Planning, Engineering, Architecture, Landscaping Architecture, Land Surveying

CLC ASSOCIATES, INC.

SPOKANE, WA • DENVER, CO

STORMWATER CONVEYANCE
AND
DRAINAGE SWALES

OPERATION & MAINTENANCE MANUAL

RECEIVED
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SPOKANE COUNTY ENGINEER

Fraser Estates

County File P-1864
CLC No. S990126

April, 2002

By
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1.00 PURPOSE

This Manual has been prepared to provide general operation and maintenance guidelines for the drainage facilities located within the Plats of Fraser Estates and Fraser Estates - First Addition, which are located outside of the County road rights-of-way. Implementation of these guidelines will insure that the drainage facilities installed will function as intended in the plat design. As additional phases are completed both within the Plat and within the Plat of Fraser Estates East, this Manual will be revised to reflect the additional storm drainage facilities requiring maintenance. As a result, when additional phases are completed, the annual recommend set aside fund amount will be modified.

2.00 INTRODUCTION

Generally, the drainage system is intended to collect onsite stormwater runoff in the streets and convey it to the various drainage swales, via concrete gutters and storm pipes. The drainage facilities consist primarily of a series of onsite drainage structures, storm pipes, treatment/storage swales, and drywells. It is of the utmost importance to provide adequate operations and maintenance activities to insure that the drainage facilities remain silt or dirt free, as this silt or dirt loading will affect the performance of the storm pipes, swales, and drywells. If these facilities were to become completely clogged, the only remedy would be to completely reconstruct the drainage facilities. Therefore, periodic maintenance is a must. A full set of engineering drawings for Fraser Estates is available for review at Spokane County Public Works, under County file P-1864.

3.00 GENERAL OPERATIONAL CHARACTERISTICS

The drainage facilities for Fraser Estates are generally very simple, functional, and have low maintenance requirements. A periodic visual inspection of the facilities will identify any required maintenance. Most maintenance will consist of keeping the pipes, structures and swales free of debris and sediment. A specific inspection schedule should be followed. See Section 4.0 for recommended maintenance schedules.

3.10 Drainage Structures and Storm Pipes

The drainage structures include concrete gutters, catch basins and drywells. These structures convey stormwater runoff from the surface streets to storage swales or the underground storm sewer system. The storm sewer system consists of piping, ditches and catch basins which direct the storm water runoff into swales containing drywells.

3.20 Drainage Swales

Drainage swales are located at sites which have moderate to high infiltration rates. All "208" drainage swales are located within drainage tracts or within the landscaping area between the curb and sidewalk.

Each swale has a flat bottom and is enclosed within earthen berms. The soil located in the floor of the swale is required to be a medium to well draining material, with a minimum infiltration rate of 0.5 inches per hour. All swale volumes and outlet structures were designed to address the runoff flow rates and volumes for the 10-year design storm event.

Swale characteristic information is provided in Table 3.20A. Additional information is provided in the engineering drawings on file at Spokane County Public Works, under file P-1864.

Table 3.20A - Swale Characteristics

Swale/Tract Label	Swale Btm. Elev.	Swale Btm. Area	Swale Volume	Outlet Structure	Outlet Elev.	Overflow Elev.
Swale A	1985.03	735	409	1-Type A	1985.53	1985.78
Swale B	1989.90	934	537	1-Type A	1990.40	1990.65
Swale C	1990.10	267	200	None	1990.60	1990.85
Swale D	1990.10	267	200	1-Type A	1990.60	1990.70
Swale D1	1976.10	1725	968	1-Type A	1976.60	1978.10
Swale D2	1976.10	3150	1726	2-Type A	1976.60	1978.10
Swale D3	1974.00	576	288	1-Type A	1974.50	1976.00
Tract G	1986.17	466	310	1-Type A	1986.67	1986.67
Tract H	1986.30	390	307	1-Type A	1986.80	1987.05
Swale H	1970.17	3,280	1,732	2-Type B	1970.67	1971.72
Swale I	1977.16	1,100	638	1-Type A	1977.66	1978.00
Tract L	1982.40	1,620	908	Catch Basin	1982.90	1984.90
Tract M	1984.15	1,405	789	1-Type A	1984.65	1985.60
Swale R	1979.24	2,633	1,409	2-Type B	1979.74	1980.64
Swale T	1983.30	2,000	1,091	1-Type B	1983.80	1984.70
Tract I	1985.36	686	431	1-Type A	1985.86	1986.76
Tract J	1986.10	624	394	1-Type A	1986.60	1987.50
Swale W1	1987.20	288	185	1-Type A	1987.70	1988.60
Swale W2	1986.35	494	313	1-Type A	1986.85	1987.75
Swale X1	1987.20	288	185	1-Type A	1987.70	1988.60
Swale X2	1986.35	494	313	1-Type A	1986.85	1987.75
Swale Y	1982.35	224	136	1-Type A	1982.85	1983.75

