Landfill Closure:
Site Grading Work Plan and Cover Design

"A" Avenue Landfill

Anacortes, Washington

Prepared for:

City of Anacortes
Engineering and Development Services
P.O. Box 547
Anacortes, Washington 98221

August 2006

Project No. 9156

Geomatrix

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1.0 INTRODUCTION

This Site Grading Work Plan (Work Plan) was prepared by Geomatrix Consultants, Inc. (Geomatrix), for the City of Anacortes, Washington (City). This Work Plan describes grading activities at the "A" Avenue Landfill site (Site) in Anacortes, in accordance with the Proposal Letter dated April 8, 2005, between the City and Geomatrix. Geomatrix has prepared this Work Plan for grading of the Site to reduce stormwater infiltration into the landfill, minimize leachate generation, minimize erosion of cover soil, and to protect the public and the environment from exposure to debris. The proposed future use of the Site is to allow the area to return to a vegetated condition in order to be compatible with the current recreational use of the surrounding area by the public.

1.1 SITE DESCRIPTION

The Site is situated in an area known as the Cranberry Lake Area, an area of wetlands, ponds, and hiking/biking trails that are part of the Anacortes Community Forest Lands (ACFL). The ACFL is owned by the City and managed by the Anacortes Parks and Recreation Department, with a five-member advisory board that oversees the implementation of the Anacortes Community Forest Management Plan.

The Site is located about 700 feet west of the intersection at "A" Avenue and 37th Street in Anacortes, Washington. It is situated in the NE ¼ of the SE ¼ of Section 26 in T. 35 N., R. 1 E. (Figure 1), approximately 1.5 miles southwest of downtown Anacortes. According to the ACFL trail map, the Site is at an elevation of approximately 400 feet above mean sea level. Drainage in the immediate area of the Site is to the northwest toward Big Beaver Pond and to the northeast toward the 32nd Street Swamp.

1.2 HISTORY OF LANDFILL OPERATIONS

During the 1960s and early 1970s, the City disposed of municipal solid waste at the Site. At that time, the facility was operated as an open-burning dump. In approximately 1973, the City ceased using the facility for disposing municipal solid waste and closed the dump/landfill. Closure operations consisted of regrading of waste materials and covering waste with a soil

cover. This closure was typical for closing municipal dumps at the time and met regulatory requirements in place before 1985.

Since 1973, the City has used the facility for storage of public works materials and has continued to place additional soil cover materials on top of the waste. These cover materials have included street sweepings, vactor materials, dead vegetation (trees, plants, etc.), and sludge. According to the City staff, cover materials are expected to average 5 or 6 feet in thickness at the present time over most of the Site and as much as 15 feet over the southwestern portion of the landfill. The closed landfill rises approximately 25 to 30 feet above the surrounding grade, and covers approximately 3.6 acres. The current site layout, elevations, and features are shown on Figure 2.

1.3 PURPOSE AND OBJECTIVES

Ms. Brit Pfaff-Dunton from the Skagit County Health Department (Health Department) has expressed two primary concerns about this Site. One concern is a potential safety issue. The Site is within a heavily-used public access area. As such, physical hazards within the refuse pile, such as broken glass and metal debris, can pose a potential public risk. The other concern was the stormwater that infiltrates into the refuse can potentially pick up leachable chemicals, and possibly affect the groundwater quality. Some of the groundwater exits the landfill by way of seeps at the edges, particularly on the north side.

Surface water sampling was conducted by Geomatrix in 2004 to characterize the constituents in the groundwater seeps exiting the landfill. The analytical laboratory results did not indicate presence of elevated levels of chemicals or metals. Consequently, the main objective of the site work presented is to cap the landfill refuse with a thick enough cover such that the public will not be exposed to the potential physical hazards associated with debris. Furthermore, although no chemical exposures were indicated during previous sampling, the additional cover materials will minimize the risk of any future chemical exposures.

Based on discussions with the City and the Health Department, the proposed mitigation measures are not required to be in strict compliance with solid waste regulations, largely because the landfill was closed prior to 1985.

2.0 PROPOSED ACTIVITIES

This section describes the site conditions and the proposed activities for final closure of the landfill. The following sections present the detailed scope of work to address the objectives of the Health Department and the City for closure of the Site. The proposed areas of the activities and grades are shown on Figures 3 and 4.

2.1 SITE EVALUATION

A wetland survey of the Site was conducted for the City in the winter of 2006 by Jeff Wiggins of ATSI. The wetland boundaries were flagged and the boundaries were surveyed by the City's surveyors, as shown on Figure 2. The wetland survey report is being issued separately by ATSI.

During the same period, the City surveyed the top of the landfill where some fill had been placed since the previous survey. The site plan and the previous and new survey information were provided to Geomatrix to develop the site contour map used in this Work Plan.

Geomatrix personnel visited the Site and identified the approximate limits of the landfill and debris, as shown on Figure 2. An area to the west of the landfill, covering as much as 1.7 acres, was found to be covered with broken glass and other debris. The area was found to be heavily vegetated with trees and brush, which covers most of the broken glass and other scattered debris.

