Kids N Us
Drainage Analysis

City of Arlington, WA

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Utilities Div.

October 6, 2006

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COA PERMIT CENTER

Prepared By:

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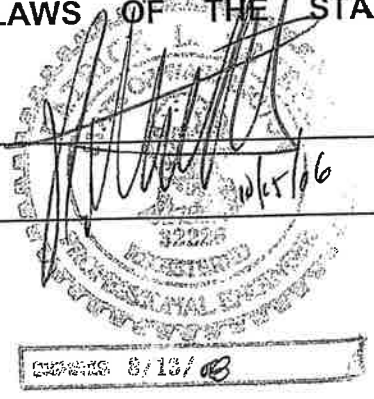
Project No.: 047-06

I HEREBY CERTIFY THAT THIS DOCUMENT WAS PREPARED BY ME OR UNDER MY DIRECT SUPERVISION, AND THAT I AM A DULY REGISTERED PROFESSIONAL ENGINEER UNDER THE LAWS OF THE STATE OF WASHINGTON.

DATE: _____

BY: _____



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Executive Summary:

This drainage analysis examines stormwater runoff for the proposed commercial development in the northwest quarter of Section 28, Township 31 North, Range 5 East, City of Arlington, Snohomish County, Washington. The site is located approximately 400' west of the intersection of Smokey Pointe Blvd 166th Place NE, on the south side of 166th. The 1.27-acre site is bordered by existing commercial development on the north and west and single-family residences on the south and east. See Attachment 1- Vicinity Map.

The proposed development will include a daycare facility with all associated concrete walks, asphalt drives and pervious pavement parking areas, play areas and landscaping requirements. All proposed utilities will be installed underground, including a storm water infiltration system.

Existing Conditions:

The site currently is undeveloped, covered with existing grasses, brush and deciduous trees. It is relatively flat with slopes of 0-2%, see Attachment 2- Existing Conditions.

Soils on site are classified as Custer fine sandy loam, with a hydrologic group "C", per the Snohomish County Soil Survey. Materials Testing & Consulting, Inc., visited the site on October 3, 2006. Their test logs can be found with the SCS soils info in Attachment 4- Soils Information. The rainfall used to determine runoff can be found in Table 1.

Table 1. Rainfall Data

Storm Event	Rainfall (Inches/24-Hour)
2 year, 24-hour	2.0
10 year, 24-hour	2.7
100 year, 24-hour	3.9

Storm water runoff currently flows south and east across the site to an existing drainage ditch along the south and easterly lines

The existing stormwater system along 166th Place NE currently discharges through the site to the existing drainage ditch along the south property line. Existing catch basins discharge to the on-site ditches at both the west and eastern property lines.

Developed Conditions:

The proposed development will include a Kids N Us daycare facility with adjoining access, parking, utilities, and landscaping. It is proposed to construct the parking stall areas with pervious pavement, to capture and infiltrate the runoff from the parking stalls and drive lanes into the existing sandy soils. An emergency overflow/infiltration trench system will be installed to ensure no ponding will occur due to unforeseen circumstances. The proposed building rooftop runoff will be tightlined into 6" perforated pipes that will allow the water to infiltrate. The play areas along the south, west and east sides will sheet flow and infiltrate through porous materials (wood chips, etc.), into the existing soils.

The storm water runoff rates for the developed conditions can be found in Table 2 – Developed Stormwater Rates, and the Stormshed calculations can be found in Attachment 9 – Basin Summaries. Materials Testing & Consulting, Inc., conducted a soils investigation, found in Attachment 8. They determined the infiltration rate of the existing sandy soil to be 2.0 inches per hour according to Tables 3.7 and 3.8 of the Stormwater Management Manual for Western Washington, 2005 Edition. Their explorations, during the month of October, were to an approximate elevation of 111.5.

The infiltration rates for the designated storms were determined by depth of water in the trench, found in the Infiltration spreadsheets for each basin, Attachment 5. A safety factor of 2 was applied to the infiltration rates provided.

The southern basin includes the playgrounds, and the pervious pavement at the east side of the building. See Attachment 3. The stormwater runoff will sheet flow across the play areas and infiltrate into the existing sandy soils.

Table 2. Developed Stormwater Rates – Southern Basin

Storm Event	Developed Peak Stormwater Runoff (cfs)	Peak Infiltration Rates (cfs)
2 year	0.10	0.10
100 year	0.33	0.31

There will be approximately 0.01' depth of water in the play areas during the 100-year storm.

The southern building basin includes only the south half of the building that is tightlined to the proposed stormwater system.

Table 3. Developed Stormwater Rates – Southern Building Basin

Storm Event	Developed Peak Stormwater Runoff (cfs)	Peak Infiltration Rates (cfs)
2 year	0.05	0.02
100 year	0.10	0.02

The required storage volume of the proposed southern infiltration trench is 275 cf with 692 sf of infiltration trench. The proposed infiltration trench offers 407 cf of storage. Additional storage is available within the Type 2 catch basins located at each end of the proposed infiltration trench.

If required, the proposed infiltration trench can back up into the pipe and cb network, allowing for additional storage not accounted for in the calculations.

The northern basin includes the pervious pavement parking area, the asphalt drive lane, approximately one-half the proposed building area, and the child drop off area. See Attachment 3.

It is proposed to construct the parking areas with pervious pavement. The pervious pavement will allow the stormwater runoff to seep into the existing sandy soils and the proposed infiltration trench. Two catchbasins are provided to allow for an overflow into the infiltration trench during larger storm events than the 100-yr.

Table 2. Developed Stormwater Rates – Southern Basin

Storm Event	Developed Peak Stormwater Runoff (cfs)	Peak Infiltration Rates (cfs)
2 year	0.24	0.15
100 year	0.51	0.17

The required storage volume of the proposed southern infiltration trench is 830 cf with 6,500 sf of infiltration area. The proposed infiltration trench offers 3,080 cf of storage. Additional storage is available within the Type 2 catch basins located at each end of the proposed infiltration trench.

If required, the proposed infiltration trench can back up into the pipe and cb network, allowing for additional storage not accounted for in the calculations.

Water Quality:

During the construction phase of the project, temporary siltation control structures will be installed. At a minimum:

- Existing vegetation will provide a natural vegetated filter strip to prevent sediment-laden runoff from leaving the site.
- Temporary silt fencing will be required along the boundaries of the development areas.
- The temporary soil stockpiles will be covered with plastic.
- A temporary construction entrance will be installed.
- The existing CB within Grannis Road will be protected with a catch basin insert, protecting the neighboring property's infiltration system

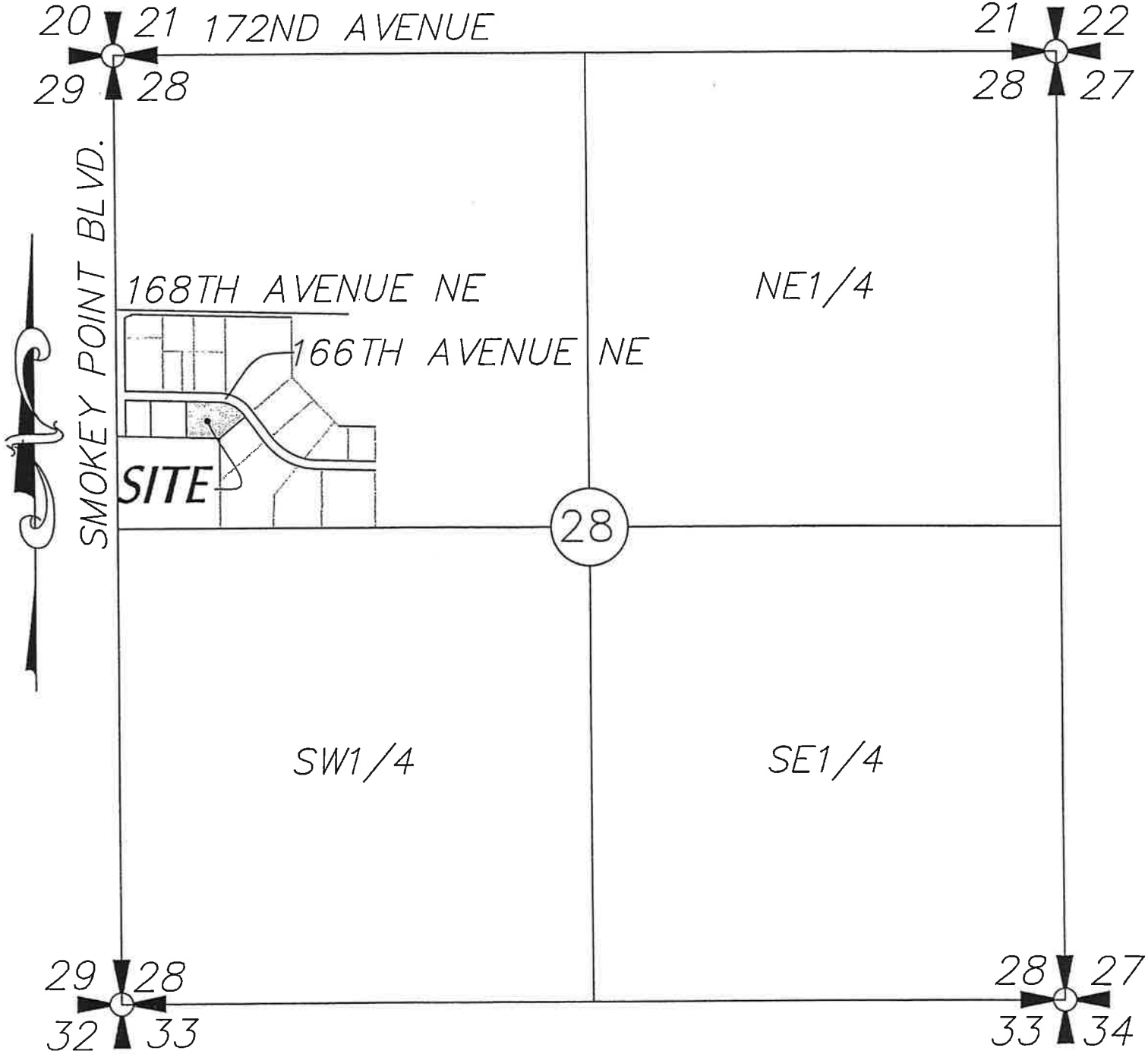
The siltation control devices will remain in place until all construction work is completed per the specifications and details on the construction plans and until all areas are stabilized.