3.30 Infiltration Structures

Infiltration outlet structures include single and double-depth (Spokane County Standard Type A and B) drywells, which are used to infiltrate stormwater runoff beyond the available swale volume. A copy of the Spokane County Standard Plan B-1a *Precast Drywells Placed in Swales* is provided in the Appendix for reference. These structures consist of a grated inlet, perforated concrete barrel sections, and buried washed drain rock, wrapped in porous filter fabric. The grate inlet elevation is set six inches above the swale bottom to provide stormwater storage and sediment removal prior to drywell infiltration.

4.00 MAINTENANCE REQUIREMENTS AND SCHEDULES

Below is a maintenance description for each of the drainage system elements contained within the Fraser Estates development, including the drainage structures, pipes and swales. All drainage facilities located outside of the County road right-of-way, are expected to be maintained by the homeowner's association. Any drainage facilities located on individual residential lots are to be maintained by the respective homeowners. Should the homeowner's association be terminated for any reason, the maintenance responsibilities will become that of the individual homeowners, located within the Fraser Estates Plat.

The Fraser Estates Homeowner's Association shall provide to the Spokane County Parks Department and the Spokane County Engineer the name, address, and 24-hour phone number for those responsible for performing routine and emergency maintenance inspections and repairs. This information shall be confirmed on a yearly basis. The homeowner's association shall provide notice of any changes to the Spokane County Parks Department and the Spokane County Engineer within 15 days of said changes.

General

Proper maintenance procedures are necessary for the continued functioning of the drainage facilities. Improper maintenance, or lack of attentive maintenance measures, may result in negative drainage impacts. It is strongly recommended that the homeowner's association designate an individual who will be responsible for making sure the maintenance measures are implemented.

Generally, maintenance personnel are to conduct a visual inspection of the drainage facilities immediately following a substantial rainfall event or snowmelt event. Substantial events include:

- Noticeably hard rain for a short period (30 minutes or more),
- Steady rain for a long period (6 hours or more), or
- Significant rainfall and/or snowmelt when the ground is frozen.

For long duration storms, longer than 24 hours, maintenance personnel are to inspect the drainage facilities during the storm event to identify any developing problems and correct them before they become major problems.

1. Inspect all concrete gutters and drainage structures (catch basins and drywells) to ensure they are clear of debris and obstructions.

2. Inspect all swale berms for breaches. Immediately repair any berm breaches with native sandy soil, compacted in place.

The above noted storm related visual inspections are in addition to the maintenance schedules noted for each item.

4.10 Drainage Structures and Storm Pipes

Catch basins and pipes should be inspected every 3 months, or after every significant storm event (½") and/or snowmelt event, whichever is more frequent. Visually inspect the pipes, inlets and outlets, making sure they are clear of debris and checking that the pipe is in good condition, without breaks or cracks. If there is any obstruction present it should be removed immediately.

A flow test in the pipe can be used to readily detect major obstructions or breaks in the pipe. This test requires a water source (hydrant or water truck) and a person at the downstream end of the pipe observing the flow exiting out of the pipe section.

All catch basins should be cleaned (vacuumed) every 6 months.

4.20 Drainage Swales

The drainage swales should be inspected every 3 months, or after every significant rainfall and/or snowmelt event, whichever is more frequent. The swales consist of earthen depressions constructed from native soils, enclosed within soil berms. Each swale should be sodded and/or hydro-seeded with a dryland grass mixture, at a minimum. A lawn sod can be used if regular irrigating is implemented.

Routine maintenance and inspections of the swales will include removal of any accumulated debris, such as leaves, weeds and trash. Any obstructions which would not allow water to flow freely from the swales via the outlet structures should be removed. Additionally, the swale berms should be inspected to insure that they are in good repair and structurally sound and that no outflow has occurred other than through the outlet structure.

The homeowner's association shall be responsible for replacement of grass turf and underlying 1-foot depth of soil in swales whenever the vegetation appears to indicate a problem due to contamination. The turf and underlying soil shall meet Spokane County requirements for permeability in effect at the time of replacement.

