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August 23, 2006

To: Hearings Official

Subject: Testimony for Dillard Heights PUD Public Hearing

This testimony is in regard to the proposed Dillard Heights PUD located in the headwaters of Amazon Creek. As a resident of Eugene and a professional Hydrologist, I am concerned about the potential on-site and off-site adverse environmental impacts associated with this proposal. I have over 15 years experience working as a Hydrologist for the federal government. My professional responsibilities include assessing the potential impacts of proposed projects on stream flow, water quality, and slope stability.

I am particularly concerned about the increase in peak stream flows that will result if this project is approved as proposed. The Dillard Heights Storm Drain Study prepared by Olson & Morris (July 18, 2006) contains several inaccuracies that result in an under estimation of pre- and post-development peak runoff. The proposed PUD does not adequately analyze the potential for increased peak flows to exceed the capacity of the existing downstream infrastructure. In addition, the mitigation measures proposed to reduce the adverse impacts associated with high peak flows are inadequate and in the long-term are likely to fail resulting in a risk to public safety and damage to property both on- and off-site. High runoff events have already resulted in significant damage to waterways in the upper Amazon basin at the current level of development. The development proposed by this PUD will increase the rate of degradation of stream channels in the basin.

The proposed development will also contribute to further degradation of water quality in Amazon Creek and its tributaries. Amazon Creek is already listed as "water quality limited" under section 303(d) of the Federal Clean Water Act for three different parameters. This proposed development has the potential to degrade water quality further and increase the risk that Amazon Creek would be listed for additional parameters in the future.

The proposed development also has the potential to contribute to unstable slopes located on the PUD site and steep down-slope areas. Even at the current level of development in this headwater area, there are numerous indicators of unstable slopes. The proposed cuts and fills, tree removal and increases in peak flows have a high potential to increase instability of the steep slopes of the area.

Olson & Morris Dillard Heights Storm Drain Study

The storm drain study contains several flawed assumptions that result in an under estimation of the potential peak runoff from the PUD site. The information for the existing site condition incorrectly indicates a Hydrologic Soil Group (HSG) of B. A soil in HSG B is composed of "Silt Loam or Loam" (USDA, TR-55, Appendix A, p. A-1). These soils are described as "moderately well to well drained soils" (Appendix A, p. A-1). Soil survey information for the PUD area (attachment 1) indicates that the soils are classified primarily as Hazilair Silty Clay Loam. Soils with that classification are included in Hydrologic Soil Group D (USDA, TR-55, Appendix A, p. A-17). A soil in HSG D is composed of "Clay loam, silty clay loam, sandy clay, silty clay, or clay" and are described as "soils have high runoff potential. They have very low infiltration rates when thoroughly wetted and consist chiefly of clay soils" (USDA, TR-55, Appendix A, p. A-1). The incorrect designation of the soils in the PUD are as HSG B by Olson and & Morris resulted in a runoff Curve Number (CN) too low to adequately predict the potential peak runoff from the site.

Tables 1 and 2 display corrected values that accurately portray the potential peak runoff conditions during a 10-year precipitation event. Table 1 shows calculations made using the T-55 methodology to estimate peak runoff pre-development. The peak flow value calculated using this method is nearly identical to the pre-development value presented by Olson & Morris (3.63 cfs and 3.65 respectively). However, when the correct HSG and associated curve number is used, the potential runoff more than doubles to 7.59 cfs. Similarly in the post development calculations submitted by Olson & Morris the incorrect low runoff curve number contributed substantially to and under estimation of peak flows. Table 2 presents peak discharge values with runoff curve numbers that more accurately represent the site conditions post development by "Subcatchment Area" as described by Olson & Morris. Below is a comparison of the peak discharge with the correct soils classification compare to the values presented by Olson & Morris.

Subcatchment (Sub-area name)	Peak discharge q_p (ft^3/s) using correct HSG and CN	Peak discharge q_p (ft^3/s) as presented by Olson and Morris
1	1.00	0.54
2	0.98	0.87
3	1.73	1.05
4	0.88	0.41
5	1.15	1.09
6	0.54	0.47
7	0.28	0.24
8	2.87	1.36

As can be seen in the values presented above, the flawed soil property assumptions resulted in incorrect estimates of pre- and post-development runoff. Because the post development numbers used by Olson & Morris significantly under estimate peak runoff potential, the values used to size mitigation measures resulted in a flawed a design for storm water detention. During a high runoff event the capacity of the proposed storm water detention facilities would quickly be overwhelmed.

Even under the flow values presented by Olson & Morris, the mitigation measures for storm water detention would in the long-term prove to be inadequate and would also require frequent maintenance. For example, the proposed mitigations submitted by Olson and Morris rely on detention of runoff behind check-dams in the ditch. In my professional career I also have been involved with the design and installation of check-dams. My experience has demonstrated that in steeply sloped areas with a high erosion potential (such as the Dillard Heights PUD area) these check dams would quickly fill with sediment during a large storm and provide no water detention capacity. Attached Figures 3 and 4 show steep bare soil areas on the cutbank above the ditch on the down-slope portion of the PUD that have a high potential for sediment delivery to the ditches resulting in a high probability that the check-dams would quickly fill with sediment. After these check-dams have filled with sediment the correct slope determination for the ditchline would be the existing 6%. Under these conditions the velocity of the runoff in the ditch would approximate that expected in a grassed waterway. The velocity of the ditch runoff would them more likely be 3.25 feet/second (Oregon Department of Transportation Hydraulics Manual, Figure 2.3, p. 14, attached) not the average flow velocity of 0.5 feet per second as stated in the report by Olson & Morris. This more rapid runoff would result in more rapid delivery of water to downstream areas increasing the probability that the system capacity would be overwhelmed.

