Water Quality Technical Report

Otay Mesa
Community Plan Update

January, 2007

Prepared for:
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APPENDICES

1. Introduction

The Otay Mesa Community is quickly developing in the City of San Diego. This area consists of approximately 7,000 acres bounded by the City of Chula Vista and the Otay River Valley on the north, the International Border on the south, Interstate 805 on the west, and the County of San Diego on the east. The far northwest arm of the Mesa is fully developed and all other areas are envisioned for residential, industrial, and commercial development in the Otay Mesa Community Plan.

The Mesa consists of flat terrain and shallow swales for drainage paths. Most of the Mesa slopes north to south resulting in runoff entering Mexico at several points. Increased development has caused concentrated flows in culverts under roads, redefined some of the historical drainage paths, and increased runoff into Mexico. For the most part, the existing drainage facilities have been constructed by private development causing non-continuous facilities and difficulty for subsequent developers to tie into the existing facilities. The Otay Mesa Creek is the only significant creek on the Mesa which lies in the East Watershed (see **Appendix A** for watersheds). The Drainage Study prepared for the Otay Mesa Community Plan Update proposes improvements to the Otay Mesa Creek with the La Media Channel and Border Detention Basin in the East Watershed to be constructed to convey flow and prevent downstream flooding. From the hydraulic analysis in the Drainage Study, Otay Mesa Creek crosses the border into Mexico just north of the Tijuana Airport and eventually to the Tijuana River. The West Perimeter Watershed and West Watershed also flow into the Tijuana River. The Tijuana River Watershed is a water quality impacted watershed; therefore, the water quality must be addressed for additional development. The Tijuana River is included in the 2002 Clean Water Act Section 303(d) List of Water Quality Limited Segments approved by the U.S. Environmental Protection Agency (EPA) and by the State Water Resources Control Board (SWRCB) on February 4, 2003.

The proposed detention basins in the West Perimeter Watershed and West Watershed will be constructed as part of development in the immediate vicinity of future projects. These detention basins are recommended to also function as treatment BMPs for runoff caused by new development. The La Media Channel and Border Detention Basin will be constructed before new development along the creek takes place (see **Appendix A** for locations). These BMPs target sediment, nutrients, trash, metals, oil & grease, and organics from existing and future development prior to crossing the border and into the Tijuana River.

This document complies with the City of San Diego's Standard Urban Storm Water Mitigation Plan and Storm Water Standards Manual.

2. Pollutants that May Affect Storm Water Quality

Future use of the undeveloped land may consist of residential, industrial, and commercial projects. From Table 2 of the City of San Diego's Storm Water Standards Manual, the anticipated and potential pollutants can be identified based on project category. For a residential development, the anticipated pollutants of concern are sediments, nutrients, trash and debris, and pesticides. The potential pollutants of concern include oxygen demanding substances, oil & grease, and bacteria & viruses. The anticipated pollutants for commercial developments include trash & debris and oil & grease. Potential pollutants are sediments, nutrients, organic compounds, oxygen demanding substances, bacteria &

viruses, and pesticides.

The Tijuana River is listed on the 303(d) list for impaired water bodies for bacteria, nutrients, oxygen demanding substances, low dissolved oxygen, pesticides, synthetic organics, and trash. This project proposes the La Media Channel and Border Detention Basin to improve existing drainage. Since residential, industrial, and commercial developments are planned uses of the site, this water quality technical report will not address additional pollutants (associated with the planned uses). Permanent storm water BMPs must be incorporated into future project where necessary to mitigate the impacts of urban runoff as a result of the development. For this project, the proposed channel and detention basin will contribute to filtering of pollutants prior to crossing the border. Heavy riparian vegetation will be allowed to grow in the channel, which traps pollutants. The channel slowly conveys runoff into a detention basin where runoff will be held for some minimum time allowing pollutants to settle prior to discharge.

3. Proposed Control Measures

The Water Quality Technical Report or the Storm Water Management Plan for future projects in the Otay Mesa Community rely on implementation of site design BMPs, source control BMPs, and treatment control BMPs. This project, Otay Mesa Community Plan Update, will only implement treatment control BMPs for the region. Future developers must address site design BMPs, source control BMPs, and additional treatment control BMPs based on anticipated and potential pollutants for the corresponding planned use. The main objective is to ensure that pollutants do not come in contact with storm water by reducing or eliminating the pollutants. These objectives are achieved by implementing the required source, site, priority project and treatment BMPs set forth in the City of San Diego Storm Water Standards.

Site Design

The following Site design BMPs are identified for future development (City Storm Water Standards – Section III.2.A and Appendix C):

1. Minimize impervious footprint. (1) Increase building density (number of stories above or below ground); (2) construct walkways, trails, patios, overflow parking lots and alleys and other low-traffic area with permeable surfaces, such as pervious concrete, porous asphalt, unit pavers, and granular materials; (3) construct streets, sidewalks and parking lot aisles to the minimum widths necessary, provided that public safety and a walkable environment for pedestrians are not compromised; and (4) minimize the use of impervious surfaces, such as decorative concrete, in the landscape design.
2. Conserve natural areas and provide buffer zones between natural water bodies and the project footprint. (1) Concentrate or cluster development on the least environmentally sensitive portions of a site while leaving the remaining land in a natural, undisturbed condition; and (2) use natural drainage systems to the maximum extent practicable (natural drainages and vegetated swales are preferred over using lined channels or underground storm drains.
3. Minimize directly connect impervious areas. (1) Where landscaping is proposed, drain rooftops into adjacent landscaping prior to discharging to the storm water conveyance system; and (2) where landscaping is proposed, drain impervious parking lots, sidewalks, walkways, trails, and patios into adjacent landscaping.

4. Maximize canopy interception and water conservation. (1) Preserve existing native trees and shrubs; and (2) plant additional native or drought tolerant trees and large shrubs in place of non-drought tolerant exotics.
5. Convey runoff safely from the tops of slopes.
6. Vegetate slopes with native or drought tolerant vegetation
7. Stabilize permanent channel crossings.
8. Install energy dissipaters, such as riprap, at the outlets of new storm drains, culverts, conduits, or channels that enter unlined channels in accordance with applicable specifications to minimize erosion. Energy dissipaters shall be installed in such a way as to minimize impacts to receiving waters.

Source Control

The following source control BMPs are identified for future development (City Storm Water Standards – Section III.2.B and Appendix C):

1. Outdoor material storage areas will be designed to reduce pollution introduction. Any hazardous materials with the potential to contaminate urban runoff shall be: (1) placed in an enclosure such as, but not limited to, a cabinet, shed, or similar structure that prevents contact with rain, runoff or spillage to the storm water conveyance system; and (2) protected by secondary containment structures such as berms, dikes or curbs. The storage area shall be pave and sufficiently impervious to contain leaks and spills and have a roof or awning to minimize direct precipitation within the secondary containment area.
2. Trash storage areas shall be: (1) paved with an impervious surface, designed not to allow run-on from adjoining areas, and screened or walled to prevent off-site transport of trash; and, (2) contain attached lids on all trash containers that exclude rain; or (3) contain a roof or awning to minimize direct precipitation.
3. Integrated pest management principles shall be employed including planting pest-resistant or well-adapted varieties such as native plants and using pesticides as a last line of defense. These principles shall be extended through the distribution of IPM educational materials to future site tenants.
4. Efficient irrigation systems and landscape design should employ rain shutoff devices to prevent irrigation during and after precipitation, irrigation design according to specific water requirements, and flow reducers or shutoff valves triggered by a pressure drop to control water loss in the event of broken sprinkler heads or lines.
5. All inlets should contain prohibitive illegal dumping language.

Priority Project

The following Priority Project design BMPs are identified for applicable future developments (City Storm Water Standards – Section III.2.C):

1. The design of private roadways shall use at least one of the following: (1) rural swale system; (2) urban curb/swale system; or (3) dual drainage system.
2. Residential driveways shall have one of the following: (1) shared access; (2) flared entrance; (3) wheelstrips (paving under tires); (4) porous paving; or (5) designed to drain into landscaping prior to discharging to the storm water conveyance system. Uncovered temporary

or guest parking on private residential lots shall be: (1) paved with permeable surface; or (2) designed to drain into landscaping prior to discharging to the storm water conveyance system.
3. Loading/unloading dock areas shall include the following: (1) cover loading dock areas, or design drainage to preclude urban run-on and runoff; and (2) an acceptable method of containment and pollutant removal, such as a shut-ff valve and containment area.
4. Maintenance bays shall include at least one of the following: (1) repair/maintenance bays shall be indoors; or, (2) designed to preclude urban run-on and runoff. Maintenance bays shall include a repair/maintenance bay drainage system to capture all wash water, leaks, and spills.
5. Outdoor areas for vehicle & equipment washing shall be: (1) self-contained to preclude run-on and run-off, covered with a roof or overhang, and equipped with a clarifier or other pre-treatment facility; and (2) properly connected to a sanitary sewer.
6. Outdoor processing areas shall: (1) cover or enclose areas that would be the most significant source of pollutants; or, (2) slope the area toward a dead-end sump; or, (3) discharge to the sanitary sewer system. Grade or berm processing area to prevent run-on from surrounding areas.
7. Where landscaping is proposed in surface parking areas, incorporate landscape areas into the drainage system. Overflow parking may be constructed with permeable paving.
8. Non-Retail fueling areas should be designed with the following: (1) paved with Portland cement concrete or equivalent; (2) designed to extend 6.5 feet from the corner of each fuel dispenser, or the length at which the hose and nozzle assembly may be operated plus 1 foot, whichever is less; (3) sloped to prevent ponding; (4) separated from the rest of the site by a grade break; and (5) designed to drain to the project's treatment control BMP. Must have overhanging roof structure or canopy that is equal to or greater than the area within the fuel dispensing area's grade break and designed not to drain onto or across the fuel dispensing area.
9. Steep hillside areas shall be landscaped with deep-rooted, drought tolerant plant species.

