catch basin should be installed at the intersection. A manhole should be constructed over the existing 12-inch storm line in Churchman Street and the downstream line lowered and upsized to 15-inch.

Table 3-2 Cost Estimate for 5th and Churchman Streets Storm Improvements

Item	Length/Number	Unit Cost	Total Cost
Reconstruct and Shed Road to Drain	1	$45,000/ls	$45,000
Extruded Curb	850 ft	$6/ft	$5,100
12" Storm Laterals	10 ft	$40/ft	$400
Catch Basin	1	$2,400/ea	$2,400
Construct Manhole over Existing S.D.	1	$2,800/ls	$2,800
Connect to Existing Catch Basin	1	$500/ls	$500
Replace 10" with lower 12" S.D.	430 ft	$40/ft	$17,200
Subtotal			$73,400
Contractor Profit and Overhead (15%)			*$11,010*
Construction Total			$84,410
PROJECT TOTAL (with 30% for contingency, engineering and inspection)			**$109,733**

Notes: 1. Shedding of street is necessary to control storm drainage problems on north side of 5th Street.
2. Lowered storm drain is tied to water treatment plant sedimentation basin drain.

3.2.3 Oaken Hills Drive at Main Street (Basin No. 17)

Description of Basin

The basin is described by the following boundaries. The west boundary is bordered by Oaken Hills Drive. The basin is bordered on the east by the ridge 500 feet west. The north boundary begins near the summit of the hill, north of the highway. The upper portion of the basin contains springs, which bleed out of the slope.

This basin contains an upper pond, which detains the peak of the storms from surcharging the downstream culverts. This pond has washed out during past rain events causing a backup of water at the highway culvert crossing. The pond is on private property.

Drainage Problems

Flows from this basin are directed in a ditch southerly toward Willamina Creek. At Main Street flows enter a concrete headwell sized approximately at 36 inches x 44 inches. Upon entering the box, flows are split between two 18-inch CMP's. At the south end of these culverts flow turns abruptly in this box and exits into 2 18-inch pipes across private property. At the south end of the lot flows are piped west under the corner of the residence. These downstream constrictions cause flooding at the concrete headwall at Main Street.

Piping downstream of the highway crosses private property. The current property owner is not interested in providing a public storm drain easement across his lot as he has a small lot and the easement would greatly impact it. If an easement cannot be acquired, then the peak flows have to be detained or the downstream flows pipe elsewhere.

Problem Solution

At the downstream end of the highway crossing the flows are restricted and back up. A 24-inch overflow pipe can be constructed for a distance of 250 feet east to the existing 18-inch culvert, thence paralleling the pipe for 150 feet south to the railroad ditch. Downstream culvert capacities would need to be reviewed to determine any deficiencies.

Table 3-3 Cost Estimate for Oaken Hills Drive Basin Storm Improvements

Item	Length/Number	Unit Cost	Total Cost
24" Storm Drain Bore (Highway)	70 ft	$200/ft	$14,000
24" Storm Drain Bores (Railroad)	80 ft	$240/ft	$19,200
Headwall at Highway	1	$6,000/ls	$6,000
Headwall at Railroad	1	$14,000/ls	$14,000
24" Storm Piping (along Highway)	235 ft	$80/ft	$18,800
24" Storm Piping (along Easement)	190 ft	$60/ft	$11,400
60" Manholes	2	$4,000/ea	$8,000
Ditching	1	$4,000/ls	$4,000
Traffic Control	1	$10,000/ls	$10,000
Subtotal			$103,400
Contractor Profit and Overhead (15%)			*$15,510*
Construction Total			$118,910
PROJECT TOTAL (with 30% for contingency, engineering and inspection)			**$154,583**

Notes: 1. Easement cost not included.
2. Railroad insurance and flagging costs not included.
3. No improvements included along State Highway.

3.2.4 Adams Street & Upper End of Bronson St. (Basin No. 7)

Description of the Basin

The basin originates at James Street. It also collects flows from a basin on Bronson Street. This basin has a small surface area on a steep slope to the south, which is bordered to the east by a cemetery. The hillside west of the cemetery contains considerable springs, which run year around. There is a small ditch with limited 8-inch piping, which ties into the trunk line at James Street. The flows are piped under the highway through a 12-inch pipe and travel along the north side of Adams Street. There is a junction box mid-block between the highway and Washington Street. At a manhole at the intersection of Adams and Washington Street the pipe is 18-inch upstream and 24-inch downstream. The 24-inch pipe is routed east toward the South Yamhill River. The route is unknown. The pipe appears flat and was full of gravel. At the south-east side of the intersection of Washington and Adams Streets surface water is piped south along Washington Street in ditches and culverts to Jackson Street, thence east to Lincoln Street, thence south one-half block to an 18-inch pipe on the east side of the street. This pipe crosses the railroad tracks and is diverted adjacent to the city park fish pond, to the river through an 18-inch pipe. At the intersection of Adams and Lincoln Streets, the flows are collected in 12-inch pipes and are routed to the river by an unknown route.

Previous Problems

There has been flooding of local residences, particularly at the Adams & Washington Street southeast corner. This area sits below the adjacent drainage ways, thereby making gravity drainage a challenge. The storm piping is shallow in order to obtain grade to the river.

During large rain events the volume of water traveling overland combined with the subsurface water percolating out of the hillside exceed the capacity of the ditch and storm systems at Bronson and James Streets. When this occurs, the water drains across Bronson Street 80 feet west of the cemetery. The residences in this area sit below Bronson Street and are impacted by flooding. The property owners above Bronson Street suffer with large quantities of groundwater in their yards.

Problem Solution

Bronson Street: It is difficult to determine the quantity of groundwater percolating out of the hillside, therefore the design should take into account previsions for excessive flows, which exceed the downstream pipe capacity. We recommend a design consisting of a French drain, perforated pipe, and a ditch to direct flows around the residences downhill. It appears that stormwater can be collected in the ditch along the adjacent highway to the east. The west side of the highway is curbed with limited storm piping. The French drain flows can be carried to the bottom of the grade along the south side of Bronson Street, thus be routed east to the existing ditch. An 8-inch perforated pipe shall be placed in the French drain. At the bottom of the grade there should be a connection to the existing storm system and an overflow pipe at a junction box, which routes flows east to the state highway.

Adams Street: At the intersection of Adams and Washington Street exists a 24-inch storm drain running parallel to Adams Street. This storm drain appears to have a flat grade as indicated by the deposition of gravel. This line is old and may be in poor condition or grade. If

needing replacement then it should be upgraded or a second parallel pipe added. The total length needed would be 750 feet of 36-inch storm drain. There is an existing 18-inch culvert crossing the railroad tracks between Ivy and Jackson Street. The old line was not functioning, so the city plugged it and constructed a new 12-inch storm drain to the river. The old 18-inch pipe should be reconnected to the 36-inch pipe with an overflow line. This will involve 200 LF of 18-inch storm line and two manholes.

Table 3-4 Cost Estimate for Bronson Street Storm Improvements

Item	Length/Number	Unit Cost	Total Cost
8" French Drain	220 ft	$11/ft	$2,420
8" Overflow Pipe	70 ft	$18/ft	$1,260
Shallow Ditch	1	$600/ls	$600
Subtotal			$4,280
Contractor Profit and Overhead (15%)			*$642*
Construction Total			$4,922
PROJECT TOTAL (with 30% for contingency, engineering and inspection)			**$6,400**

Notes: 1. Easement cost not included.

Table 3-5 Cost Estimate for Adams Street Storm Improvements

Item	Length/Number	Unit Cost	Total Cost
Upgrade 12" to 18" and Connect	1	$500/ls	$500
Replace C.B. w/ MH and Slotted Cover	1	$3,600/ls	$3,600
18" Storm Piping (Native B.F.)	600 ft	$45/ft	$27,000
36" Storm Piping (Native B.F.)	750 ft	$90/ft	$67,500
72" Manhole	1	$6,000/ea	$6,000
Clean 24" Storm Piping	1	$1,800/ls	$1,800
Ditching	1	$1,800/ls	$1,800
Connect to Existing Manhole	1	$3,800/ea	$3,800
Subtotal			$108,400
Contractor Profit and Overhead (15%)			*$16,260*
Construction Total			$124,660
PROJECT TOTAL (with 30% for contingency, engineering and inspection)			**$162,058**

Notes: 1. Easement cost not included.
2. Exact location of 24" storm drain unknown.

3.2.5 Northeast End of Barber Avenue (Basin No. 5)

Description of Basin

The basin originates in the vicinity of Cherry Street and Barber Avenue. Flows are piped across Hwy 18 business loop in a 12-inch pipe. This pipe also collects the drainage from the highway through parallel piping systems on each side of the highway. These are combined and routed to Washington Street, where the system turns north and outfalls into the South Yamhill River. At several of the intersections at Washington Street there are no catch basins to collect flows. The streets drain to these intersections therefore flooding occurs. A few of the houses sit below the street level and flood.

Previous Problems

Willamina High School is located in this vicinity, therefore there is a lot of foot traffic. Since there are no sidewalks in this area, foot traffic has to walk through ponding areas. In addition, there are approximately 5 houses on the east side of Barber Avenue and the west side of Polk Street, which flood regularly since they sit below street level.

Problem Solution

Flooding has occurred at several homes between Barber Avenue and Polk Street. Constructing French drains connected to a 12-inch pipe can drain this area. The pipe should be connected to the existing line in Polk Street. In addition, catch basins and curbs should be constructed at the intersection of Polk, Barber and Washington Streets to reduce flooding of the intersection. There has also been flooding in front of Willamina High School. This flooding is from the lack of curb and from catch basins located in the wrong areas. Corrections consist of approximately 150 feet of curb plus rebuilding the asphalt in an area 40 feet x 40 feet.

Table 3-6 Cost Estimate for Barber Avenue Storm Improvements

Item	Length/Number	Unit Cost	Total Cost
French Drain	220 ft	$11/ft	$2,420
12" Storm Piping	120 ft	$40/ft	$4,800
Connect to Existing S.D.	1	$400/ls	$400
Catch Basins	4	$2,400/ea	$9,600
Connect to Existing Manhole	2	$800/ea	$1,600
Standard Curb	300	$10/ft	$3,000
Gravel Resurfacing	1	$3,000/ls	$3,000
Remove and Recontour Asphalt	1	$2,000/ls	$2,000
Misc. Grading	1	$2,000/ls	$2,000
Subtotal			$27,820
Contractor Profit and Overhead (15%)			*$4,173*
Construction Total			$31,993
PROJECT TOTAL (with 30% for contingency, engineering and inspection)			**$41,590**

Notes: 1. Easement cost not included.
2. Location of existing manholes at Washington Street has not been confirmed.

3.2.6 Pioneer Drive (Basin No. 2)

Description of Basin

The basin begins south of Hill Drive by the city water reservoir running north to Willamina Creek. The primary basin passes through the Pioneer Heights Subdivision with the remaining flows proceeding through Bales Subdivision, west fanning out 800 feet to the east at the summit of Pioneer Drive. The flows exiting the detention structure in the Pioneer Heights Subdivision travel across a shallow ditch immediately downstream. There has been some reported flooding as this area does not have a very defined ditch. When flows increase, the stream fans out over the property. Flows along the south side of Pioneer Drive are routed west to the Pioneer Heights Subdivision. On the north side the drainage sheds across lots collecting near the west side of the intersection of Barber Avenue and Ash Street. In this vicinity the drainage travels northwest and passes under a 15-inch driveway culvert prior to reaching Willamina Creek. The

culvert size is marginal and has backed up stormwater during larger rain events. A minor study of this area was performed in 1997 at the time when Bales Subdivision was proposed.

Drainage Problem

Most of the development along the north side of Pioneer Drive sits below the street. The right-of-way is narrow ranging from 33 feet to a maximum of 45 feet. There is inadequate room on the north side to allow the construction of an adequate ditch. The grade differential in this area forces drainage away from the road and onto the lots. There is no drainage easements downstream across private properties to allow city facilities thus making the problem a civil matter and costly to address. The lots west of Ash Street and Barber Avenue will allow subdividing. Upon this occurrence, public facilities can then be built. The city is currently working with property owners in the resolution of drainage easements on a volunteer basis. All downstream property owners want resolution to this issue.

Problem Solution

Pioneer Subdivision detains the entire basin upstream releasing flows through multiple orifices. Storm events from 2 to 50 years are released through two 12-inch diameter pipes. Downstream, lies a mostly undefined channel where the flows fan out over the downstream property.

The downstream basin below Pioneer Subdivision is routed through a 24-inch pipe. This pipe acquires 3.5 acres of attributing area downstream of the subdivision. The culvert needs to be upgraded to 30-inch to carry the flows. To collect the drainage from the intersection of Cedar Avenue and Barber Street, a 12-inch pipe is needed. This needs to be upgraded to 15-inch prior to the 30-inch culvert. At this size it should carry future development in this area.

Additional right-of-way needs to be acquired along Pioneer Avenue to coincide with the width approved on the Transportation Plan. Upon acquisition of this right-of-way, storm drainage should be constructed to collect flows on the north side of Pioneer Drive. At Cedar Avenue the piping will turn north and be connected with the proposed system.

Table 3-7 Cost Estimate for Pioneer Drive Storm Improvements

Item	Length/Number	Unit Cost	Total Cost
12" Storm Piping	1200 ft	$45/ft	$54,000
15" Storm Piping	875 ft	$48/ft	$42,000
24" Storm Piping	30 ft	$60/ft	$1,800
12" Storm Laterals	190 ft	$45/ft	$8,550
48" Manholes	6	$2,400/ea	$14,400
Field Inlet	1	$2,200/ea	$2,200
Catch Basins	6	$2,100/ea	$12,600
Subtotal			$135,550
Contractor Profit and Overhead (15%)			*$20,333*
Construction Total			$155,883
PROJECT TOTAL (with 30% for contingency, engineering and inspection)			**$202,648**

Notes: 1. 12" storm line depth at Ash Street summit estimated at 10 to 12 feet.
2. 15" storm line shown with rock backfill; this could change to native.
3. Does not include easement costs.

3.3 CITY-WIDE ALTERNATIVE ANALYSIS

These alternatives were analyzed during the course of our investigation. These alternatives are:

Option #1 – No Change to the Existing System

Selection of this option would result in a continuation of the localized ponding and flooding problems. Although it is the least expensive alternative, it is not considered a viable option, as the current problems will continue to escalate as development continues.

Option #2 – Increase Pipe Sizes in Lower Portion of System

This option holds merit, as the lower portion of the storm drainage system is old and deteriorated, as well as undersized. Replacement of the piping in this area would generally occur in areas that are not currently developed. This will help to reduce costs. Projects can be broken out to fit yearly budgets. The disadvantage is that this is in the flood plain and low areas therefore development most likely will not pay for the building of these lines.