After construction, the collected storm water runoff will flow through separator tees prior to entering the infiltration system. The tees will prevent oils from entering the system and will also have screens installed on the inlet, preventing solids as small as ¼" from entering the system. The existing sandy soils onsite will offer treatment as the water infiltrates.

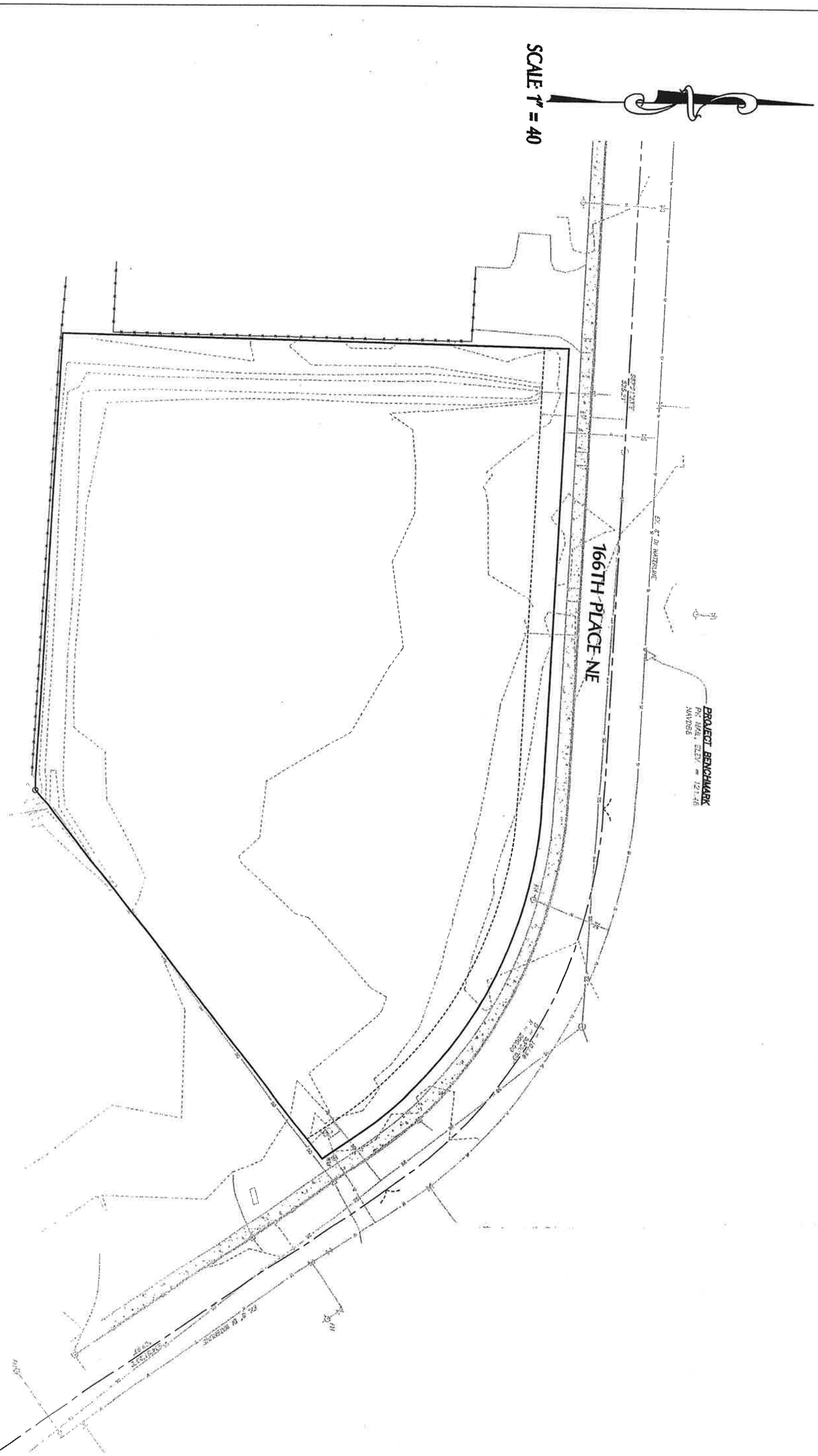
Conclusions:

The proposed development increase stormwater runoff. It is proposed to capture and infiltrate the runoff through the use of a cb/pipe network and infiltration trench. The system will be capable of detaining the 100-year storm event while infiltration is occurring.

ATTACHMENT 1
VICINITY MAP


20
21
172ND AVENUE
21
22
29
28
28
27
SMOKEY POINT BLVD.
168TH AVENUE NE
NE1/4
166TH AVENUE NE
SITE
28
SW1/4
SE1/4
29
28
28
27
32
33
33
34

ATTACHMENT 2
Existing Conditions



ATTACHMENT 2 – EXISTING CONDITIONS

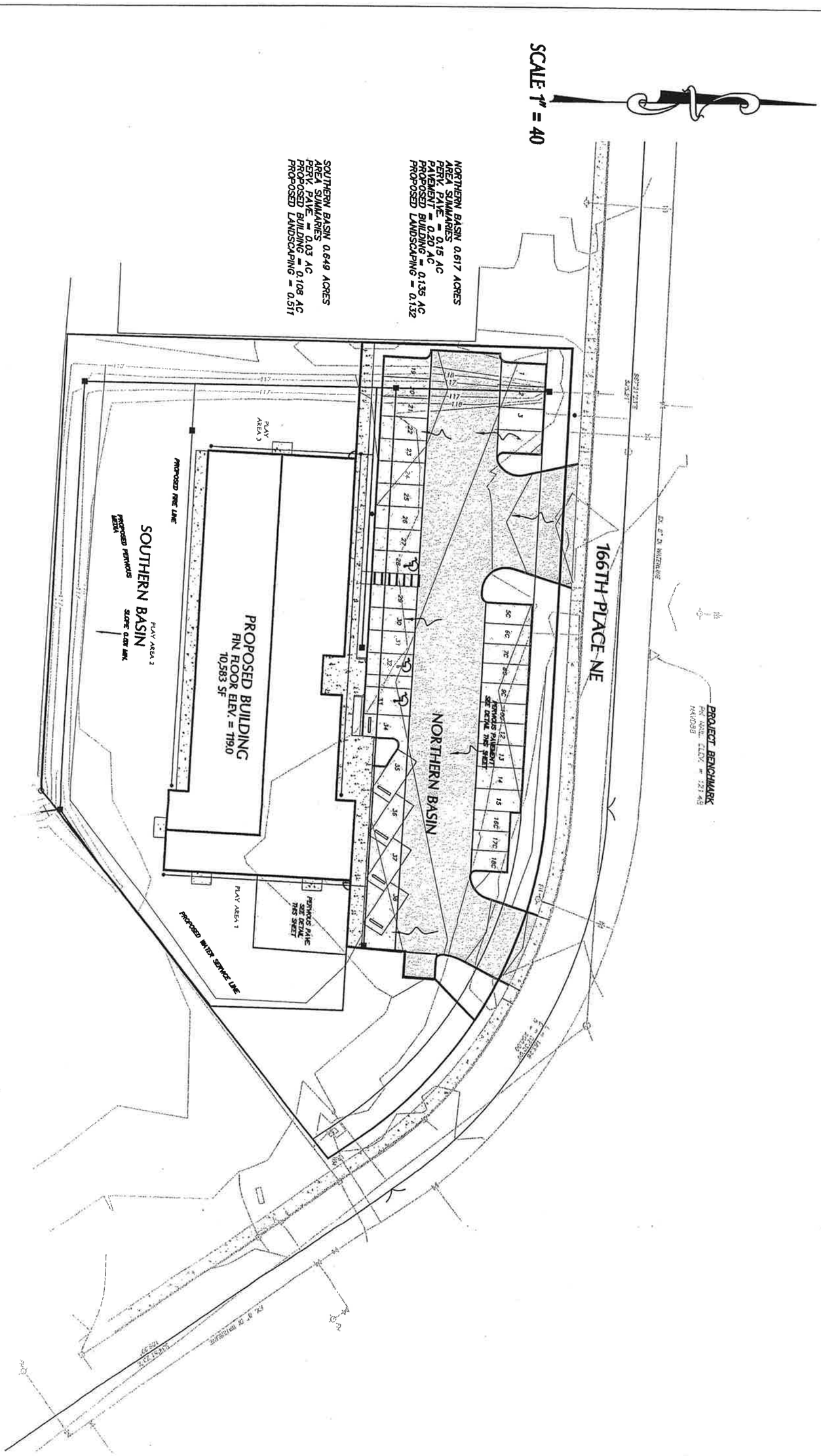
Sound Development Group, LLC.
ENGINEERING, SURVEYING & LAND DEVELOPMENT SERVICES
1111 CLEVELAND AVENUE, SUITE 202
MOUNT VERNON, WA 98273
Tel: 360-404-2010 Fax: 360-404-2013