Although the report by Olson & Morris states that system downstream capacity (37.7 cfs at MH 65304) is adequate for the expected runoff from the PUD area. After the corrected runoff values are considered, there is a significant possibility that the downstream capacity will be exceed. The damage done by exceeding the capacity of the downstream infrastructure represents a significant risk to public health and safety including an increased risk of slope failure and stormwater or flood hazard in violation of EC 9.8320(6).

Table 1. Calculations of peak discharge for the existing condition (pre-development) using corrected Hydrologic Soil Group and associated curve number

Sub-area name	Drainage area A_m (mi^2)	Time of concentration (hr)	24-hr rainfall P (in)	Runoff curve number CN	Runoff Q (in)	A_mQ	Initial abstraction I_a (in)	I_a/P	Unit peak discharge q_u (csm/in)	Peak discharge q_p (ft^3/s)
Existing condition with incorrect CN[1]	0.0171	0.5	4.3	74	1.85	0.0316	0.703	0.1635	115	3.63
Existing condition corrected CN[2]	0.0171	0.5	4.3	87	2.90	0.0496	0.290	0.0674	153	7.59

[1] Calculations by Al Johnson using same CN as used by Olson & Morris in the Dillard Heights Storm Drain Study, July 18, 2006

[2] Calculations by Al Johnson using Hydrologic Soils Group by soil series (USDA Urban Hydrology for Small Watersheds (TR-55), Appendix 1, p. A-1 and A-17) and corrected curve number from TR-55 (Table 2-2c).

Table 2. Calculations of peak discharge by sub-area post development using corrected Hydrologic Soil Group and associated curve number (procedures and values according to TR-55)

Sub-area name	Drainage area A_m (mi^2)	Time of concentration (hr)	24-hr rainfall P (in)	Runoff curve number CN	Runoff Q (in)	A_mQ	Initial abstraction I_a (in)	I_a/P	Unit peak discharge q_u (csm/in)	Peak discharge q_p (ft^3/s)
1	0.0019	0.167	4.3	87	3.10	0.0059	0.299	0.070	170	1.00
2	0.0018	0.083	4.3	87[1]	3.10	0.0056	0.299	0.070	175	0.98
3	0.0030	0.167	4.3	90	3.20	0.0096	0.222	0.052	180	1.73
4	0.0016	0.167	4.3	87	3.10	0.0050	0.299	0.070	175	0.88
5	0.0020	0.083	4.3	90[1]	3.20	0.0064	0.222	0.052	180	1.15
6	0.0010	0.083	4.3	87[1]	3.10	0.0031	0.299	0.070	175	0.54
7	0.0005	0.083	4.3	87[1]	3.10	0.0016	0.299	0.070	175	0.28
8	0.0053	0.167	4.3	87	3.10	0.0164	0.299	0.070	175	2.87

[1] Same CN as used by Olson & Morris in the Dillard Heights Storm Drain Study, July 18, 2006

Degradation of Stream Channels

Streams can be considered a transport system that in addition to water also moves masses of sediment from higher to lower elevation. Stream Power, reduced to it's simplest terms, is a product of discharge (Q) and the slope of the channel and multiplied by a constant, the specific weight of water. An increase in discharge results in a higher capacity of the stream to transport sediment and degrade channel beds and banks. The Dillard Heights PUD area contributes runoff to channels immediately down stream within the East Fork of Amazon Creek. The amount of existing development in this area has already contributed to a degradation of stream channel conditions. Photo 1 shows a deeply incised stream channel (gulley approximately 8 feet deep) downstream of the Dillard Heights PUD. This stream and others display indications of recent downcutting and active erosion. Erosion of the bed and banks of these streams is currently adding additional sediment and increasing turbidity in downstream areas including the mainstem of Amazon Creek. The Metrowaterways Study, a multi-year study being conducted by the U.S. Army Corps of Engineers, Lane County, and the cities of Eugene and Springfield is focused on determining the function and health of waterways in the greater metropolitan area. Amazon Creek has been identified as a Priority Planning corridor in this study. Key observations of a draft report on the Amazon Creek Planning Area indicate that headwater streams in the Amazon Creek basin are suffering from extensive and severe erosion, scouring, and large scale bank failure (Metrowaterways Draft Report, February 1, 2006). The movement of sediment off site from these stream channels has adverse effects on the entire length of Amazon Creek. Even at the current level of development, channels downstream of the Dillard Heights PUD are exhibiting these degraded conditions. Further upslope development will contribute to an increase in channel degradation.

Photo 1. Currently degrading channel downstream of the Dillard Heights PUD.

Water Quality

Amazon Creek is currently listed as "water quality limited" under section 303(d) of the Federal Clean Water Act for three parameters; Arsenic, Lead, and E. Coli. As noted in the Key Observations for the Amazon Creek Priority Planning Area for the Metrowaterways Study (Feburary 1, 2006), "pollutants of concern" also include low dissolved oxygen, toxins, temperature and turbidity in Amazon Creek. Although the proposed PUD has the potential to adversely affect all of these parameters, the most notable adverse effect would likely be from an increase in erosion of stream channels including those immediately downstream of the PUD site. In addition to adverse effects on stream channels, sediments (particularly clay particles) have the potential to adversely affect the entire length of Amazon Creek and Fern Ridge Reservoir due to and increase in turbidity.

Slope Stability

As channels downstream of the PUD area experience further bank erosion and downcutting, this will significantly increase the risk of landslides. It is possible that some of these slope failures could be relatively large catastrophic events that endanger public safety down-slope. Even with the current degree of development, evidence of slope failure potential is evident. Attached Figures 1 and 2 show some of the indicators visible on the surface of Dillard Road immediately adjacent to the PUD area. These indicators include road surface cracking indicating a failing sub-grade and guard rail deformations as the supporting posts fail. Both incremental soil erosion or catastrophic slope fail have the potential to adversely affect water quality downstream on the PUD area.