The top of the landfill was noted to be primarily unvegetated and generally sloped to the east with two terraces. At the toe of the upper terrace located in the middle of the landfill, a pile of railroad tracks, a pile of railroad ties, and a metal dumpster were noted. On the lower terrace, near the eastern boundary of the top of the landfill, a pile of trees and other dead plant material were present. Most of the slopes were noted to be vegetated and sloping at 3 horizontal to 1 vertical (3H:1V) or flatter, with a few exceptions. No protrusion of debris was noted on the side slopes, but some debris was noted on the north side slope, which appeared to be surface dumping rather than protrusion out of the landfill.

The wetlands locations were also observed by Geomatrix and compared to the Site topography. Wetlands A and B are connected by a small diameter culvert under the hiking trail. Wetland B was not a depression and appeared to have formed from surface water runoff. Wetland C consisted of a 15- to 20-foot diameter depression with vegetation. Wetland D consisted of an

8- to 10-foot diameter depression and appeared to be the remnant of a former manhole or other man-made feature. Wetlands E, F, and G had formed along the low lying gully separating the landfill from the natural ridge to the west. ATSI has classified Wetlands A, E, and F as Category I requiring 200-feet buffer and Wetlands B, C, D, and G as Category III requiring 50-feet buffer. Wetland D poses a safety hazard; therefore, we recommend filling this man-made depression to prevent possible accidents.

Geomatrix staff met with City Engineer Jeff Miller and discussed the site conditions and proposed activities at the Site. The recommendations and proposed activities are based on the discussions with Mr. Miller. We understand that City personnel will be performing the work.

2.2 CONCEPTUAL DESIGN

The general approach to the design was based on minimizing the cost and level of effort needed while meeting the objectives of the Health Department. The criteria used for design of the landfill closure are:

- Landfill footprint will not be expanded (will not affect the wetlands);
- The stormwater runoff scheme will not starve/dry any wetlands;
- Vegetated side slopes that are already at slopes of 3 horizontal to 1 vertical (3H:1V) or flatter will not be disturbed;
- Stormwater collection ditches will not be steeper than 10 percent grade;
- New slopes will not be steeper than 3H:1V, except where the slope lengthy exceeds 50 feet; then those slopes may be at 2.5H:1V with a 6 to 10 feet wide bench at mid-point of the slope;
- An attempt will be made to construct a natural delineator/barrier around the toe of the landfill by trees and brush;
- The landfill cover over unvegetated or disturbed areas will consist of a minimum of 1.5 feet of clean soil (free of debris) and a 0.5 foot of fine-grained clean soil with organic material; and
- Strict compliance with the solid waste regulations will not be required.

The area west of the landfill that is covered with glass and debris will be cordoned off with fencing to limit public access to that area. The overall approach to regrading the top of the landfill is to have it drain toward the east, which generally matches existing grades.

Stormwater collection ditches and diversion berms will be constructed on the final layer to minimize surface soil erosion, channel the runoff to the east, and drain to the relatively flat meadow beyond the eastern toe of the landfill. A soil berm will be installed east of the ditches' drainage discharge, along the hiking trail, to prevent flow of stormwater runoff across the trail. This berm will also act as a retention pond that will drain to Wetland B and downgradient to Wetland A. This approach will have no negative impact to the existing wetlands, and should promote development of new wetlands along the ditches and the drainage area to the east. The detailed description and sequence of construction is described in the following sections.

2.2.1 Fencing of Western Debris Area

Along the western boundary of the landfill is a large area covered with glass and other debris that are exposed on the surface or just beneath the surface brush and vegetation. The area is moderately wooded and flat, and poses a physical hazard to hikers if they venture off the trails. Removal of the debris and placement in the landfill or covering in place poses a problem with respect to access and impact to the wetlands. The removal of this debris is deemed unfeasible due to the presence of trees, dense vegetation, and wetlands within this area. Therefore, cordoning off the area with fencing was decided, to limit public access. The approximate location of the proposed fencing is shown on Figure 3. The actual limits shall be determined in the field after mobilization.

The City will decide on the type of fencing to be used. The fencing should be permanent and high enough to prevent people from crossing over; appropriate warning signs to inform the hikers to keep out should be posted. In the area where the fence crosses wetland, attempts should be made to span the wetland with minimal disturbance.

2.2.2 Existing Waste

The waste and other debris on the side slopes or outside the landfill footprint should be removed and disposed in the landfill. This removal excludes the surface debris in the Western Debris Area discussed in Section 2.2.1. The existing railroad tracks should be shipped to a recycler and the existing railroad ties should be recycled or disposed in a permitted solid waste landfill. The existing dead trees and woody plant material on the eastern side of the landfill may be chipped and used as needed. The wood chips may be used during construction as temporary sediment filtration media downgradient of the earthwork activities, or alternatively, stockpiled on the western side of the landfill once that area has been capped and seeded. This

material may later be used by the community to spread over the hiking trails prone to muddy or boggy surface.

2.2.3 Flattening Slopes

Side slopes steeper than 3H:1V are more prone to instability and failure. The segments of the existing side slopes that are steeper than 3H:1V should be flattened to the maximum slope of 3H:1V. In areas where the total slope length exceeds 50 feet, a 6-to 10-feet wide bench may be installed at mid-point of the slope and the side slope may be 2.5H:1V. The objective of this step is to establish permanent stable slopes by flattening the existing slopes and constructing new slopes no steeper than 3H:1V. Figure 3 shows the side slopes that need to be flattened, as well as the proposed new slopes.