SCALE:	1"= 100'
DRAWN BY:	TAZ
CHECKED BY:	PLS
DATE:	MAY '06

SHEET TITLE:
KIDS N US SITE PLAN
FOR
DUJARDIN DEVELOPMENT
CITY OF ARLINGTON

DRAWING NO.	047.DWG
JOB NO.	047-06
SHEET NO.	1 OF 1

ATTACHMENT 3
Developed Conditions



ATTACHMENT 3 – DEVELOPED CONDITIONS

Sound Development Group, LLC.
ENGINEERING, SURVEYING & LAND DEVELOPMENT SERVICES
1111 CLEVELAND AVENUE, SUITE 202
MOUNT VERNON, WA 98273
Tel: 360-404-2010 Fax: 360-404-2013

SCALE: 1"= 100'
DRAWN BY: TAZ
CHECKED BY: PLS
DATE: MAY '06

SHEET TITLE:
KIDS N US SITE PLAN
FOR
DUJARDIN DEVELOPMENT
CITY OF ARLINGTON

DRAWING NO. 047.DWG
JOB NO. 047-06
SHEET NO. 1 OF 1

ATTACHMENT 4
Soils Information

SOIL SURVEY OF SNOHOMISH COUNTY AREA, WASHINGTON — SHEET NUMBER 19

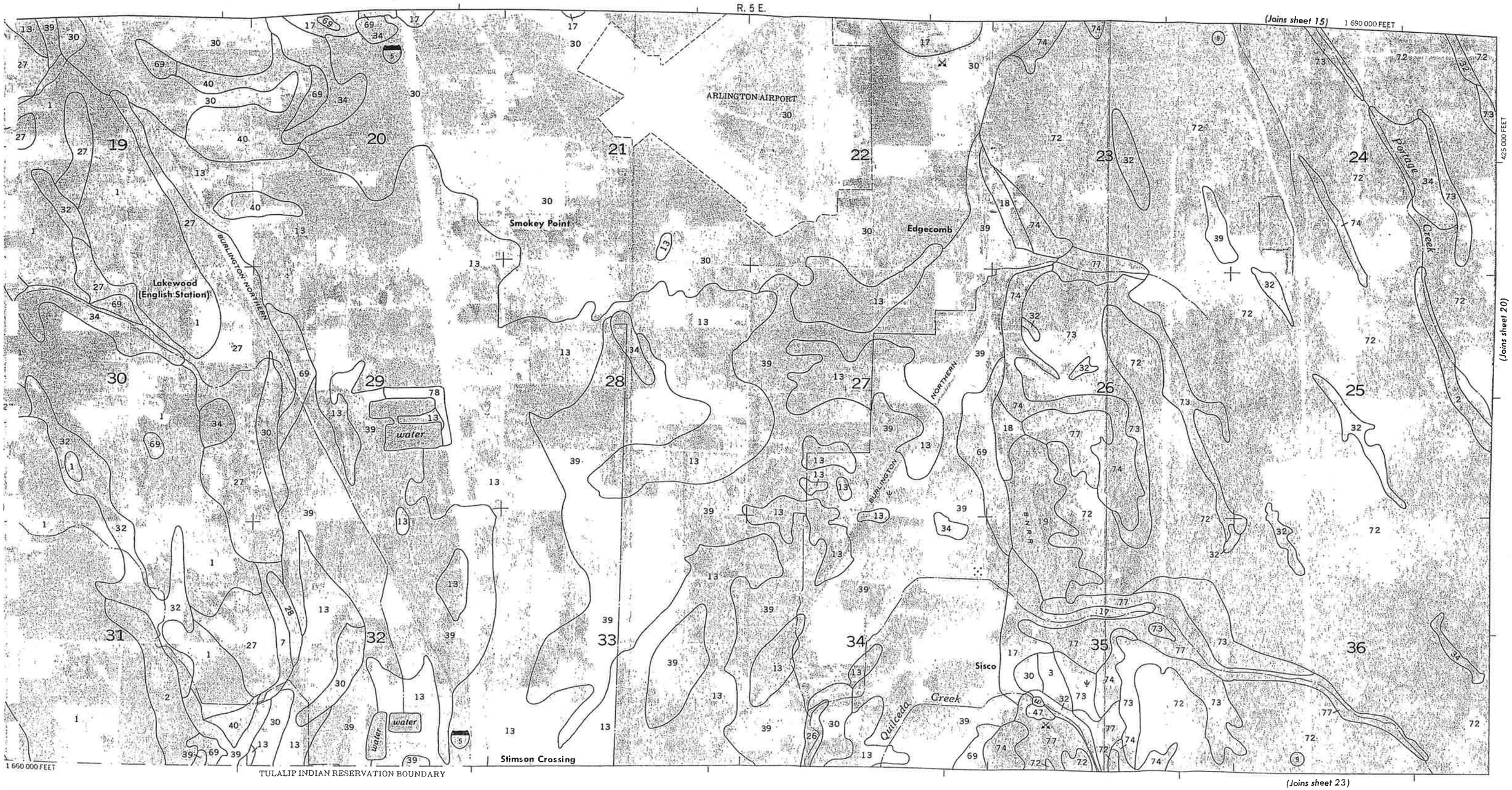


TABLE 15.--WATER FEATURES

[“Flooding” and “water table” and terms such as “rare,” “apparent,” and “perched” are explained in the text. The symbol < means less than; > means more than. Absence of an entry indicates that the feature is not a concern]

Soil name and map symbol	Hydrologic group	Flooding			High water table		
		Frequency	Duration	Months	Depth	Kind	Months
					Ft		
, 2, 3---------- Alderwood	C	None----------	---	---	1.5-3.0	Perched	Jan-Mar
4*: Alderwood----------	C	None----------	---	---	1.5-3.0	Perched	Jan-Mar
Everett----------	A	None----------	---	---	>6.0	---	---
5*, 6*: Alderwood----------	C	None----------	---	---	1.5-3.0	Perched	Jan-Mar
Urban land.							
7---------- Bellingham	C	None----------	---	Oct-Jun	+1-1.0	Apparent	Oct-Jun
---------- Bellingham Variant	D	Frequent--------	Very long-----	Oct-Jun	+1-1.0	Apparent	Oct-Jun
, 10, 11---------- Cathcart	C	None----------	---	---	>6.0	---	---
12*. Cryohemists							
13---------- Custer	C	None----------	---	---	0-1.0	Apparent	Nov-Mar
14---------- Elwell	C	None----------	---	---	1.5-3.0	Perched	Nov-Jun
15*: Elwell----------	C	None----------	---	---	1.5-3.0	Perched	Nov-Jun
Olomount----------	C	None----------	---	---	1.5-3.5	Perched	Nov-May
16*: Elwell----------	C	None----------	---	---	1.5-3.0	Perched	Nov-Jun
Olomount----------	C	None----------	---	---	1.5-3.5	Perched	Nov-May
Rock outcrop.							
17, 18, 19---------- Everett	A	None----------	---	---	>6.0	---	---
20*. Fluvaquents							
21---------- Getchell	C	None----------	---	---	1.5-3.0	Perched	Dec-May
22*: Getchell----------	C	None----------	---	---	1.5-3.0	Perched	Dec-May
Oso----------	C	None----------	---	---	1.5-3.0	Perched	Nov-May
23*: Getchell----------	C	None----------	---	---	1.5-3.0	Perched	Dec-May

See footnote at end of table.

slope where practical. Grazing when the soil is wet results in compaction of the surface layer, poor tilth, poor infiltration, and excessive runoff.

Periodic mowing and spreading of droppings help to maintain uniform growth and discourage selective grazing. Proper grazing practices and weed control are needed for maximum quality of forage. In some years supplemental irrigation is also needed. Fertilizer is needed for optimum growth of grasses and legumes. Legumes benefit from applications of agricultural lime.

The main limitation for homesites and septic tank absorption fields is steepness of slope.

This map unit is in capability subclass IVe.

11—Cathcart loam, 25 to 50 percent slopes. This very deep, well drained soil is on foothills and mountain foot slopes. It formed in glacial drift derived from sandstone and siltstone and in volcanic ash. Areas are 50 to 200 acres in size. The native vegetation is mainly conifers and hardwoods. Elevation is 50 to 1,000 feet. The average annual precipitation is about 45 inches, the average annual air temperature is about 50 degrees F, and the average frost-free season in 165 to 185 days.

Typically, the surface layer is very dark grayish brown loam about 8 inches thick. The subsoil is dark brown and yellowish brown loam and sandy loam about 27 inches thick. The substratum to a depth of 60 inches or more is olive loam. In some areas the subsoil is sandy clay loam or clay loam. Weathered siltstone is at a depth of 40 to 60 inches in places.

Included in this unit are small areas of Tokul soils on till plains and Pastik, Winston, and Ragnar soils on terraces and outwash plains. Included areas make up about 15 percent of the total acreage.

Permeability of this Cathcart soil is moderate. Available water capacity is high. Effective rooting depth is 60 inches or more. Runoff is rapid, and the hazard of water erosion is high.

This unit is used mainly as woodland.

Douglas-fir is the main woodland species on this unit. On the basis of a 100-year site curve, the mean site index is 175. On the basis of a 50-year site curve, the mean site index is 130. The mean annual increment at culmination (CMAI) for Douglas-fir at age 60 is 186 cubic feet per acre. Among the trees of limited extent are western hemlock, western redcedar, and Pacific madrone. Among the common forest understory plants are western swordfern, trailing blackberry, red huckleberry, Oregon-grape, and brackenfern.