Comments on Staff Report

Roadside ditch runoff – the report indicates that the Public Works staff conceptually approves the applicant's stormwater drainage proposal. (p. III-27). For reason previously stated I urge city staff to re-evaluate that position. The proposed rip-rap and check-dams would ultimately fail to prevent further erosion, scouring, and turbidity due to increased in flow and turbidity.

The staff report states:
"we also observed numerous bent trees scattered throughout the entire forested areas of the project site. Bends in nearly all of the trees observed did not generally seem to face any particular direction nor significantly correlate with directions or magnitude of ground slope or subsurface conditions that might cause slope movement. This substantiates our general experience regarding bent trees – bent trees do not necessarily have anything to do with slope movement." (p. III-8).

In my professional opinion, the staff that made these observations did not adequately analyze the situation. Trees bent in seemingly random directions often is an indication of potentially unstable slopes particularly of deep seated land flows. The rational stated in the staff report that bent trees scattered throughout the site were affected by sunlight in a dense canopy, disease, or other physical is not consistent with my observations of the site or other forested areas exhibiting indicators of unstable slopes.

AC Johnson

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USDA

United States
Department of
Agriculture

**Natural
Resources
Conservation
Service**

**Conservation
Engineering
Division**

Technical
Release 55

June 1986

Urban Hydrology for Small Watersheds

TR-55

To show bookmarks which navigate through the document.

Click the show/hide navigation pane button ▤, and then click the bookmarks tab. It will navigate you to the contents, chapters, rainfall maps, and printable forms.

Table 2-2c Runoff curve numbers for other agricultural lands [1]

Cover description		Curve numbers for hydrologic soil group			
Cover type	Hydrologic condition	A	B	C	D
Pasture, grassland, or range—continuous forage for grazing. [2]	Poor	68	79	86	89
	Fair	49	69	79	84
	Good	39	61	74	80
Meadow—continuous grass, protected from grazing and generally mowed for hay.	—	30	58	71	78
Brush—brush-weed-grass mixture with brush the major element. [3]	Poor	48	67	77	83
	Fair	35	56	70	77
	Good	30 [4]	48	65	73
Woods—grass combination (orchard or tree farm). [5]	Poor	57	73	82	86
	Fair	43	65	76	82
	Good	32	58	72	79
Woods. [6]	Poor	45	66	77	83
	Fair	36	60	73	79
	Good	30 [4]	55	70	77
Farmsteads—buildings, lanes, driveways, and surrounding lots.	—	59	74	82	86

[1] Average runoff condition, and $I_a = 0.2S$.

[2] *Poor:* <50%) ground cover or heavily grazed with no mulch.
Fair: 50 to 75% ground cover and not heavily grazed.
Good: > 75% ground cover and lightly or only occasionally grazed.

[3] *Poor:* <50% ground cover.
Fair: 50 to 75% ground cover.
Good: >75% ground cover.

[4] Actual curve number is less than 30; use CN = 30 for runoff computations.

[5] CN's shown were computed for areas with 50% woods and 50% grass (pasture) cover. Other combinations of conditions may be computed from the CN's for woods and pasture.

[6] *Poor:* Forest litter, small trees, and brush are destroyed by heavy grazing or regular burning.
Fair: Woods are grazed but not burned, and some forest litter covers the soil.
Good: Woods are protected from grazing, and litter and brush adequately cover the soil.

Appendix A Hydrologic Soil Groups

Soils are classified into hydrologic soil groups (HSG's) to indicate the minimum rate of infiltration obtained for bare soil after prolonged wetting. The HSG's, which are A, B, C, and D, are one element used in determining runoff curve numbers (see chapter 2). For the convenience of TR-55 users, exhibit A-1 lists the HSG classification of United States soils.

The infiltration rate is the rate at which water enters the soil at the soil surface. It is controlled by surface conditions. HSG also indicates the transmission rate—the rate at which the water moves within the soil. This rate is controlled by the soil profile. Approximate numerical ranges for transmission rates shown in the HSG definitions were first published by Musgrave (USDA 1955). The four groups are defined by SCS soil scientists as follows:

Group A soils have low runoff potential and high infiltration rates even when thoroughly wetted. They consist chiefly of deep, well to excessively drained sand or gravel and have a high rate of water transmission (greater than 0.30 in/hr).

Group B soils have moderate infiltration rates when thoroughly wetted and consist chiefly of moderately deep to deep, moderately well to well drained soils with moderately fine to moderately coarse textures. These soils have a moderate rate of water transmission (0.15-0.30 in/hr).

Group C soils have low infiltration rates when thoroughly wetted and consist chiefly of soils with a layer that impedes downward movement of water and soils with moderately fine to fine texture. These soils have a low rate of water transmission (0.05-0.15 in/hr).

Group D soils have high runoff potential. They have very low infiltration rates when thoroughly wetted and consist chiefly of clay soils with a high swelling potential, soils with a permanent high water table, soils with a claypan or clay layer at or near the surface, and shallow soils over nearly impervious material. These soils have a very low rate of water transmission (0-0.05 in/hr).

In exhibit A-1, some of the listed soils have an added modifier; for example, "Abrazo, gravelly." This refers to a gravelly phase of the Abrazo series that is found in SCS soil map legends.

Disturbed soil profiles

As a result of urbanization, the soil profile may be considerably altered and the listed group classification may no longer apply. In these circumstances, use the following to determine HSG according to the texture of the new surface soil, provided that significant compaction has not occurred (Brakensiek and Rawls 1983).