Treatment Control

Treatment control BMPs are designed to filter or treat runoff prior to discharging into an on-site or off-site storm drain system. The largest watershed of the Mesa is the East Watershed encompassing approximately 4,000 acres. This watershed flows into Mexico at a single point between Britannia and La Media roads. The La Media Channel and Border Detention Basin will function as a treatment design BMP (See Exhibit A for locations). Runoff drains to the La Media Channel where runoff is slowly conveyed through heavy riparian vegetation. The channel slopes at 0.25% for approximately 3,500 feet and behaves similar to a vegetated swale. Runoff is then discharged into the Border Detention Basin where storm water flow is slowed in order for pollutants to settle. The basin is approximately 58 acres with a maximum water depth of 6ft. These BMPs were chosen on the basis of site design feasibility and the City Storm Water Standards- Section III.2.D. Additional site treatment control BMPs may be necessary and addressed for future developments.

4. Operation and Maintenance Procedures

Grass Lined Channel

1) Inspect swales at least twice annually for erosion, damage to vegetation, and sediment and debris. See BMP detail TC-30 in **Appendix B** for preferred schedule.
2) Regularly inspect swales for pools of standing water to prevent mosquito breeding.
3) Every few years maintenance of dead or fallen trees may be required.

Detention Basin

An effective maintenance program should include the following key components:

1. Weather-triggered inspections – Inspect after several storm events for bank stability and to determine if the desired residence time has been achieved.
2. Regular inspections – Inspect semi-annually and after significant storm events. Inspect for the issues as described in BMP detail TC-22 in **Appendix B**.
3. Sediment Removal – Remove accumulated sediment when accumulated sediment volume exceeds 10-20% of the basin volume or when accumulation reaches 6 inches or if re-suspension is observed. Significant sediment deposition is not expected after development on The Mesa is completed.
4. Water Removal – Basin will be designed with a "low-flow" outlet; however, if water remains remove standing water by cleaning drainage path within 72 hours after accumulation.
5. General Maintenance Activities – see BMP detail TC-22 in **Appendix B** for maintenance activities and suggested frequency.

5. Operation and Maintenance Responsibility

A Maintenance District will be created for maintaining the channel and regional detention basin. Project detention/water quality basins and BMPs will be maintained by the project owners.

6. Installation Costs

La Media Channel and Border Detention Basin

Preliminary Opinion of Probable Construction Cost
2/8/2005
Kimley-Horn and Associates
Construction Items

Item No.	Description	Quantity	Units	Unit Price	Cost
1	Excavation	822,500	CY	$2	$1,645,000
2	Airway Road culvert (6~5'wx5'h)	300	CY	$1,500	$450,000
3	La Media/Airway Road culvert (6~10'wx6'h)	1,500	CY	$1,500	$2,250,000
4	Siempre Viva Road culvert (8~10'wx8'h)	1,490	CY	$1,500	$2,235,000
5	Detention Basin Outlet Structure	1	LS	$100,000	$100,000
6	Traffic Control	1	LS	$100,000	$100,000
7	Utility Relocation	1	LS	$150,000	$150,000
8	Street Repair	1	LS	$50,000	$50,000
9	Erosion Control	1	LS	$50,000	$50,000
10	Revegetation	1	LS	$600,000	$600,000
		Subtotal			$7,630,000
		Contingency	20%		$1,526,000
		Total			$9,156,000

Land Acquisition

1	Land Acquisition (outside MHPA)*	2,610,000	SF	$4	$10,440,000
2	Land Acquisition (inside MHPA)**	1,820,000	SF	$1	$1,820,000
		Subtotal			$12,260,000
		Contingency	20%		$2,452,000
		Total			$14,712,000

Total Cost (Construction and Land Acquisition) $23,868,000

Notes:
* Includes area of detention basin and channel south of Siempre Viva
** Includes entire area within MHPA boundary
*** Estimate does not include engineering, environmental, geotechnical, surveying, etc.

8. Conclusion

The future developments on the Mesa will include source, site, priority project, and treatment control BMPs consistent with the City of San Diego Storm Water Standards. This project consists of treatment control which will be in place before adjacent development is completed. The treatment control consist of a detention basin and a grass lined channel for the watershed to minimize downstream flooding and to treat and filter runoff prior to discharge across border. Use of these control measures complies with the Municipal Storm Water National Pollutant Discharge Elimination System (NPDES) Permit and the City of San Diego's Storm Water Standards.

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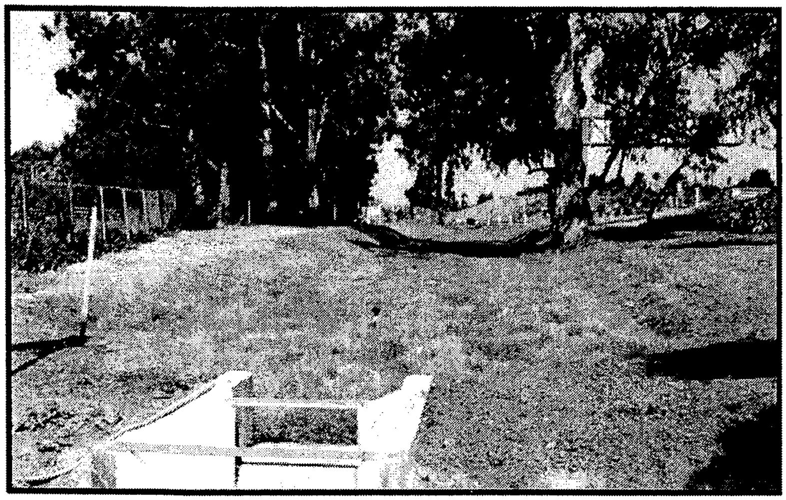

Design Considerations

- Tributary Area
- Area Required
- Slope
- Water Availability

Description

Vegetated swales are open, shallow channels with vegetation covering the side slopes and bottom that collect and slowly convey runoff flow to downstream discharge points. They are designed to treat runoff through filtering by the vegetation in the channel, filtering through a subsoil matrix, and/or infiltration into the underlying soils. Swales can be natural or manmade. They trap particulate pollutants (suspended solids and trace metals), promote infiltration, and reduce the flow velocity of stormwater runoff. Vegetated swales can serve as part of a stormwater drainage system and can replace curbs, gutters and storm sewer systems.

California Experience

Caltrans constructed and monitored six vegetated swales in southern California. These swales were generally effective in reducing the volume and mass of pollutants in runoff. Even in the areas where the annual rainfall was only about 10 inches/yr, the vegetation did not require additional irrigation. One factor that strongly affected performance was the presence of large numbers of gophers at most of the sites. The gophers created earthen mounds, destroyed vegetation, and generally reduced the effectiveness of the controls for TSS reduction.

Advantages

- If properly designed, vegetated, and operated, swales can serve as an aesthetic, potentially inexpensive urban development or roadway drainage conveyance measure with significant collateral water quality benefits.

Targeted Constituents

☑	Sediment	▲
☑	Nutrients	●
☑	Trash	●
☑	Metals	▲
☑	Bacteria	●
☑	Oil and Grease	▲
☑	Organics	▲

Legend *(Removal Effectiveness)*

● Low ■ High

▲ Medium

CASQA

CALIFORNIA STORMWATER QUALITY ASSOCIATION

- Roadside ditches should be regarded as significant potential swale/buffer strip sites and should be utilized for this purpose whenever possible.

Limitations

- Can be difficult to avoid channelization.
- May not be appropriate for industrial sites or locations where spills may occur
- Grassed swales cannot treat a very large drainage area. Large areas may be divided and treated using multiple swales.
- A thick vegetative cover is needed for these practices to function properly.
- They are impractical in areas with steep topography.
- They are not effective and may even erode when flow velocities are high, if the grass cover is not properly maintained.
- In some places, their use is restricted by law: many local municipalities require curb and gutter systems in residential areas.
- Swales are mores susceptible to failure if not properly maintained than other treatment BMPs.

Design and Sizing Guidelines

- Flow rate based design determined by local requirements or sized so that 85% of the annual runoff volume is discharged at less than the design rainfall intensity.
- Swale should be designed so that the water level does not exceed 2/3rds the height of the grass or 4 inches, which ever is less, at the design treatment rate.
- Longitudinal slopes should not exceed 2.5%
- Trapezoidal channels are normally recommended but other configurations, such as parabolic, can also provide substantial water quality improvement and may be easier to mow than designs with sharp breaks in slope.
- Swales constructed in cut are preferred, or in fill areas that are far enough from an adjacent slope to minimize the potential for gopher damage. Do not use side slopes constructed of fill, which are prone to structural damage by gophers and other burrowing animals.
- A diverse selection of low growing, plants that thrive under the specific site, climatic, and watering conditions should be specified. Vegetation whose growing season corresponds to the wet season are preferred. Drought tolerant vegetation should be considered especially for swales that are not part of a regularly irrigated landscaped area.
- The width of the swale should be determined using Manning's Equation using a value of 0.25 for Manning's n.

Construction/Inspection Considerations

- Include directions in the specifications for use of appropriate fertilizer and soil amendments based on soil properties determined through testing and compared to the needs of the vegetation requirements.
- Install swales at the time of the year when there is a reasonable chance of successful establishment without irrigation; however, it is recognized that rainfall in a given year may not be sufficient and temporary irrigation may be used.
- If sod tiles must be used, they should be placed so that there are no gaps between the tiles; stagger the ends of the tiles to prevent the formation of channels along the swale or strip.
- Use a roller on the sod to ensure that no air pockets form between the sod and the soil.
- Where seeds are used, erosion controls will be necessary to protect seeds for at least 75 days after the first rainfall of the season.

Performance

The literature suggests that vegetated swales represent a practical and potentially effective technique for controlling urban runoff quality. While limited quantitative performance data exists for vegetated swales, it is known that check dams, slight slopes, permeable soils, dense grass cover, increased contact time, and small storm events all contribute to successful pollutant removal by the swale system. Factors decreasing the effectiveness of swales include compacted soils, short runoff contact time, large storm events, frozen ground, short grass heights, steep slopes, and high runoff velocities and discharge rates.

Conventional vegetated swale designs have achieved mixed results in removing particulate pollutants. A study performed by the Nationwide Urban Runoff Program (NURP) monitored three grass swales in the Washington, D.C., area and found no significant improvement in urban runoff quality for the pollutants analyzed. However, the weak performance of these swales was attributed to the high flow velocities in the swales, soil compaction, steep slopes, and short grass height.