The main limitation for the harvesting of timber is steepness of slope, which restricts the use of wheeled and tracked equipment in skidding operations. Cable yarding systems generally are safer and disturb the soil less. Unsurfaced roads and skid trails are soft when wet and they may be impassable during rainy periods. Logging roads require suitable surfacing for year-round use. Rock for road construction is not readily available on this unit.

Establishing plant cover on steep road cut and fill slopes reduces erosion. Steep yarding paths, skid trails, and firebreaks are subject to rilling and gullying unless adequate water bars are provided or they are protected by plant cover.

Brush competition is the main concern for the production of timber. Reforestation can be accomplished by planting Douglas-fir seedlings. When openings are made in the canopy, invading brushy plants, if not controlled, can prevent reforestation.

The main limitation for homesites and septic tank absorption fields is steepness of slope.

This map unit is in capability subclass VIe.

12—Cryohemists, nearly level. These deep, very poorly drained soils are in depressional areas on high mountain ridgetops. The soils formed in material derived mainly from sedges and mosses. Areas are 10 to 30 acres in size. The native vegetation is mainly sedges and mosses. Elevation is 1,800 to 3,700 feet. Slope is 0 to 1 percent. The average annual precipitation is about 95 inches, the average annual air temperature is about 41 degrees F, and the average frost-free season is 85 to 105 days.

Typically, the upper layer is dark grayish brown and very dark gray organic material about 10 inches thick. The next layer is black, very dark grayish brown and dark reddish brown organic material about 26 inches thick. Below this is light gray diatomaceous earth about 3 inches thick over grayish brown and olive gray clay loam that extends to a depth of 60 inches or more. Texture of the lower layer varies widely within short distances. Thickness of the organic material ranges from 16 inches to more than 60 inches.

Included in this unit are small areas of Getchell, Potchub, and Verlot soils on mountainsides and ridgetops. Included areas make up about 15 percent of the total acreage.

Permeability of these Cryohemists is moderately slow. Available water capacity is high. Effective rooting depth is limited by a seasonal water table that is at a depth of 0 to about 10 inches. Runoff is ponded.

This unit is used mainly for wetland wildlife habitat. It provides nesting areas for ducks, heron, and other waterfowl. Plantings of smartweed, wild millet, or bullrush encourage added populations. This unit also provides habitat for muskrats and beavers. Logging in the area may disturb the value of the unit as nesting areas for waterfowl.

This map unit is in capability subclass Vw.

13—Custer fine sandy loam. This very deep, poorly drained soil is in basins on outwash plains. It formed in glacial outwash. Areas are 15 to 40 acres in size. The native vegetation is mainly conifers and hardwoods. Elevation is near sea level to 150 feet. Slope is 0 to 2 percent. The average annual precipitation is about 40 inches, the average annual air temperature is about 50

degrees F, and the average frost-free season is 150 to 200 days.

Typically, the surface layer is very dark grayish brown fine sandy loam about 9 inches thick. The upper part of the subsoil is loamy fine sand about 7 inches thick. The lower part is gray and olive sand about 19 inches thick and has iron-cemented concretions that form a discontinuous hardpan. The substratum is gray sand about 14 inches thick over gravelly coarse sand that extends to a depth of 60 inches or more. In some areas a hardpan is not present in the subsoil.

Included in this unit are small areas of Indianola soils on terraces, Norma soils in upland drainageways, and Custer soils that have been partially drained. Included areas make up about 15 percent of the total acreage.

Permeability of this Custer soil is moderately slow in the discontinuous hardpan and very rapid below it. Available water capacity is low. Effective rooting depth is limited by a seasonal high water table that is at a depth of about 12 inches. Runoff is very slow. Ponding occurs from November to March.

This unit is used mainly for pasture and as cropland. A few areas are used as woodland.

The main limitation for pasture is wetness. Grazing when the soil in this unit is wet results in compaction of the surface layer. Use of proper stocking rates, pasture rotation, and restricted grazing during wet periods helps to keep the pasture in good condition and protects the soil from erosion. Periodic mowing and spreading of droppings help to maintain uniform growth and discourage selective grazing. Proper grazing practices, weed control, and fertilizer are needed for maximum quality of forage. Fertilizer is needed for optimum growth of grasses and legumes.

The depth to the water table is the main limitation of the soil in this unit for crops such as strawberries. Open ditches and tile drains help to remove excess water. Chiseling or subsoiling may be needed to improve permeability and increase rooting depth. Crops may require supplemental irrigation during the growing season. The organic matter content can be maintained by using all crop residue, plowing under green manure crops, and using a suitable cropping system.

This unit is suited to use as woodland. On the basis of a 50-year site curve, the estimated mean site index for red alder is 90. The estimated mean annual increment at culmination (CMAI) for red alder at 40 years of age is 101 cubic feet per acre.

The main limitation for the harvesting of timber is wetness. The seasonal high water table limits the use of equipment when the soil in this unit is wet. Use of wheeled and tracked equipment when the soil is wet produces ruts, compacts the soil, and damages the roots of trees. Unsurfaced roads and skid trails are soft when wet, and they may be impassable during rainy periods. Logging roads require suitable surfacing for year-round use. Rock for road construction is not readily available on this unit.

The establishment of seedlings is the main concern in the production of timber. The seasonal high water table and ponding reduce root respiration, which results in high seedling mortality. If seed trees are present, natural reforestation of cutover areas by red alder occurs rapidly. Western redcedar may also be suitable for reforestation. Because the rooting depth is restricted by the discontinuous hardpan and the seasonal high water table, trees are subject to windthrow. When openings are made in the canopy, invading brushy plants, if not controlled, can delay reforestation.

The main limitation for homesites is the seasonal high water table. Wetness can be reduced by installing drain tile around footings. The main limitations for septic tank absorption fields are ponding, wetness, and moderately slow permeability. If effluent penetrates below the discontinuous hardpan, seepage into the water table is also a limitation. Cutbanks on this unit are subject to caving in.

This map unit is in capability subclass IVw.

14—Elwell silt loam, 3 to 30 percent slopes. This moderately deep, moderately well drained soil is on mountainsides and ridgetops. It formed in glacial till and volcanic ash. Areas are 20 to 50 acres in size. The native vegetation is mainly conifers. Elevation is 800 to 1,800 feet. The average annual precipitation is about 70 inches, the average annual air temperature is about 45 degrees F, and the average frost-free season is 130 to 150 days.

Typically, the surface layer is black silt loam about 2 inches thick. The subsoil is strong brown, brown, and yellowish brown silt loam about 21 inches thick. The substratum is pale olive gravelly fine sandy loam about 4 inches thick. An olive, weakly cemented hardpan is at a depth of about 27 inches. Depth to the hardpan ranges from 20 to 40 inches. In some areas the hardpan is at a depth of more than 40 inches.

Included in this unit are small areas of Rober and Olomount soils on mountainsides and ridgetops and Skykomish soils on terraces. Included areas make up about 15 percent of the total acreage.

Permeability of this Elwell soil is moderate to the hardpan and very slow through it. Available water capacity is moderate. Effective rooting depth is 20 to 40 inches. A seasonal perched water table is at a depth of 18 to 36 inches from November to June. Runoff is slow, and the hazard of water erosion is slight.

This unit is used mainly as woodland, watershed, and wildlife habitat.

Western hemlock is the main woodland species on this unit. On the basis of a 100-year site curve, the mean site index is 152. On the basis of a 50-year site curve, the mean site index is 108. The mean annual increment at culmination (CMAI) for western hemlock at age 50 is 241 cubic feet per acre. Among the trees of limited extent are Douglas-fir, western redcedar, Pacific silver fir, red alder, and bigleaf maple. Among the common forest

ATTACHMENT 5
Infiltration Spreadsheet

KIDS N US ARLINGTON
SDG JOB # 047-06
NORTHERN PER
Date: October 10, 2006

INPUT VARIABLES:

Infiltration Rate	2 Inch/hr	Trench Voids	0.3
	4.62963E-05 ft/sec	Pipe Size	0 in
Trench Dimensions			
Width =	16 ft	Depth =	0 ft
Length =	261 ft		
Infiltration Area (a)			
Width x Length	4176 sq ft		

UNDERGROUND STORAGE AVAILABLE:

TRENCH/PIPE :	0.00 cf

Bottom of infiltration trench Elev.	40.80
Maximum water surface elevation	42.80
Bottom of Test hole or ground water elev.	30.00
Depth from trench bottom to impermeable layer	3.00
Maximum water depth	2.00

INFILTRATION RATE:
Darcys Law of Ground Water

Where:Q=f * I * a and I=(H+L)/L

f=infiltration rate
I=hydraulic gradient
a=surface area of infiltration
H=depth of water above trench bottom
L=depth from trench bottom to impermeable layer

Infiltration Rate of Media $(f_d)=0.5*f$	Depth to impermeable layer (L)	Water Depth in BMP (varies) (H)	Hydraulic Gradient (I)	Infiltration area (a)	Infiltration Rate (Q)
2.31481E-05	3.00	0	1.00	4176.00	0.10
2.31481E-05	3.00	0.5	1.17	4176.00	0.11
2.31481E-05	3.00	1	1.33	4176.00	0.13
2.31481E-05	3.00	1.5	1.50	4176.00	0.15
2.31481E-05	3.00	2	1.67	4176.00	0.16
2.31481E-05	3.00	2.5	1.83	4176.00	0.18
2.31481E-05	3.00	3	2.00	4176.00	0.19
2.31481E-05	3.00	3.5	2.17	4176.00	0.21
2.31481E-05	3.00	4	2.33	4176.00	0.23