HSG	*Soil textures*
A	Sand, loamy sand, or sandy loam
B	Silt loam or loam
C	Sandy clay loam
D	Clay loam, silty clay loam, sandy clay, silty clay, or clay

Drainage and group D soils

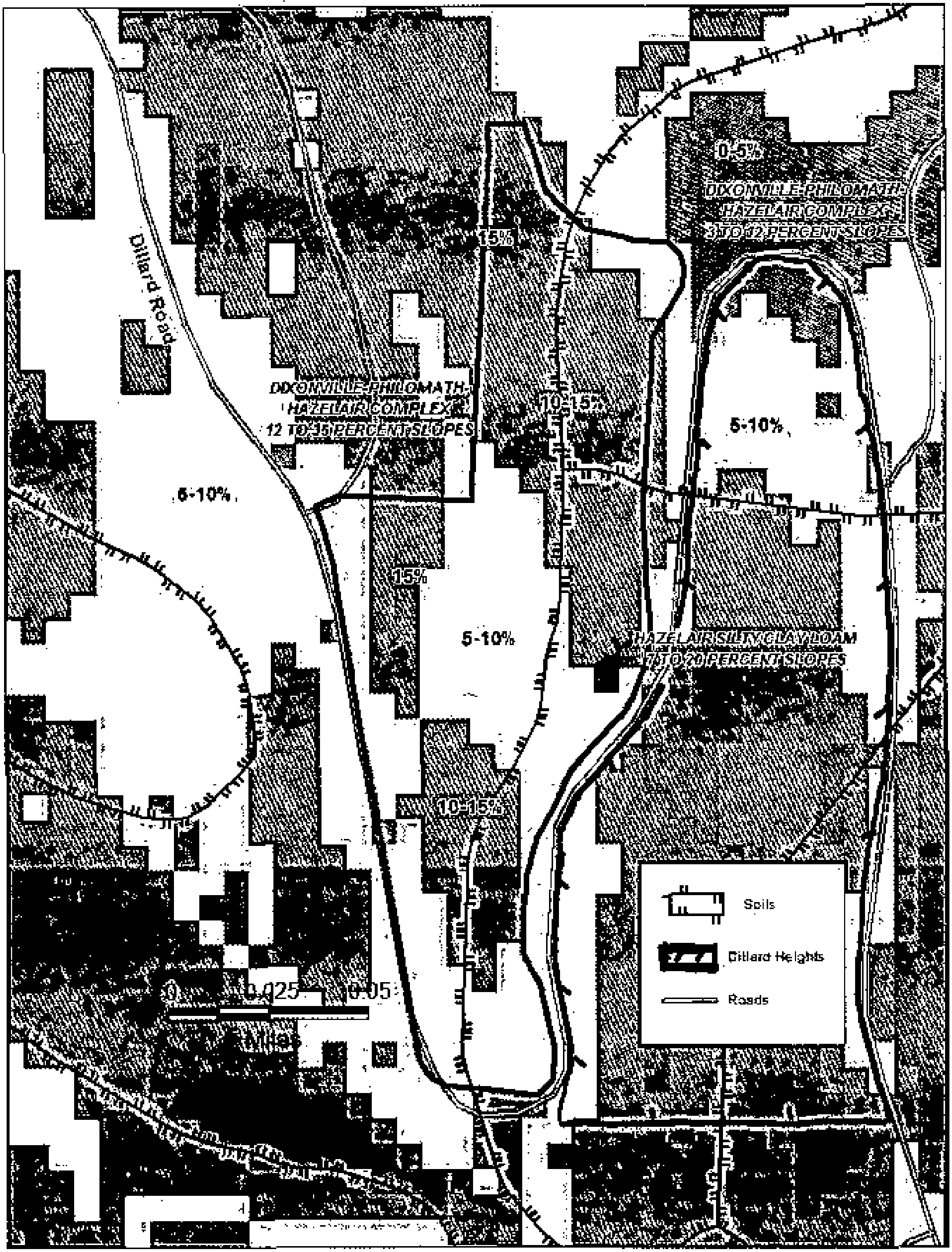
Some soils in the list are in group D because of a high water table that creates a drainage problem. Once these soils are effectively drained, they are placed in a different group. For example, Ackerman soil is classified as A/D. This indicates that the drained Ackerman soil is in group A and the undrained soil is in group D.