4.30 Infiltration Structures

The infiltration structures (drywells) consist of a grated inlet, perforated concrete barrel sections, and buried washed drain rock, wrapped in porous filter fabric. Drywells should be inspected every 3 months, or after every significant rainfall and/or snowmelt event, whichever is more frequent. During routine inspection, if standing water is found 72 hours or more after the last significant rainfall event, the infiltration structure is most likely clogged due to silt and sediment. The structure shall be vacuumed of standing water and sediment.

All drywells should be cleaned (vacuumed) every 6 months.

5.00 Recommended Set-Aside Funds for Maintenance & Future Replacement Costs

There will be annual maintenance costs, major renovation costs and future replacement costs of the drainage facilities. These costs are the responsibility of the homeowner's association or successors in interest. Major renovation and future replacement costs have been converted to annual costs, in the form of recommended set-aside funds. It is assumed that ½ of the pipe and 2 drywells will need to be replaced within 20 years.

The estimated annual maintenance costs and recommended annual set-aside costs are listed below in Table 5.00A. It is recommended the homeowner's association set-aside these funds annually, to ensure that adequate maintenance and replacement measures of the drainage facilities will be implemented.

Table 5.00A - Maintenance and Future Replacement Costs

Drainage Facility	Annual Maintenance Costs	Annual Set-Aside Funds for Future Replacement or Major Renovation (1)
Swales, Drainage Structures & Pipes	$ 6,500	$ 622
Drywells	$ 7,600	$ 476
Sub-total Annual Costs	**$ 14,100**	**$ 1,098**

Grand Total/year = $ 15,198
Cost per lot/year = $ 286.75 (53 lots)

Note: (1) Assume replacement in 20 yrs, with 4% inflation and a 6% rate of return on investments for Future Replacement set-aside account.