KIDS N US ARLINGTON
SDG JOB # 047-06
SOUTHERN BAS
Date: October 10, 2006

INPUT VARIABLES:

Infiltration Rate	2 Inch/hr	Trench Voids	0.3
	4.62963E-05 ft/sec	Pipe Size	12 in

Trench Dimensions

Width =	4 ft	Depth =	1.5 ft
Length =	173 ft		

Infiltration Area (a)

Width x Length	692 sq ft

UNDERGROUND STORAGE AVAILABLE:

TRENCH/PIPE :	406.51 cf

Bottom of infiltration trench Elev.	40.80
Maximum water surface elevation	42.80
Bottom of Test hole or ground water elev.	30.00
Depth from trench bottom to impermeable layer	3.00
Maximum water depth	2.00

INFILTRATION RATE:
Darcys Law of Ground Water

Where:Q=f * I * a and I=(H+L)/L

f=infiltration rate
I=hydraulic gradient
a=surface area of infiltration
H=depth of water above trench bottom
L=depth from trench bottom to impermeable layer

Infiltration Rate of Media (f_d)=0.5*f	Depth to impermeable layer (L)	Water Depth in BMP (varies) (H)	Hydraulic Gradient (I)	Infiltration area (a)	Infiltration Rate (Q)
2.31481E-05	3.00	0	1.00	692.00	0.02
2.31481E-05	3.00	0.5	1.17	692.00	0.02
2.31481E-05	3.00	1	1.33	692.00	0.02
2.31481E-05	3.00	1.5	1.50	692.00	0.02
2.31481E-05	3.00	2	1.67	692.00	0.03
2.31481E-05	3.00	2.5	1.83	692.00	0.03
2.31481E-05	3.00	3	2.00	692.00	0.03
2.31481E-05	3.00	3.5	2.17	692.00	0.03
2.31481E-05	3.00	4	2.33	692.00	0.04

KIDS N US ARLINGTON
SDG JOB # 047-06
SOUTHERN BAS
Date: October 10, 2006

INPUT VARIABLES:

Infiltration Rate	2 Inch/hr	Trench Voids	0.3
	4.62963E-05 ft/sec	Pipe Size	0 in
Trench Dimensions			
Width =	60 ft	Depth =	0 ft
Length =	220 ft		
Infiltration Area (a)			
Width x Length	13200 sq ft		

UNDERGROUND STORAGE AVAILABLE:

TRENCH/PIPE :	0.00 cf

Bottom of infiltration trench Elev.	40.80
Maximum water surface elevation	42.80
Bottom of Test hole or ground water elev.	30.00
Depth from trench bottom to impermeable layer	3.00
Maximum water depth	2.00

INFILTRATION RATE:
Darcys Law of Ground Water

Where: $Q = f * I * a$ and $I = (H+L)/L$

f=infiltration rate
I=hydraulic gradient
a=surface area of infiltration
H=depth of water above trench bottom
L=depth from trench bottom to impermeable layer

Infiltration Rate of Media $(f_d)=0.5*f$	Depth to impermeable layer (L)	Water Depth in BMP (varies) (H)	Hydraulic Gradient (I)	Infiltration area (a)	Infiltration Rate (Q)
2.31481E-05	3.00	0	1.00	13200.00	0.31
2.31481E-05	3.00	0.5	1.17	13200.00	0.36
2.31481E-05	3.00	1	1.33	13200.00	0.41
2.31481E-05	3.00	1.5	1.50	13200.00	0.46
2.31481E-05	3.00	2	1.67	13200.00	0.51
2.31481E-05	3.00	2.5	1.83	13200.00	0.56
2.31481E-05	3.00	3	2.00	13200.00	0.61
2.31481E-05	3.00	3.5	2.17	13200.00	0.66
2.31481E-05	3.00	4	2.33	13200.00	0.71

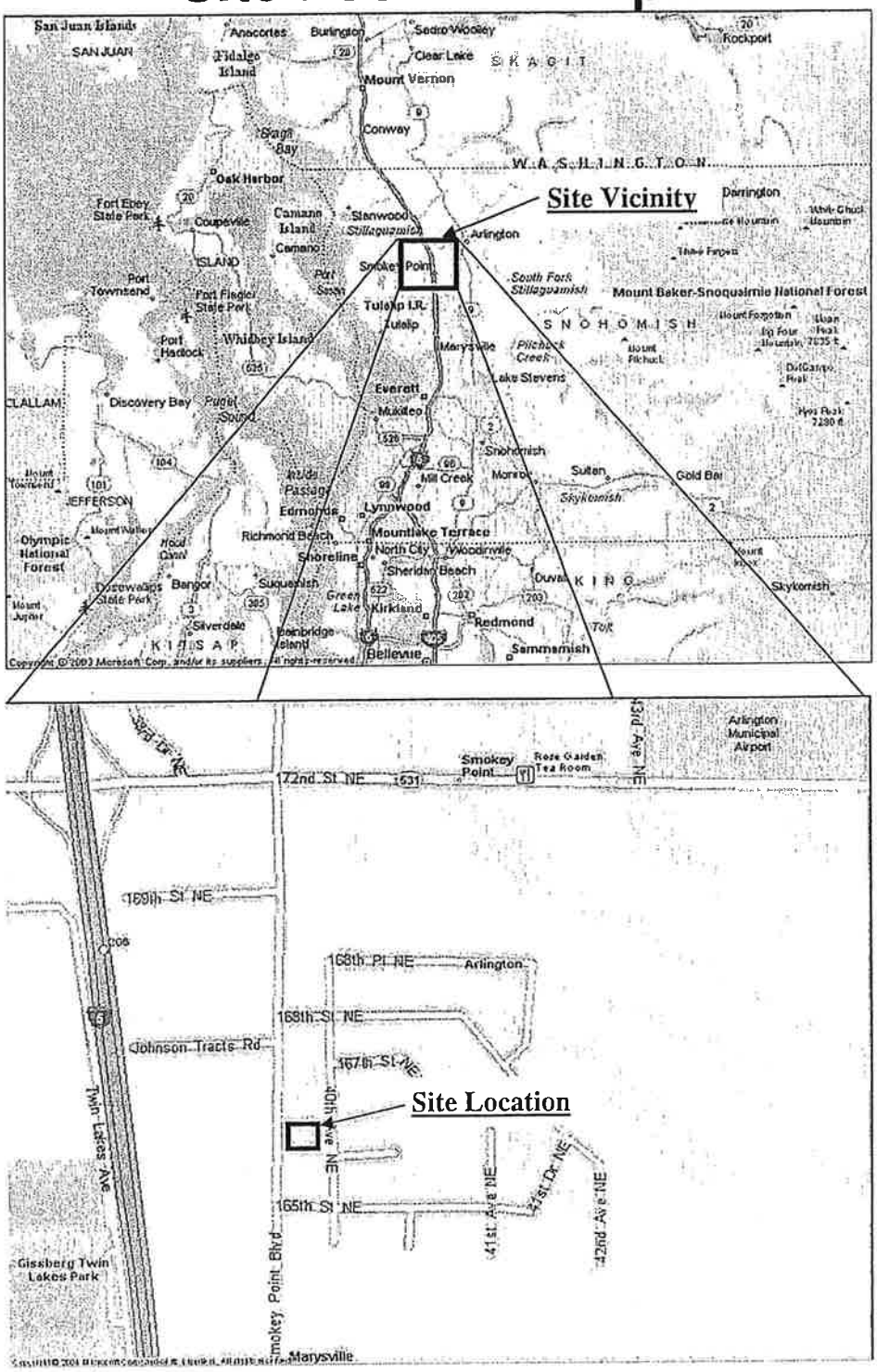
ATTACHMENT 6
Operation and Maintenance

- Lawns and landscaping around the proposed buildings shall be maintained by mowing and removing the clippings. Lawn clippings and yard waste shall not be disposed of on site.
- The proposed catch basins shall be checked on a yearly basis and silt removed when depth reaches no more that 1". Trash and debris shall be removed.
- The use of herbicides and pesticides shall be minimized.