Exhibit A: Hydrologic Soil Groups for the United States

HARECREEK	B
HARGILL	B
HARGREAVE	B
HARJO	D
HARKEN	C
HARL	B
HARLAKE	D
HARLESTON	C
HARM	D
HARMILLER	B
HARNEY	B
HARPER	D
HARPERSVILLE	D
HARPETH	B
HARPOLE	A
HARPOLE	B
HARPS	C
HARPT	B
HARRAH	B
HARREL	B
HARRIMAN	C
HARRINGTON	C
HARRIS	D
HARRISBURG	D
HARRISON	B
HARROD	B
HARSLOW	C
HARSTINE	C
HART	C
HARTEN	C
HARTFORD	A
HARTLAND	B
HARTLESS	B
HARTNIT	C
HARTOP	B
HARTSELLS	B
HARTSHORN	B
HARTWELL	D
HARTWICK	A
HARTZ	B
HARVESTER	B
HARVEY	C
HASKILL	B
HASLIE	A/D
HASSEE	D
HASSELL	C
HASSLER	C
HASSMAN	D
HASTEE	D
HAT	C
HATBORO	D
HATCH	D
HATCHERY	C
HATCHET	B
HATCHIE	C
HATERMUS	D
HATERTON	C
HATFIELD	C
HATHAWAY	B
HATKNOLL	B
HATLIFF	C
HATMAKER	C
HATRANCH	D
HATSPRING	C
HATTON	C
HATU	D
HATUR	C
HATWAI	C
HAUBSTADT	C
HAUG	B/D
HAUGAN	B
HAUGEN	B
HAULINGS	D
HAUZ	C
HAVA	C
HAVANA	B
HAVELOCK	B/D
HAVEN	B
HAVENSNECK	B
HAVERDAD	C
HAVERHILL	D
HAVERMOM	B
HAVERSID	B
HAVERTEL	B
HAVILAND	B
HAWICK	A
HAWKEYE	A
HAWKSNEST	C/D
HAWKSPRINGS	B
HAWKSTONE	B
HAWLEY	B
HAWTHORNE	B
HAXBY	C
HAYCRIK	C
HAYES	B
HAYESTON	B
HAYESVILLE	B
HAYESVILLE, Stony	C
HAYFORD	C
HAYLAND	C
HAYNAP	A
HAYNER	C
HAYNESS	B
HAYRACK	C
HAYRIVER	B
HAYSPUR	D
HAYSTACK	B
HAYSTORE	C
HAYSUM	B
HAYTI	D
HAYWIRE	C
HAZCLAIR	D
HAZELCAMP	B
HAZEN	B
HAZLEHURST	C
HAZTON	D
HEADLEY	B
HEADQUARTERS	B
HEAKE	D
HEALDTON	D
HEALING	B
HEAPO	B
HEAPO	C
HEARNE	D
HEATH	D
HEATHCOAT	D
HEATLY	A
HEATON	A
HEBBRONVILLE	B
HEBER	A
HEBO	D
HECETA	D
HECHTMAN	D
HECKLER	B
HECKISON	D
HECKLY	C
HEDGE	D
HEDSTROM	B
HEDVILLE	D
HEELAND	D
HEELY	B
HEESER	B
HEEFD	B
HEFLIN	B
HEGGE	D
HEGLAR	B
HEIDEL	B
HEIGHTS	B/D
HEIL	D
HEINSAW	C
HEINZ	B
HEISLER	B
HEISSPITZ	D
HEITT	C
HEIZER	D
HELEMANO	B
HELLGATE	B
HELLMAN	C
HELLWIG	C/D
HELM	D
HELMER	C
HELMET	C
HELMICK	D
HELVETIA	C
HELY	C
HEMAN	D
HEMCROSS	B
HEMINGFORD	B
HEMPHILL	D
HEMPSTEAD	B
HENCO	B/D
HENDAP	D
HENDERSON	B
HENDON	C
HENDRICKS	B
HENDY	C
HENKIN	B
HENKLE, Extremely Cobby	B
HENKLE	C
HENLEY	C
HENLINE	C
HENMEL	C
HENNEWAY	B
HENNINGS	B
HENRIETTA	B/D
HENRY	D
HENRYSFORK	C
HENRYSLAKE	D
HEPPSIE	D
HERAKLE	D
HERBEL	A
HERBERT	B
HERBMAN	A
HERBOLD	C
HERCULES	C
HERDCAMP	D
HERITO	C
HERJUN	B
HERLONG	D
HERMANTOWN	C
HERMERING	B
HERMIT	B
HERMSHALE	C
HERNANDEZ	B
HERNDON	B
HERO	B
HEROD	D
HERRICK	B
HERSEY	B
HERSH	B
HERTY	D
HESHOTAUTHLA	D
HESPER	B
HESS	B
HESSELBERG	D
HESSING	B
HESSLAN	C
HETLAND	C
HETTINGER	C/D
HEUSSER	C
HEUVELTON	C
HEVERLO	B
HEWITT	D
HEWOLF	B
HEXT	B
HEYDER	B
HEYDLAUFF	D
HEYTOU	B
HEYTO, Stony, Cool	C
HIAHC	C
HIATHA	D
HIBAR	C
HIBBARD	C
HIBBING	C
HIBLER	C
HIBRITEN	B
HIBSAW	D
HICKEY	D
HICKIWAN	D
HICKS	B
HICKSVILLE	C
HICORIA	B/D
HICOTA	B
HIDATSA	B
HIDEAWAY	D
HIDEWOOD	B/D
HIDVALLE	B
HIGGINS	D
HIGGINSVILLE	C
HIGH GAP	C
HIGHBANK	C
HIGHCAMP	B
HIGHCREEK	B
HIGHHORN	B
HIGHLAND	B
HIGHLAND	C
HIGHPOINT	D
HIGHSPLINT	B
HIGHTOWER	C
HIGHUP	C
HIGHVALLEY	B
HIHIMANU	B
HILAIRE	B
HILDEBRECHT	C
HILDRETH	D
HILEA	D
HILES	B
HILGRAVE	B
HILINE	D
HILKEN	C
HILLBRICK	D
HILLCITY	B
HILLCO	B
HILLCREEK	B
HILLEMANN	C
HILLIARD	B
HILLIARD, Moderatelly Well Drained	C
HILLSDALE	B
HILLTISH	B
HILLTO	C
HILLTOPPE	C
HILLVIEW	B/D
HILLWOOD	B
HILMAR	B/D
HILO	A
HILTABIDEL	D
HINDES	C
HINDMAN	B
HINESBURG	C
HINGHAM	B
HINKER	C
HINKLE	D
HINMAN	C
HINSDALE	D
HINTERLAND	D
HINTON	B
HIRAMSBURG	C
HIRSCHDALE	C
HISEGA	C
HISNA	D
HISTOSOLS	D
HITCHCOCK	B
HITILO	A
HITT	B
HIWOOD	A
HOADLY	C
HOBAN	B
HOBBS	B
HOBBY	C
HOBE	A
HOBIT	C
HOBONNY	D
HOBSON	C
HOBUCKEN	D
HOCAR	D
HOCKINSON	B/D
HOCKINSO, Moderately Wet	C
HOCKLEY	C
HOCKLE, Graded	D
HODEDO	C
HODENPYL	B
HODGSON	C
HOEHNE	A
HOFFMAN	B
HOFFMANVILLE	C
HOFSTAD	D
HOGADERO	B
HOGAN	C
HOGCREEK	C
HOGENSBORG	D
HOGHEAVEN	B
HOGMALAT	D
HOGRANCH	B
HOGRIS	B
HOGRIS, Extremely Cobbly	D
HOH	B
HOHMANN	C
HOKO	C
HOLBORN	C