Option #3 – Provide Detention in the Existing System

This option need to be carefully examined as delaying the release downstream may stack peak flows with the drainage basin upstream. The placement of large detention structures would require additional sediment containment facilities to be constructed prior to the structure, or substantial annual cleaning costs. Unlike Option #2, the existing piping would remain in place. The advantage is that there would be short-term cost savings.

Option #4 – On-site Detention with Mainline Upgrades

As development occurs, detention of peak storms should be held back on-site. The lower portion of the existing systems should be upgraded. This option spreads costs between new development and local citizens. This option works best for areas where development space is still available. Some large tracts of land are available in the city in addition to the areas available for infill. The only downside of this option and Option #3 is the presence of springs in the hillsides. This fills a portion of the pipe so that peak storm capacity is reduced.

Recommended Option

General discussions with City personnel indicate that either Option #2 or Option #4 would be the direction the City would be interested in pursuing. Currently the City is in the process of upgrading the water and sewer facilities. These projects are placing a financial burden on the citizens of Willamina. It has been suggested that the City complete small projects over the next 3 to 4 years then attempt to pursue a large, citywide project.

Fourth and D Streets Springs

There is an existing subsurface spring drainage system near the intersection of 4th and "D" Streets. This system previously was used for the city water supply until the city's demand became too high. During the winter months this pipe was under a large hydraulic head from the

rising water table. The flows used a large portion of the downstream pipe capacity. In addition, the city water source has problems with high turbidity during this same period. The city may be able to use this subsurface water as an emergency drinking water source to avoid the turbidity problems at the river and to reduce the impact to the downstream pipe capacity. Flows from this basin could be collected in a tank and pumped to the water treatment plant. The distance is approximately 2,000 feet from the collection system to the treatment plant. Water rights would have to be reviewed for this project.

The downstream corridor has alternating 12-inch and 24-inch trunk lines outfalling to the river. Both pipes have capacity problems due to flat grade adjacent to the river. It appears that the most cost-effective solution for trunk line deficiencies is to replace the 12-inch pipes with larger pipes and transfer flows from the 24-inch lines as needed to handle surcharging flows.

Additional Capital Improvements

Table 3-8 lists capital improvements in addition to those needed for the identified problem areas.

Table 3-8 Cost Estimates for Additional Capital Improvements

Project	Project Detail	Project Cost
Fourth and D Streets - Collect and Pump Springs	collection structure, pumps and 1500 ft of 8-inch pressure main	$90,000
D Street Size Upgrade from First St. to Water St.	900 ft of 21-inch pipe, 3 manholes, and 90-foot bore	$98,000
Monitoring Manholes	4 monitoring manholes @ $4,000/ea	$16,000
Hill Drive 18-inch Storm Line	180 ft of 18-inch storm drain with catch basins	$24,000
Adams and James St. Upgrade from Junction Box on Adams to Cherry St.	550 ft of 18-inch storm line, 90-foot bore, 5 manholes	$94,200

AREA = 14.00 ac
RUNOFF COEFFICIENT = 0.3
RAINFALL INTENSITY = 2.05 in/hr
TOTAL FLOWRATE = 8.61 cfs

AREA = 15.60 ac
RUNOFF COEFFICIENT = 0.3
RAINFALL INTENSITY = 2.05 in/hr
TOTAL FLOWRATE = 9.59 cfs

AREA = 11.19 ac
RUNOFF COEFFICIENT = 0.3
RAINFALL INTENSITY = 2.05 in/hr
TOTAL FLOWRATE = 6.88 cfs

AREA = 12.51 ac
RUNOFF COEFFICIENT = 0.5
RAINFALL INTENSITY = 1.65 in/hr
TOTAL FLOWRATE = 10.32 cfs

AREA = 21.43 ac
RUNOFF COEFFICIENT = 0.6
RAINFALL INTENSITY = 2.62 in/hr
TOTAL FLOWRATE = 33.69 cfs

AREA = 3.32 ac
RUNOFF COEFFICIENT = 0.6
RAINFALL INTENSITY = 2.62 in/hr
TOTAL FLOWRATE = 5.22 cfs

AREA = 59.80 ac
RUNOFF COEFFICIENT = 0.5
RAINFALL INTENSITY = 1.20 in/hr
TOTAL FLOWRATE = 35.88 cfs

AREA = 13.25 ac
RUNOFF COEFFICIENT = 0.6
RAINFALL INTENSITY = 2.62 in/hr
TOTAL FLOWRATE = 20.83 cfs

AREA = 292 ac
RUNOFF COEFFICIENT = 0.3
RAINFALL INTENSITY = 0.76 in/hr
TOTAL FLOWRATE = 66.58 cfs

25 YEAR BASIN FLOWS

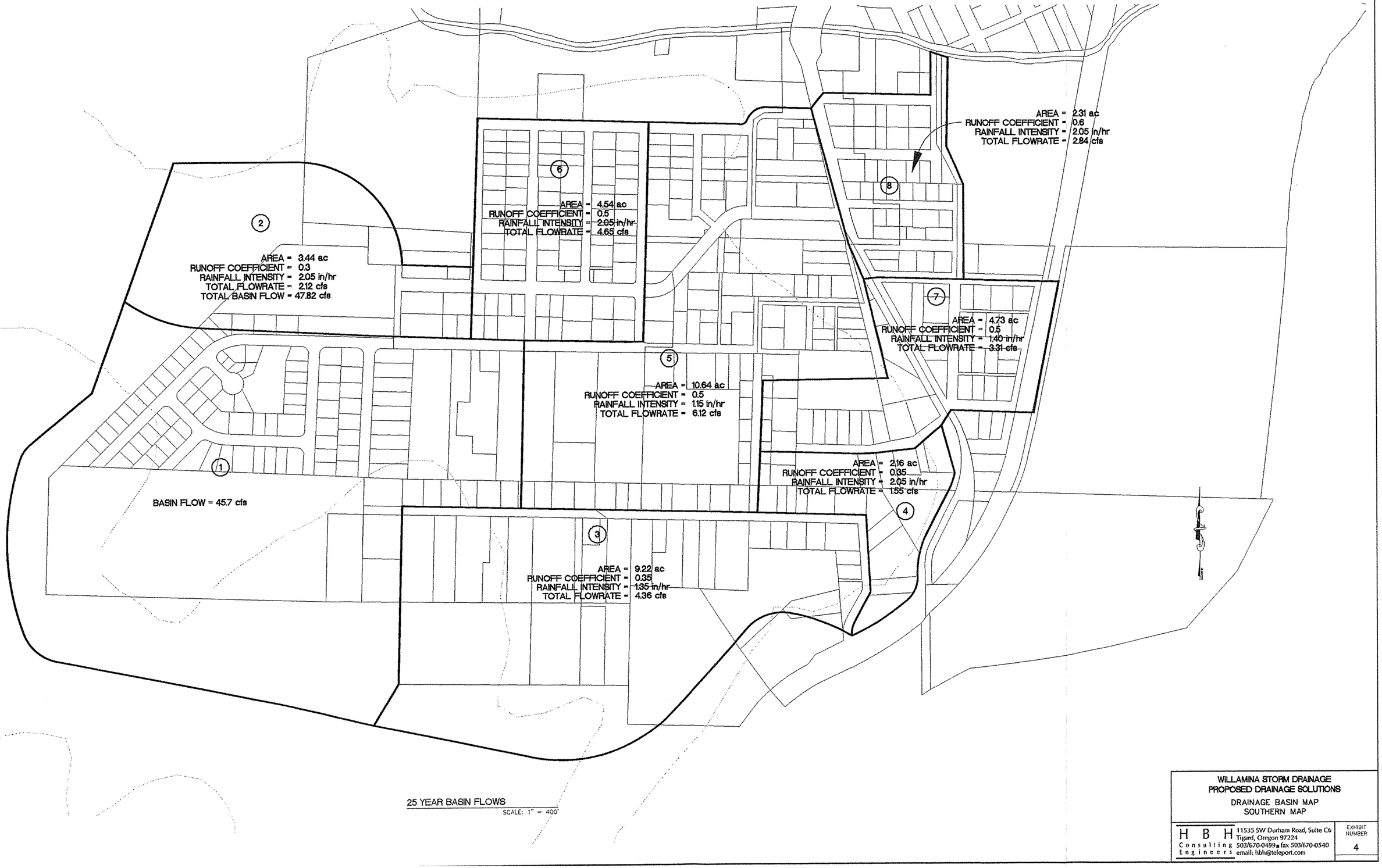
SCALE: 1" = 400'

WILLAMINA STORM DRAINAGE
PROPOSED DRAINAGE SOLUTIONS

DRAINAGE BASIN MAP
NORTHERN MAP

H B H Consulting Engineers
11535 SW Durham Road, Suite C6
Tigard, Oregon 97224
503/670-0499 fax 503/670-0540
email: hbh@teleport.com

EXHIBIT NUMBER 3



25 YEAR BASIN FLOWS

SCALE: 1" = 400'

WILLAMINA STORM DRAINAGE
PROPOSED DRAINAGE SOLUTIONS

DRAINAGE BASIN MAP
SOUTHERN MAP

H B H Consulting Engineers
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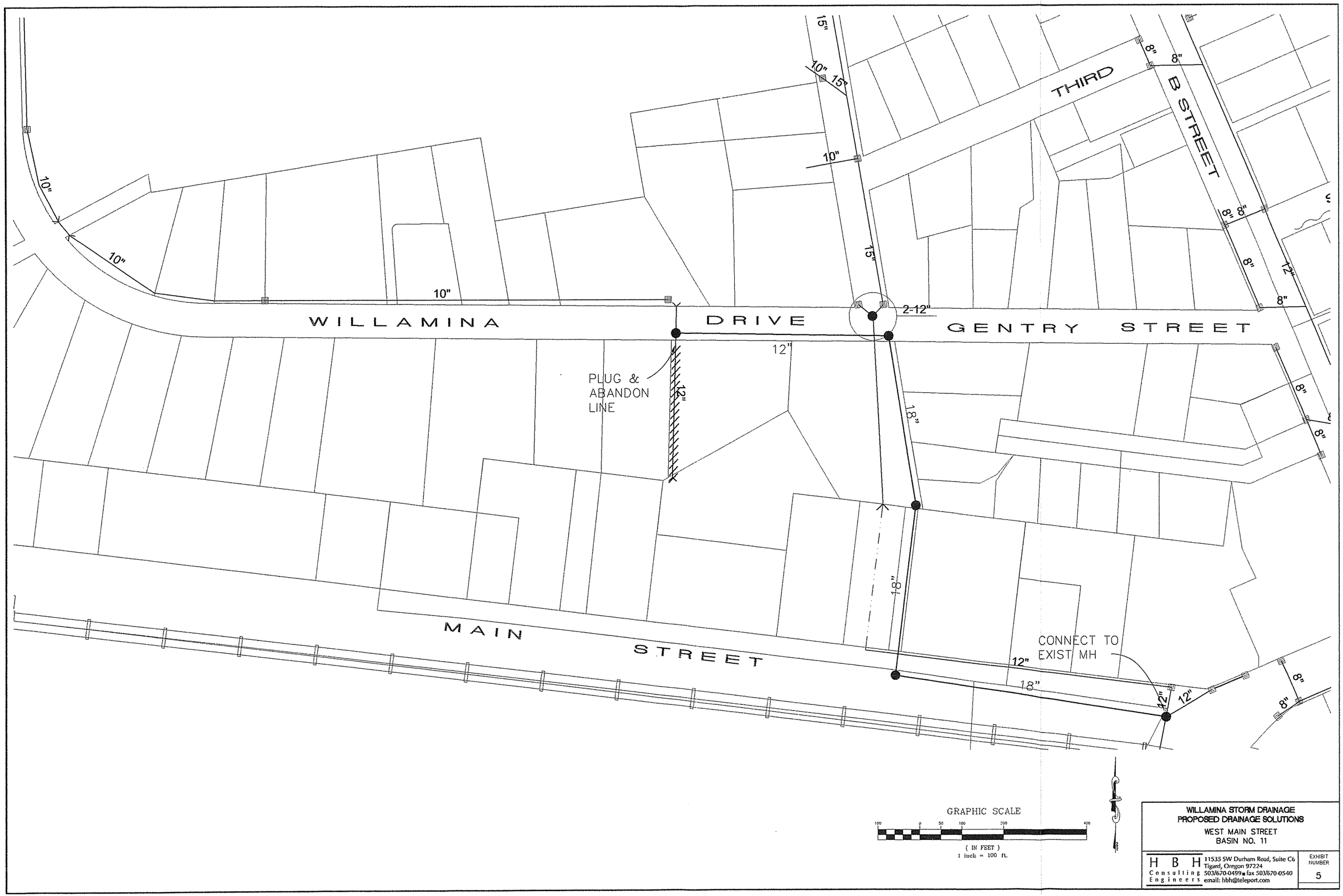
EXHIBIT NUMBER 4