TECHNICAL APPENDIX

SITE MAPS

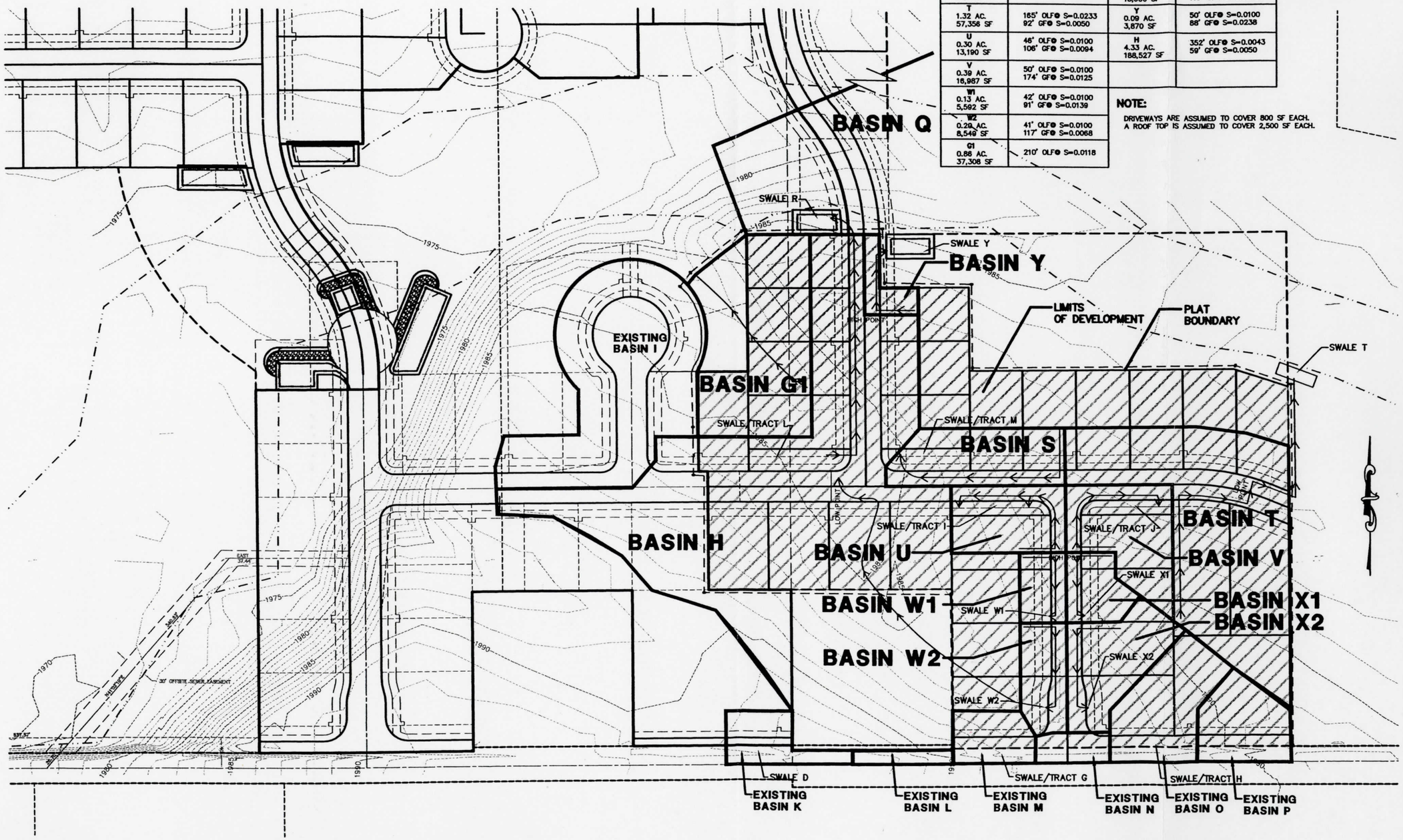
PRECAST DRYWELL, DETAIL B-1A

SW 1/4 SEC. 32, T.26 N., R.44 E.,W.M.
SPOKANE COUNTY, WASHINGTON

BASIN	FLOW	BASIN	FLOW
Q 235.70 AC. 10,267,092 SF	6,650' OLF@ S=0.0689	X1 0.16 AC. 6,964 SF	46' OLF@ S=0.0100 91' GF@ S=0.0139
S 0.38 AC. 16,446 SF	62' OLF@ S=0.0100 228' GF@ S=0.0244	X2 0.36 AC. 15,800 SF	56' OLF@ S=0.0100 116' GF@ S=0.0068
T 1.32 AC. 57,356 SF	165' OLF@ S=0.0233 92' GF@ S=0.0050	Y 0.09 AC. 3,870 SF	50' OLF@ S=0.0100 88' GF@ S=0.0238
U 0.30 AC. 13,190 SF	46' OLF@ S=0.0100 106' GF@ S=0.0094	H 4.33 AC. 188,527 SF	352' OLF@ S=0.0043 59' GF@ S=0.0050
V 0.39 AC. 16,987 SF	50' OLF@ S=0.0100 174' GF@ S=0.0125		
W1 0.13 AC. 5,592 SF	42' OLF@ S=0.0100 91' GF@ S=0.0139		
W2 0.29 AC. 8,549 SF	41' OLF@ S=0.0100 117' GF@ S=0.0068		
G1 0.86 AC. 37,308 SF	210' OLF@ S=0.0118		

NOTE:

DRIVEWAYS ARE ASSUMED TO COVER 800 SF EACH.
A ROOF TOP IS ASSUMED TO COVER 2,500 SF EACH.



COUNTY DATUM
BASED ON INVERT ELEVATION OF SEWER MANHOLE NO. 31 AS SHOWN ON "MILLWOOD-NORTHWOOD SEWER EXTENSION PLAN" SHEET 8 OF 21, ELEVATION=1956.64

THE DESIGN IMPROVEMENTS SHOWN IN THIS SET OF PLANS AND CALCULATIONS CONFORM TO APPLICABLE EDITIONS OF THE SPOKANE COUNTY STANDARDS FOR ROAD AND SEWER CONSTRUCTION AND THE SPOKANE COUNTY GUIDELINES FOR STORMWATER MANAGEMENT. ALL DESIGN DEVIATIONS HAVE BEEN APPROVED BY THE SPOKANE COUNTY ENGINEER. I APPROVE THESE PLANS FOR CONSTRUCTION.

LEGEND

OLF	OVERLAND FLOW
GF	GUTTER FLOW
→	FLOW PATH FOR Tc CALCULATION

GRAPHIC SCALE
60 0 30 60 120
(IN FEET)
1 inch = 60 ft.