Another project in Durham, NC, monitored the performance of a carefully designed artificial swale that received runoff from a commercial parking lot. The project tracked 11 storms and concluded that particulate concentrations of heavy metals (Cu, Pb, Zn, and Cd) were reduced by approximately 50 percent. However, the swale proved largely ineffective for removing soluble nutrients.

The effectiveness of vegetated swales can be enhanced by adding check dams at approximately 17 meter (50 foot) increments along their length (See Figure 1). These dams maximize the retention time within the swale, decrease flow velocities, and promote particulate settling. Finally, the incorporation of vegetated filter strips parallel to the top of the channel banks can help to treat sheet flows entering the swale.

Only 9 studies have been conducted on all grassed channels designed for water quality (Table 1). The data suggest relatively high removal rates for some pollutants, but negative removals for some bacteria, and fair performance for phosphorus.

Table 1 Grassed swale pollutant removal efficiency data

Removal Efficiencies (% Removal)							
Study	TSS	TP	TN	NO_3	Metals	Bacteria	Type
Caltrans 2002	77	8	67	66	83-90	-33	dry swales
Goldberg 1993	67.8	4.5	-	31.4	42–62	-100	grassed channel
Seattle Metro and Washington Department of Ecology 1992	60	45	-	-25	2–16	-25	grassed channel
Seattle Metro and Washington Department of Ecology, 1992	83	29	-	-25	46–73	-25	grassed channel
Wang et al., 1981	80	-	-	-	70–80	-	dry swale
Dorman et al., 1989	98	18	-	45	37–81	-	dry swale
Harper, 1988	87	83	84	80	88–90	-	dry swale
Kercher et al., 1983	99	99	99	99	99	-	dry swale
Harper, 1988.	81	17	40	52	37–69	-	wet swale
Koon, 1995	67	39	-	9	-35 to 6	-	wet swale

While it is difficult to distinguish between different designs based on the small amount of available data, grassed channels generally have poorer removal rates than wet and dry swales, although some swales appear to export soluble phosphorus (Harper, 1988; Koon, 1995). It is not clear why swales export bacteria. One explanation is that bacteria thrive in the warm swale soils.

Siting Criteria

The suitability of a swale at a site will depend on land use, size of the area serviced, soil type, slope, imperviousness of the contributing watershed, and dimensions and slope of the swale system (Schueler et al., 1992). In general, swales can be used to serve areas of less than 10 acres, with slopes no greater than 5 %. Use of natural topographic lows is encouraged and natural drainage courses should be regarded as significant local resources to be kept in use (Young et al., 1996).

Selection Criteria (NCTCOG, 1993)

- Comparable performance to wet basins
- Limited to treating a few acres
- Availability of water during dry periods to maintain vegetation
- Sufficient available land area

Research in the Austin area indicates that vegetated controls are effective at removing pollutants even when dormant. Therefore, irrigation is not required to maintain growth during dry periods, but may be necessary only to prevent the vegetation from dying.

The topography of the site should permit the design of a channel with appropriate slope and cross-sectional area. Site topography may also dictate a need for additional structural controls. Recommendations for longitudinal slopes range between 2 and 6 percent. Flatter slopes can be used, if sufficient to provide adequate conveyance. Steep slopes increase flow velocity, decrease detention time, and may require energy dissipating and grade check. Steep slopes also can be managed using a series of check dams to terrace the swale and reduce the slope to within acceptable limits. The use of check dams with swales also promotes infiltration.

Additional Design Guidelines

Most of the design guidelines adopted for swale design specify a minimum hydraulic residence time of 9 minutes. This criterion is based on the results of a single study conducted in Seattle, Washington (Seattle Metro and Washington Department of Ecology, 1992), and is not well supported. Analysis of the data collected in that study indicates that pollutant removal at a residence time of 5 minutes was not significantly different, although there is more variability in that data. Therefore, additional research in the design criteria for swales is needed. Substantial pollutant removal has also been observed for vegetated controls designed solely for conveyance (Barrett et al, 1998); consequently, some flexibility in the design is warranted.

Many design guidelines recommend that grass be frequently mowed to maintain dense coverage near the ground surface. Recent research (Colwell et al., 2000) has shown mowing frequency or grass height has little or no effect on pollutant removal.

Summary of Design Recommendations

1) The swale should have a length that provides a minimum hydraulic residence time of at least 10 minutes. The maximum bottom width should not exceed 10 feet unless a dividing berm is provided. The depth of flow should not exceed 2/3rds the height of the grass at the peak of the water quality design storm intensity. The channel slope should not exceed 2.5%.

2) A design grass height of 6 inches is recommended.

3) Regardless of the recommended detention time, the swale should be not less than 100 feet in length.

4) The width of the swale should be determined using Manning's Equation, at the peak of the design storm, using a Manning's n of 0.25.

5) The swale can be sized as both a treatment facility for the design storm and as a conveyance system to pass the peak hydraulic flows of the 100-year storm if it is located "on-line." The side slopes should be no steeper than 3:1 (H:V).

6) Roadside ditches should be regarded as significant potential swale/buffer strip sites and should be utilized for this purpose whenever possible. If flow is to be introduced through curb cuts, place pavement slightly above the elevation of the vegetated areas. Curb cuts should be at least 12 inches wide to prevent clogging.

7) Swales must be vegetated in order to provide adequate treatment of runoff. It is important to maximize water contact with vegetation and the soil surface. For general purposes, select fine, close-growing, water-resistant grasses. If possible, divert runoff (other than necessary irrigation) during the period of vegetation

establishment. Where runoff diversion is not possible, cover graded and seeded areas with suitable erosion control materials.

Maintenance

The useful life of a vegetated swale system is directly proportional to its maintenance frequency. If properly designed and regularly maintained, vegetated swales can last indefinitely. The maintenance objectives for vegetated swale systems include keeping up the hydraulic and removal efficiency of the channel and maintaining a dense, healthy grass cover.

Maintenance activities should include periodic mowing (with grass never cut shorter than the design flow depth), weed control, watering during drought conditions, reseeding of bare areas, and clearing of debris and blockages. Cuttings should be removed from the channel and disposed in a local composting facility. Accumulated sediment should also be removed manually to avoid concentrated flows in the swale. The application of fertilizers and pesticides should be minimal.

Another aspect of a good maintenance plan is repairing damaged areas within a channel. For example, if the channel develops ruts or holes, it should be repaired utilizing a suitable soil that is properly tamped and seeded. The grass cover should be thick; if it is not, reseed as necessary. Any standing water removed during the maintenance operation must be disposed to a sanitary sewer at an approved discharge location. Residuals (e.g., silt, grass cuttings) must be disposed in accordance with local or State requirements. Maintenance of grassed swales mostly involves maintenance of the grass or wetland plant cover. Typical maintenance activities are summarized below:

- Inspect swales at least twice annually for erosion, damage to vegetation, and sediment and debris accumulation preferably at the end of the wet season to schedule summer maintenance and before major fall runoff to be sure the swale is ready for winter. However, additional inspection after periods of heavy runoff is desirable. The swale should be checked for debris and litter, and areas of sediment accumulation.
- Grass height and mowing frequency may not have a large impact on pollutant removal. Consequently, mowing may only be necessary once or twice a year for safety or aesthetics or to suppress weeds and woody vegetation.
- Trash tends to accumulate in swale areas, particularly along highways. The need for litter removal is determined through periodic inspection, but litter should always be removed prior to mowing.
- Sediment accumulating near culverts and in channels should be removed when it builds up to 75 mm (3 in.) at any spot, or covers vegetation.
- Regularly inspect swales for pools of standing water. Swales can become a nuisance due to mosquito breeding in standing water if obstructions develop (e.g. debris accumulation, invasive vegetation) and/or if proper drainage slopes are not implemented and maintained.

Cost

Construction Cost

Little data is available to estimate the difference in cost between various swale designs. One study (SWRPC, 1991) estimated the construction cost of grassed channels at approximately $0.25 per ft^2. This price does not include design costs or contingencies. Brown and Schueler (1997) estimate these costs at approximately 32 percent of construction costs for most stormwater management practices. For swales, however, these costs would probably be significantly higher since the construction costs are so low compared with other practices. A more realistic estimate would be a total cost of approximately $0.50 per ft^2, which compares favorably with other stormwater management practices.

Table 2 Swale Cost Estimate (SEWRPC, 1991)

Component	Unit	Extent	Unit Cost			Total Cost		
			Low	Moderate	High	Low	Moderate	High
Mobilization / Demobilization-Light	Swale	1	$107	$274	$441	$107	$274	$441
Site Preparation								
Clearing[b]	Acre	0.5	$2,200	$3,800	$5,400	$1,100	$1,900	$2,700
Grubbing[c]	Acre	0.25	$3,800	$5,200	$6,600	$950	$1,300	$1,650
General								
Excavation[d]	Yd³	372	$2.10	$3.70	$5.30	$781	$1,376	$1,972
Level and Till[e]	Yd²	1,210	$0.20	$0.35	$0.50	$242	$424	$605
Sites Development								
Salvaged Topsoil Seed, and Mulch[f] ..	Yd²	1,210	$0.40	$1.00	$1.60	$484	$1,210	$1,936
Sod[g]	Yd²	1,210	$1.20	$2.40	$3.60	$1,452	$2,904	$4,356
Subtotal	--	--	--	--	--	$5,116	$9,388	$13,660
Contingencies	Swale	1	25%	25%	25%	$1,279	$2,347	$3,415
Total	--	--	--	--	--	$6,395	$11,735	$17,075

Source: (SEWRPC, 1991)

Note: Mobilization/demobilization refers to the organization and planning involved in establishing a vegetative swale.

[a] Swale has a bottom width of 1.0 foot, a top width of 10 feet with 1:3 side slopes, and a 1,000-foot length.

[b] Area cleared = (top width + 10 feet) x swale length.

[c] Area grubbed = (top width x swale length).

[d] Volume excavated = (0.67 x top width x swale depth) x swale length (parabolic cross-section).