Attachment 1

Slopes and Soils
Dillard Heights



Slope derived from 10 meter USGS elevation data

OREGON DEPARTMENT OF TRANSPORTATION
HIGHWAY DIVISION

HYDRAULICS MANUAL

PREPARED BY THE HYDRAULICS UNIT JANUARY 1990

The Oregon Department of Transportation
HIGHWAY DIVISION

After a maximum of 300 feet, sheet flow usually becomes shallow concentrated flow. The average velocity for this flow can be determined from Figure 2.3, in which average velocity is a function of watercourse slope and type of channel. This figure was taken from the 1972 Soil Conservation Service Handbook.

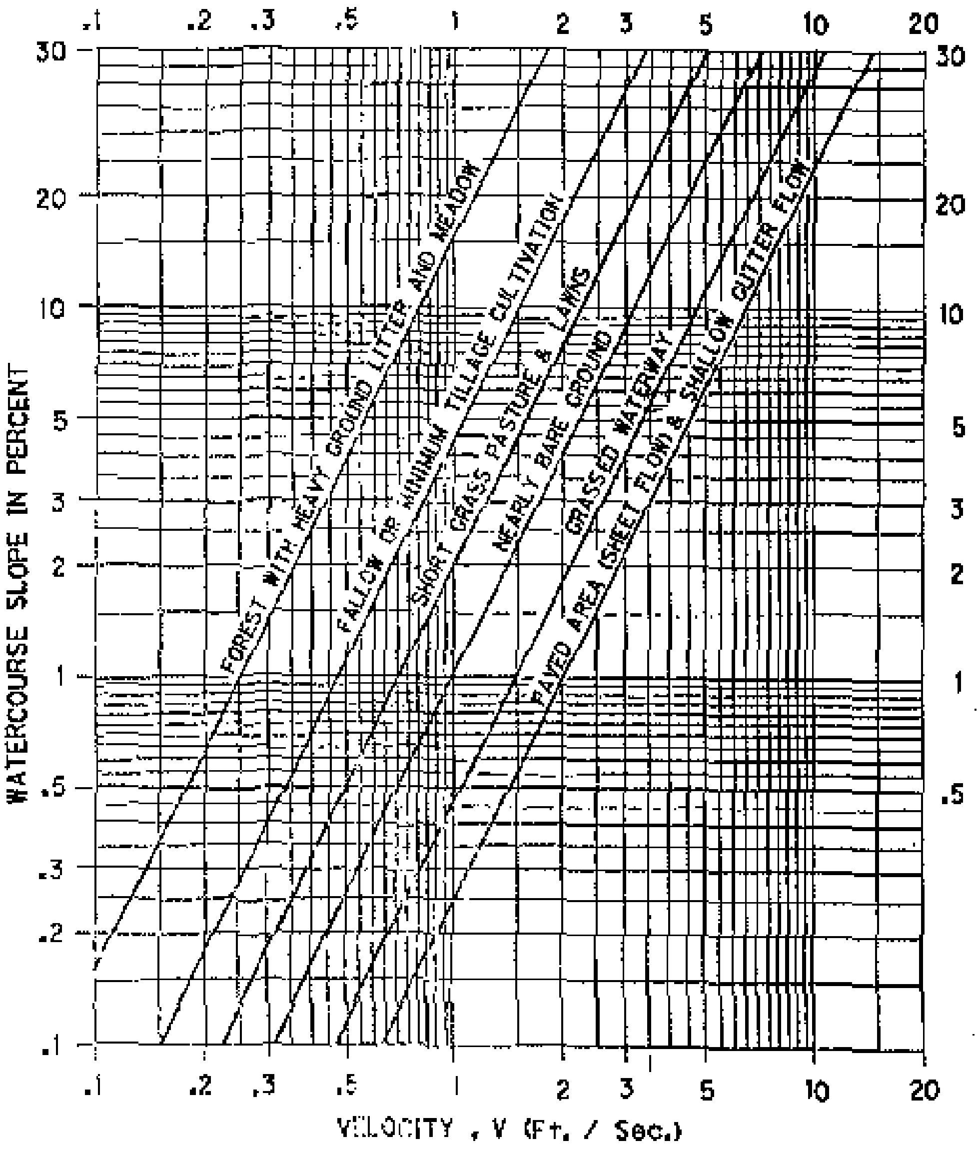


Figure 2.3

Figure 1.