UNDERGROUND SERVICE ALERT
ONE-CALL NUMBER
456·8000
CALL TWO BUSINESS DAYS BEFORE YOU DIG

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STATE OF WASHINGTON
PROFESSIONAL ENGINEER
EXPIRES 07/04/02

PREPARED UNDER THE DIRECT SUPERVISION OF DAVID N. RANDALL, P.E. WASHINGTON REGISTRATION NO. 28984 FOR AND ON BEHALF OF CLC ASSOCIATES, INC.

Date	Description
08/29/01	PRELIMINARY SUBMITTAL

Spokane County No. P-1864
CLC Job Number: S990126B
Drawn By: RLM
Designed By: DNR
Checked By: DNR

THESE PLANS ARE INSTRUMENTS OF PROFESSIONAL SERVICE AND ARE PROTECTED BY COMMON LAW, STATUTORY AND OTHER RESERVED RIGHTS INCLUDING COPYRIGHT. THEY MAY NOT BE REPRODUCED OR USED FOR ANY PURPOSE WITHOUT THE WRITTEN CONSENT OF CLC ASSOCIATES, INC. (AN AFFILIATE OF COLORADO LAND CONSULTANTS, INC.)

BASIN MAP
FRASER ESTATES FIRST ADDITION
POST-DEVELOPED CONDITION
SPOKANE COUNTY, WASHINGTON

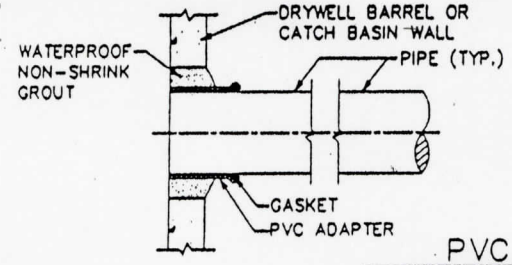
Sheet Title
DRAINAGE BASINS PLAN

B1.01
Sheet Number

J:\Land Projects\99126B\dwg\B1.01.dwg, 02/20/2002 05:04:10 PM, DAVIDRA

GENERAL NOTES

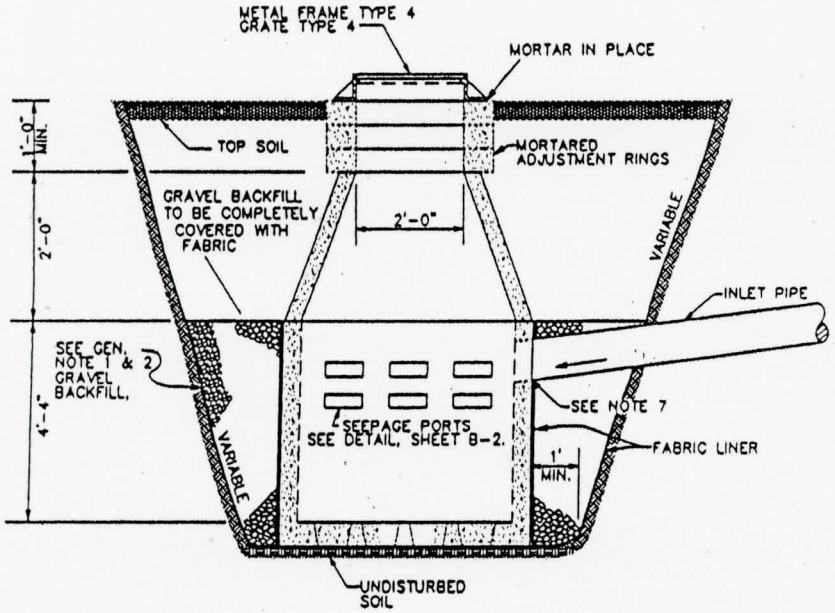
1. GRAVEL BACKFILL QUANTITY FOR DRYWELLS :
   TYPE "A" - 30 CUBIC YARDS MINIMUM / 42 TONS.
   TYPE "B" - 40 CUBIC YARDS MINIMUM / 56 TONS.
   OR AS SPECIFIED ON ROAD PLANS.
2. SPECIAL BACKFILL MATERIAL FOR DRYWELLS SHALL CONSIST OF WASHED GRAVEL GRADED FROM 1" TO 3" WITH A MAXIMUM OF 5% PASSING THE U.S. No. 200 SCREEN, AS MEASURED BY WEIGHT. A MAXIMUM OF 10% OF THE AGGREGATE, AS MEASURED BY WEIGHT, MAY BE CRUSHED OR FRACTURED ROCK. THE REMAINING 90% SHALL BE NATURALLY OCCURRING UNFRACTURED MATERIAL.
3. FABRIC SHALL BE MODERATE SURVIVABILITY AS OUTLINED IN STANDARD SPECIFICATIONS 9-33
4. SEE STANDARD PLANS SHEETS B-2 AND B-3 FOR PRECAST CONCRETE DETAILS.
5. ADJUSTMENT BLOCKS SHALL BE CEMENT CONCRETE.
6. PRECAST RISER MAY BE USED IN COMBINATION WITH OR IN LIEU OF ADJUSTING BLOCKS.
7. WHEN PVC PIPE IS USED A PVC ADAPTER SHALL BE INSTALLED.
8. PIPES SHALL BE GROUTED INTO DRYWELLS.