[e] Area tilled = $\left(\text{top width} + \frac{8(\text{swale depth}^2)}{3(\text{top width})}\right)$ x swale length (parabolic cross-section).

[f] Area seeded = area cleared x 0.5.

[g] Area sodded = area cleared x 0.5.

Table 3 Estimated Maintenance Costs (SEWRPC, 1991)

Component	Unit Cost	Swale Size (Depth and Top Width)		Comment
		1.5 Foot Depth, One-Foot Bottom Width, 10-Foot Top Width	3-Foot Depth, 3-Foot Bottom Width, 21-Foot Top Width	
Lawn Mowing	\$0.85 / 1,000 ft²/ mowing	\$0.14 / linear foot	\$0.21 / linear foot	Lawn maintenance area=(top width + 10 feet) x length. Mow eight times per year
General Lawn Care	\$9.00 / 1,000 ft²/ year	\$0.18 / linear foot	\$0.28 / linear foot	Lawn maintenance area = (top width + 10 feet) x length
Swale Debris and Litter Removal	\$0.10 / linear foot / year	\$0.10 / linear foot	\$0.10 / linear foot	–
Grass Reseeding with Mulch and Fertilizer	\$0.30 / yd²	\$0.01 / linear foot	\$0.01 / linear foot	Area revegetated equals 1% of lawn maintenance area per year
Program Administration and Swale Inspection	\$0.15 / linear foot / year, plus \$25 / inspection	\$0.15 / linear foot	\$0.15 / linear foot	Inspect four times per year
Total	--	**\$0.58 / linear foot**	**\$ 0.75 / linear foot**	–

Maintenance Cost

Caltrans (2002) estimated the expected annual maintenance cost for a swale with a tributary area of approximately 2 ha at approximately $2,700. Since almost all maintenance consists of mowing, the cost is fundamentally a function of the mowing frequency. Unit costs developed by SEWRPC are shown in Table 3. In many cases vegetated channels would be used to convey runoff and would require periodic mowing as well, so there may be little additional cost for the water quality component. Since essentially all the activities are related to vegetation management, no special training is required for maintenance personnel.

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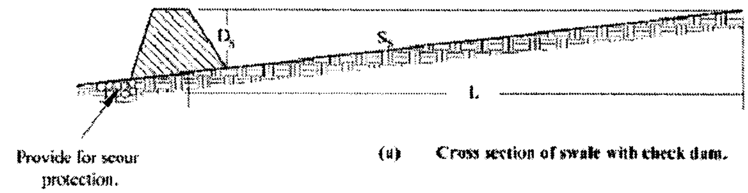
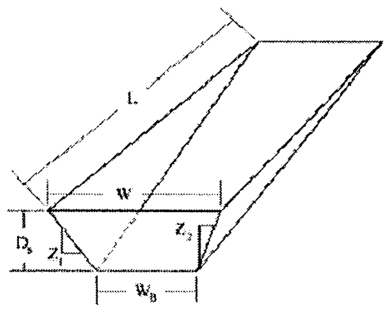


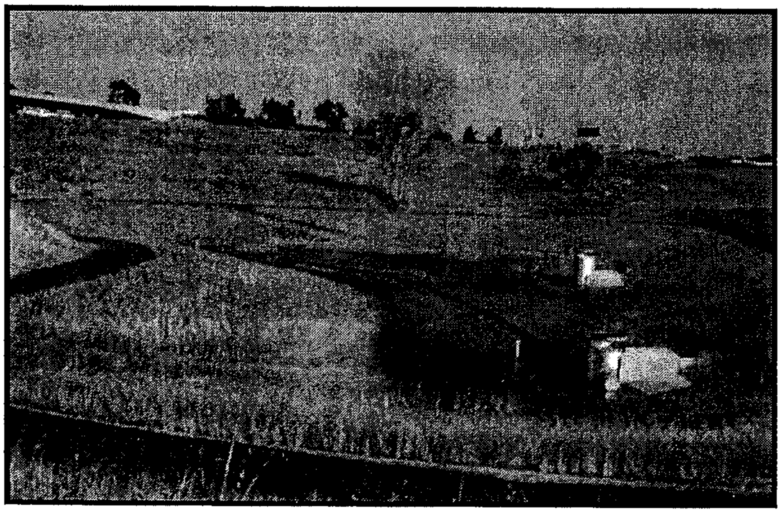
(a) Cross section of swale with check dam.



(b) Dimensional view of swale impoundment area.

Notation:

- L = Length of swale impoundment area per check dam (ft)
- D_s = Depth of check dam (ft)
- S_s = Bottom slpe of swale (ft/ft)
- W = Top width of check dam (ft)
- W_B = Bottom width of check dam (ft)
- $Z_{1\&2}$ = Ratio of horizontal to vertical change in swale side slope (ft/ft)



Design Considerations

- Tributary Area
- Area Required
- Hydraulic Head

Description

Dry extended detention ponds (a.k.a. dry ponds, extended detention basins, detention ponds, extended detention ponds) are basins whose outlets have been designed to detain the stormwater runoff from a water quality design storm for some minimum time (e.g., 48 hours) to allow particles and associated pollutants to settle. Unlike wet ponds, these facilities do not have a large permanent pool. They can also be used to provide flood control by including additional flood detention storage.

California Experience

Caltrans constructed and monitored 5 extended detention basins in southern California with design drain times of 72 hours. Four of the basins were earthen, less costly and had substantially better load reduction because of infiltration that occurred, than the concrete basin. The Caltrans study reaffirmed the flexibility and performance of this conventional technology. The small headloss and few siting constraints suggest that these devices are one of the most applicable technologies for stormwater treatment.

Advantages

- Due to the simplicity of design, extended detention basins are relatively easy and inexpensive to construct and operate.
- Extended detention basins can provide substantial capture of sediment and the toxics fraction associated with particulates.
- Widespread application with sufficient capture volume can provide significant control of channel erosion and enlargement caused by changes to flow frequency

Targeted Constituents

☑	Sediment	▲
☑	Nutrients	●
☑	Trash	■
☑	Metals	▲
☑	Bacteria	▲
☑	Oil and Grease	▲
☑	Organics	▲

Legend ***(Removal Effectiveness)***

● Low ■ High

▲ Medium

relationships resulting from the increase of impervious cover in a watershed.

Limitations

- Limitation of the diameter of the orifice may not allow use of extended detention in watersheds of less than 5 acres (would require an orifice with a diameter of less than 0.5 inches that would be prone to clogging).

- Dry extended detention ponds have only moderate pollutant removal when compared to some other structural stormwater practices, and they are relatively ineffective at removing soluble pollutants.

- Although wet ponds can increase property values, dry ponds can actually detract from the value of a home due to the adverse aesthetics of dry, bare areas and inlet and outlet structures.

Design and Sizing Guidelines

- Capture volume determined by local requirements or sized to treat 85% of the annual runoff volume.

- Outlet designed to discharge the capture volume over a period of hours.

- Length to width ratio of at least 1.5:1 where feasible.

- Basin depths optimally range from 2 to 5 feet.

- Include energy dissipation in the inlet design to reduce resuspension of accumulated sediment.

- A maintenance ramp and perimeter access should be included in the design to facilitate access to the basin for maintenance activities and for vector surveillance and control.

- Use a draw down time of 48 hours in most areas of California. Draw down times in excess of 48 hours may result in vector breeding, and should be used only after coordination with local vector control authorities. Draw down times of less than 48 hours should be limited to BMP drainage areas with coarse soils that readily settle and to watersheds where warming may be determined to downstream fisheries.

Construction/Inspection Considerations

- Inspect facility after first large to storm to determine whether the desired residence time has been achieved.

- When constructed with small tributary area, orifice sizing is critical and inspection should verify that flow through additional openings such as bolt holes does not occur.

Performance

One objective of stormwater management practices can be to reduce the flood hazard associated with large storm events by reducing the peak flow associated with these storms. Dry extended detention basins can easily be designed for flood control, and this is actually the primary purpose of most detention ponds.

Dry extended detention basins provide moderate pollutant removal, provided that the recommended design features are incorporated. Although they can be effective at removing some pollutants through settling, they are less effective at removing soluble pollutants because of the absence of a permanent pool. Several studies are available on the effectiveness of dry extended detention ponds including one recently concluded by Caltrans (2002).

The load reduction is greater than the concentration reduction because of the substantial infiltration that occurs. Although the infiltration of stormwater is clearly beneficial to surface receiving waters, there is the potential for groundwater contamination. Previous research on the effects of incidental infiltration on groundwater quality indicated that the risk of contamination is minimal.

There were substantial differences in the amount of infiltration that were observed in the earthen basins during the Caltrans study. On average, approximately 40 percent of the runoff entering the unlined basins infiltrated and was not discharged. The percentage ranged from a high of about 60 percent to a low of only about 8 percent for the different facilities. Climatic conditions and local water table elevation are likely the principal causes of this difference. The least infiltration occurred at a site located on the coast where humidity is higher and the basin invert is within a few meters of sea level. Conversely, the most infiltration occurred at a facility located well inland in Los Angeles County where the climate is much warmer and the humidity is less, resulting in lower soil moisture content in the basin floor at the beginning of storms.

Vegetated detention basins appear to have greater pollutant removal than concrete basins. In the Caltrans study, the concrete basin exported sediment and associated pollutants during a number of storms. Export was not as common in the earthen basins, where the vegetation appeared to help stabilize the retained sediment.

Siting Criteria

Dry extended detention ponds are among the most widely applicable stormwater management practices and are especially useful in retrofit situations where their low hydraulic head requirements allow them to be sited within the constraints of the existing storm drain system. In addition, many communities have detention basins designed for flood control. It is possible to modify these facilities to incorporate features that provide water quality treatment and/or channel protection. Although dry extended detention ponds can be applied rather broadly, designers need to ensure that they are feasible at the site in question. This section provides basic guidelines for siting dry extended detention ponds.