WILLAMINA STORM DRAINAGE
PROPOSED DRAINAGE SOLUTIONS
WEST MAIN STREET
BASIN NO. 11

H B H Consulting Engineers
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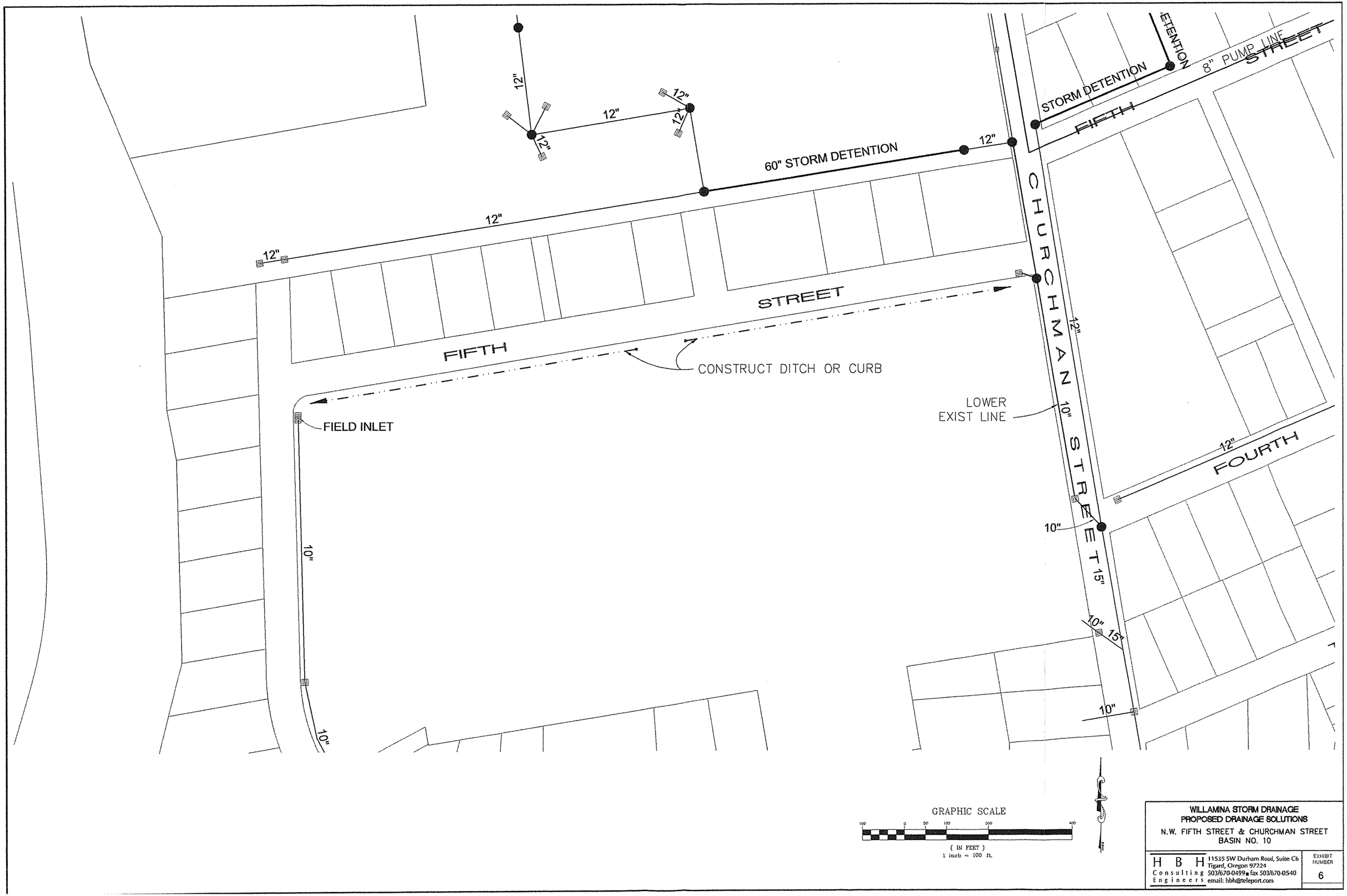
EXHIBIT NUMBER
5



WILLAMINA STORM DRAINAGE
PROPOSED DRAINAGE SOLUTIONS
N.W. FIFTH STREET & CHURCHMAN STREET
BASIN NO. 10

H B H Consulting Engineers
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Tigard, Oregon 97224
503/670-0499 ■ fax 503/670-0540
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EXHIBIT NUMBER
6

DITCH

DITCH

DITCH

DITCH

OAKEN HILLS DRIVE

CONSTRUCT
END WALLS

BORE 1 – 24" PIPE
60 LF

12"

12"

18"

18"

18"

18"

12"

8"

12"

24"

MAIN STREET

MONITORING
MH

24"

2 - 30"
40' LONG

BORE 2 – 24" PIPE
40 LF (EA)

54"

12"

12"

DITCH

12"

4' X 2' BOX
CULVERT

12"

12"

12"

12"

12"

12"

GRAPHIC SCALE

50 0 25 50 100 200

(IN FEET)
1 inch = 50 ft.

WILLAMINA STORM DRAINAGE
PROPOSED DRAINAGE SOLUTIONS
OAKEN HILLS DRIVE @ MAIN STREET
BASINS NO. 16 & 17

H . B . H Consulting Engineers
11535 SW Durham Road, Suite C6
Tigard, Oregon 97224
503/670-0499 ■ fax 503/670-0540
email: bbh@teleport.com

EXHIBIT NUMBER
7

POLK AVENUE
DITCH
12"
ADAMS STREET
18"
24"
8"
WASHINGTON
CONSTRUCT MH
OVER EXIST 24" SD
INSTALL 750 LF
36" STORM DRAIN
BORE 1 – 18"
90 LF
HP
BRANSON STREET
HIGHWAY 157
TRENCH DRAIN
JACKSON STREET
LINCOLN STREET
IVY STREET
INSTALL MH WITH
SLOTTED COVER
REPLACE 12" PIPE
WITH 18" PIPE

GRAPHIC SCALE
100 0 50 100 200 400
(IN FEET)
1 inch = 100 ft.

WILLAMINA STORM DRAINAGE
PROPOSED DRAINAGE SOLUTIONS
ADAMS ST & UPPER END OF BRONSON ST
BASIN NO. 07

H B H Consulting Engineers
11535 SW Durham Road, Suite C6
Tigard, Oregon 97224
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EXHIBIT NUMBER 8

WILLAMINA

LAMSON AVENUE

BAKER AVENUE

BARBER AVENUE

POLK AVENUE

ADAMS

WASHINGTON

JACK STREET

STATE

HIGHWAY 157

BRANSON STREET

AVENUE

STREET

INSTALL CURB AND CATCH BASINS AT RETURNS

TRENCH DRAIN

DITCH

2-12"

3-12"

15"

12"

18"

8"

GRAPHIC SCALE

100 0 50 100 200 400

(IN FEET)

1 inch = 100 ft.

WILLAMINA STORM DRAINAGE
PROPOSED DRAINAGE SOLUTIONS

NORTHEAST END OF BARBER AVENUE
BASIN NO. 5

H B H Consulting Engineers
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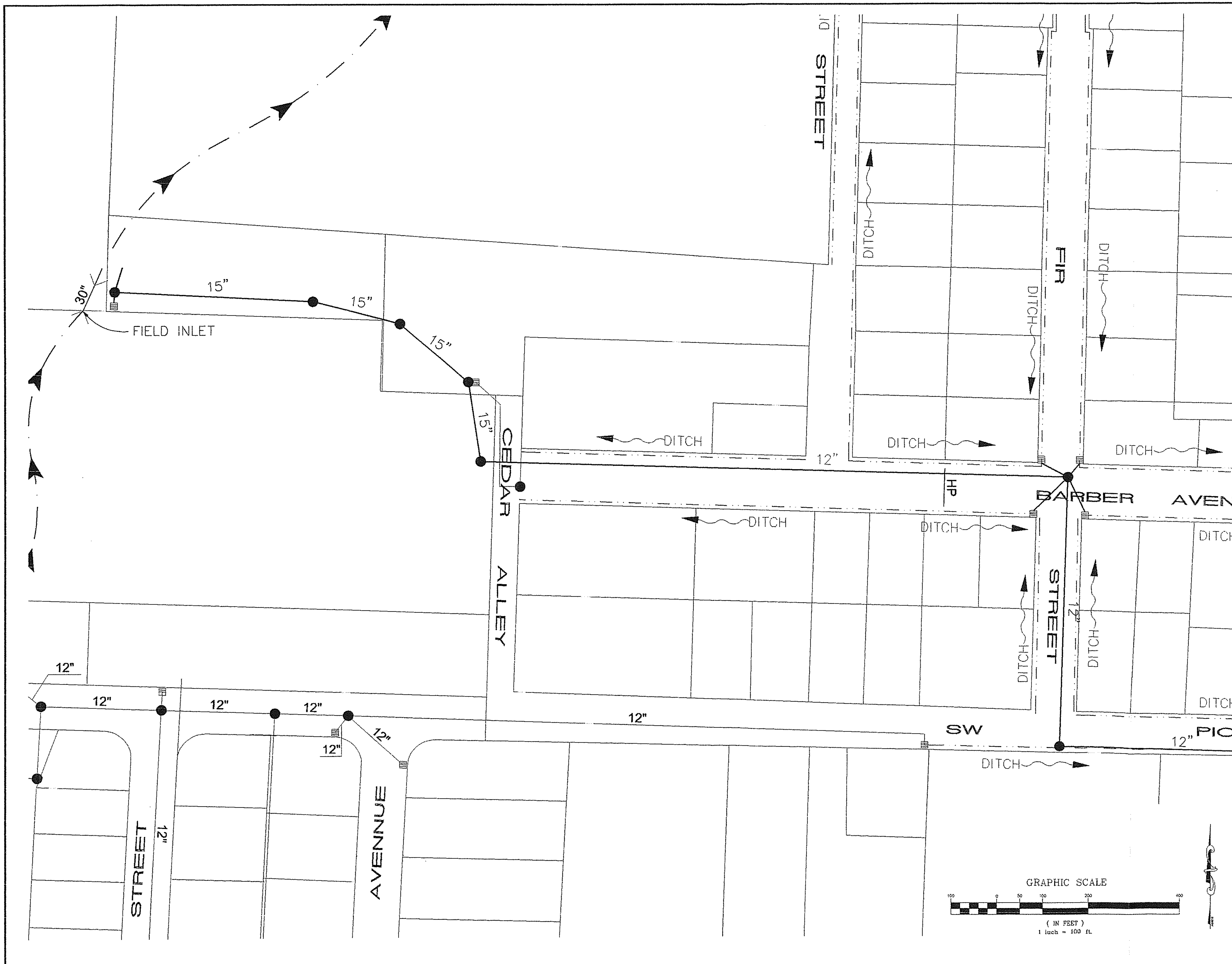
EXHIBIT NUMBER 9



WILLAMINA STORM DRAINAGE
PROPOSED DRAINAGE SOLUTIONS

PIONEER DRIVE
BASIN NO. 02

HBH Consulting Engineers
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Tigard, Oregon 97224
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email: hbh@teleport.com

EXHIBIT NUMBER 10

City of Willamina
Stormwater Master Plan

CHAPTER 4

City of Willamina
Stormwater Master Plan

STORMWATER QUALITY REGULATIONS 4

4.1 REGULATION HISTORY

Since the passage of the 1972 Federal Water Pollution Control Act (Clean Water Act), the quality of the Nation's waters has improved dramatically. Despite this progress, however, degraded waterbodies still exist. According to the 1996 National Water Quality Inventory, approximately 40 percent of surveyed U.S. waterbodies are still impaired by pollution and do not meet water quality standards. A leading source of this impairment is polluted runoff. In fact, according to the Inventory, 50 percent of impaired rivers are affected by urban/suburban and construction sources of stormwater runoff. Furthermore, Oregon Department of Environmental Quality (DEQ) estimates that as much as 70 to 80 percent of pollution enters the Willamette River from non-point sources.

Phase I of the U.S. Environmental Protection Agency's (EPA) stormwater program was promulgated in 1990 under the Clean Water Act. Phase I relies on National Pollutant Discharge Elimination System (NPDES) permit coverage to address stormwater runoff from: (1) medium and "large" municipal separate storm sewer systems (MS4s) generally serving populations of 100,000 or more people, (2) construction sites greater than 5 acres, and (3) ten categories of industrial sources.

Large municipal entities (Cities and Counties with populations greater than 250,000) and medium size municipal entities (Cities and Counties with populations between 50,000 to 250,000) currently must obtain stormwater discharge permits for their MS4s. This process of obtaining a stormwater discharge permit can be time-consuming and expensive. Municipalities must prepare and submit a two-part application to DEQ for review and approval. This two-part application generally consists of several hundred pages of documentation. The application requires information about the existing stormwater system, outfall locations, legal authority to control stormwater, tributary areas, land use and soil types, location of industrial facilities, landfills, and hazardous waste facilities, and more.

DEQ administers the NPDES 1200-C permitting program for construction sites with greater than 5 acres. The permit requires the applicant to prepare an erosion control plan showing what measures will be taken to prevent erosion and sediment transport. Methods to reduce polluted runoff include limiting the amount of disturbed ground, reestablishing vegetative cover immediately following grading activities, and installing sediment fences, hay bales, and check dams to capture sediment before leaving the site.

Currently, most industries in Oregon are required to obtain permits from DEQ that regulate the discharge of stormwater from their sites. These permits require implementation of stormwater pollution control plans that specify requirements for materials storage, spill control, preventative maintenance, erosion control, and stormwater monitoring.

The EPA has proposed the Storm Water Phase II Rule as the next step in their effort to preserve, protect, and improve the Nation's water resources from polluted stormwater runoff.

The Phase II proposed program would expand the existing Phase I program by requiring additional owners and operators of MS4s in urbanized areas and construction sites, through the use of NPDES permits, to implement programs and practices to control polluted stormwater runoff. Phase II will include all municipalities within an Urbanized Area, and all municipalities of 10,000 people or more outside of any Urbanized Area. An Urbanized Area is defined as a land area that has a residential population of at least 50,000 and an overall population density of at least 1,000 people per square mile. The program will also cover construction sites with 1 acre or more of disturbed land. The final Phase II Rule is scheduled to be issued in November 1999. (An overview fact sheet of the proposed Phase II Rule is provided in Appendix A.)

Because Willamina is not in an Urbanized Area, and since the current population is under 2,000, it is highly unlikely that the Phase II Rule will include the City. However, construction sites over one acre and certain industrial users within the City may be subject to the permitting requirements.

Finally, the listing of some salmon and steelhead trout runs as threatened under the Endangered Species Act may force additional measures to protect water quality and habitat. It is unknown at this time whether any such measures, if any, would affect the City of Willamina.

4.2 WATER QUALITY ISSUES

Stormwater runoff often contains materials that may degrade the quality of the waterways that the runoff enters and may harm stream ecology. These potentially harmful materials include sediments, organics, nutrients, and metals. In addition, runoff from impervious surfaces contributes to higher peak flows and warmer stream temperatures.

Sediments and other solid materials are a concern, in part, because they add turbidity to a receiving stream. Turbidity can harm stream ecology in a number of ways. It can reduce light penetration and photosynthesis, hinder fish respiration, and reduce visibility, which affects their ability to find food. Additionally, the deposition of solid materials on the stream bottom can harm benthic (bottom-dwelling) organisms and their habitat. The amount and form of solids contained in a stormwater sample are measured in laboratory tests for total solids (TS), total suspended solids (TSS), and total dissolved solids (TDS).

Organic materials are a concern because they can affect the amount of dissolved oxygen available in the water column for fish and other aquatic organisms which use dissolved oxygen for respiration. A reduction in dissolved oxygen occurs as the organic materials are naturally biodegraded by stream bacteria that utilize the organic material as a food source and the oxygen for respiration during metabolism. The amount of organic materials contained in stormwater runoff is measured in laboratory tests for biochemical oxygen demand (BOD) and chemical oxygen demand (COD).

Nutrients such as nitrogen and phosphorus are a concern because their presence can lead to excessive algae growth as well as undesirable fluctuations in pH and dissolved oxygen resulting in toxicity and nuisance conditions. Under some environmental conditions, algae can grow rapidly to nuisance levels if a growth-limiting nutrient is provided in sufficient concentrations. Nitrogen compounds are generally measured as total Kieldahl nitrogen (TKN), ammonia (NH_3), and nitrite plus nitrate ($N0_{2+3}$). Phosphorus compounds are generally measured as total phosphorus (TP), soluble phosphorus (SP), and ortho-phosphorus (OP).