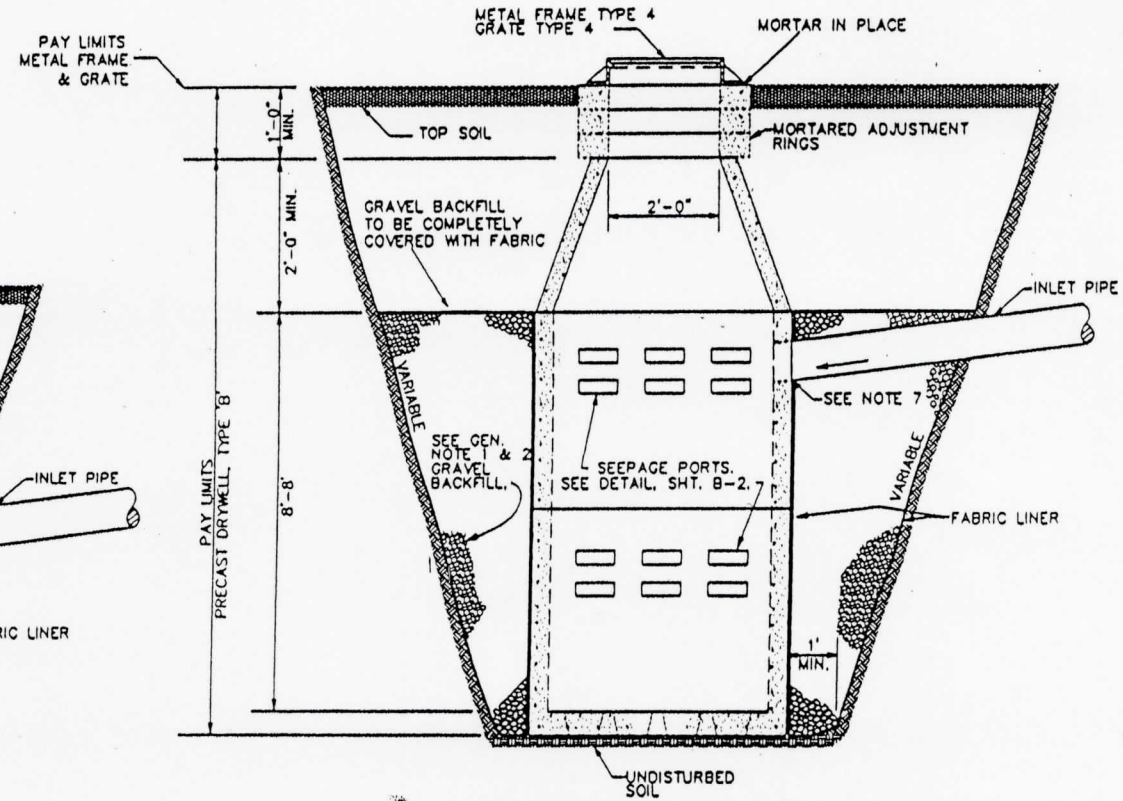
NOTE:

PVC PIPE ADAPTERS AND GASKET MAY VARY IN SHAPE AND SIZE AS ILLUSTRATED IN DETAIL BY ACCEPTABLE ALTERNATE IN ACCORDANCE WITH A.S.T.M.-C-428.

PVC ADAPTER (SAND COLLAR)



DRYWELL - TYPE 'A' SWALE



DRYWELL - TYPE 'B' SWALE

NO.	DATE	BY	CKD.	APPR.	REVISION

SPOKANE COUNTY
DEPARTMENT OF PUBLIC WORKS
SPOKANE, WA. 99206 456-3600

APPROVED: COUNTY ENGINEER
DATE 12-2-98

STANDARD
PRECAST DRYWELLS PLACED IN SWALES

SHEET B-1a