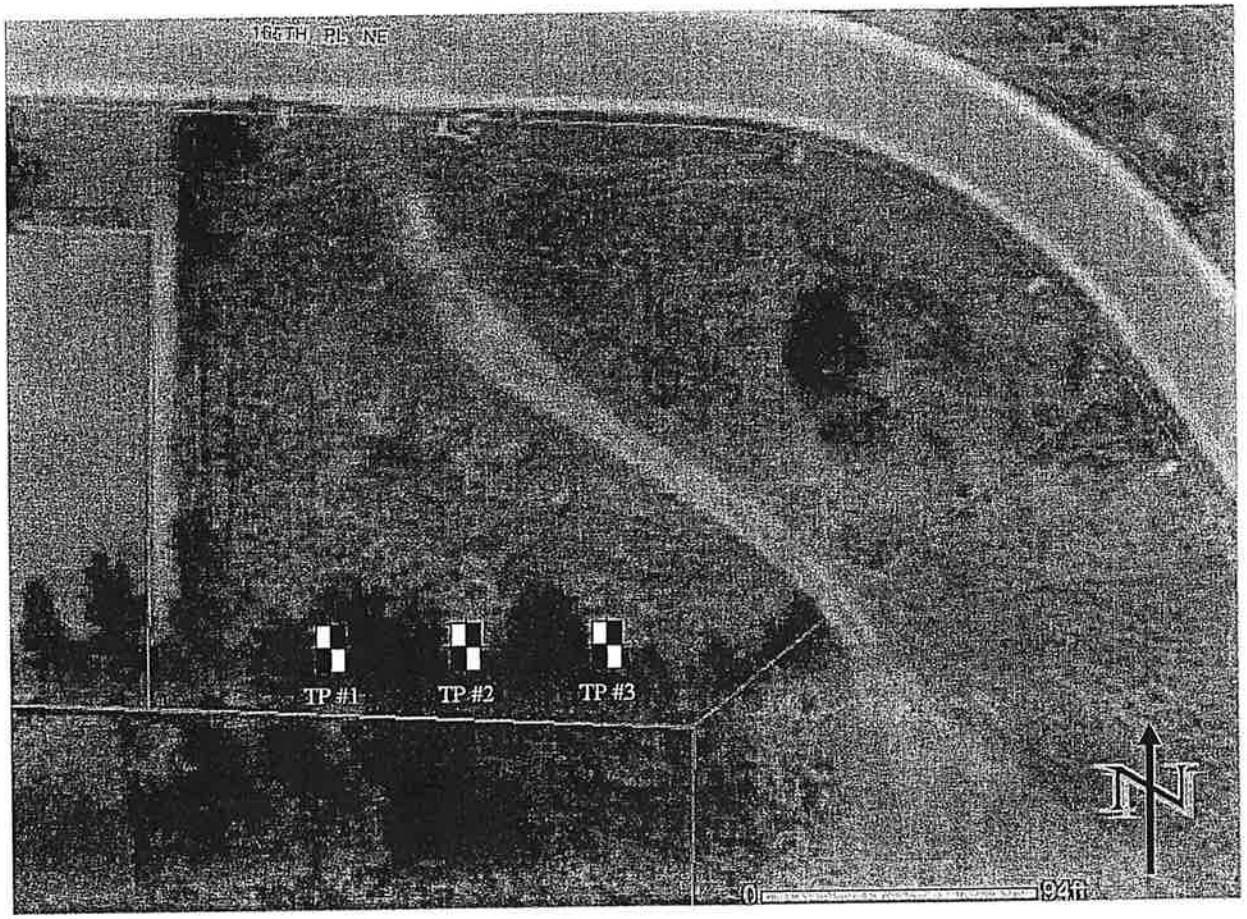
ATTACHMENT 7

Soils Investigation/Infiltration report

Site Location Maps



Site Plan Showing Test Pit Locations



Test Pit Logs

Depth (ft)	USCS	Soil Description	Date Excavated
Test Pit 1		**35' North, 60' East of Southwest Property Corner**	**10/3/06**
0.0-0.3	**OL**	Sod and grass roots	
0.3-1.3	**SP**	Orange brown **SAND** with silt, medium dense, moist	
1.3-3.2	**SP**	Grey **SAND**, medium dense, moist, moderate mottling, streaks to 2" thick, coarse grained	
3.2-6.0	**SP**	Grey gravelly **SAND**, dense, wet, gravel rounded to 1-1/2" diameter, with occasional dark brown silt lenses.	
		Sample taken at 0.3, 1.3, 3.2 and 5.0 feet. Rapid seepage observed at 5.8 feet. No mottling below 4.2 feet. No caving. Base of test pit at 6.0 feet.	
Test Pit 2		**35' North, 100' East of Southwest Property Corner**	**10/3/06**
0.0-0.4	**OL**	Sod and grass roots	
0.4-2.3	**SP**	Orange to dark orange **SAND**, medium dense, moist, with trace silt	
2.3-6.5	**SP**	Light grey **SAND**, medium dense to dense, moist to wet, becomes coarse grained at 3.3', light mottling to 5.0'.	
		Sample taken at 2.3 feet. Rapid seepage observed at 6.0 feet. No caving. Base of test pit at 6.5 feet.	
Test Pit 3		**35' North, 150' East of Southwest Property Corner**	**10/3/06**
0.0-0.7	**OL**	Sod and grass roots	
0.7-1.6	**SP**	Dark orange and mottled black **SAND** with some silt, loose to medium dense, moist	
1.6-6.5	**SP-SM**	Grey to light grey **SAND with silt**, medium dense to dense, moist, with trace very light mottling, becomes coarse grained at 5.3'	
		Sample taken at 1.6 feet. Rapid seepage observed at 6.2 feet. No caving. Base of test pit at 6.5 feet.	

Kids 'n Us – Smokey Pt.
DuJardin Development

Materials Testing & Consulting, Inc.
October 9, 2006

Sieve Report

Project: Kids & Us
Project #: 06B260
Client: DuJardin Development
Source: Test Pit 1 @ -1.3' to 3.2'
Sample#: 061593

Date Received: 03-Oct-06
Sampled By: M.Veenstra
Date Tested: 06-Oct-06
Tested By: C. Shear, V. Duran

ASTM D-2487 Unified Soils Classification System
SP, Poorly graded Sand

ACCREDITED

Specifications
No Specs
Sample Meets Specs ? Yes

$D_{(10)}$ = 0.121 mm
$D_{(30)}$ = 0.224 mm
$D_{(60)}$ = 0.344 mm
Liquid Limit = n/a
Fracture % = n/a

% Gravel = 1.0%
% Sand = 95.9%
% Silt & Clay = 3.0%
Plastic Limit = n/a
Moisture %, as sampled = 11.0%

Coeff. of Curvature, C_c = 1.21
Coeff. of Uniformity, C_U = 2.86
Fineness Modulus = 1.54
Plasticity Index = n/a

ASTM C-136, ASTM D-4318

Sieve Size US	Sieve Size Metric	Actual Cumulative Percent Passing	Interpolated Cumulative Percent Passing	Specs Max	Specs Min
6.00"	150.00		100%	100.0%	0.0%
4.00"	100.00		100%	100.0%	0.0%
3.00"	75.00		100%	100.0%	0.0%
2.50"	63.00		100%	100.0%	0.0%
2.00"	50.00		100%	100.0%	0.0%
1.75"	45.00		100%	100.0%	0.0%
1.50"	37.50		100%	100.0%	0.0%
1.25"	31.50		100%	100.0%	0.0%
1.00"	25.00		100%	100.0%	0.0%
7/8"	22.40		100%	100.0%	0.0%
3/4"	19.00	100%	100%	100.0%	0.0%
5/8"	16.00		100%	100.0%	0.0%
1/2"	12.50	99%	99%	100.0%	0.0%
3/8"	9.50	99%	99%	100.0%	0.0%
1/4"	6.30		99%	100.0%	0.0%
#4	4.75	99%	99%	100.0%	0.0%
#8	2.360		99%	100.0%	0.0%
#10	2.000	99%	99%	100.0%	0.0%
#16	1.180		98%	100.0%	0.0%
#20	0.850	98%	98%	100.0%	0.0%
#30	0.600		87%	100.0%	0.0%
#40	0.425	80%	80%	100.0%	0.0%
#50	0.300		49%	100.0%	0.0%
#60	0.250		37%	100.0%	0.0%
#80	0.180	19%	19%	100.0%	0.0%
#100	0.150		15%	100.0%	0.0%
#140	0.106		8%	100.0%	0.0%
#170	0.090		5%	100.0%	0.0%
#200	0.075	3.0%	3.0%	100.0%	0.0%

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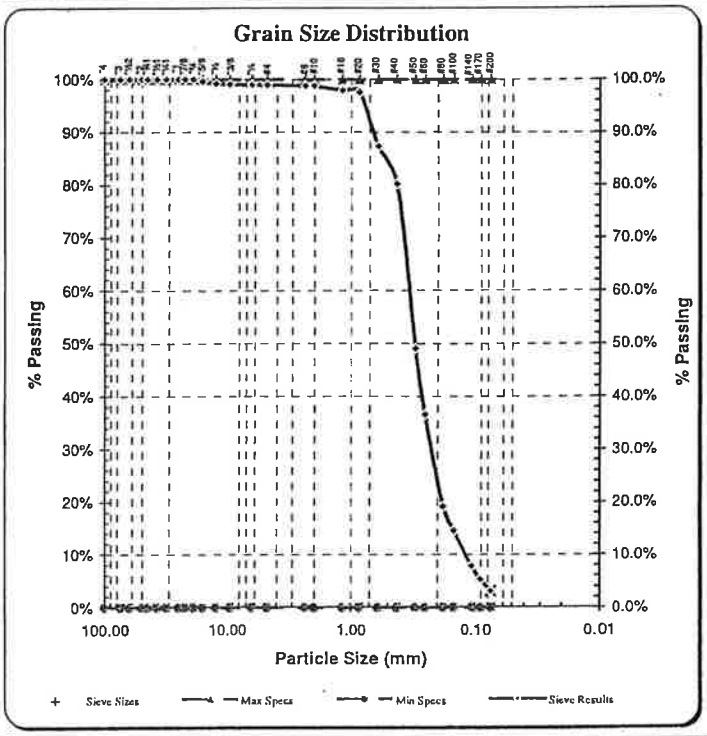

Comments:

Reviewed by: C. S

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Sieve Report

Project: Kids & Us
Project #: 06B260
Client: DuJardin Development
Source: Test Pit 2 @ -2.3' to 3.3'
Sample#: 061594

Date Received: 03-Oct-06
Sampled By: M.Veenstra
Date Tested: 06-Oct-06
Tested By: C. Shear, V. Duran

ASTM D-2487 Unified Soils Classification System
SP, Poorly graded Sand

ACCREDITED

Specifications
No Specs
Sample Meets Specs ? Yes

$D_{(10)}$ = 0.122 mm
$D_{(30)}$ = 0.229 mm
$D_{(60)}$ = 0.395 mm
Liquid Limit = n/a
Fracture % = n/a

% Gravel = 3.8%
% Sand = 93.3%
% Silt & Clay = 2.9%
Plastic Limit = n/a
Moisture %, as sampled = 12.7%