Prior to the start of earthwork, silt fences should be installed at the toe of the side slopes to be regraded or newly constructed. This is particularly important near the existing wetlands, where stormwater can cause erosion of the fine-grained soil into the wetlands. The steep slopes should be regraded by the equipment from the top of the landfill. Excess soil on the slope should be pulled up to the top until 3H:1V has been achieved. The long slopes, which will be benched, may be flattened in two stages, flattening the top half first, then the bottom half. This approach will be convenient for the crew performing the work and eliminate the possibility of expanding the landfill footprint. Regraded side slopes should be compacted with tracked excavation equipment until firm subgrade is achieved. The disturbed surfaces should be compacted by at least three passes of the equipment. Excavated soil from the slopes should be used in grading of the top of the landfill.

If any waste is encountered, the waste should be excavated to the depth of 1.5 feet and replaced with clean fill. The purpose of this task is to maintain a minimum cover thickness of 1.5 feet over the waste.

2.2.4 Landfill Regrade

The top of the landfill should be regraded to the elevations and slopes shown on Figure 3. The proposed regrade should start from the west to the east. Clean, imported fill will be used to achieve the design grades, if needed. Some minor cuts of the existing grades are proposed to achieve the desired elevations and slopes. The regrading activity should provide a minimum of 1.5 feet of clean cover soil over the waste. If waste or debris is encountered within the areas of the cut, additional cut should be made to maintain a minimum of 1.5 feet of clean cover soil

over the waste or debris. The regraded areas should be compacted with at least three passes by a compaction roller to achieve a firm subgrade.

The imported fill must be clean fill, free from any miscellaneous debris. The silty, clayey, and organic portions of the imported fill should be stockpiled for use as final layer. Gravel and cobble in the imported fill should be stockpiled for use as riprap for armoring the proposed stormwater management features.

Vegetated side slopes that are already flatter than 3H:1V are proposed to be left undisturbed. However, the City should inspect the area annually and if areas are found to have debris or otherwise pose a hazard, it should be covered with 2 feet of clean imported fill.

Silt fences or other Best Management Practices (BMPs) should be installed downgradient of the earthwork area to minimize sediment transport.

2.2.5 Landfill Final Layer

The regraded areas and other unvegetated surfaces should be covered with a minimum of 6 inches of fine-grained, imported soil with 4 to 10 percent organic content to sustain vegetation growth. The final grades of the landfill with the final layer are shown on Figure 4. Cross sections of the landfill are shown on Figure 5, and cross sections and details of stormwater management features are shown on Figure 6.

The final layer should be compacted with roller or tracked with construction equipment with a minimum of two passes in order to achieve a relatively firm surface. The regraded and newly constructed side slopes should be protected against erosion by spreading straw across the surface, then crimping the straw into the soil with a minimum of two passes of tracked equipment in the top to bottom direction. This technique will compact the final layer, create mini ridges to slow down the stormwater runoff and minimize erosion. The straw will help reduce the amount of sediment transport after a storm event.

When placing the final layer, the soil should be seeded to promote growth of vegetation. Alternatively, the final layer could be hydroseeded. A mixture of local grass and wild flower seeds may be used to seed the final layer.

2.2.6 Stormwater Collection System

Stormwater drainage ditches should be constructed on top of the landfill as work progresses from west to east, after installation of the final layer. The ditches should be constructed to the dimensions shown on the drawings, with maximum slopes of 3H:1V toward the ditch centerline. The ditches on top of the landfill should be 10-feet wide and the ditches on the sideslopes (around 10 percent grade) should be 15-feet wide. After surface regrading and covering with fine-grained soil, the ditches should be lined with a filter media such as geotextile, burlap, or jute. The filter media in turn should be covered with riprap to prevent erosion. Stormwater velocities should be minimized by use of check dams and riprap. Ditches on top of the landfill should be armored with 12 inches of riprap, and the ditches on the sideslopes should be armored with a minimum of 18 inches of riprap to slow down the stormwater velocity and minimize erosion of the final layer.

Stormwater diversion berms should be constructed, as shown on Figure 4, to intercept the stormwater runoff and divert it toward the drainage ditches. The diversion berms should be 2-feet high and sloped at 1.5H:1V or flatter. The upgradient side of the berms should be lined with filter media, extending 10 feet beyond the toe of the berm and covered with a minimum of 12 inches of riprap.

The ditches' discharge area should be cleared of all vegetation to approximately 30 feet beyond the toe of the landfill, lined with filter media and armored with an 18-inch-thick layer of riprap. This feature is similar to a protective outfall apron.

The 25-year storm event, with precipitation of 2.7 inches in a 24-hour period, was used in calculating the stormwater management features. The hydrology model from the Stormwater Management Manual for Western Washington was used to calculate the stormwater runoff.

2.2.7 Stormwater Retention Berm

The regrading of the Site will cause additional stormwater runoff to flow to the east. In order to prevent the stormwater from crossing over the hiking trail, an earthen berm should be constructed along the trail, as shown on Figures 3 and 4. The berm shall be terminated above Wetland B to allow discharge into the wetland and toward Wetland A. A minimum of 1 foot of freeboard shall be maintained along the entire length of the berm.

The footprint of the berm should be stripped of all vegetation and compacted. The berm should be constructed in 1-foot-compacted lifts to final grade. Imported fine-grained soil should be used to construct the berm. The earthen berm should be a maximum of 3-feet high, 2-feet wide at the core, and with minimum slopes of 3H:1V. The upgradient side of the berm should be lined with filter media, extending 5 feet beyond the toe of the berm and covered with minimum of 12 inches of riprap.