Metals are of interest because if they are present in significant concentrations, they are toxic to aquatic organisms and tend to bio-accumulate in natural systems. Because the discharge of stormwater occurs intermittently, acute toxicity is a concern, whereas chronic toxicity is generally not. Metals of significant interest include lead (Pb), copper (Cu), and zinc (Zn).

The quantity of stormwater runoff plays a major factor in the water quality of rivers and streams. When natural groundcover is replaced by impervious surfaces such as buildings and pavement, rainfall is forced to runoff into the storm drainage system rather than allowing to percolate into the soil. This creates higher peak flow rates immediately following storms, thereby increasing streambank erosion. The reduction of groundwater recharge contributes to lower base stream flow in the dry summer months. This in turn can degrade the riparian habitat, reducing vegetative cover and increasing likelihood of streambank erosion. Animal and aquatic life also depend on year-round fresh water to thrive.

Water temperature is currently considered a serious threat to water quality. Several Oregon creeks and rivers are listed as water-quality limited by DEQ because of temperature. A small increase in a stream's temperature can greatly impact its ecology. Higher temperatures reduce the amount of dissolved oxygen available for fish and other aquatic life. Threatened species such as salmon and cutthroat trout spawn in cold-water streams. In urban areas, runoff is warmed from surfaces such as rooftops and pavement. Removal of vegetation on streambanks also allows sunlight to warm streams directly.

In 1983, the EPA initiated the National Urban Runoff Program (NURP). During the course of their study, they evaluated the chemical characteristics of stormwater runoff for a number of different areas by land use category. The chemical characteristics of stormwater vary considerably depending on the nature of the runoff surface, as shown in Table 4-1. It is noted that residential land use has the largest median concentrations of pollutants listed.

Table 4-1 Median Runoff Concentration By Land Use Category

Parameter (mg/L)	Land Use Category			
	Residential	Commercial	Mixed	Open/Non-Urban
BOD	10.0	9.3	7.8	---
COD	73.0	57.0	65.0	40.0
TSS	101.0	69.0	67.0	70.0
Pb	0.144	0.104	0.114	0.030
Cu	0.033	0.029	0.027	---
Zn	0.135	0.226	0.254	0.195
TKN	1.90	1.180	1.290	0.965
NO_{2+3}	0.736	0.572	0.558	0.543
TP	0.383	0.201	0.263	0.121
SP	0.143	0.080	0.056	0.026

Source: National Urban Runoff Program as reported in Stahre and Urbonas (1990).

Abbreviations:

BOD	Biochemical Oxygen Demand
COD	Chemical Oxygen Demand
Cu	Copper
mg/L	Milligrams per Liter
NO_{2+3}	Nitrite plus Nitrate
Pb	Lead
SP	Soluble Phosphorus
TP	Total Phosphorus
TSS	Total Suspended Solids
TKN	Total Kieldahl Nitrogen
Zn	Zinc

City of Willamina
Stormwater Master Plan

CHAPTER 5

City of Willamina
Stormwater Master Plan

BEST MANAGEMENT PRACTICES 5

5.1 INTRODUCTION

Best Management Practices (BMPs) are those physical, structural and managerial practices, and prohibition of practices, that, when used singly or in combination, control stormwater peak flow rates and volumes and prevent or reduce pollution of surface water or groundwater.

5.2 DETENTION FACILITIES

Detention facilities are used to provide temporary storage of stormwater to reduce the rate of runoff during and following a storm event. Typical facilities include ponds, concrete basins, and buried vaults.

Detention facilities can also be effective in treatment of stormwater through various means. In most cases, detention facilities remove soil particles and suspended solids as a result of sedimentation. Other facilities, such as wet ponds, may also provide removal of dissolved pollutants, such as nutrients, through plant absorption.

Above-ground detention facilities, such as detention ponds, are often less expensive to construct, are typically easier to inspect and maintain, and can be designed to remove dissolved pollutants. However, above-ground facilities have associated limitations and concerns. They may be a safety hazard to children and others and may require fencing, they typically require more land; and when not properly maintained, may become an eyesore.

Underground detention facilities are useful when land availability is an issue, they have no safety issues, and may be more aesthetically appropriate in some situations. These facilities are often more expensive to construct and more difficult to inspect and maintain.

5.3 INFILTRATION FACILITIES

Infiltration facilities include trenches, basins, and drain fields made of coarse granular material. Stormwater runoff is diverted to these facilities and is allowed to percolate into the underlying soils, thereby reducing the quantity of surface runoff. Physical treatment occurs as the stormwater is filtered through the infiltration material and native soil.

Infiltration facilities are effective in areas where the native soil conditions and the underlying groundwater table are conducive to percolation. These areas can be characterized generally as having medium or coarse textured soils and a deep groundwater table. Infiltration facilities are not effective in areas having fine textured soils or shallow groundwater tables because stormwater will not percolate rapidly into the subsurface in these areas. The use of infiltration

facilities may raise concerns in some areas about the potential for transporting pollutants to the groundwater.

In general, we do not recommend their use in the Willamina, because of unfavorable soil conditions and high groundwater.

5.4 SOURCE CONTROL BMPS

Source control BMPs are facilities included in storm sewer systems for water quality enhancement. They include sedimentation manholes, oil/water separators, and trapped catch basins. These BMPs provide water quality functions primarily through sedimentation. Oil/water separators and trapped catch basins also provide some removal of floating scum and oils.

The limitations associated with these facilities are:

they are only applicable where a storm sewer is in place,
they require routine maintenance, and
they are generally not large enough to provide stormwater detention.

5.5 VEGETATIVE PRACTICES

Vegetative practices are all stormwater control methods that utilize vegetation. They include water quality swales, filter strips, shallow marshes, site landscaping, and naturally occurring areas that are vegetated.

Vegetative practices are effective in removing pollutants from stormwater as a result of filtration, infiltration, absorption to soil particles, and biologic uptake of nutrients and trace elements. They have the added benefit of enhancing wildlife habitat value and reducing stormwater runoff velocity. Vegetated areas also allow direct percolation of rainfall into the ground, thereby reducing direct runoff.

Vegetative practices may not provide significant stormwater storage volumes for attenuation of peak flows. These facilities typically require routine maintenance such as mowing or plant harvesting, and may not be appropriate in some urban settings because of space limitations.

5.6 FACILITY DESIGN APPROVAL

A stormwater quality control facility shall be approved only if the following are met:

1. The plat, site plan, or permit application includes plans and a certification prepared by an Oregon registered professional engineer that the proposed stormwater quality control facilities have been designed in accordance with generally-accepted design criteria expected to achieve removal efficiencies of targeted pollutants.

2. A financial assurance, or equivalent security acceptable to the City, is provided by the application which assures that the stormwater quality control facilities are constructed according

to the plans established in the plat, site plan, or permit approval. The financial assurance may be combined with other financial assurance requirements imposed by the City.

3. An operation and maintenance plan documenting how the water quality facility will be maintained, and a statement as to who will be responsible for assuring the long-term compliance with the plan. A copy of the operation and maintenance plan shall be forwarded to the City no later than one month following construction of the water quality facility.

CHAPTER 6

City of Willamina
Stormwater Master Plan

OPERATION AND MAINTENANCE

6

6.1 EXISTING OPERATION AND MAINTENANCE PRACTICES

The City's Public Works Department is responsible for operating and maintaining storm water facilities. Facilities are maintained on a regular basis and as specific needs arise, but no formal maintenance schedule is currently followed. For example, catch basins are generally cleaned twice per year, or as conditions warrant. Catch basins that become clogged are cleaned immediately to prevent flooding. Inspection of facilities occurs as part of performing general maintenance activities in the community.

6.2 RECOMMENDED OPERATION AND MAINTENANCE PRACTICES

Many of the maintenance activities recommended below are currently practiced by City staff. However, we recommend that the City consider developing a more formalized maintenance program and schedule based on the approach outlined below. This approach consists of a preventative maintenance program, routine maintenance program, and a program for responding to emergency spills.

6.2.1 Preventative Maintenance

Preventative maintenance consists of all measures taken to prevent conditions from developing which would reduce the storm water system's ability to function properly. As noted above, many of these maintenance activities are currently being implemented.

Maintenance tasks for a preventative program would include:

- Street cleaning
- Leaf removal
- Garbage collection
- Hazardous waste collection
- Erosion control

The streets that have the most traffic should be cleaned most often because they collect greater amounts of sediment, debris, and other problem materials and pollutants. A City leaf removal program will reduce the potential for storm sewer blockage and subsequent flooding caused by leaf debris. Adequate garbage service should be provided to ensure that refuse is disposed of in a sanitary landfill and not washing down the storm drain. A municipally-sponsored hazardous waste program would give citizens the opportunity to drop off household wastes, such as motor oil, paint, pesticides, and herbicides, for proper disposal. Erosion control measures can be required by the City for construction projects as a condition of obtaining a building permit.

6.2.2 Routine Maintenance

Routine maintenance consists of maintenance practices that are done at regular intervals to ensure satisfactory performance of the storm water system. Specific tasks to be included in a routine maintenance program are discussed below.

Drainage channels should be maintained by removing debris and other materials that significantly impede storm water flow. Excessive sediment should also be removed and disposed of in a manner that will prevent future transport. Attention should be paid to controlling erosion in channels by maintaining vegetation and providing channel protection such as rip-rap, where necessary.

Pipes and culverts should be cleaned by flushing them with water, pulling a cleaning "pig" through them, or removing the obstructions with a hand tool. The conditions of pipes should be reviewed periodically by visual inspection and by using television equipment.

Storm water detention and treatment facilities should be maintained by removing excessive sediment, removing over-abundant plant material, repairing fences and other safety structures, inspecting erosion control features and adding protection where necessary, and inspecting and repairing inlet and outlet control structures. Sediment and excess vegetation should be disposed of properly to prevent future transport back into the storm sewer system.

Manholes should be inspected routinely. Where necessary, excess sediment should be removed. Manholes should also be used to inspect entrance and exit pipes for sediment build-up or structural failures.

Storm water catch basins, inlets and trash screens should be inspected regularly. Excessive sediment and debris should be removed to ensure that they do not become clogged.

A Maintenance Activity Schedule (Table 6-1) contains a listing of suggested maintenance activities and a schedule of frequency for the activities. It is intended to be used as a general guide by the City public works staff in developing a more specific maintenance activity schedule for the City, as staffing and funding allow.

6.3 DOCUMENTATION AND RECORDKEEPING

Documentation and recordkeeping is an important component in the operation and maintenance of the storm sewer system. This includes maintaining up-to-date maps of the system, storing as-built drawings of constructed components, keeping a maintenance log of when and where maintenance tasks are performed, and documenting problems in the system as they occur.

Table 6-1 Storm Water Facilities Maintenance Schedule

Maintenance Operation	SUGGESTED FREQUENCY					
	Weekly	Monthly	Quarterly	Bi-annually	Annually	As Needed
Preventative						
Street Cleaning				X		
Leaf Removal					X	
Garbage Collection	X					
Hazardous Waste Collection					X	
Erosion Control						X
Routine Maintenance						
Channels					X	
Pipes/Culverts					X	
Detention/Treatment Facilities				X		
Manholes					X	
Catch Basins/Inlets				X		

A large map of the existing storm sewer system in Willamina has been provided with this Plan. City staff should update this map as new construction occurs, and as field observation provides new or corrective information. As-built drawings for new construction should be kept in conjunction with the storm sewer map to provide additional detail in those specific locations

The City should keep a log of all maintenance tasks performed. The log would include the date, location, components maintained, time required to do maintenance, quantity of sediment or other materials removed, and space for additional comments.

Documentation of drainage problems occurring in the system should include both photographs and written statements. Photographs should show any problems that exist at the time, with particular attention given to erosion and flooding. The photographs should be dated and properly located on a sketch map of the area. Written statements indicating the problem or describing the conditions during a flood should be dated and properly signed by the person(s) making the observations. Additional information should include high-water elevations, flood profiles, estimate of low velocity, current direction, and sketch maps showing the extent of flooding. Also to be noted is what corrective actions were taken, if any. It should be noted that detailed field documentation is necessary in cases of property damage, in preparation of any claims or litigation that may result.

City of Willamina
Stormwater Master Plan

CHAPTER 7

City of Willamina
Stormwater Master Plan
DESIGN STANDARDS

7

7.1 ENGINEERING STANDARDS

7.1.1 DRAINAGE REQUIREMENTS

All stormwater runoff shall be conveyed to a public storm sewer or natural drainage channel. Receiving waters, including underground storm drainage systems, shall have adequate capacity to carry necessary flow without overflowing or causing damage to public property or welfare. The cost for the approved system shall be wholly borne by the developer, including any off-site system that is required.

A. Calculations

Drainage calculations performed and stamped by a Civil Engineer registered in the State of Oregon shall be included with all plan submittals. Peak design flows may be calculated using the Rational Formula, Q=CiA for basins under 100 acres. The Natural Resources Conservation Service (NRCS) TR-55 or other approved methods may be used for basins larger than 100 acres.

B. Design Storm

The following guidelines shall apply for selecting a design storm:

Design Element	Post-Development Storm Event for Conveyance	Post-Development Release Rate
Residential Area	25 year	5 year Pre-Development Rate*
Industrial Area	25 year	5 year Pre-Development Rate*
Commercial Area	25 year	5 year Pre-Development Rate*
Critical facilities, sag inlets, and minor drainage ways	50 year	N/A

* – Release rate requirements may vary at the discretion of the City Engineer depending on downstream conditions.

Major drainageways or waterways which have a 100-year delineated floodplain boundary as shown on the FIRM shall pass these events.

C. Rainfall Intensity-Duration-Frequency Curve

ODOT Rainfall Intensity-Duration-Frequency (Zone 8) curve shall be used to determine rainfall intensity when using Rational Method.

D. Runoff Coefficients for Rational Method

Land Use	Slope		
	< 2%	2% to 7%	> 7%
Agricultural	.15	.20	.25
Low Density Residential	.40	.45	.50
Medium Density Residential	.50	.50	.55
High Density Residential	.70	.70	.70
Commercial	.85	.85	.85
Light Industrial	.65	.65	.65
Heavy Industrial	.75	.75	.75
Parks and Open Spaces	.10	.15	.20
Mobile Home Parks	.60	.65	.70
Roofs and Paved Surfaces	.92	.92	.92
Woodland, Forests	.10	.15	.20
Meadows, Pastureland	.25	.30	.35
Unimproved Areas	.10	.20	.30

E. Time of Concentration

Time of Concentration shall be calculated using the Natural Resources Conservation Service (NRCS) Method or other approved method. Minimum time of concentration for the Rational Method is 10 minutes.