Coeff. of Curvature, C_C = 1.09
Coeff. of Uniformity, C_U = 3.23
Fineness Modulus = 1.93
Plasticity Index = n/a

ASTM C-136, ASTM D-4318

Sieve Size US	Sieve Size Metric	Actual Cumulative Percent Passing	Interpolated Cumulative Percent Passing	Specs Max	Specs Min
6.00"	150.00		100%	100.0%	0.0%
4.00"	100.00		100%	100.0%	0.0%
3.00"	75.00		100%	100.0%	0.0%
2.50"	63.00		100%	100.0%	0.0%
2.00"	50.00		100%	100.0%	0.0%
1.75"	45.00		100%	100.0%	0.0%
1.50"	37.50		100%	100.0%	0.0%
1.25"	31.50		100%	100.0%	0.0%
1.00"	25.00	98%	98%	100.0%	0.0%
7/8"	22.40		98%	100.0%	0.0%
3/4"	19.00	98%	98%	100.0%	0.0%
5/8"	16.00		98%	100.0%	0.0%
1/2"	12.50	97%	97%	100.0%	0.0%
3/8"	9.50	97%	97%	100.0%	0.0%
1/4"	6.30		96%	100.0%	0.0%
#4	4.75	96%	96%	100.0%	0.0%
#8	2.360		95%	100.0%	0.0%
#10	2.000	95%	95%	100.0%	0.0%
#16	1.180		89%	100.0%	0.0%
#20	0.850	87%	87%	100.0%	0.0%
#30	0.600		74%	100.0%	0.0%
#40	0.425	65%	65%	100.0%	0.0%
#50	0.300		43%	100.0%	0.0%
#60	0.250	35%	35%	100.0%	0.0%
#80	0.180	19%	19%	100.0%	0.0%
#100	0.150		14%	100.0%	0.0%
#140	0.106		8%	100.0%	0.0%
#170	0.090		5%	100.0%	0.0%
#200	0.075	2.9%	2.9%	100.0%	0.0%

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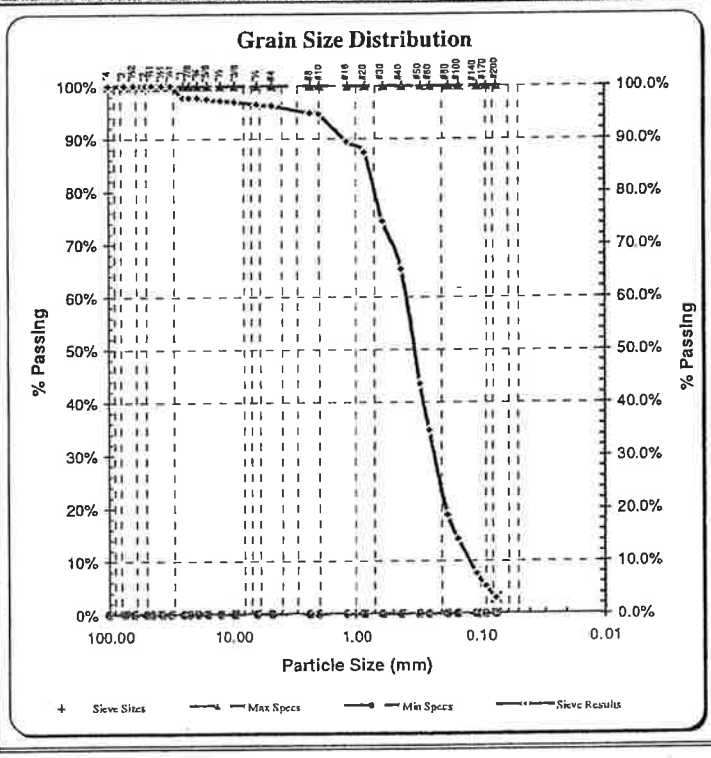

Comments: _____

Reviewed by: C. S

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Sieve Report

Project: Kids & Us
Project #: 06B260
Client: DuJardin Development
Source: Test Pit 3 @ -1.6' to 3.6'
Sample#: 061595

Date Received: 03-Oct-06
Sampled By: M.Veenstra
Date Tested: 06-Oct-06
Tested By: C. Shear, V. Duran

ASTM D-2487 Unified Soils Classification System
SP-SM, Poorly graded Sand with Silt

ACCREDITED

Specifications
No Specs
Sample Meets Specs ? Yes

$D_{(10)}$ = 0.087 mm
$D_{(30)}$ = 0.164 mm
$D_{(60)}$ = 0.286 mm
Liquid Limit = n/a
Fracture % = n/a

% Gravel = 1.8%
% Sand = 91.5%
% Silt & Clay = 6.8%
Plastic Limit = n/a
Moisture %, as sampled = 13.0%

Coeff. of Curvature, C_C = 1.07
Coeff. of Uniformity, C_U = 3.27
Fineness Modulus = 1.28
Plasticity Index = n/a

ASTM C-136, ASTM D-4318

Sieve Size US	Sieve Size Metric	Actual Cumulative Percent Passing	Interpolated Cumulative Percent Passing	Specs Max	Specs Min
6.00"	150.00		100%	100.0%	0.0%
4.00"	100.00		100%	100.0%	0.0%
3.00"	75.00		100%	100.0%	0.0%
2.50"	63.00		100%	100.0%	0.0%
2.00"	50.00		100%	100.0%	0.0%
1.75"	45.00		100%	100.0%	0.0%
1.50"	37.50		100%	100.0%	0.0%
1.25"	31.50		100%	100.0%	0.0%
1.00"	25.00		100%	100.0%	0.0%
7/8"	22.40		100%	100.0%	0.0%
3/4"	19.00	100%	100%	100.0%	0.0%
5/8"	16.00		100%	100.0%	0.0%
1/2"	12.50	100%	100%	100.0%	0.0%
3/8"	9.50	99%	99%	100.0%	0.0%
1/4"	6.30		99%	100.0%	0.0%
#4	4.75	98%	98%	100.0%	0.0%
#8	2.360		98%	100.0%	0.0%
#10	2.000	98%	98%	100.0%	0.0%
#16	1.180		97%	100.0%	0.0%
#20	0.850	96%	96%	100.0%	0.0%
#30	0.600		91%	100.0%	0.0%
#40	0.425	87%	87%	100.0%	0.0%
#50	0.300		63%	100.0%	0.0%
#60	0.250	53%	53%	100.0%	0.0%
#80	0.180	34%	34%	100.0%	0.0%
#100	0.150		26%	100.0%	0.0%
#140	0.106		15%	100.0%	0.0%
#170	0.090		11%	100.0%	0.0%
#200	0.075	6.8%	6.8%	100.0%	0.0%

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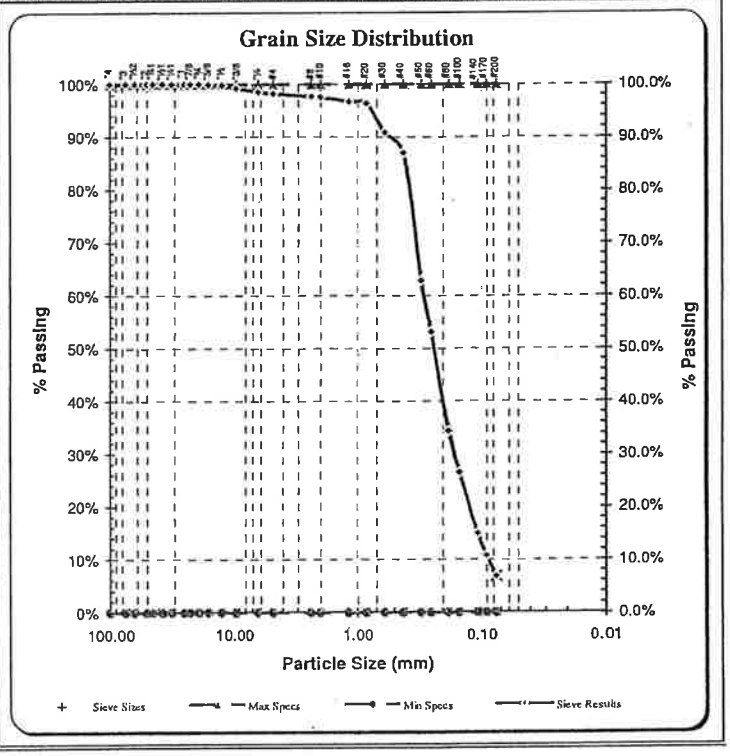

Comments:

Reviewed by: C. S

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ATTACHMENT 8
Basin Summaries

STORMSHED CALCULATIONS
NORTHERN BASIN
JOB # 047-06
OCTOBER 2006

RLPCOMPUTE [LP NORTHERN] SUMMARY

2 yr	MatchQ=PeakQ= 0.2377 cfs Peak Out Q: 0.1533 cfs - Peak Stg: 100.05 ft - Active Vol: 111.85 cf
100 yr	MatchQ=PeakQ= 0.5113 cfs Peak Out Q: 0.1742 cfs - Peak Stg: 100.40 ft - Active Vol: 825.75 cf

Running M:\SDG\2006\047-06 - Dujardin - Lot 18 The Park Site Plan Feas\drain\LP NORTHERN Report.pgm on Wednesday, October 11, 2006

Summary Report of all RLPool Data

Project Precips

[2 yr]	2.00 in
[5 yr]	3.10 in
[10 yr]	2.70 in
[25 yr]	4.50 in
[100 yr]	3.90 in
[Other]	1.27 in