In general, dry extended detention ponds should be used on sites with a minimum area of 5 acres. With this size catchment area, the orifice size can be on the order of 0.5 inches. On smaller sites, it can be challenging to provide channel or water quality control because the orifice diameter at the outlet needed to control relatively small storms becomes very small and thus prone to clogging. In addition, it is generally more cost-effective to control larger drainage areas due to the economies of scale.

Extended detention basins can be used with almost all soils and geology, with minor design adjustments for regions of rapidly percolating soils such as sand. In these areas, extended detention ponds may need an impermeable liner to prevent ground water contamination.

The base of the extended detention facility should not intersect the water table. A permanently wet bottom may become a mosquito breeding ground. Research in Southwest Florida (Santana et al., 1994) demonstrated that intermittently flooded systems, such as dry extended detention ponds, produce more mosquitoes than other pond systems, particularly when the facilities remained wet for more than 3 days following heavy rainfall.

A study in Prince George's County, Maryland, found that stormwater management practices can increase stream temperatures (Galli, 1990). Overall, dry extended detention ponds increased temperature by about 5°F. In cold water streams, dry ponds should be designed to detain stormwater for a relatively short time (i.e., 24 hours) to minimize the amount of warming that occurs in the basin.

Additional Design Guidelines

In order to enhance the effectiveness of extended detention basins, the dimensions of the basin must be sized appropriately. Merely providing the required storage volume will not ensure maximum constituent removal. By effectively configuring the basin, the designer will create a long flow path, promote the establishment of low velocities, and avoid having stagnant areas of the basin. To promote settling and to attain an appealing environment, the design of the basin should consider the length to width ratio, cross-sectional areas, basin slopes and pond configuration, and aesthetics (Young et al., 1996).

Energy dissipation structures should be included for the basin inlet to prevent resuspension of accumulated sediment. The use of stilling basins for this purpose should be avoided because the standing water provides a breeding area for mosquitoes.

Extended detention facilities should be sized to completely capture the water quality volume. A micropool is often recommended for inclusion in the design and one is shown in the schematic diagram. These small permanent pools greatly increase the potential for mosquito breeding and complicate maintenance activities; consequently, they are not recommended for use in California.

A large aspect ratio may improve the performance of detention basins; consequently, the outlets should be placed to maximize the flowpath through the facility. The ratio of flowpath length to width from the inlet to the outlet should be at least 1.5:1 (L:W) where feasible. Basin depths optimally range from 2 to 5 feet.

The facility's drawdown time should be regulated by an orifice or weir. In general, the outflow structure should have a trash rack or other acceptable means of preventing clogging at the entrance to the outflow pipes. The outlet design implemented by Caltrans in the facilities constructed in San Diego County used an outlet riser with orifices

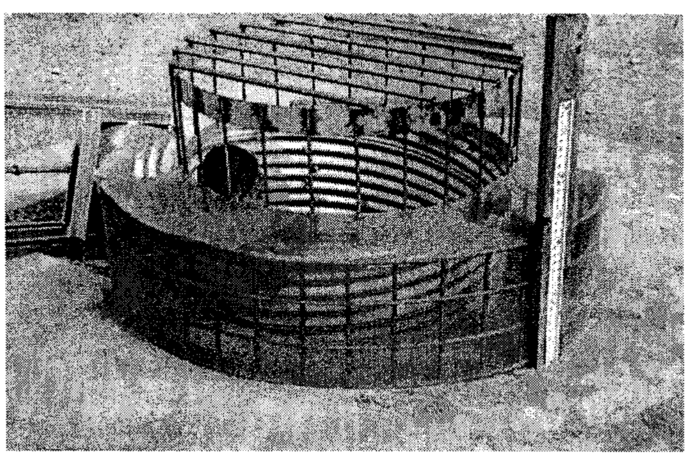


Figure 1
Example of Extended Detention Outlet Structure

sized to discharge the water quality volume, and the riser overflow height was set to the design storm elevation. A stainless steel screen was placed around the outlet riser to ensure that the orifices would not become clogged with debris. Sites either used a separate riser or broad crested weir for overflow of runoff for the 25 and greater year storms. A picture of a typical outlet is presented in Figure 1.

The outflow structure should be sized to allow for complete drawdown of the water quality volume in 72 hours. No more than 50% of the water quality volume should drain from the facility within the first 24 hours. The outflow structure can be fitted with a valve so that discharge from the basin can be halted in case of an accidental spill in the watershed.

Summary of Design Recommendations

(1) Facility Sizing - The required water quality volume is determined by local regulations or the basin should be sized to capture and treat 85% of the annual runoff volume. See Section 5.5.1 of the handbook for a discussion of volume-based design.

Basin Configuration – A high aspect ratio may improve the performance of detention basins; consequently, the outlets should be placed to maximize the flowpath through the facility. The ratio of flowpath length to width from the inlet to the outlet should be at least 1.5:1 (L:W). The flowpath length is defined as the distance from the inlet to the outlet as measured at the surface. The width is defined as the mean width of the basin. Basin depths optimally range from 2 to 5 feet. The basin may include a sediment forebay to provide the opportunity for larger particles to settle out.

A micropool should not be incorporated in the design because of vector concerns. For online facilities, the principal and emergency spillways must be sized to provide 1.0 foot of freeboard during the 25-year event and to safely pass the flow from 100-year storm.

(2) Pond Side Slopes - Side slopes of the pond should be 3:1 (H:V) or flatter for grass stabilized slopes. Slopes steeper than 3:1 (H:V) must be stabilized with an appropriate slope stabilization practice.

(3) Basin Lining – Basins must be constructed to prevent possible contamination of groundwater below the facility.

(4) Basin Inlet – Energy dissipation is required at the basin inlet to reduce resuspension of accumulated sediment and to reduce the tendency for short-circuiting.

(5) Outflow Structure - The facility's drawdown time should be regulated by a gate valve or orifice plate. In general, the outflow structure should have a trash rack or other acceptable means of preventing clogging at the entrance to the outflow pipes.

The outflow structure should be sized to allow for complete drawdown of the water quality volume in 72 hours. No more than 50% of the water quality volume should drain from the facility within the first 24 hours. The outflow structure should be fitted with a valve so that discharge from the basin can be halted in case of an accidental spill in the watershed. This same valve also can be used to regulate the rate of discharge from the basin.

The discharge through a control orifice is calculated from:

$$Q = CA(2g(H-H_o))^{0.5}$$

where: Q = discharge (ft^3/s)
C = orifice coefficient
A = area of the orifice (ft^2)
g = gravitational constant (32.2)
H = water surface elevation (ft)
H_o= orifice elevation (ft)

Recommended values for C are 0.66 for thin materials and 0.80 when the material is thicker than the orifice diameter. This equation can be implemented in spreadsheet form with the pond stage/volume relationship to calculate drain time. To do this, use the initial height of the water above the orifice for the water quality volume. Calculate the discharge and assume that it remains constant for approximately 10 minutes. Based on that discharge, estimate the total discharge during that interval and the new elevation based on the stage volume relationship. Continue to iterate until H is approximately equal to H_o. When using multiple orifices the discharge from each is summed.

(6) Splitter Box - When the pond is designed as an offline facility, a splitter structure is used to isolate the water quality volume. The splitter box, or other flow diverting approach, should be designed to convey the 25-year storm event while providing at least 1.0 foot of freeboard along pond side slopes.

(7) Erosion Protection at the Outfall - For online facilities, special consideration should be given to the facility's outfall location. Flared pipe end sections that discharge at or near the stream invert are preferred. The channel immediately below the pond outfall should be modified to conform to natural dimensions, and lined with large stone riprap placed over filter cloth. Energy dissipation may be required to reduce flow velocities from the primary spillway to non-erosive velocities.

(8) Safety Considerations - Safety is provided either by fencing of the facility or by managing the contours of the pond to eliminate dropoffs and other hazards. Earthen side slopes should not exceed 3:1 (H:V) and should terminate on a flat safety bench area. Landscaping can be used to impede access to the facility. The primary spillway opening must not permit access by small children. Outfall pipes above 48 inches in diameter should be fenced.

Maintenance

Routine maintenance activity is often thought to consist mostly of sediment and trash and debris removal; however, these activities often constitute only a small fraction of the maintenance hours. During a recent study by Caltrans, 72 hours of maintenance was performed annually, but only a little over 7 hours was spent on sediment and trash removal. The largest recurring activity was vegetation management, routine mowing. The largest absolute number of hours was associated with vector control because of mosquito breeding that occurred in the stilling basins (example of standing water to be avoided) installed as energy dissipaters. In most cases, basic housekeeping practices such as removal of debris accumulations and vegetation management to ensure that the basin dewaters completely in 48-72 hours is sufficient to prevent creating mosquito and other vector habitats.

Consequently, maintenance costs should be estimated based primarily on the mowing frequency and the time required. Mowing should be done at least annually to avoid establishment of woody vegetation, but may need to be performed much more frequently if aesthetics are an important consideration.

Typical activities and frequencies include:

- Schedule semiannual inspection for the beginning and end of the wet season for standing water, slope stability, sediment accumulation, trash and debris, and presence of burrows.
- Remove accumulated trash and debris in the basin and around the riser pipe during the semiannual inspections. The frequency of this activity may be altered to meet specific site conditions.
- Trim vegetation at the beginning and end of the wet season and inspect monthly to prevent establishment of woody vegetation and for aesthetic and vector reasons.
- Remove accumulated sediment and re-grade about every 10 years or when the accumulated sediment volume exceeds 10 percent of the basin volume. Inspect the basin each year for accumulated sediment volume.

Cost

Construction Cost

The construction costs associated with extended detention basins vary considerably. One recent study evaluated the cost of all pond systems (Brown and Schueler, 1997). Adjusting for inflation, the cost of dry extended detention ponds can be estimated with the equation:

$$C = 12.4V^{0.760}$$

where: C = Construction, design, and permitting cost, and
V = Volume (ft^3).

Using this equation, typical construction costs are:

$ 41,600 for a 1 acre-foot pond

$ 239,000 for a 10 acre-foot pond

$ 1,380,000 for a 100 acre-foot pond

Interestingly, these costs are generally slightly higher than the predicted cost of wet ponds (according to Brown and Schueler, 1997) on a cost per total volume basis, which highlights the difficulty of developing reasonably accurate construction estimates. In addition, a typical facility constructed by Caltrans cost about $160,000 with a capture volume of only 0.3 ac-ft.