The upgradient surface of the berm should be armored with a minimum of 1 foot of riprap. A layer of filter media will be placed on the upstream face of the slope, before placing riprap.

The existing culvert under the hiking trail should be augmented with an additional culvert of the same dimensions (4-to-6-inch diameter), to allow flow of the anticipated stormwater runoff during the peak flow. Alternatively, a 1-to 2-feet-wide bridge may be constructed using logs to allow flow of the stormwater under the trail.

2.2.8 Re-Vegetation

Two rows of hybrid poplar trees should be planted around the toe of the landfill. The first row of trees should be planted 10 feet apart at the toe of the landfill and the second row should be approximately 9 to 10 feet up the slope at off-set centerline from the first row. This practice should be repeated at the toe of the upper slopes where a bench is installed. In addition, planting/seeding the space between the trees with local bush-type vegetation is recommended.

The trees and bushes will serve as erosion and sediment control measures at the toe of the landfill slopes, provide a perimeter landfill delineator, provide a physical barrier against hikers climbing the landfill slope, enhance the natural wooded setting of the area, and draw up possible leachate in groundwater. Poplar trees in particular, and other vegetation, have been used in other landfill closures throughout Washington to draw up groundwater and leachate, thereby minimizing leachate generation and migration.

3.0 INSPECTIONS AND MAINTENANCE

All features of the completed work should be inspected regularly to verify proper function as intended. The completed Site should be inspected immediately after completion and after major storm events during the first wet season. Any damage discovered should be documented, corrected and evaluated. If it is determined that the damage may occur again, it should be brought to the attention of the designer. An alternate re-design may be proposed to minimize the need for future maintenance.

The Site should be inspected annually after the first year and after a 25-year, or worse, storm event or to verify that the features are intact and functioning as designed. Any damage should be repaired.