After a maximum of 300 feet, sheet flow typically becomes shallow concentrated flow. Open channel flow is assumed to begin where surveyed cross-section information has been obtained, where channels are visible on aerial photographs, or where blue lines (indicating streams) appear on United States Geological Survey (USGS) quadrangle sheets.

F. Detention Requirements

In general, development of areas of 0.5 acres and greater within the City of Willamina shall provide runoff control to limit the developed condition's peak rates of runoff for a 25-year storm event to the pre-development runoff rate of a 5-year storm event. Stricter requirements may be necessary at the discretion of the City Engineer based on downstream conditions.

Control orifices and structures shall be sized using approved engineering methods. To prevent plugging, the minimum diameter of the orifice shall be 2 inches. The detention facility shall have an overflow system with the capacity to safely pass the 25-year storm event to an accessible drainage feature.

Detention shall be supplied either by underground storage in conduits and structures, or with above-ground ponds. Underground detention facilities are preferred by the City Engineer due to maintenance issues. Temporary parking lot ponding may be utilized as storage volume with approval of the City Engineer.

Calculations for detention facilities shall be performed and stamped by a Civil Engineer registered in the State of Oregon, and shall be submitted with drainage calculations.

If, in the opinion of the City Engineer, the soil, topography, or other site condition make an on-site detention facility impractical or ineffective, any or all of the detention requirements may be waived by the City Engineer.

G. Storm Drainage Pipe

The minimum design velocity for storm drainage pipes shall be 3.0 fps when flowing half-full or full. Pipe slopes of 15% or greater require anchor walls at approved intervals. Manning's n value of 0.015 for concrete pipe and 0.013 for plastic pipe shall be used for flow and velocity calculations. Manning's equation shall be used for design of piped systems.

Standard pipe material is HDPE. Concrete and PVC pipe may be accepted at the discretion of the City Engineer.

No plastic pipe (except HDPE) shall be used for storm drains where petroleum products are encountered. When pipe depths exceed 10 feet, calculations for pipe loading and strength shall be submitted.

Public storm drainage lines crossing private property shall have a minimum easement width of 15 feet. Smaller easement widths may be allowed with approval from the City Engineer.

H. Manholes

Manholes are required at:

All changes in horizontal or vertical alignment greater than 15 degrees.
All connections and changes in pipe size.
At a maximum spacing of 500 feet.

I. Inlets and Catch Basins

Inlets must be placed at all low points in streets, at intersections, at points where changes in the street configuration will direct flow across the street, and at intervals on continuous grades that will limit the width of flow in the gutter to five feet for the specified design storm event. Inlets shall be sized to convey all flow in gutter for the design storm event.

Minimum lateral diameter for connection to an inlet or catch basin shall be 12 inches. Minimum inlet lead slopes shall be 0.02.
W1
Water from all low areas must be collected and conveyed to the storm drainage system.

J. Culverts

Culvert design shall be performed using the Federal Highway Administration publication Hydraulic Design of Highway Culverts. Other methods may be used with approval of the City Engineer.

7.2 BMP DESIGN STANDARDS

A. Water Quality Swale

The water quality storm event is defined as one-third of the 2-year storm event.

The swale width and profile shall be designed to convey the water quality design storm event at a maximum design depth of 6 inches, maximum design velocity of 0.9 feet per second, and minimum length of 100 feet using a Manning's 'n' value of 0.25.

Side slopes shall be no greater than 4:1 in the treatment area. A minimum of one foot of freeboard above the design water surface shall be proviced for facilities not protected by high flow storm diversion devices.

Longitudinal slope should be in the range 2 to 4 percent. Check dams should be installed if slope is greater than 4 percent, and underdrains should be installed if slopes are less than 2 percent.

The swale should have a hydraulic residence time of 9 minutes for the water quality design storm event.

The swale should use a flow spreading device at the inlet to provide uniform flow distribution across the swale bottom.

The swale should have a minimum bottom width of 4 feet. For swales wider than 8 feet, a flow spreading device should be installed every 100 feet.

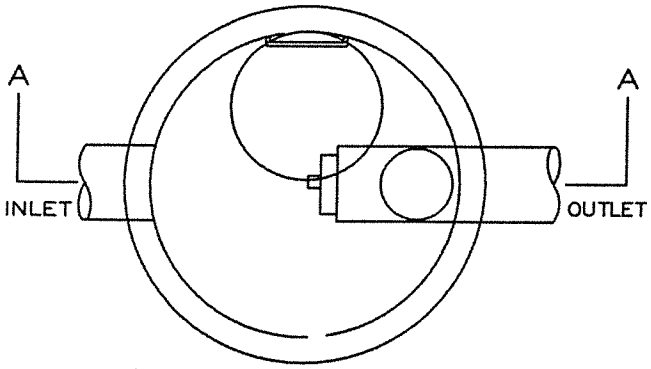
Grasses shall be established as soon as possible following construction of the swale. Select grass species that produce a cover of fine-hardy vegetation that can withstand the prevailing moisture and light condition. Seed mix should be a low-maintenance variety.

Mowing is necessary to keep grass in active growth phase, and to maintain dense cover. Normal grass height should be at least 2 inches above design flow depth.

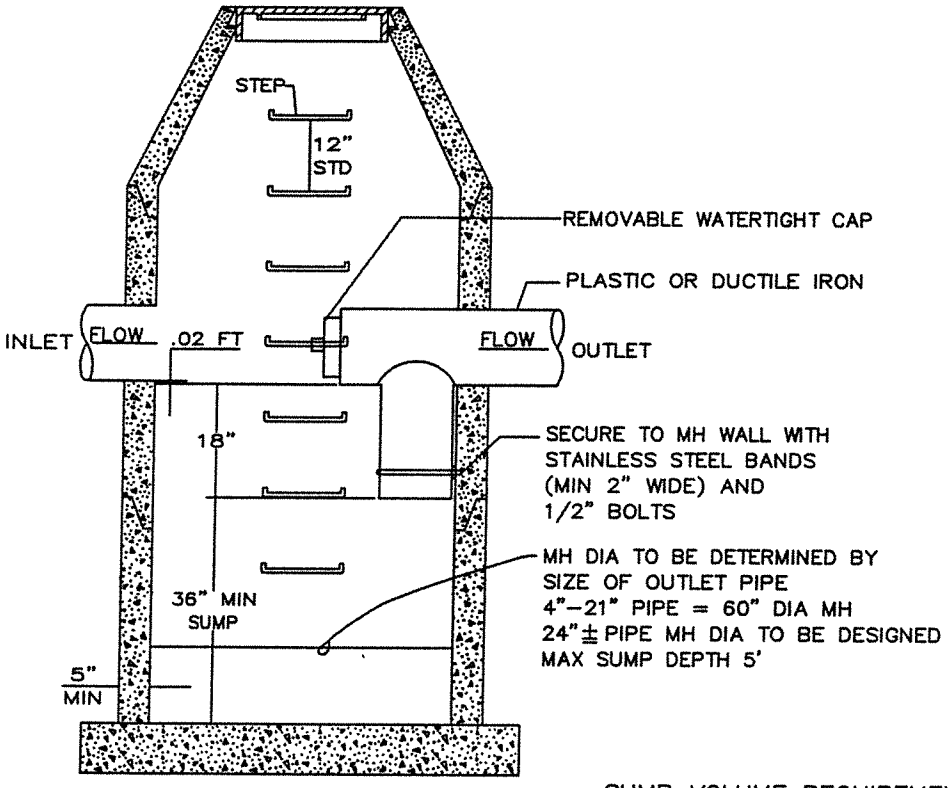
Sufficient access must be provided to the swale for maintenance activities.

B. Sedimentation Manhole

Sedimentation manholes shall be designed and constructed as shown in Figure 7-1.



PLAN



SECTION A–A

SUMP VOLUME REQUIREMENTS

SINGLE FAMILY RESIDENTIAL	3.5 CF/ACRE
MULTI FAMILY RESIDENTIAL	22.0 CF/ACRE
COMMERCIAL/INDUSTRIAL	94.0 CF/ACRE

SEDIMENTATION MANHOLE

DRAWING NO. 100–ST

FILE DRAFT: STORM SD DRAWING SD100ST 2/18/98 NL

City of Willamina
Stormwater Master Plan

CHAPTER 8

City of Willamina
Stormwater Master Plan

CAPITAL IMPROVEMENTS PLAN

8

8.1 CAPITAL IMPROVEMENT PLAN

Details of the proposed capital improvement projects are presented in the Chapter 3. Table 8-1 contains the Capital Improvements List. These cost estimates are based on present day conditions and are subject to change due to the effects of inflation.

Table 8-1 Capital Improvements List

Storm Drainage Improvement	Project Cost
Pioneer Drive	$202,648
Adams Street	$162,058
Bronson Street	$6,400
NE End of Barber	$41,590
Fifth and Churchman	$109,733
West Main Street	$133,674
Oaken Hills Drive	$154,583
Fourth and "D" Streets	$90,000
"D" Street Upgrade	$98,000
Monitoring Manholes	$12,000
Hill Drive	$24,000
Adams and James Streets	$94,200
Total Capital Improvements Cost	**$1,128,886**

8.2 FINANCING METHODS

8.2.1 Systems Development Charges (SDC's)

Since portions of the stormwater capital improvements may be financed through SDCs, it is useful to consider SDC development briefly. SDCs are developed by considering the percent of the proposed capital improvements which will benefit new development, and the amount of impervious area added as a result of new development.

SDC's are discussed in detail in Chapter 9.

8.2.2 Taxing Districts

Taxing districts are sometimes formed to fund projects in special, well-defined areas. These taxing districts are commonly referred to as local improvement districts (LIDs). They are often formed by property owners who see the need for infrastructure improvements that will specifically benefit their area and not the community as a whole. This type of financing is generally incidental when compared to the overall financing needs of a community.

8.2.3 Bonding

Bonds are long term notes issued by corporations or government entities for the purpose of financing major projects. The borrower receives money now, in return for a promise to pay later, with interest. The bonding powers of communities are often used to secure funding for large stormwater projects. This method of financing allows a community to obtain the needed capital quickly under the terms of a specific financial arrangement. Payment of the bond itself would be made with funds resulting from one of the other methods of financing discussed in this section of the report.

8.2.4 FEMA

FEMA is the acronym for the Federal Emergency Management Agency. This agency was established in May 1977 to follow up on the 1968 national Flood Insurance Act, the 1973 Flood Disaster Protection Act, and the 1969 National Environmental Policy Act. Their goal is the successful management of floodplains, public safety and the preservation of natural resources. FEMA funds projects which prevent recurring damage to public and private property.

8.2.5 Oregon Department of Transportation (ODOT)

Grant monies may be available through ODOT if the stormwater improvements are completed in conjunction with projects that would otherwise be funded through an existing grant program. These programs include grants for street and pedestrian improvements.

8.3 OPERATION AND MAINTENANCE COSTS

Maintenance costs have been evaluated by discussing staffing and budget with Mike Crafford, the City's Public Works Superintendent and by historic information of other communities.

In the future, maintenance costs will increase. Costs will increase as the community grows, and more facilities are added that must be maintained. For example, the local stormwater treatment facilities that are proposed in the capital improvement plan will require routine maintenance. Sediment, debris, and vegetation will have to be removed from these facilities to ensure that they function properly. Inlet and outlet control structures will have to be inspected and repaired if necessary.

City of Willamina
Stormwater Master Plan

CHAPTER 9

City of Willamina
Stormwater Master Plan

SYSTEMS DEVELOPMENT CHARGE

9

9.1 INTRODUCTION AND GENERAL INFORMATION

The storm drainage system is used to manage drainage within the City and to assist in controlling flooding. To the extent that new projects are undertaken to improve the quality of storm drainage for the existing city, the portion of the project not related to an increase in capacity is not included in the calculation of the storm drainage Systems Development Charge (SDC). Unused capacity in the system is valued at its current replacement value, less any share of the value that came from non-local sources or unpaid debt. New projects which are included in the Capital Improvement List and which increase capacity for the purpose of serving new development will be eligible for improvement fee funding.

9.2 CALCULATING IMPROVEMENT FEES

9.2.1 Methodology for Storm Drainage Improvement Fees

The following is the general methodology to calculate the Storm Drainage Improvement Fee SDC based on a per square foot of impervious area calculation. The SDC will be applied to all development based on building permit plans.

Steps in Calculating:

1. Determine SDC eligible project cost.

2. Translate design population into single- and multiple-family housing units based upon current development mix (see methodology for Water and Sewer SDCs). If design is based on a total square feet of impervious area, go to Step 5.

3. Determine average feet of impervious area for single- and multiple-family housing units.

4. Apply square feet of impervious area averages to housing units and add impervious area calculations by type to arrive at total amount for project.

5. Divide SDC eligible project cost by total square feet of impervious area to calculate Improvement Fee SDC.

9.2.2 Methodology for Storm Drainage Reimbursement Fees

The following is the general methodology to calculate the Storm Drainage Reimbursement Fee SDC based on a per square foot of impervious area calculation. The SDC will be applied to all development based on building permit plans.

Steps in Calculating:

1. Determine present replacement value of the facility and subtract any non-local share of value to determine total local share of present value.

2. Determine percent of capacity remaining in the component. Multiply result time total local share of value to produce the SDC eligible present replacement value of the unused capacity.

3. Translate design population into single- and multiple-family housing units based upon current development mix (see methodology for Water and Sewer SDCs). If design is based on a total square feet of impervious area, go to Step 6.

4. Determine average feet of impervious area for single- and multiple-family housing units.

5. Apply square feet of impervious area averages to housing units and add impervious area calculations by type to arrive at total amount for project.

6. Divide SDC eligible project cost by total square feet of impervious area to calculate Reimbursement Fee SDC.

Impervious Area Assumptions

At 1,500 square feet of house, plus 1,000 square feet of driveway and walkways, we assume a total of 2,500 square feet of impervious surface for the average single-family house.

At approximately 1,200 square feet per multi-family unit, plus required parking of 500 square feet per unit, an estimate of 1,750 square feet of impervious area per unit can be assumed.

Level of Development

Based on methodology developed for the Sewer and Water SDC's, the City presently has 1,070 EDU's. During the 20-year planning period, an additional 389 EDU's are expected. Assuming that all development will be single-family, which is a conservative assumption, an additional 972,500 square feet of impervious area will be developed (389 EDU x 2,500 SF/EDU = 972,500 SF).