An economic concern associated with dry ponds is that they might detract slightly from the value of adjacent properties. One study found that dry ponds can actually detract from the perceived value of homes adjacent to a dry pond by between 3 and 10 percent (Emmerling-Dinovo, 1995).

Maintenance Cost

For ponds, the annual cost of routine maintenance is typically estimated at about 3 to 5 percent of the construction cost (EPA website). Alternatively, a community can estimate the cost of the maintenance activities outlined in the maintenance section. Table 1 presents the maintenance costs estimated by Caltrans based on their experience with five basins located in southern California. Again, it should be emphasized that the vast majority of hours are related to vegetation management (mowing).

Table 1 Estimated Average Annual Maintenance Effort

Activity	Labor Hours	Equipment & Material ($)	Cost
Inspections	4	7	183
Maintenance	49	126	2282
Vector Control	0	0	0
Administration	3	0	132
Materials	-	535	535
Total	**56**	**$668**	**$3,132**

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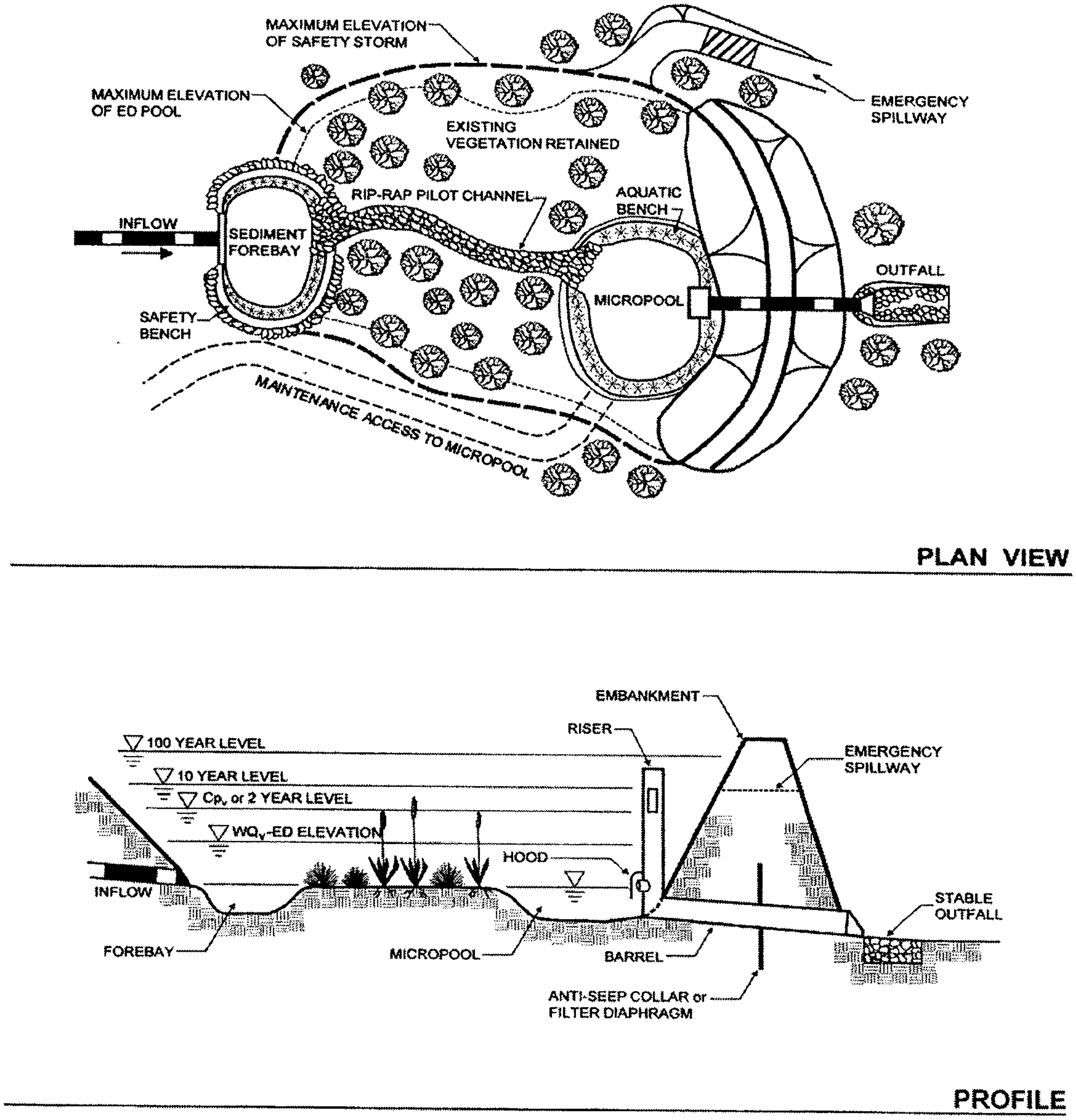

Schematic of an Extended Detention Basin (MDE, 2000)

Drainage Study for the Otay Mesa Community Plan Update

June, 2006

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APPENDICES

I. BACKGROUND

This report has been prepared as an appendix to the Otay Mesa Community Plan update EIR. Its purpose is to provide a summary of the existing drainage situation and facilities and proposed future facilities, including alternatives for draining the large central watershed. In addition, this report presents recommendations for drainage design criteria and storm water quality requirements for each of the watersheds on the Mesa.

For most of its early history, Otay Mesa was used for agriculture and farming was the primary land use. As industrial and commercial development started taking place in the 1960s, the City of San Diego recognized the need for a comprehensive drainage Master Plan for the Mesa. Because most of the Mesa drains to the South into Mexico, there was concern that the new development would increase the runoff crossing the border. The City needed to establish criteria for the new development such that there was no increase in runoff as a result of the new construction.

In May of 1987, the City Council approved a contract to prepare the Otay Mesa Drainage Master Plan. In August of 1987, the City published a Notice to "All Private Engineers" that established "Drainage Requirements for Development in Otay Mesa" (attached). The Master Plan was published in January, 1988, and included a proposed concrete Channel from Airway Road to Siempre Viva Road that followed the existing drainage channel.

The Master plan was updated with the "Otay Mesa Drainage Study" published in August, 1999. The most significant recommendation change was moving the proposed new channel from the creek alignment to a new location directly adjacent to La Media Road and Siempre Viva Road.

Reproduction of 1987 NOTICE from Engineering and Development Department

NOTICE

Date: August 7, 1987

To: All Private Engineers

From: Subdivision Engineer

Subject: Drainage requirements for development in Otay Mesa

In order to minimize the effects of increased storm water runoff in Mexico, due to development of property in Otay Mesa, all property in Otay Mesa that is within the water shed that drains into Mexico, shall be developed with the following requirements:

1. Each property owner shall provide storm water detention facilities so that there will be no increase in the rate of runoff due to development of the property.

2. The detention facilities shall be designed so that the rate of runoff from the property will not be greater after development than it was before development for a 5 year, 10 year, 25 year and 50 year storm.

3. All drainage facilities crossing four-lane major or higher classification streets shall be designed for a Q100 (existing). Other facilities, except the major channel referred to in paragraph 5, may be designed for Q50 (existing).

4. The Drainage Design Manual shall be used as guidelines for design of drainage facilities and computing design discharges.

5. The City Engineer's Office, Flood Control Section, is preparing a preliminary plan for the main north-south channel from Otay Mesa Road near La Media to the Mexican Border. The preliminary design will include the design "Q" (Q100 existing), the invert grade, and the water surface elevation at the major road crossings.

C.R. Lockhead
Subdivision Engineer

II. EXISTING DRAINAGE FACILITIES

Information was collected for existing drainage and flood control facilities on Otay Mesa through as-built plans, SanGIS maps, and site visits. Most of the existing drainage facilities were constructed as part of the private development that is taking place on the Mesa. Many of these facilities are not continuous because of the piecemeal nature of the development. This creates challenges for the subsequent developers that need to tie into the existing facilities. Many of the existing facilities are temporary.

Most of the development to-date has occurred in the East Watershed, which therefore includes most of the existing drainage facilities on the Mesa. The existing system is a combination of storm drains, improved channels, and detention basins, which in many areas discharge to natural drainage paths that do not have adequate hydraulic capacity.

The "Existing Drainage Facilities" drawing shows the facilities as-of the date of this report. The area is developing rapidly, and therefore new facilities are continuously being constructed. There are currently no dedicated drainage rights-of-way on the Mesa. Many of the projects, as they were mapped and constructed, dedicated portions of the properties to the city as drainage easements or flood water storage easements. Eventually, the systems and their easements will be continuous.

III. HYDROLOGIC ANALYSIS

The Otay Mesa Study area is shown on the Watershed Map, and includes all of the Mesa area within the City of San Diego divided into five watersheds (with the exception of the far northwest arm of the Mesa, which is fully developed).

Watersheds	Acres	mi^2
West Perimeter Watershed	258	0.40
West Watershed	2,190	3.42
North Perimeter Watershed	590	0.92
East Watershed	3,864	6.04
Border Crossing Watershed	223	0.35
TOTAL	7,125	11.13

Most of the Mesa slopes from North to South, with the flow entering Mexico at several points. The northern and western perimeters of the Mesa flow into the adjacent Canyons. These perimeter watersheds are divided into several independent smaller watersheds. The watershed boundaries on the Mesa are not well defined because the Mesa is so flat. There are very few defined natural drainage paths, with much of the runoff sheet-flowing across the Mesa. The watershed boundaries shown are based on field investigations and best available mapping, but the actual drainage boundaries may be very different.

The only watershed that has been studied significantly from a drainage perspective is the East Watershed. Hydrologic models have been prepared for both of the previous drainage studies. The peak flows calculated in the two studies are different, primarily because of different assumptions relative to developed area, proposed drainage facilities, and watershed areas. The East Watershed includes a large area of unincorporated County property. The hydrologic model assumed the same industrial development for the unincorporated area. If land uses change in the County area, it may change the runoff rates. The differences for the concentration point at the border are shown below.