FIGURES

FIGURES

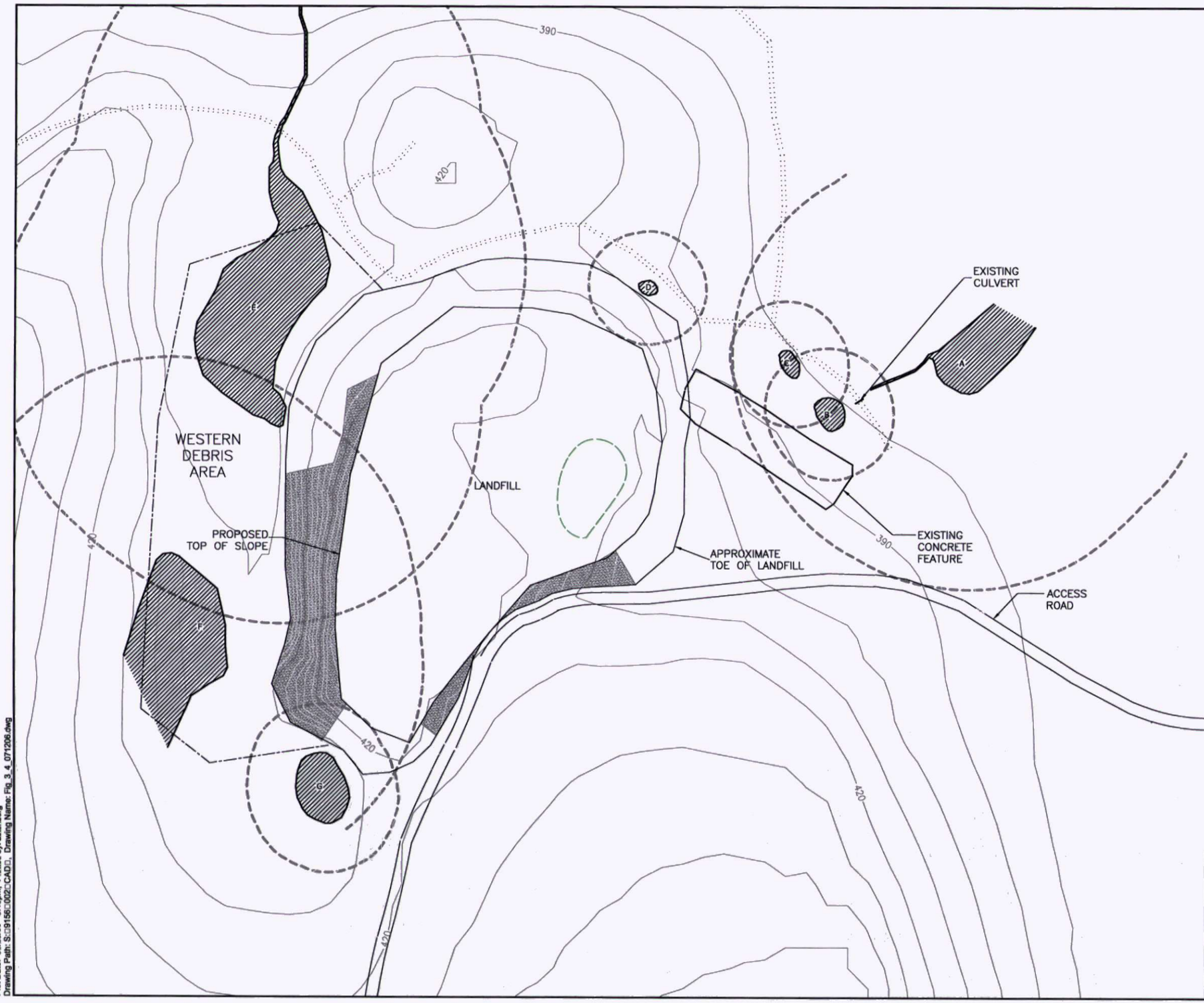
0 2,000 Feet

Note: Photo from City of Anacortes, 2001

S:\9156\000BaseInfo\SiteLocation082806.mxd

SITE LOCATION
Anacortes A Ave. Landfill
Anacortes, Washington

By: klb	Date: 07/13/06	Project No. 9156
Geomatrix		Figure 1



LEGEND

- WETLAND
- WETLAND BUFFER
- HIKING TRAILS
- APPROXIMATE AREA OF UNVEGETATED SLOPE
- APPROXIMATE LIMITS OF SURFACE DEBRIS
- APPROXIMATE AREA OF WOOD WASTE PILE

NOTES:

1. SURVEY INFORMATION AND BASE MAP PROVIDED BY THE CITY OF ANACORTES.
2. WETLANDS IDENTIFIED BY ATSI AND LAND SURVEYED BY CITY OF ANACORTES.

N

0 50 100
APPROXIMATE SCALE IN FEET

SITE LAYOUT
Anacortes A Ave. Landfill
Anacortes, Washington

By: APS	Date: 08/28/06	Project No. 9156
Geomatrix		Figure 2

Plot Date: 08/28/06 - 3:13pm, Plotted by: asterberg
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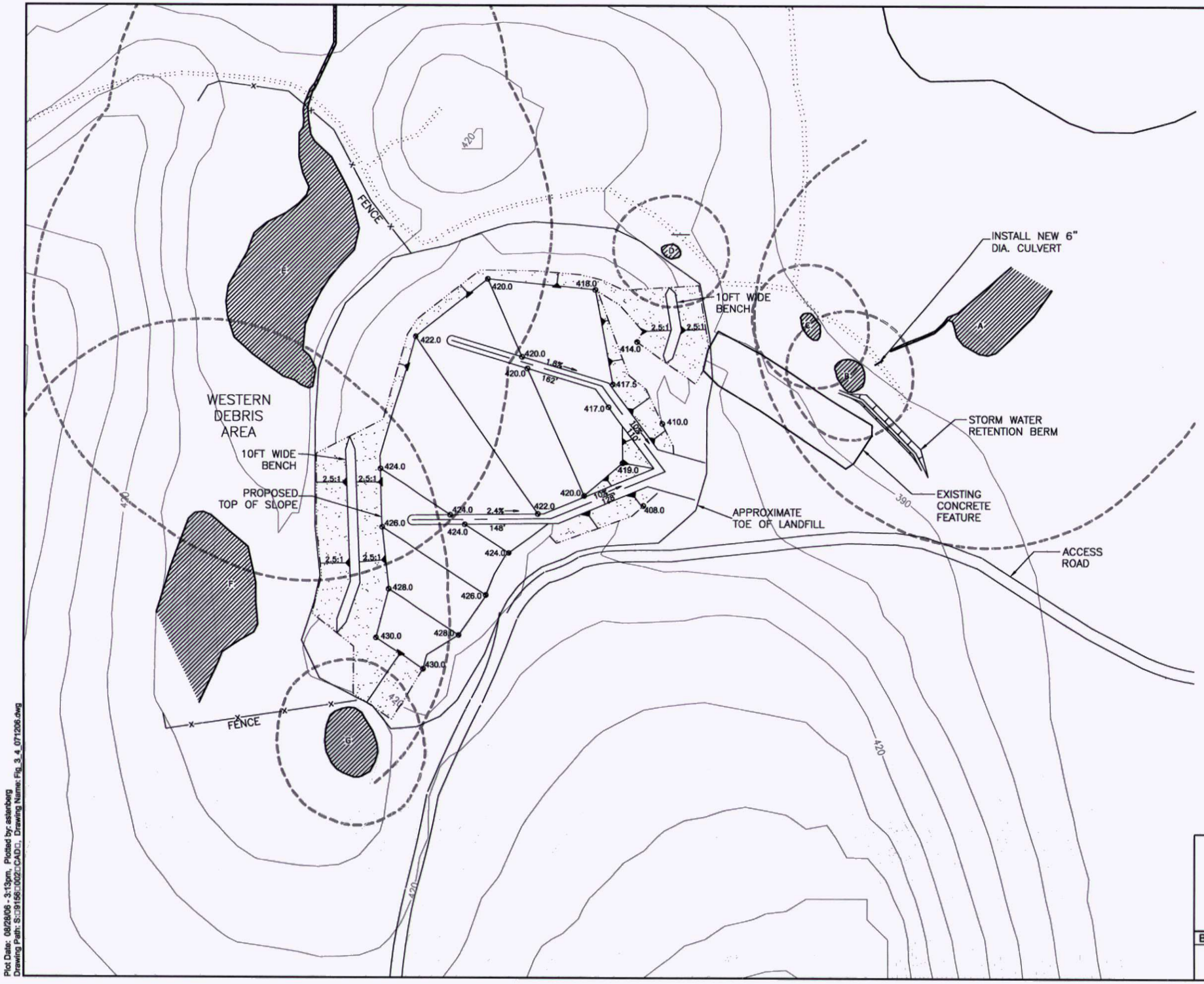