9.3 REIMBURSEMENT FEES

A majority of the City's existing drainage system is at, or over, its design capacity. In addition, we found no outstanding bond issues relating to storm drainage projects. Thus, no reimbursement fees are available.

9.4 IMPROVEMENT FEES

The storm drainage master plan provides for improvements needed for present and future demands. The study evaluates six areas in depth, and provides a general overview of remaining areas. All projects proposed are based in a 20-year demand. Table 9-1 lists the capital improvements and calculates the applicable improvement fees.

Table 9-1 Storm Drainage SDC Improvement Fees

Storm Drainage Improvement	Project Cost	Development Percentage	Development Cost
Pioneer Drive	$202,648	80%	$162,118
Adams Street	$162,058	50%	$81,029
Bronson Street	$6,400	50%	$3,200
NE End of Barber	$41,590	40%	$16,636
Fifth and Churchman	$109,733	30%	$32,920
West Main Street	$133,674	10%	$13,337
Oaken Hills Drive	$154,583	50%	$77,292
Fourth and "D" Streets	$90,000	50%	$45,000
"D" Street Upgrade	$98,000	50%	$49,000
Monitoring Manholes	$12,000	0%	$0
Hill Drive	$24,000	100%	$24,000
Adams and James Streets	$94,200	100%	$94,200
Total Development Cost			**$598,732**
Total Impervious Area			**972,500**
STORM DRAINAGE SDC IMPROVEMENT FEE (MAX.)			**$0.62/SF**

Based upon the calculated maximum of $0.62/SF, the maximum fee for a single-family dwelling would be $1,550.

City of Willamina
Stormwater Master Plan

APPENDIX A

United States Environmental Protection Agency | Office of Water (4203) | EPA 833-F-99-001 April 1999 Fact Sheet 1.0

Storm Water Phase II Proposed Rule

An Overview

Storm Water Phase II Proposed Rule Fact Sheet Series

Overview

1.0 – Storm Water Phase II Proposed Rule Overview

Small MS4 Program

2.0 – Small MS4 Storm Water Program Overview

2.1 – Who's Covered? Designation and Waivers of Regulated Small MS4s

2.2 – Urbanized Areas: Definition and Description

Minimum Control Measures

2.3 – Public Education and Outreach Minimum Control Measure

2.4 – Public Participation/ Involvement Minimum Control Measure

2.5 – Illicit Discharge Detection and Elimination Minimum Control Measure

2.6 – Construction Site Runoff Control Minimum Control Measure

2.7 – Post-Construction Runoff Control Minimum Control Measure

2.8 – Pollution Prevention/Good Housekeeping Minimum Control Measure

2.9 – Permitting and Reporting: The Process and Requirements

2.10 – Federal and State-Owned MS4s: Program Implementation

Construction Program

3.0 – Construction Program Overview

Industrial "No Exposure"

4.0 – Conditional No Exposure Exemption for Industrial Activity

This fact sheet is based on the Storm Water Phase II Proposed Rule. Therefore, the information provided herein is subject to change upon publication of the final Phase II rule in November 1999. A revised series of fact sheets will be provided at that time. A comprehensive list of the current fact sheets is in the text box at left.

Why Is Phase II of EPA's Storm Water Program Necessary?

Since the passage of the Clean Water Act (CWA), the quality of our Nation's waters has improved dramatically. Despite this progress, however, degraded waterbodies still exist. According to the 1996 National Water Quality Inventory (Inventory), a biennial summary of State surveys of water quality, approximately 40 percent of surveyed U.S. waterbodies are still impaired by pollution and do not meet water quality standards. A leading source of this impairment is polluted runoff. In fact, according to the Inventory, 50 percent of impaired rivers are affected by urban/suburban and construction sources of storm water runoff.

Phase I of the U.S. Environmental Protection Agency's (EPA) storm water program was promulgated in 1990 under the CWA. Phase I relies on National Pollutant Discharge Elimination System (NPDES) permit coverage to address storm water runoff from: (1) "medium" and "large" municipal separate storm sewer systems (MS4s) generally serving populations of 100,000 or more people, (2) construction sites greater than 5 acres, and (3) ten categories of industrial sources.

The Storm Water Phase II Proposed Rule, published on January 9, 1998, is the next step in EPA's effort to preserve, protect, and improve the Nation's water resources from polluted storm water runoff. The Phase II proposed program would expand the existing Phase I program by requiring additional owners and operators of MS4s in urbanized areas and construction sites, through the use of NPDES permits, to implement programs and practices to control polluted storm water runoff. See Fact Sheets 2.0 and 3.0 for overviews of the proposed Phase II programs for MS4s and construction activity.

Phase II is intended to further reduce adverse impacts to water quality and aquatic habitat by instituting the use of controls on the still unregulated sources of storm water discharges that have the greatest likelihood of causing continued environmental degradation. The environmental problems associated with discharges from MS4s in urbanized areas and discharges resulting from construction activity are outlined below.

MS4s in Urbanized Areas

Discharges from MS4s in urbanized areas are a concern because of the high concentration of pollutants found in these discharges. Concentrated development in urbanized areas results in a proliferation of surfaces, such as city streets, driveways, parking lots ,and lawns, on which pollutants from concentrated human activities settle and remain until a storm event washes them into nearby storm drains. Common pollutants include pesticides, fertilizers, oils, salt, litter and other debris, and sediment. Another concern is the possible illicit connections of sanitary sewers, which can result in fecal coliform bacteria entering the storm sewer system. Storm water runoff picks up and transports these and other harmful pollutants then discharges them – untreated – to waterways via storm sewer systems. When left uncontrolled, these discharges can result in fish kills, the destruction of spawning habitats, a loss in aesthetic value, and contamination of drinking water supplies and recreational waterways that can threaten public health.

Construction Activity

Uncontrolled runoff from construction sites is a water quality concern because of the devastating effects that sedimentation can have on local waterbodies, particularly small streams. Numerous studies have shown that the amount of sediment transported by storm water runoff from construction sites with no controls is significantly greater than from sites with controls. In addition to sediment, construction activities yield pollutants such as pesticides, petroleum products, construction chemicals, solvents, asphalts, and acids that can contaminate storm water runoff. During storms, construction sites may be the source of sediment-laden runoff, which can overwhelm a small stream channel's capacity, resulting in streambed scour, streambank erosion, and destruction of near-stream vegetative cover. Where left uncontrolled, sediment-laden runoff has been shown to result in the loss of in-stream habitats for fish and other aquatic species, an increased difficulty in filtering drinking water, the loss of drinking water reservoir storage capacity, and negative impacts on the navigational capacity of waterways.

What Is the Difference Between the Phase II Proposed Rule and the Interim Phase II Rule?

The Phase II Proposed Rule, when final, will supersede the interim Phase II storm water rule published on August 7, 1995 (60 FR 40230), which requires all unregulated (non-Phase I) storm water dischargers to apply for NPDES permit coverage by August 7, 2001. The Phase II Proposed Rule would narrow the universe of covered dischargers and extend their deadline for NPDES permit coverage to 3 years and 90 days from the publication of the rule (expected in November 1999).

Would Municipally Owned or Operated Sources Exempted by the Intermodal Surface Transportation Efficiency Act (ISTEA) of 1991 Be Affected by the Proposed Rule?

Provisions within ISTEA temporarily exempted Phase I industrial activities owned or operated by municipalities with populations less than 100,000 people (with the exception of power plants, airports, and uncontrolled sanitary landfills) from the need to apply for or obtain a storm water discharge permit. Congress extended the permitting moratorium for these facilities to allow small municipalities additional time to comply with NPDES requirements. The interim Phase II rule set a deadline of August 7, 2001, for these facilities to submit a permit application, thereby ending this temporary exemption. The Phase II Proposed Rule would maintain this deadline for all ISTEA-exempted municipally owned or operated industrial activities (e.g., treatment works treating domestic sewage with a design flow of 1.0 mgd or more, or those required to have an approved pretreatment program) to be covered under an NPDES storm water permit.

How Was the Phase II Proposed Rule Developed?

EPA developed the Phase II Proposed Rule during extensive consultations with a cross-section of interested stakeholders brought together on a subcommittee chartered under the Federal Advisory Committee Act, and with representatives of small entities participating in an advisory process mandated under the Small Business Regulatory Enforcement Fairness Act. EPA considered and attempted to address the primary concerns of the participating State, Tribal, municipal, industrial, and environmental representatives in the proposed preamble and rule language.

Why Does Part of the Phase II Proposed Rule Use a Question and Answer Format?

The provisions pertaining to owners or operators of small MS4s were written in a "readable regulation" form that uses the "plain language" method. Questions and answers are used to create more reader-friendly and understandable regulations. The plain language method uses "must" instead of "shall" to indicate a requirement and words like "should," "could," or "encourage" to indicate a recommendation or guidance. Also, the readable regulation format allows guidance to be included with rule requirements. Such guidance is enclosed in parentheses and directly follows the requirements it explains.

Who Would Be Covered by the Phase II Proposed Rule?

The proposal would automatically cover two classes of storm water dischargers on a nationwide basis:

(1) Owners or operators of small MS4s located in "urbanized areas" as defined by the Bureau of the Census. A "small" MS4 is any MS4 not already covered by Phase I of the NPDES storm water program. See Fact Sheets 2.1 and 2.2 for more information on small MS4 coverage.

(2) Owners or operators of construction activities that disturb equal to or greater than 1 (one) and less than 5 (five) acres of land. See Fact Sheet 3.0 for more information on construction activity coverage.

Waivers

Phase II dischargers designated on a nationwide basis would be eligible to certify for a waiver from the Phase II program requirements if they meet the necessary criteria. See Fact Sheets 2.1 (small MS4 waiver) and 3.0 (construction waivers) for details.

Additional Designations by the Permitting Authority

Small MS4s located outside of urbanized areas and construction activity disturbing less than 1 acre, as well as any non-Phase I industrial sources, could be designated for coverage by the NPDES permitting authority on a case-by-case basis where watershed plans, total maximum daily loads (TMDLs) analyses, or other local water quality assessments identify a need to control these sources of storm water runoff. See Fact Sheet 2.1 for more information on the proposal to require evaluation, and potential designation, of certain small MS4s located outside of urbanized areas.

What Would Be Required by the Phase II Proposed Rule?

Owners or operators of Phase II-designated small MS4s and construction activity would be required to apply for NPDES permit coverage, most likely under a general rather than individual permit, and to implement storm water discharge management controls, commonly referred to as best management practices (BMPs). Specific requirements proposed for each type of discharge are listed below.

Small MS4s

- A regulated small MS4 owner or operator would need to develop and implement a storm water management program designed to reduce the discharge of pollutants from their MS4 to the "maximum extent practicable" and to protect water quality. The proposal assumes the use of narrative, rather than numeric, effluent limitations in the form of measurable goals.
- The small MS4storm water management program would need to include the following six minimum control measures: public education and outreach; public participation/ involvement; illicit discharge detection and elimination; construction site runoff control; post-construction runoff control; and pollution prevention/good housekeeping. See Fact Sheets 2.3 through 2.8 for more information on each measure, including BMPs and measurable goals.
- A regulated small MS4 owner or operator would need to include their selection of BMPs and measurable goals for each minimum measure in their permit application. The evaluation and assessment of those chosen BMPs and measurable goals would then need to be included in periodic reports to the NPDES permitting authority. See Fact Sheet 2.9 for more information on permitting and reporting.

Construction Activity

- The specific requirements for storm water controls on Phase II construction activity would be defined by the NPDES permitting authority on a State-by-State basis.
- It is anticipated that NPDES permitting authorities would use their existing Phase I general permits for construction activity as a guide for their Phase II permits. If this occurs, a storm water pollution prevention plan would likely need to be developed for each construction site. See Fact Sheet 3.0 for more information on potential program requirements and appropriate BMPs for Phase II construction activity.

What Is the Proposed Phase II Program Approach?

The proposed Phase II program, based on the use of federally enforceable NPDES permits:

- Encourages the use of general permits;
- Provides flexibility for regulated owners and operators to determine the most appropriate storm water controls;
- Allows for the recognition and inclusion of existing NPDES and non-NPDES storm water programs in Phase II permits;
- Includes public education and participation efforts as primary elements of the small MS4 program;
- Attempts to facilitate and promote watershed planning and to implement the storm water program on a watershed basis; and
- Works toward a unified and comprehensive storm water program with the existing NPDES Storm Water Phase I program.

How Would the Phase II Proposed Rule Address the Phase I Industrial "No Exposure" Provision?

In addition to the designation of two classes of new sources, Phase II addresses the "no exposure" provision originally included in the 1990 regulations for Phase I of the NPDES storm water program (see 40 CFR 122.26(b)(14)). This provision was remanded to EPA for further rulemaking and, subsequently, included in its revised form in the Phase II proposal.

Under the proposal, a conditional no exposure exemption would be made available to owners or operators of *all* categories of Phase I regulated industrial activity (except category (x) construction activity and facilities individually designated by the NPDES permitting authority) who can certify that industrial materials, material handling operations, and industrial processes are not exposed to storm water. The proposal includes a *No Exposure Certification Checklist* that is intended to be submitted to the NPDES permitting authority for approval. See Fact Sheet 4.0 for more information on the no exposure exemption.

What Is the Proposed Phase II Program Implementation "Tool Box?"

EPA is committed to providing tools to facilitate implementation of the final Phase II storm water program in an effective and cost-efficient manner. The "tool box" is expected to include the following components:

- Fact Sheets;
- Guidance Documents;
- Information Clearinghouse/Web Site;
- Training and Outreach Efforts;
- Technical Research; and
- Support for Demonstration Projects.

EPA plans to have a preliminary working toolbox in place by the time the final Phase II rule is published. Three years after publication of the final rule, when the general permits are issued, a fully operational tool box is scheduled to be available.

In addition to these tools, the American Public Works Association (APWA) currently is conducting introductory workshops on the Storm Water Phase II Proposed Rule. For more information on workshop dates, locations, and registration, call APWA at 202 393-2792, or visit: www.apwa.net/education/edu-3202.htm.

What Is the Proposed Phase II Schedule?

- The final Phase II rule is scheduled for publication in the *Federal Register* in November 1999.
- The Conditional No Exposure Exemption option would be available immediately upon publication of the final rule.
- The NPDES permitting authority would issue general permits for Phase II-designated small MS4s and construction activity within 3 years from the date of publication of the final rule.
- Owners or operators of Phase II-designated small MS4s and construction activity would obtain permit coverage within 3 years and 90 days of publication of the final rule.
- The regulated small MS4s would fully implement their storm water management programs by the end of the first permit term, typically a 5-year period.