Q100 at Border East Watershed		
	Area (mi^2)	Q100(cfs)
1988 Study	5.72	5,050
1999 Study	6.63	3,529
2004 CPU	6.78	3,673

As part of this study, new hydrologic models have been prepared for the main watersheds which flow into the Tijuana River. For the East Watershed, HEC-1 has been used, since both previous studies used this model. For the other watersheds, the standard City of San Diego Modified Rational Method (AES) has been used. The results of these analyses are shown in the table below.

Hydrologic Analysis Summary			
	Area (mi^2)	Q50(cfs)	Q100(cfs)
West Perimeter Watershed	0.40	170	444
West Watershed	3.42	672	1,676
East Watershed	6.78	1,280	3,673
	10.60	2,122	5,793

In addition to the above flows, the Spring Canyon open space area contributes 109 cfs (Q50) and 257 cfs (Q100) from 1.2 mi^2. Since the Tijuana River Watershed is a water-quality impacted watershed, the quality and quantity of flow will need to be addressed before additional development takes place.

IV. HYDRAULIC ANALYSIS

Most of the Mesa is very flat, resulting in local flooding during storms at the low points and along some drainage ditches. The only significant creek on the Mesa is the main channel in the East Watershed, Otay Mesa Creek, which flows from North to South along La Media Road and crosses the border into Mexico just north of the Tijuana Airport.

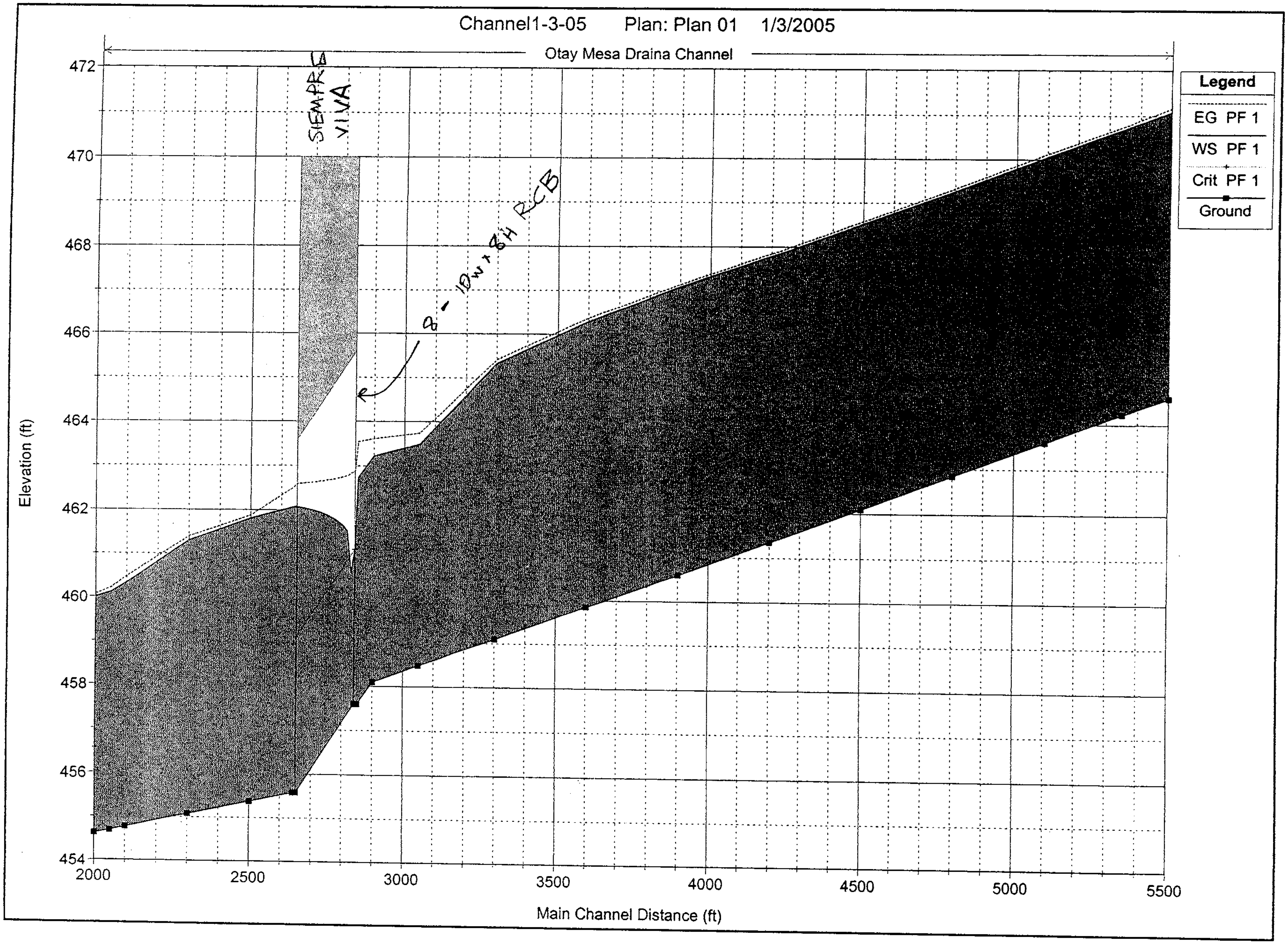
A HEC-RAS hydraulic model was prepared for this channel from the border north to Otay Mesa Road. The purpose of this model was to identify the 100-year floodplain for this reach for present conditions. The proposed future drainage project along this alignment will be designed to contain the 100-year flow, reducing or eliminating flooding impacts to adjacent properties.

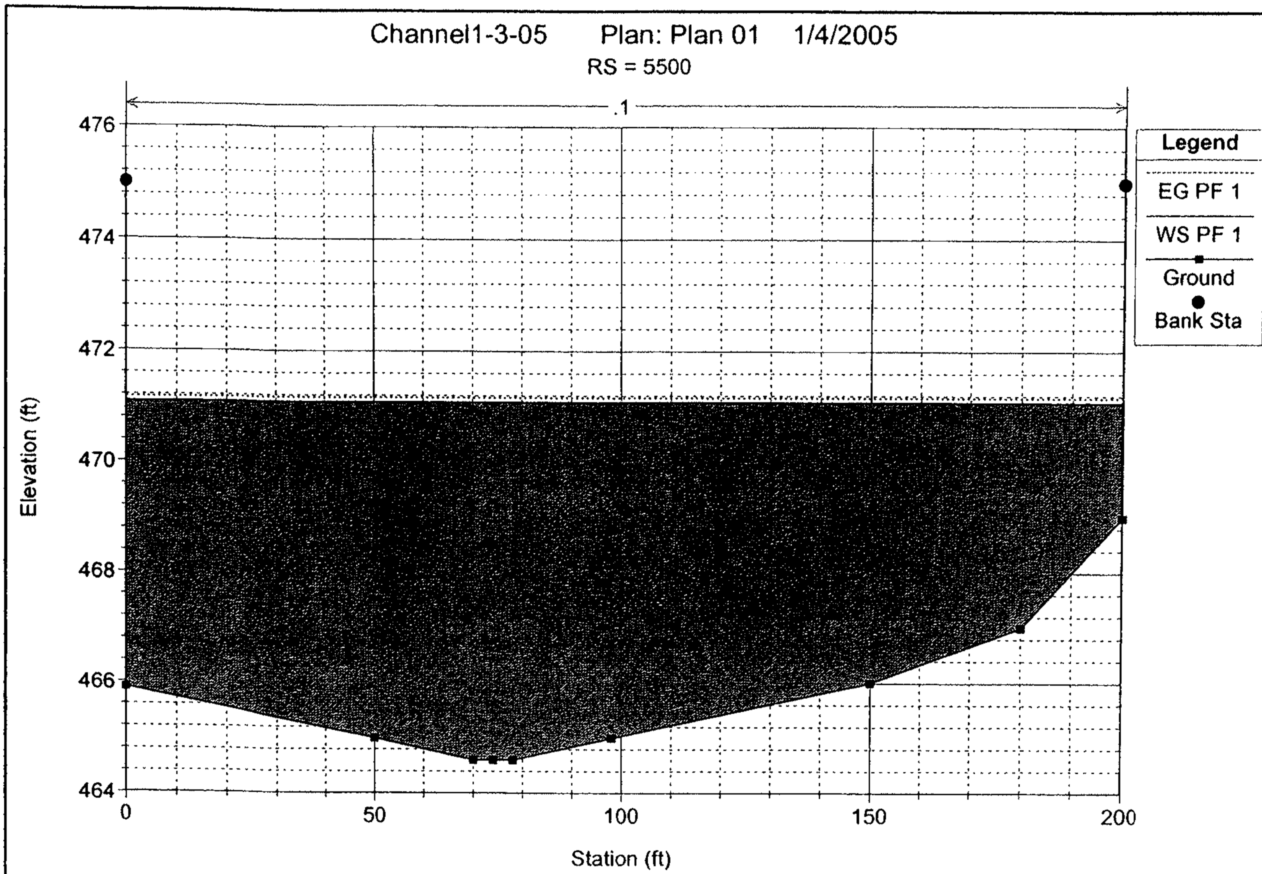
The HEC-RAS model was also used to size the proposed new channel from Airway Road to just south of Siempre Viva Road. Several alternative cross-sections were modeled to reflect input on the environmental aspects of the channel.

A significant tributary to the main channel enters just upstream of the Siempre Viva Road crossing. This tributary conveys flow from the De La Fuente Business Park and the Siempre Viva Business Park. The existing channel from La Media Road to the proposed main channel is approximately 15 feet wide and 4 feet deep, with a hydraulic capacity of approximately 120 cfs. The 100 year flow in this channel is 1116 cfs. A proposed new channel has a 50 ft bottom width with 1.5:1.0 side slopes and will convey the 100 year flow. A double 10' x 4.5' RCB will also be required for the flow under La Media Road. The cost estimate does not include these facilities.