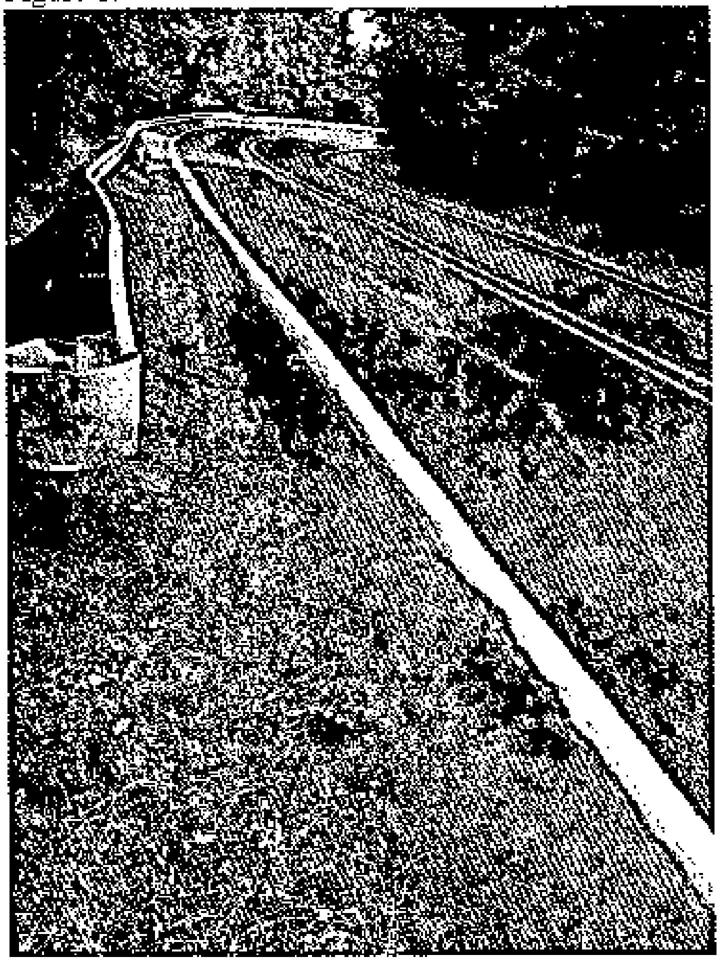


Figure 2.

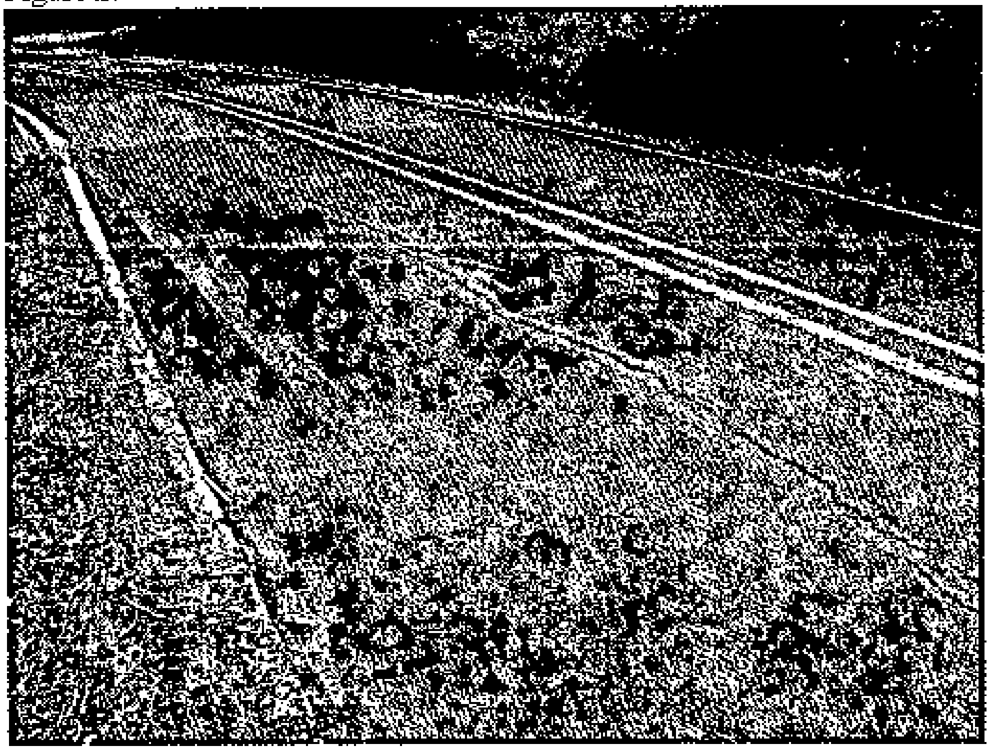


Figure 3.