For Additional Information

Contacts

- U.S. EPA Office of Wastewater Management
  - Phone : 202 260-5816
  - E-mail: SW2@epa.gov
  - Internet: www.epa.gov/owm/sw2.htm
- Your NPDES Permitting Authority. (A list of names and telephone numbers for each U.S. EPA Region is included in Fact Sheet 2.9. This list, including State storm water contacts, can be obtained by contacting the U.S. EPA Office of Wastewater Management.)

Reference Documents

- Storm Water Phase II Proposed Rule Fact Sheet Series.
  - Contact the U.S. EPA Water Resource Center at 202 260-7786 or at waterpubs@epa.gov
  - Internet: www.epa.gov/owm/sw2.htm
- Storm Water Phase II Proposed Rule, published on Jan. 9, 1998 in the *Federal Register* (63 FR 1536).
  - Internet: www.epa.gov/owm/sw2.htm

City of Willamina
Stormwater Master Plan

APPENDIX B

ORDINANCE NO. 567

AN ORDINANCE PROVIDING FOR THE ESTABLISHMENT OF SYSTEM DEVELOPMENT CHARGE (SDC) FEES, PROCEDURES FOR COLLECTING AND DISPENSING SDC FEES, AND DECLARING AN EMERGENCY.

THE CITY OF WILLAMINA, OREGON ORDAINS AS FOLLOWS:

SECTION 1. PURPOSE

The purpose of the system development charge is to impose a portion of the cost of capital improvements for water, wastewater, drainage, streets, flood control, and parks and recreation upon those developments that create the need for, or increase the demands on capital improvements.

SECTION 2. SCOPE

The system development charge imposed by this ordinance is separate from and in addition to any applicable tax, assessment, charge or fee otherwise provided by law or imposed as a condition of development.

SECTION 3. DEFINITIONS

For purposes of this ordinance, the following mean:

(1) "Capital improvements", means facilities or assets used for:

(a) Water supply, treatment and distribution;

(b) Wastewater-collection, transmission, treatment and disposal;

(c) Drainage and flood control;

(d) Transportation; or

(e) Parks and recreation.

(2) "City Administrator" shall mean City Recorder, in the case where the City does not have a City Administrator on staff.

(3) "Development" means a building or mining operation making a physical change in the use or appearance of a structure or land, dividing land into two or more parcels (including partitions and subdivisions), and creating or termination of a right of access.

(4) "Improvement fee" means a fee for costs associated with capital improvements to be constructed after the date the fee is adopted pursuant to this ordinance.

(5) "Land area" means the area of a parcel of land as measured by projection of the parcel boundaries upon a horizontal plane with the exception of a portion of the parcel within a recorded right-of-way, or easement subject to a servitude for a public street or scenic or preservation purpose.

(6) "Owner" means the owner or owners of record title or the purchaser or purchases under a recorded sales agreement and other persons having an interest of record in the described real property.

(7) "Parcel of land" means a lot, parcel, block, or other tract of land that is occupied or may be occupied by a structure, or structures or other use, and that includes the yards and other open spaces required under the zoning, subdivision, or other development ordinance.

(8) "Qualified public improvement" means a capital improvement that is:

(a) Required as a condition of residential development approval;

(b) Identified in the improvement plan adopted pursuant to this ordinance, and

(c) Not located on or contiguous to a parcel of land that is the subject of the residential development approval.

(9) "Reimbursement fee" means a fee for costs associated with capital improvements constructed or under construction on the date the fee is adopted pursuant to Section 4.

(10) "System development charge" means a reimbursement fee, an improvement fee or a combination thereof assessed or collected at the time of increased usage of a capital improvement, at the time of issuance of a development permit or building permit, or at the time of connection to the capital improvement. System development charge includes that portion of a sewer or water system connection charge that is greater than the amount necessary to reimburse the City for its average cost of inspecting and installing connections with water and sewer facilities. "System development charge, does not include fees assessed or collected as part of a local improvement district or a charge in lieu of a local improvement district assessment, or the cost of complying with requirements or conditions imposed by a land use decision.

SECTION 4. SYSTEM DEVELOPMENT CHARGE ESTABLISHED

(1) System development charges shall be established and may be revised by resolution of the Council.

(2) Unless otherwise exempted by the provisions of the ordinance, or other local or state law, a system development charge is imposed upon all persons who develop parcels of land that connect to or which will otherwise use or create a need for the sewer facilities, storm sewers, water facilities, streets, or parks and open spaces of the City.

SECTION 5. METHODOLOGY

(1) The methodology used to establish the reimbursement fee shall consider the cost of then existing facilities, prior contributions by then existing users, the value of unused capacity, rate making principals employed to finance publicly owned capital improvements, and other relevant factors identified by the Council. The methodology shall promote the objective that future systems users shall contribute no more than an equitable share of the cost of then existing facilities.

(2) The methodology used to establish the improvement fee shall consider the cost of projected capital improvements needed to increase the capacity of the systems to which the fee is related.

(3) The methodology used to establish the improvement fee or the reimbursement fee, or both, shall be contained in a resolution adopted by the Council.

SECTION 6. AUTHORIZED EXPENDITURES

(1) Reimbursement fees shall be applied only to capital improvements associated with the systems for which the fees are assessed, including expenditures relating to repayment of indebtedness.

(2) Improvement fees.

(a) Improvement fees shall be spent only on improvements associated with the systems for which the fees are assessed, including expenditures relating to repayment of indebtedness;

(b) A capital improvement being funded wholly, or in part from revenues derived from the improvement fee shall be included in the improvement plan adopted by the City pursuant to this ordinance.

(3) Notwithstanding subsection (1) and (2) of this section, system development charge revenues may be expended on the direct costs of complying with the provisions of this ordinance, including the costs of developing system development charge methodologies and providing an annual accounting of system development charge expenditures.

SECTION 7. EXPENDITURE RESTRICTIONS

(1) System development charges shall not be expended for costs associated with the construction of administrative office facilities that are more than an incidental part of other capital improvements.

(2) System development charges shall not be expended for costs of the operation or routine maintenance of capital improvements.

SECTION 8. IMPROVEMENT PLAN

The Council shall adopt a plan by resolution that:

(1) Lists the capital improvements that may be funded with improvement fee revenues;

(2) List the estimated cost and time of construction of each improvement; and

(3) Describes the process for modifying the plan.

SECTION 9. COLLECTION OF CHARGE

(1) The system development charge is payable upon issuance of:

(a) A building permit;

(b) A permit to connect to the water system; or

(c) A permit to connect to the sewer system.

(2) If development is commenced or connection is made to the water or sewer systems without an appropriate permit, the system development charge is immediately payable upon the earliest date that a permit was required.

(3) The City administrator, or his designee, shall collect the applicable system development charge when a permit that allows the building or development of a parcel is issued, or when a connection to the water or sewer system of the City is made.

(4) The City administrator, or his designee, shall not issue such permit or allow such connection until the charge has been paid in full, or until provision for installment payments has been made pursuant to Section 11, or unless an exemption is granted pursuant to Section 12.

SECTION 10. DELINQUENT CHARGES - HEARINGS

(1) When, for any reason, the system development charge has not been paid, the City administrator shall report to the Council the amount of the uncollected charge, the description of the real property to which the charge is attributable, the date upon which the charge was due, and the name of the person responsible for the payment of the fee.

(2) The City Council shall schedule a public hearing on the matter and direct that notice of the hearing be given to each owner or person responsible for payment of the fee, with a copy of the City administrator's report concerning the unpaid charge. Notice of the hearing shall be given either personally, or by certified mail, return receipt requested, or by both personal and mailed notice and by posting notice on the parcel at least ten (10) days before the date set for the hearing.

(3) At the hearing, the Council may accept, reject, or modify the determination of the City administrator as set forth in the report.

(4) The City recorder shall report to the City administrator the amount of the system development charge, the date on which the payment is due, the name of the owner, and the description of the parcel.

SECTION 11. INSTALLMENT PAYMENT

(1) When a system development charge of twenty-five dollars or more is due and collectible, the owner of the parcel of land subject to the development charge may apply for payment in at least ten semi-annual installments, to include interest on the unpaid balance, in accordance with Oregon Revised Statutes 223.208.

(2) The City recorder shall provide application forms for installment payments which shall include a waiver of all rights to contest the validity of the lien, except for the correction of computational errors.

(3) An applicant for installment payment shall have the burden of demonstrating the applicant's authority to assent to the imposition of a lien on the parcel and that the interest of the applicant is adequate to secure payment of the lien.

(4) The City recorder shall report to the City administrator the amount of the system development charge, the dates on which the payments are due, the name of the owner, and the description of the parcel.

(5) The City administrator shall docket the lien in the lien docket. From that time, the City shall have a lien upon the described parcel for the amount of the system development charge, together with interest on the unpaid balance at the rate established by resolution of the Council. The lien shall be enforceable in the manner provided in Oregon Revised Statutes Chapter 223.

SECTION 12. EXEMPTIONS, REDUCTIONS AND WAIVERS

(1) Structures and uses established and existing on or before July 1, 1991, are exempt from system development charges imposed by this ordinance, except water and sewer charge, to the extent of the structure or use then existing and to the extent of the parcel of land as it is constituted on that date. Structure and uses affected by this subsection shall pay the water or sewer charges pursuant to the terms of this ordinance upon the receipt of a permit to connect to the water or sewer system.

(2) Additions to single-family dwellings that do not constitute the addition of a dwelling unit, as defined by the State Uniform Building Code, are exempt from all portions of the system development charge.

(3) An alteration, addition, replacement or change in use that does not increase the parcel's or structure's use of the public improvement facility is exempt from all portions of the system development charge.

SECTION 13. CREDITS

(1) A system development charge shall be imposed when a change of use of a parcel or structure occurs, but credit shall be given for the computed system development charge to the extent that prior structures existed and services were established on or before July 1, 1991. The credit so computed shall not exceed the calculated system development charge. No refund shall be made on account of such credit.

(2) A credit shall be given for the cost of a qualified public improvement which is located partially on and partially off the parcel that is the subject of the residential development approval. The credit shall be given only for the cost of the portion of the improvement not located on or wholly contiguous to the property. The credit provided for by this subsection shall be only for the improvement fee charges for the type of improvement being constructed and shall not exceed the improvement fee even if the cost of the capital improvement exceeds the applicable improvement fee.

(3) Credit shall not be transferable from one development to another, except in compliance with standards adopted by the City Council.

(4) Credit shall not be transferable from one type of capital improvement to another.

SECTION 14. SEGREGATION AND USE OF REVENUE

(1) All funds derived from a particular type of system development charge are to be segregated by accounting practices from all other funds of the City. That portion of the system development charge calculated and collected on account of a specific facility system shall be used for no purpose other than those set forth in Section 6.

(2) The City administrator shall provide the City Council with an annual accounting, based on the City's fiscal year, for system development charges showing the total amount of system development charge revenues collected for each type of facility and the projects funded from each account.

SECTION 15. APPEAL PROCEDURE

(1) A person challenging the propriety of an expenditure of system development charge revenues may appeal the decision of the expenditure to the City Council by filing a written request with the City administrator describing with particularity the decision and the expenditure from which the person appeals. AN appeal of an expenditure must be filed within two years of the date of the alleged improper expenditure.

(2) Appeals of any other decision required or permitted to be made by the City administrator under this ordinance must be filed within ten days of the date of the decision.

(3) After providing notice to the appellant, the Council shall determine whether the City administrator's decision or the expenditure is in accordance with this ordinance and the provision of Oregon Revised Statutes 223.297 to 233.314 and may affirm, modify or overrule the decision. If the Council determines that there has been an improper expenditure of system development charge revenues, the Council shall direct that a sum equal to the misspent amount shall be deposited within one year to the credit of the account or fund from which it was spent.

SECTION 16. PROHIBITED CONNECTION

(1) No person may connect to the water or sewer systems of the City, unless the appropriate system development charge has been paid, or the installment payment method has been applied for and approved.

(2) Any person found to be violating any provision of this ordinance shall be served by the City of Willamina with written notice stating the nature of the violation and providing a reasonable time limit for the satisfactory correction. The offender shall, within the period of time stated in such notice, permanently cease all violations. Any person who shall continue any violation beyond the time limit provided for, upon conviction thereof before the Municipal Judge, shall be fined in an amount not to exceed Two Hundred Dollars ($200.00) for each violation. Each day in which any such violation shall continue shall be deemed a separate offense. Any person violating any of the provision of this ordinance shall become liable to the City of Willamina for any expense, loss or damage occasioned by the City of Willamina by reason of such violation.

SECTION 17. VALIDITY

The invalidity of any section, clause, sentence or provision of this ordinance shall not affect the validity of any other part of this ordinance which can be given effect without such invalid part or parts.

SECTION 18. EMERGENCY CLAUSE

The Council desires and deems it necessary for the preservation of the health, peace and safety of the City of Willamina, Oregon that this ordinance take effect at once, and therefore, an emergency is hereby declared to exist, and this ordinance shall be in full force and effect from and after its passage and approval.

PASSED BY THE CITY COUNCIL OF THE CITY OF WILLAMINA, OREGON ON THIS 27TH DAY OF OCTOBER, 1994, BY THE FOLLOWING VOTE;

AYES: Councilors Eddy, Goff, Greb, Horne

NAYES: None

SUBMITTED AND APPROVED BY THE MAYOR THIS 27TH DAY OF OCTOBER, 1994.