LEGEND

- WETLAND
- WETLAND BUFFER
- HIKING TRAILS
- 420.0 SPOT ELEVATION
- 1.8% DIRECTION OF SLOPE
- 3H:1V FLATTENING BOUNDARY
- SLOPES TO BE CONSTRUCTED AT 2.5H:1V OR FLATTER
- PROPOSED FENCING AROUND DEBRIS-COVERED AREA

NOTES:

1. SURVEY INFORMATION AND BASE MAP PROVIDED BY THE CITY OF ANACORTES.
2. ALL NEW SLOPES SHALL BE 3H:1V, EXCEPT WHERE NOTED OTHERWISE.

N

0 50 100

APPROXIMATE SCALE IN FEET

PROPOSED RE-GRADE
Anacortes A Ave. Landfill
Anacortes, Washington

By: APS	Date: 08/28/06	Project No. 09156.000
Geomatrix		Figure 3

Plot Date: 06/28/06 - 3:13pm, Plotted by: astenberg
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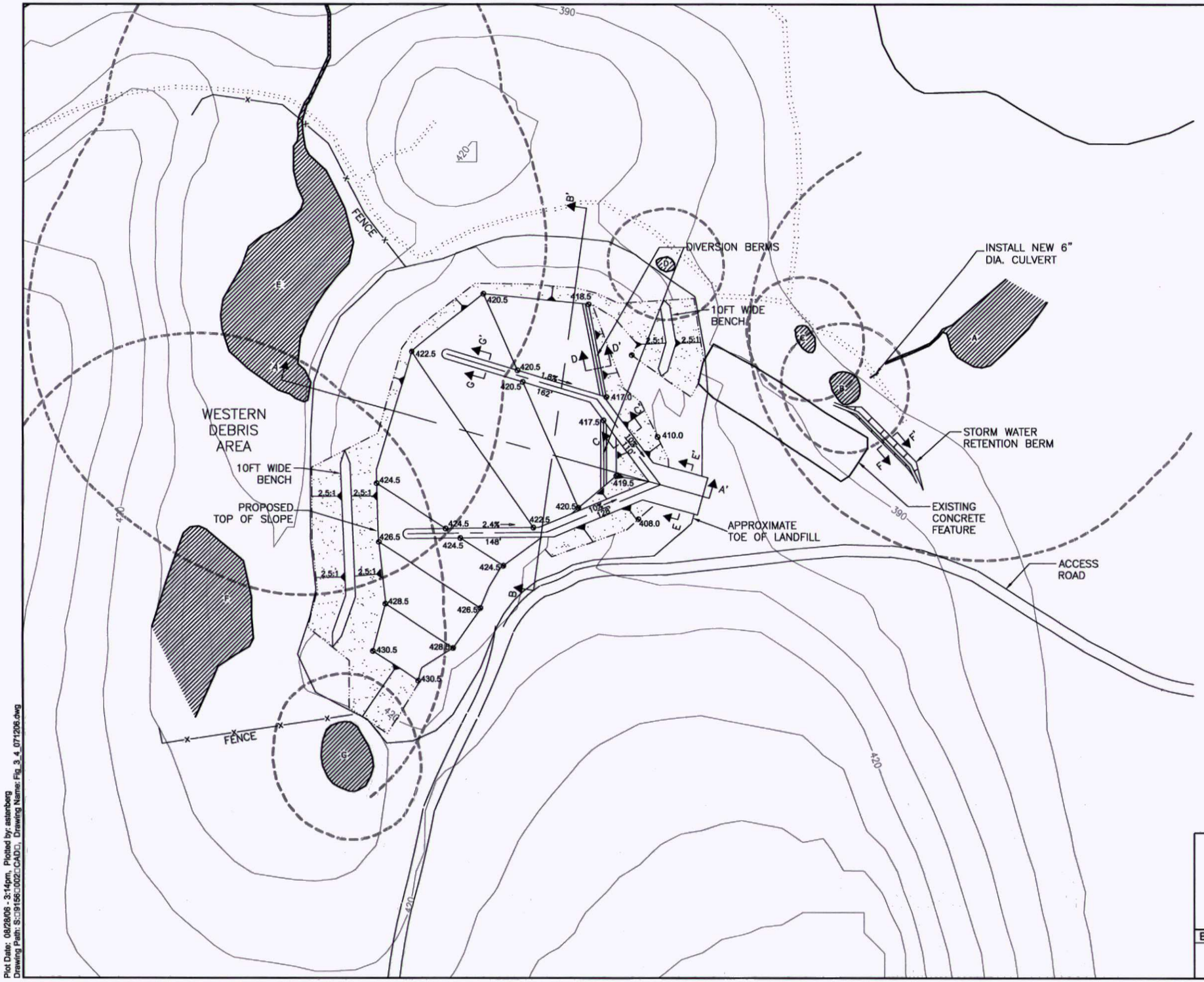

LEGEND

- WETLAND
- WETLAND BUFFER
- HIKING TRAILS
- 420.5 SPOT ELEVATION
- 1.8% DIRECTION OF SLOPE
- PROPOSED FENCING AROUND DEBRIS-COVERED AREA
- CROSS-SECTION LOCATION (A A')