BasinID	Peak Q (cfs)	Peak T (hrs)	Peak Vol (ac-ft)	Area ac	Method /Loss	Raintype	Event
NORTHERN	0.2377	8.00	0.0810	0.62	SBUH/SCS	TYPE1A	2 yr
NORTHERN	0.5113	8.00	0.1751	0.62	SBUH/SCS	TYPE1A	100 yr

Drainage Area: NORTHERN

Hyd Method:	SBUH Hyd		Loss Method:	SCS CN Number
Peak Factor:	484.00		SCS Abs:	0.20
Storm Dur:	24.00 hrs		Intv:	10.00 min
	Area	CN	TC	
Pervious	0.1320 ac	86.00	0.08 hrs	
Impervious	0.4850 ac	98.00	0.08 hrs	
Total	0.6170 ac			

Supporting Data:

Pervious CN Data:

LANDSCAPE AREA	86.00	0.1320 ac

Impervious CN Data:

PERV. PAVEMENT	98.00	0.1500 ac
ASPHALT	98.00	0.2000 ac
PROPOSED BUILDING	98.00	0.1350 ac

Pervious TC Data:

Flow type:	Description:	Length:	Slope:	Coeff:	Travel Time
Sheet	SHEET	0.00 ft	2.00%	0.1500	0.00 min
Fixed	None Entered	0.00 ft	0.00%	5.0000	5.00 min

Impervious TC Data:

Flow type:	Description:	Length:	Slope:	Coeff:	Travel Time
Fixed	None Entered	0.00 ft	0.00%	5.0000	5.00 min

HYDLIST SUMMARY

[NORTHERN 2] [NORTHERN 100]

LSTEND

HydID	Peak Q (cfs)	Peak T (hrs)	Peak Vol (ac-ft)	Cont Area (ac)
NORTHERN 2	0.15	8.17	0.0810	0.6170
NORTHERN 100	0.17	9.00	0.1753	0.6170

STORLIST

[INF TRENCH]

LSTEND

Node ID: INF TRENCH

Desc:	Manhole structure			
Start El:	100.0000 ft		Max El:	101.5000 ft
Contrib Basin:			Contrib Hyd:	
	Length	Width	Void Ratio	
	205.0000 ft	10.0000 ft	100.00	

DISCHLIST

[INFIL]

LSTEND

Control Structure ID: INFIL - Stage Discharge rating curve

Descrip:	Multiple Orifice	
Start El	Max El	Increment
100.0000 ft	101.5000 ft	0.10
Stage		Discharge
100.0000 ft		0.1500 cfs
100.5000 ft		0.1800 cfs
101.0000 ft		0.2000 cfs
101.5000 ft	0.2300 cfs	

STORMSHED CALCULATIONS
SOUTHERN BLDG BASIN
JOB # 047-06
OCTOBER 2006

RLPCOMPUTE [LP SOUTH BUILD] SUMMARY

2 yr	MatchQ=PeakQ= 0.0477 cfs Peak Out Q: 0.0200 cfs - Peak Stg: 100.11 ft - Active Vol: 52.71 cf
100 yr	MatchQ=PeakQ= 0.0962 cfs Peak Out Q: 0.0200 cfs - Peak Stg: 100.59 ft - Active Vol: 272.69 cf

Running M:\SDG\2006\047-06 - Dujardin - Lot 18 The Park Site Plan Feas\drain\LP SOUTH BUILD Report.pgm on Thursday, October 12, 2006

Summary Report of all RLPool Data

Project Precips

[2 yr]	2.00 in
[5 yr]	3.10 in
[10 yr]	2.70 in
[25 yr]	4.50 in
[100 yr]	3.90 in
[Other]	1.27 in

BASLIST2

[SOUTHERN BUILDING] Using [TYPE1A] As [2 yr]
[SOUTHERN BUILDING] Using [TYPE1A] As [100 yr]

LSTEND

BasinID	Peak Q (cfs)	Peak T (hrs)	Peak Vol (ac-ft)	Area ac	Method /Loss	Raintype	Event	
SOUTHERN BUILDING		0.0477	8.00	0.0160	0.11	SBUH/SCS	TYPE1A	2 yr
SOUTHERN BUILDING		0.0962	8.00	0.0330	0.11	SBUH/SCS	TYPE1A	100 yr

Drainage Area: SOUTHERN BUILDING

Hyd Method:	SBUH Hyd		Loss Method:	SCS CN Number
Peak Factor:	484.00		SCS Abs:	0.20
Storm Dur:	24.00 hrs		Intv:	10.00 min
	Area	CN	TC	
Pervious	0.0000 ac	86.00	0.00 hrs	
Impervious	0.1080 ac	98.00	0.08 hrs	
Total	0.1080 ac			

Supporting Data:
Impervious CN Data:

BUILDING	98.00	0.1080 ac

Impervious TC Data:

Flow type:	Description:	Length:	Slope:	Coeff:	Travel Time
Fixed	None Entered	0.00 ft	0.00%	5.0000	5.00 min

HYDLIST SUMMARY

[SOUTH BUILD 2] [SOUTH BUILD 100]

LSTEND

HydID	Peak Q (cfs)	Peak T (hrs)	Peak Vol (ac-ft)	Cont Area (ac)
SOUTH BUILD 2	0.02	6.17	0.0160	0.1080
SOUTH BUILD 100	0.02	5.83	0.0330	0.1080

STORLIST

[INF TRENCH SOUTH]

LSTEND

Node ID: INF TRENCH SOUTH

Desc:	Manhole structure			
Start El:	100.0000 ft		Max El:	101.5000 ft
Contrib Basin:			Contrib Hyd:	
	Length	Width	Void Ratio	
	100.0000 ft	4.6500 ft	100.00	

DISCHLIST

[INF SOUTH BUILD]

LSTEND

Control Structure ID: INF SOUTH BUILD - Stage Discharge rating curve

Descrip:	Multiple Orifice	
Start El	Max El	Increment
100.0000 ft	101.5000 ft	0.10
Stage		Discharge
100.5000 ft		0.0200 cfs
101.0000 ft		0.0200 cfs
100.0000 ft		0.0200 cfs
101.5000 ft		0.0200 cfs

STORMSHED CALCULATIONS
SOUTHERN BASIN
JOB # 047-06
OCTOBER 2006

RLPCOMPUTE [LP SOUTHERN] SUMMARY

2 yr MatchQ=PeakQ= 0.1008 cfs Peak Out Q: 0.1050 cfs - Peak Stg: 100.00 ft - Active Vol: 0.30 cf
100 yr MatchQ=PeakQ= 0.3255 cfs Peak Out Q: 0.3065 cfs - Peak Stg: 100.01 ft - Active Vol: 4.73 cf

Running M:\SDG\2006\047-06 - Dujardin - Lot 18 The Park Site Plan Feas\drain\LP SOUTHERN Report.pgm on Thursday, October 12, 2006

Summary Report of all RLPool Data

Project Precips

[2 yr]	2.00 in
[5 yr]	3.10 in
[10 yr]	2.70 in
[25 yr]	4.50 in
[100 yr]	3.90 in
[Other]	1.27 in

BASLIST2

[SOUTHERN] Using [TYPE1A] As [2 yr]
[SOUTHERN] Using [TYPE1A] As [100 yr]

LSTEND

BasinID	Peak Q (cfs)	Peak T (hrs)	Peak Vol (ac-ft)	Area ac	Method /Loss	Raintype	Event
SOUTHERN	0.1008	8.00	0.0404	0.54	SBUH/SCS	TYPE1A	2 yr
SOUTHERN	0.3255	8.00	0.1133	0.54	SBUH/SCS	TYPE1A	100 yr

Drainage Area: SOUTHERN

Hyd Method:	SBUH Hyd		Loss Method:	SCS CN Number
Peak Factor:	484.00		SCS Abs:	0.20
Storm Dur:	24.00 hrs		Intv:	10.00 min
	Area	CN	TC	
Pervious	0.5090 ac	86.00	0.12 hrs	
Impervious	0.0300 ac	98.00	0.08 hrs	
Total	0.5390 ac			

Supporting Data:

Pervious CN Data:

LANDSCAPE AREA	86.00	0.5090 ac

Impervious CN Data:

PERV. PAVEMENT	98.00	0.0300 ac

Pervious TC Data:

Flow type:	Description:	Length:	Slope:	Coeff:	Travel Time
Sheet	SHEET	50.00 ft	2.00%	0.1500	7.12 min

Impervious TC Data:

Flow type:	Description:	Length:	Slope:	Coeff:	Travel Time
Fixed	None Entered	0.00 ft	0.00%	5.0000	5.00 min

HYDLIST SUMMARY

[SOUTHERN 2] [SOUTHERN 100]

LSTEND

HydID	Peak Q (cfs)	Peak T (hrs)	Peak Vol (ac-ft)	Cont Area (ac)
SOUTHERN 2	0.11	8.00	0.0405	0.5390
SOUTHERN 100	0.31	8.00	0.1136	0.5390

STORLIST

[INF TRENCH SOUTH]

LSTEND

Node ID: INF TRENCH SOUTH

Desc:	Manhole structure			
Start El:	100.0000 ft		Max El:	101.5000 ft
Contrib Basin:			Contrib Hyd:	
	Length	Width	Void Ratio	
	100.0000 ft	4.6500 ft	100.00	

DISCHLIST

[INFIL SOUTHERN]

LSTEND

Control Structure ID: INFIL SOUTHERN - Stage Discharge rating curve

Descrip:	Multiple Orifice	
Start El	Max El	Increment
100.0000 ft	101.5000 ft	0.10
Stage		Discharge
100.5000 ft		0.1400 cfs
101.0000 ft		0.1600 cfs
100.0000 ft		0.3100 cfs
101.5000 ft		0.1800 cfs