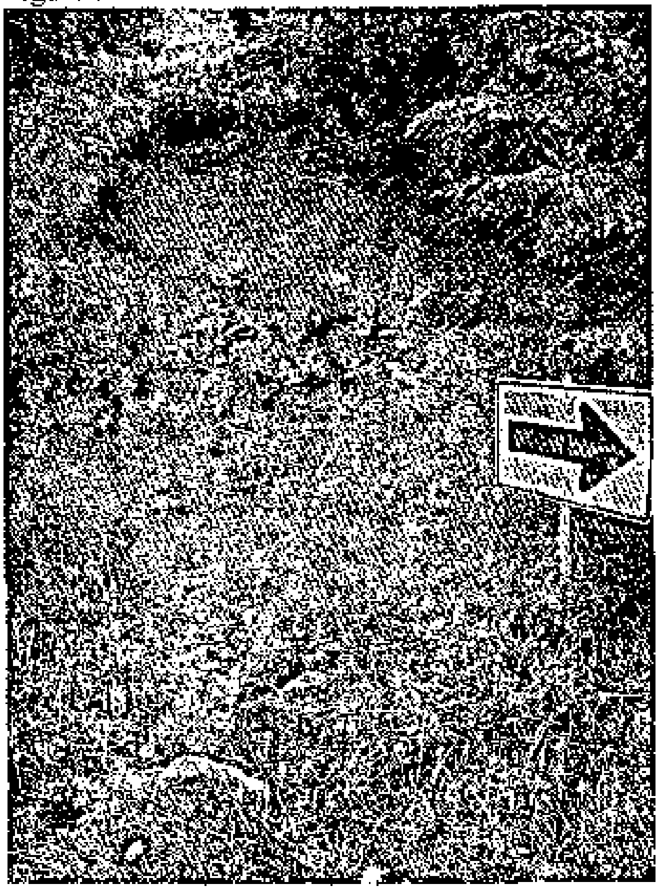
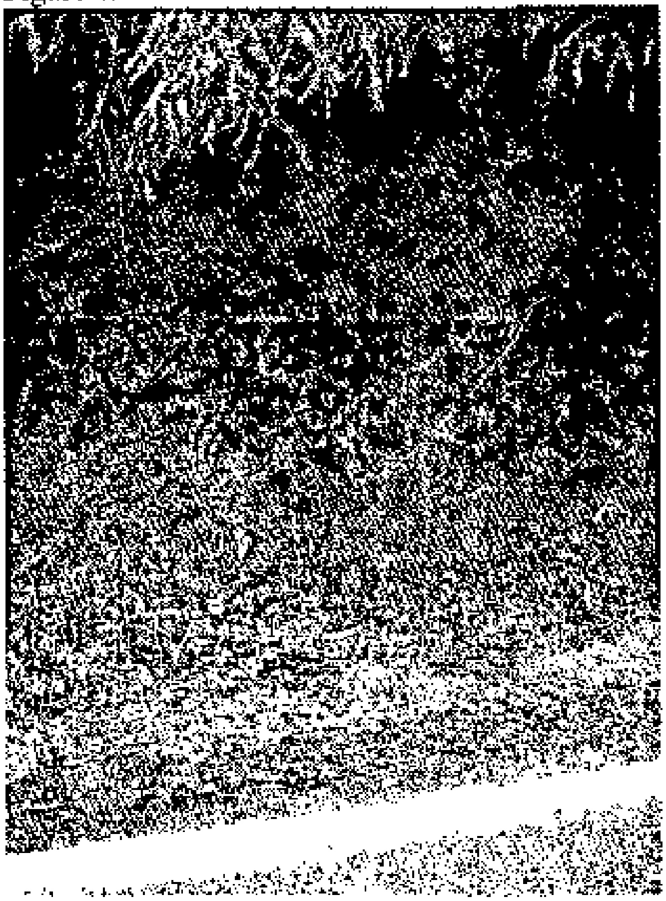


Figure 4.



303(d) list 2002 – Amazon Creek

Record ID	Waterbody Name	Sub-Basin	River Mile	Parameter	Season	List Date	Listing Status
8897	Amazon Creek	UPPER WILLAMETTE	0 to 22.6	Arsenic	Year Around	2002	303(d) List
8901	Amazon Creek	UPPER WILLAMETTE	0 to 22.6	Lead	Year Around	2002	303(d) List
8905	Amazon Creek	UPPER WILLAMETTE	0 to 22.6	E Coli	June 1 - September 30	2002	303(d) List
8906	Amazon Creek	UPPER WILLAMETTE	0 to 22.6	E Coli	October 1 - May 31	2002	303(d) List

There are 4 records in the table.

Water Quality Limited Streams Database
Details for Waterbody Segment Record ID 8897

The table below provides details for **Record ID 8897**.

Field	Details
Waterbody Name	Amazon Creek
Sub Basin Name	UPPER WILLAMETTE
HUC	17090003
LLID	1232651442279
River Mile	0 to 22.6
Parameter	Arsenic
Criteria	Table 20
Season	Year Around
Listing Status	303(d) List
Supporting Data	RM 13.6: 9/9 samples > criterion of 0.0022 ug/L. RM 20.5: 17/17 samples > criterion of 0.0022 ug/L. City of Eugene Public works data.
Sample Matrix Description	Water Column
List Date	2002
Beneficial Uses	fishing drinking water

Water Quality Limited Streams Database
Details for Waterbody Segment Record ID 8906

The table below provides details for **Record ID 8906.**

Field	Details
Waterbody Name	Amazon Creek
Sub Basin Name	UPPER WILLAMETTE
HUC	17090003
LLID	1232651442279
River Mile	0 to 22.6
Parameter	E Coli
Criteria	126 organisms per 100ml, no single sample > 406
Season	October 1 - May 31
Listing Status	303(d) List
Supporting Data	Site at 29th Avenue RM 20.5: 9/19 samples > 406. City of Eugene public works data.
Sample Matrix Description	Water Column
List Date	2002
Beneficial Uses	water contact recreation

Water Quality Limited Streams Database
Details for Waterbody Segment Record ID 8901

The table below provides details for **Record ID 8901**.

Field	Details
Waterbody Name	Amazon Creek
Sub Basin Name	UPPER WILLAMETTE
HUC	17090003
LLID	1232651442279
River Mile	0 to 22.6
Parameter	Lead
Criteria	Table 20
Season	Year Around
Listing Status	303(d) List
Supporting Data	RM 20.5: 4/9 samples > hardness based criterion. RM 13.6: 1/27 samples > hardness based criterion. City of Eugene Public works data.
Sample Matrix Description	Water Column
List Date	2002
Beneficial Uses	anadromous fish passage resident fish and aquatic life salmonid fish rearing

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Water Quality Limited Streams Database
Details for Waterbody Segment Record ID 8905

The table below provides details for **Record ID 8905**.

Field	Details
Waterbody Name	Amazon Creek
Sub Basin Name	UPPER WILLAMETTE
HUC	17090003
LLID	1232651442279
River Mile	0 to 22.6
Parameter	E Coli
Criteria	126 organisms per 100ml, no single sample > 406
Season	June 1 - September 30
Listing Status	303(d) List
Supporting Data	Site at 29th Avenue RM 20.5: 4/10 samples > 406. City of Eugene public works data.
Sample Matrix Description	Water Column
List Date	2002
Beneficial Uses	water contact recreation