NOTES:

1. SURVEY INFORMATION AND BASE MAP PROVIDED BY THE CITY OF ANACORTES

N

0 50 100

APPROXIMATE SCALE IN FEET

PROPOSED FINAL LAYER
Anacortes A Ave. Landfill
Anacortes, Washington

By: APS	Date: 08/28/06	Project No. 09156.000
Geomatrix		Figure 4

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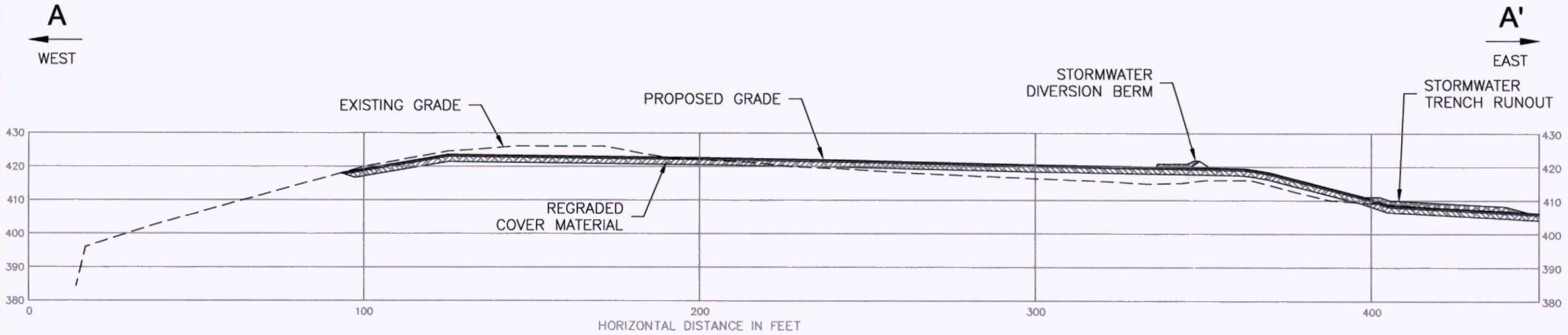
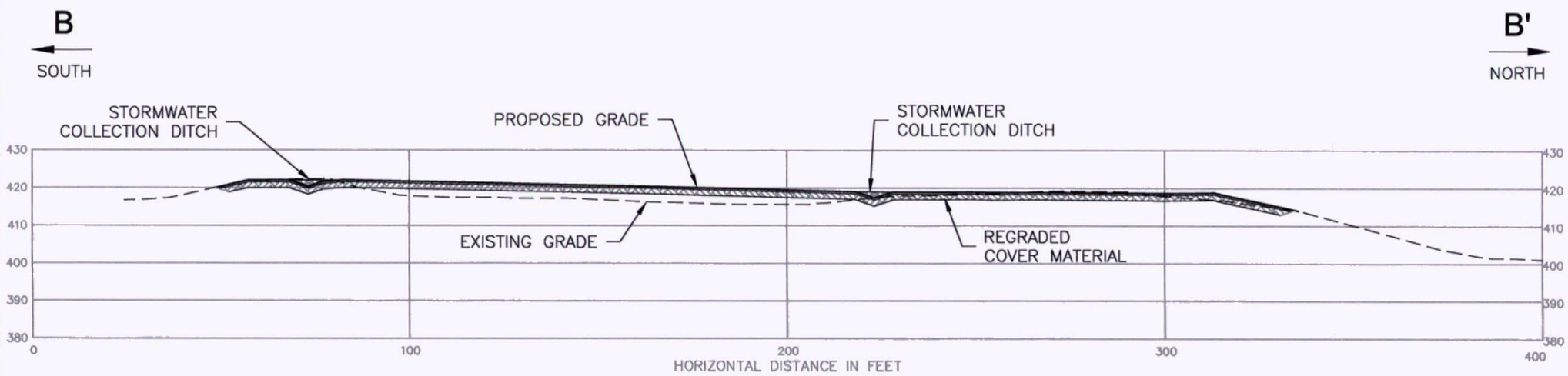
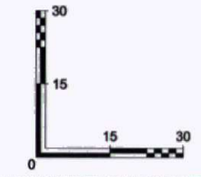


CROSS–SECTION A–A'



CROSS–SECTION B–B'



LANDFILL CROSS-SECTIONS A-A' & B-B'
Anacortes A Ave. Landfill
Anacortes, Washington