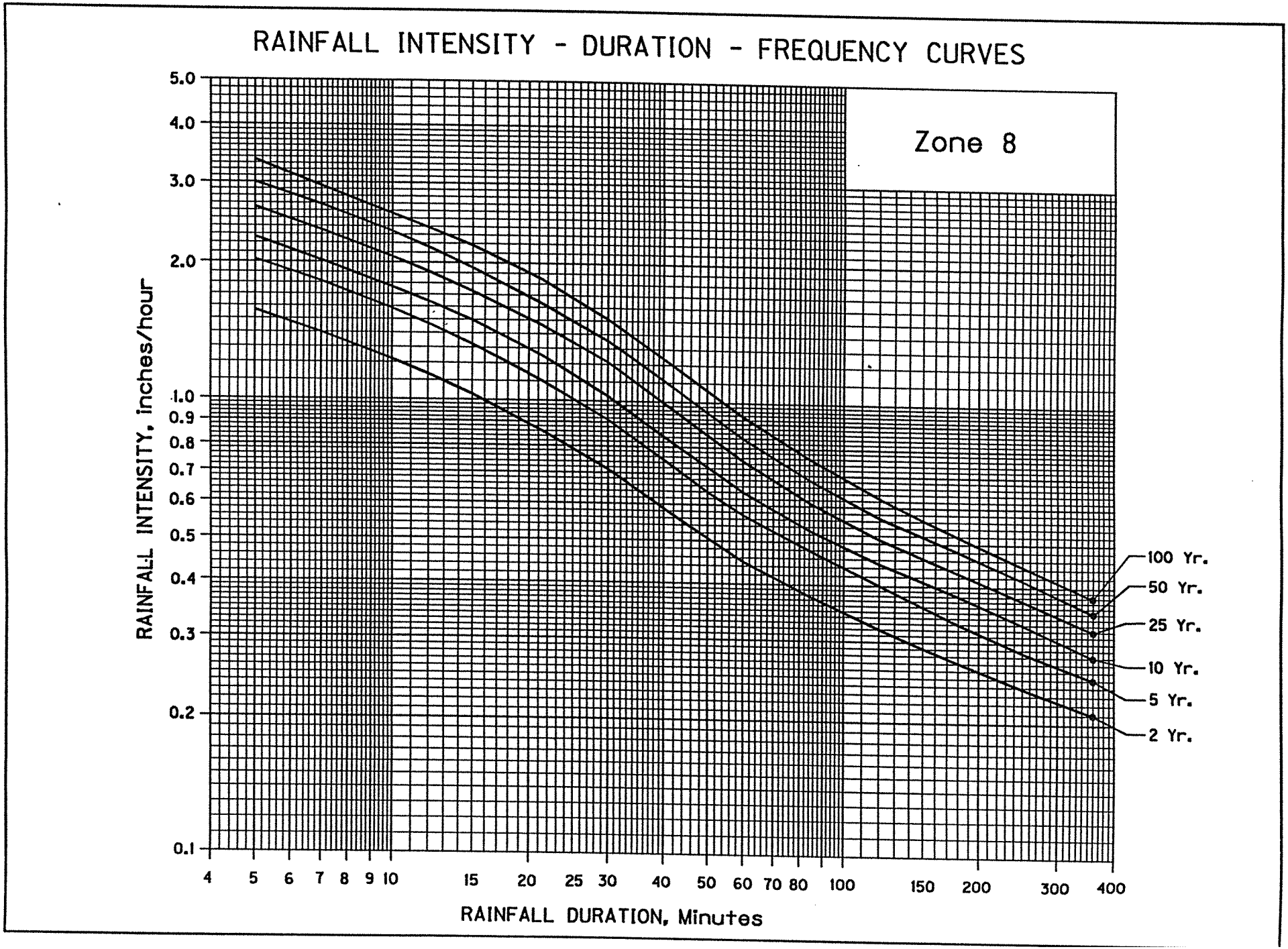
Mayor

ATTEST:

City Recorder

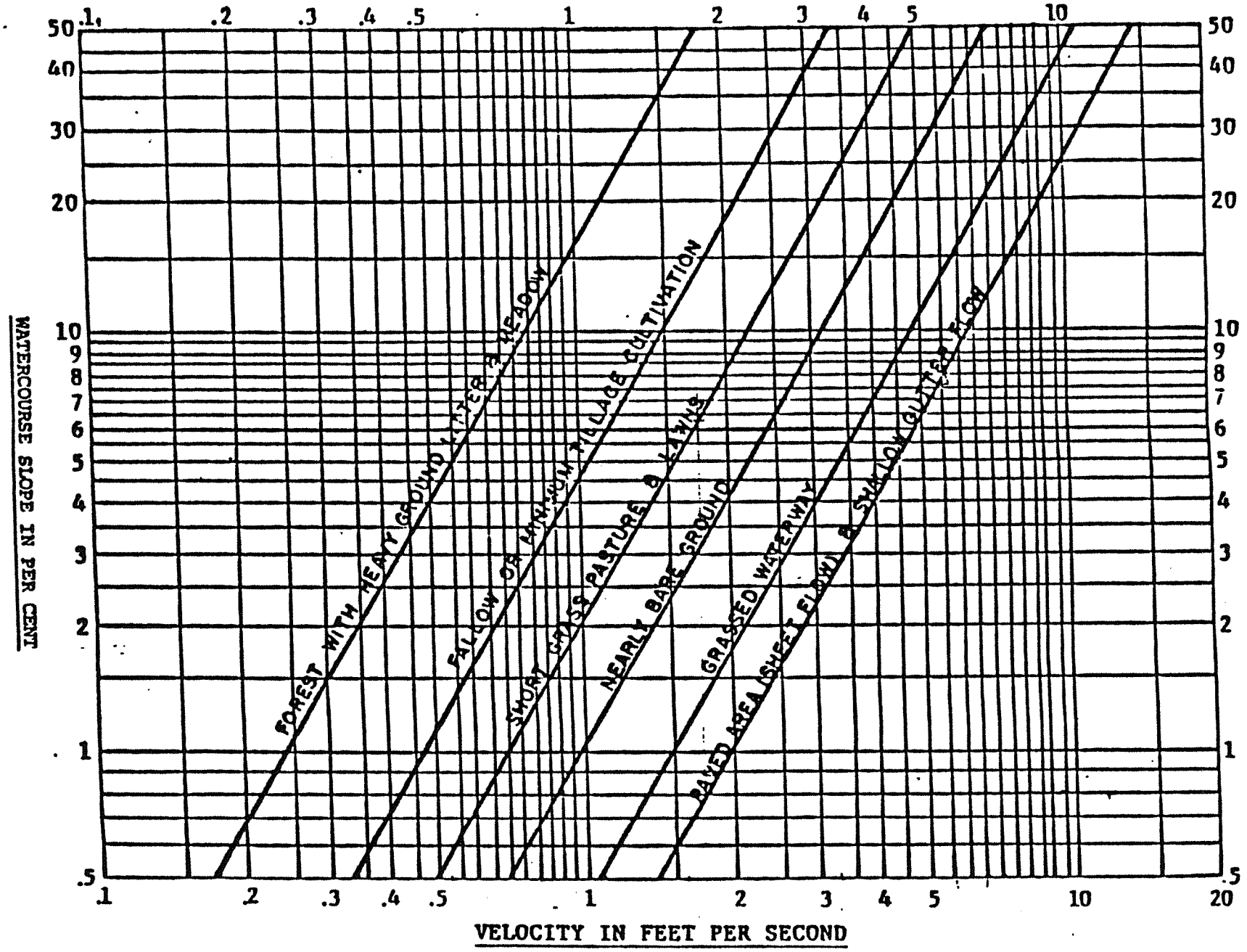
City of Willamina
Stormwater Master Plan

APPENDIX C


RAINFALL INTENSITY - DURATION - FREQUENCY CURVES
Zone 8
RAINFALL INTENSITY, inches/hour
5.0
4.0
3.0
2.0
1.0
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
4 5 6 7 8 9 10 15 20 25 30 40 50 60 70 80 100 150 200 300 400
RAINFALL DURATION, Minutes
100 Yr.
50 Yr.
25 Yr.
10 Yr.
5 Yr.
2 Yr.

DOT Zone 8 IDF Curve Tabular Data (Dundee)

Rainfall Duration (Min)	Rainfall Intensity, inches/hour				
	5 year Storm	10 year Storm	25 year Storm	50 year Storm	100 year Storm
5	2.01	2.25	2.63	3.00	3.35
6	1.90	2.12	2.50	2.81	3.12
7	1.81	2.01	2.35	2.68	2.95
8	1.71	1.91	2.24	2.55	2.80
9	1.65	1.83	2.14	2.43	2.69
10	1.60	1.78	2.07	2.33	2.58
11	1.51	1.70	1.98	2.25	2.48
12	1.48	1.65	1.90	2.18	2.40
13	1.41	1.60	1.85	2.10	2.31
14	1.38	1.55	1.79	2.01	2.24
15	1.32	1.50	1.72	1.95	2.19
20	1.13	1.30	1.50	1.69	1.90
25	1.00	1.14	1.35	1.50	1.69
30	0.91	1.02	1.21	1.36	1.51
35	0.82	0.92	1.10	1.21	1.38
40	0.75	0.84	0.98	1.11	1.24
45	0.69	0.78	0.92	1.02	1.15
50	0.64	0.73	0.85	0.95	1.08
55	0.60	0.68	0.80	0.89	1.00
60	0.57	0.64	0.75	0.84	0.94
70	0.53	0.59	0.68	0.76	0.85
80	0.49	0.54	0.63	0.70	0.78
90	0.46	0.52	0.59	0.66	0.74
100	0.44	0.49	0.56	0.62	0.69
110	0.42	0.47	0.53	0.60	0.66
120	0.40	0.45	0.51	0.57	0.63
130	0.385	0.44	0.49	0.55	0.60
140	0.37	0.42	0.48	0.53	0.58
150	0.36	0.41	0.46	0.52	0.56
160	0.35	0.40	0.45	0.50	0.54
170	0.34	0.39	0.44	0.49	0.53
180	0.33	0.38	0.43	0.48	0.52



AVERAGE VELOCITIES FOR ESTIMATING TRAVEL TIME FOR OVERLAND FLOW

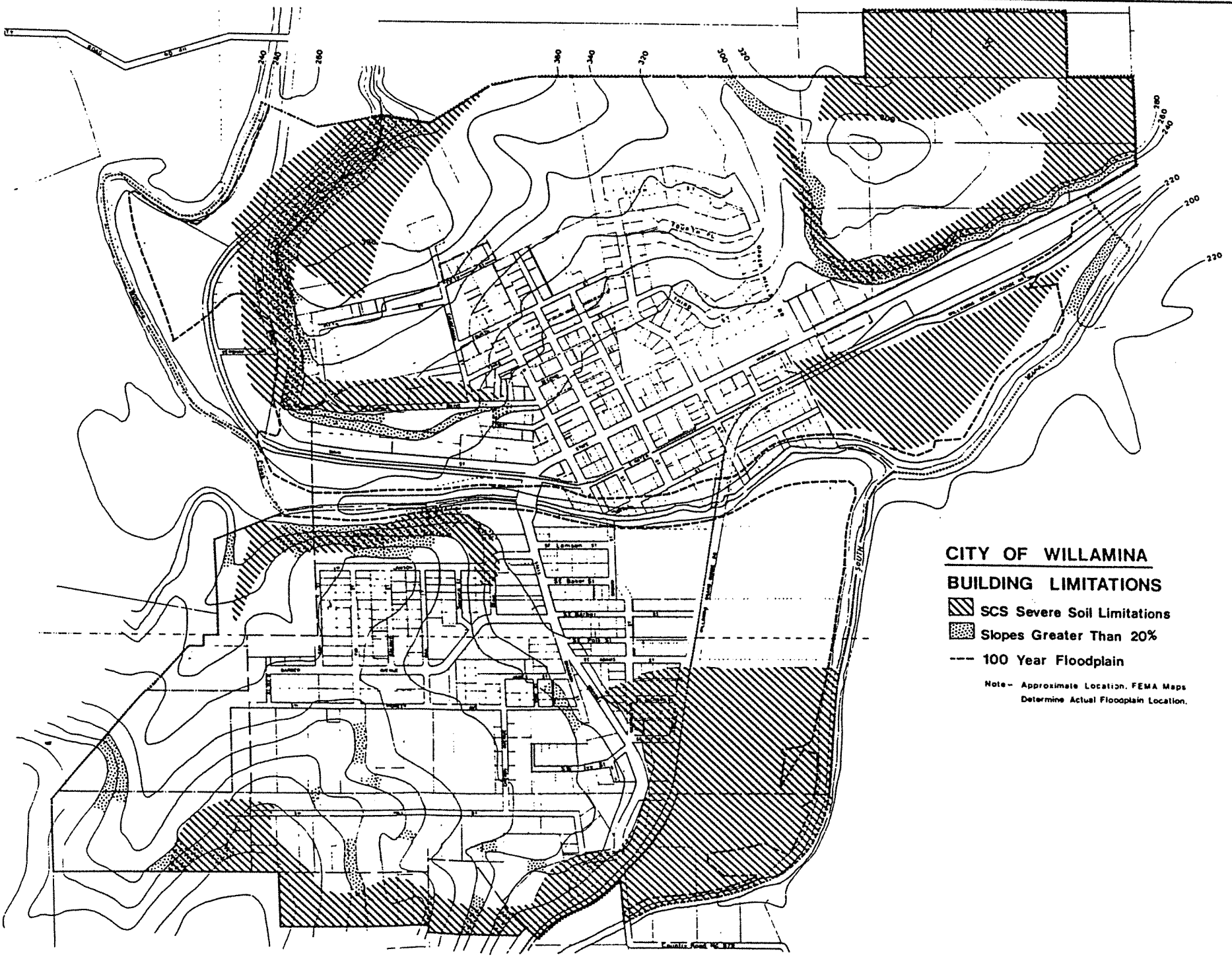
Table 2.1

RUNOFF COEFFICIENTS FOR THE RATIONAL METHOD

	FLAT	ROLLING 2% - 10%	HILLY OVER 10%
Pavement & Roofs	0.90	0.90	0.90
Earth Shoulders	0.50	0.50	0.50
Drives & Walks	0.75	0.80	0.85
Gravel Pavement	0.50	0.55	0.60
City Business Areas	0.80	0.85	0.85
Apartment Dwelling Areas	0.50	0.60	0.70
Light Residential: 1 to 3 units/ac.	0.35	0.40	0.45
Normal Residential: 3 to 6 units/ac.	0.50	0.55	0.60
Dense Residential: 6 to 15 units/ac.	0.70	0.75	0.80
Lawns	0.17	0.22	0.35
Grass Shoulders	0.25	0.25	0.25
Side Slopes, Earth	0.60	0.60	0.60
Side Slopes, Turf	0.30	0.30	0.30
Median Areas, Turf	0.25	0.30	0.30
Cultivated Land, Clay & Loam	0.50	0.55	0.60
Cultivated Land, Sand & Gravel	0.25	0.30	0.35
Industrial Areas, Light	0.50	0.70	0.80
Industrial Areas, Heavy	0.60	0.80	0.90
Parks & Cemeteries	0.10	0.15	0.25
Playgrounds	0.20	0.25	0.30
Woodland & Forests	0.10	0.15	0.20
Meadows & Pasture Land	0.25	0.30	0.35
Unimproved Areas	0.10	0.20	0.30

2.4.7.2 Rainfall Intensity "i"

The rainfall intensity "i" indicates the severity of the rainfall. Rainfall intensity is related to the rainfall duration and the statistical recurrence interval of the design storm. In the rational method the rainfall intensity corresponding to a duration equal to the time of concentration (Sec. 2.4.7.3) is used to calculate the peak flow. The rainfall intensity can be selected from the appropriate intensity-duration-frequency (I-D-F) curve found in Appendix 2.A.


CITY OF WILLAMINA
BUILDING LIMITATIONS
SCS Severe Soil Limitations
Slopes Greater Than 20%
100 Year Floodplain
Note- Approximate Location. FEMA Maps Determine Actual Floodplain Location.