By: APS	Date: 08/28/06	Project No. 09156.000
Geomatrix		Figure 5

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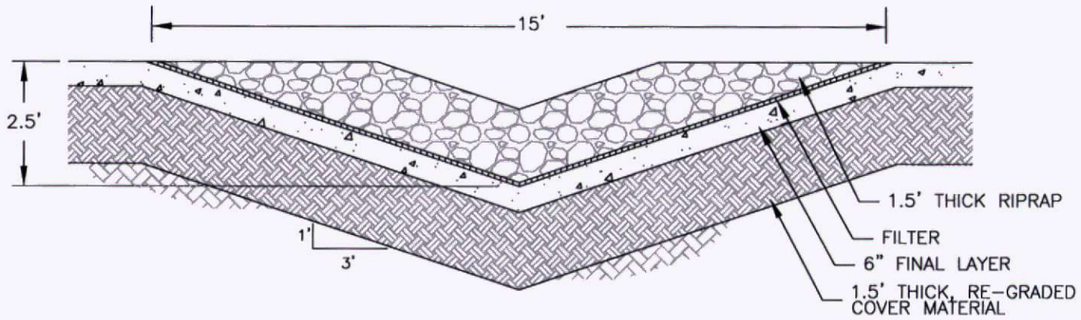
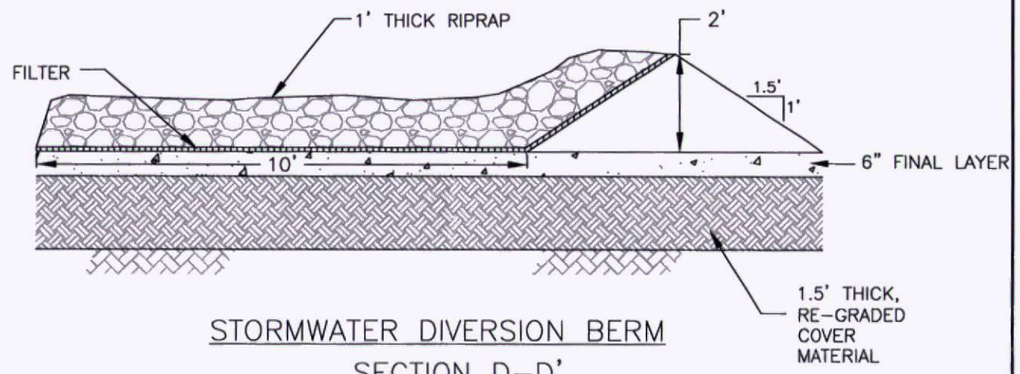


STORMWATER COLLECTION DITCH

SECTION C–C'

NOT TO SCALE



STORMWATER DIVERSION BERM

SECTION D–D'

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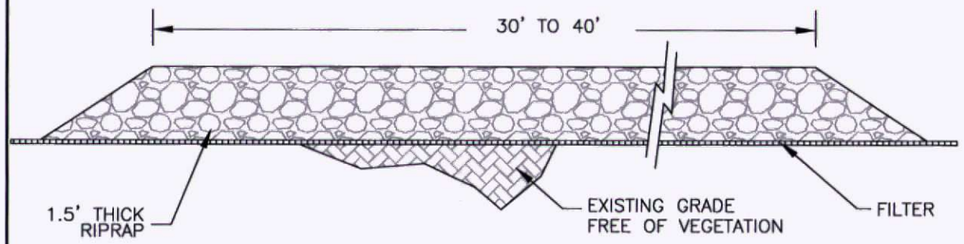

STORMWATER TRENCH RUNOUT

SECTION E–E'

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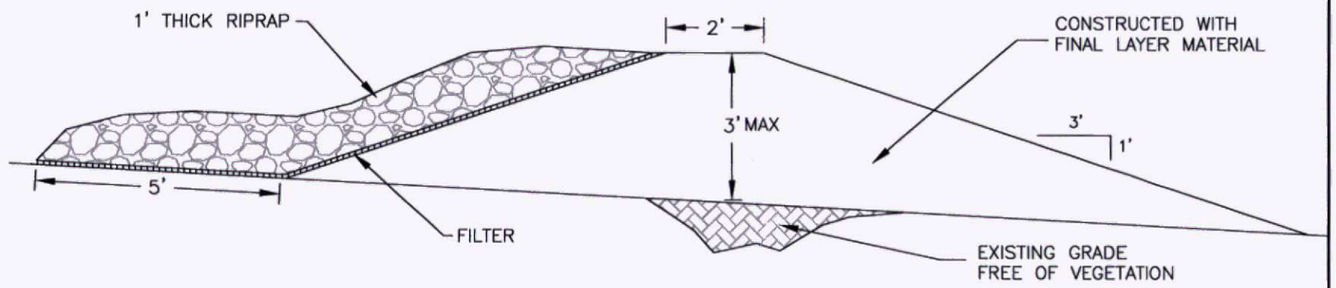

STORMWATER RETENTION BERM

SECTION F–F'

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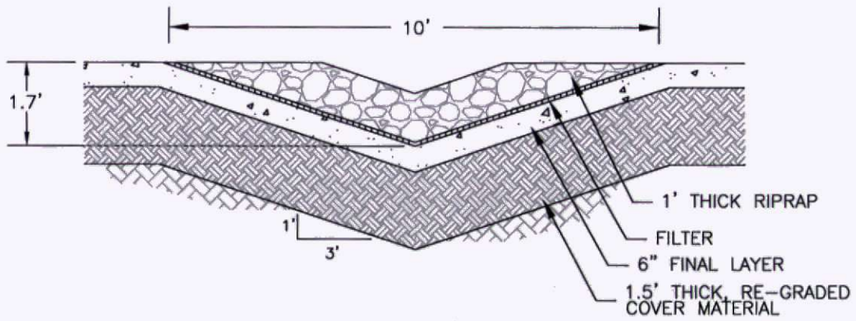

STORMWATER COLLECTION DITCH

SECTION G–G'

NOT TO SCALE

NOT TO SCALE

CROSS SECTIONS
Anacortes A Ave. Landfill
Anacortes, Washington

By: APS	Date: 08/28/06	Project No. 09156.000
Geomatrix		Figure 6

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