HEC-RAS Plan: Plan 01 River: Otay Mesa Draina Reach: Channel Profile: PF 1

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Channel	5500	PF 1	2500.00	464.60	471.08		471.16	0.002743	2.33	1073.59	200.00	0.18
Channel	5350	PF 1	2500.00	464.23	470.69		470.76	0.002572	2.16	1279.19	335.44	0.17
Channel	5100	PF 1	2500.00	463.60	470.06		470.12	0.002591	2.17	1275.99	335.16	0.17
Channel	4800	PF 1	2500.00	462.85	469.27		469.33	0.002666	2.19	1263.56	334.04	0.18
Channel	4500	PF 1	2500.00	462.10	468.51		468.56	0.002430	2.08	1358.84	378.24	0.17
Channel	4200	PF 1	2500.00	461.35	467.79		467.85	0.002365	2.07	1371.79	379.61	0.17
Channel	3900	PF 1	2500.00	460.60	467.09		467.15	0.002266	2.04	1392.50	381.79	0.16
Channel	3600	PF 1	2500.00	459.85	466.30		466.37	0.002969	2.32	1153.04	281.59	0.19
Channel	3300	PF 1	2500.00	459.10	465.33		465.42	0.003423	2.41	1109.99	285.62	0.20
Channel	3050	PF 1	3000.00	458.48	463.50		463.74	0.014532	4.06	777.90	261.33	0.39
Channel	2900	PF 1	3000.00	458.10	463.23	461.14	463.61	0.000245	4.97	603.31	222.92	0.41
Channel	2850	PF 1	3000.00	457.60	462.74	461.24	463.55	0.000521	7.22	415.32	168.05	0.58
Channel	2750		Culvert									
Channel	2640	PF 1	3000.00	455.59	462.07	458.95	462.52	0.011957	5.38	557.46	183.64	0.37
Channel	2500	PF 1	3000.00	455.38	461.81		461.87	0.001846	2.07	1492.22	277.64	0.15
Channel	2300	PF 1	3000.00	455.08	461.31		461.40	0.003272	2.45	1261.91	277.98	0.19
Channel	2100	PF 1	3000.00	454.78	460.34		460.48	0.006864	3.05	1006.36	275.43	0.27
Channel	2050	PF 1	3000.00	454.70	460.11		460.21	0.003838	2.56	1191.75	275.37	0.21
Channel	2000	PF 1	3000.00	454.63	460.00	456.55	460.06	0.002196	2.06	1582.39	378.00	0.16


Channel1-3-05 Plan: Plan 01 1/3/2005
Otay Mesa Draina Channel
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Elevation (ft)
472
470
468
466
464
462
460
458
456
454
2000
2500
3000
3500
4000
4500
5000
5500
Main Channel Distance (ft)
SIEMPRE VIVA
8 - 10w x 8H RCB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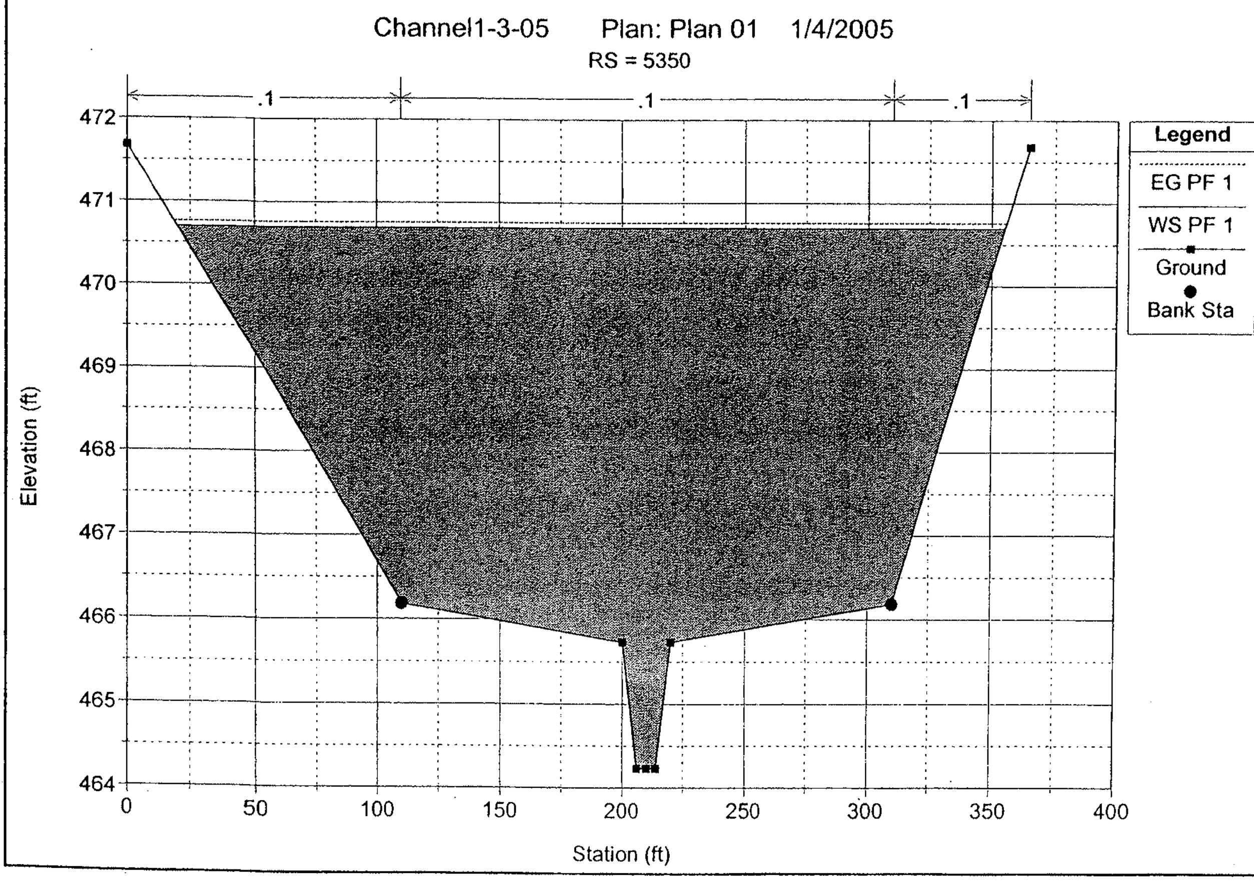
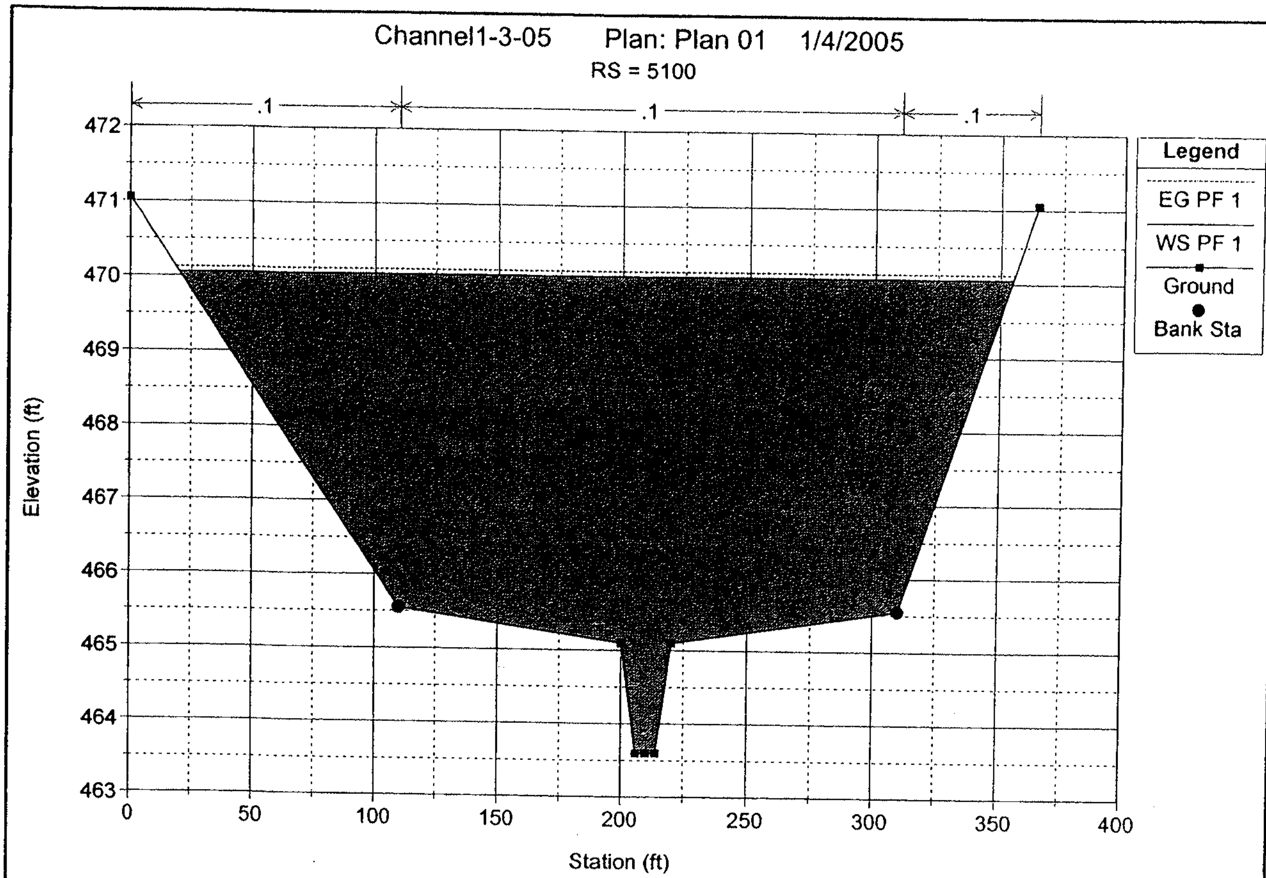
RS = 5500
.1
Legend
EG PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
476
474
472
470
468
466
464
0
50
100
150
200
Station (ft)


Channel1-3-05 Plan: Plan 01 1/4/2005
RS = 5350
.1
.1
.1
Legend
EG PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
472
471
470
469
468
467
466
465
464
0
50
100
150
200
250
300
350
400
Station (ft)



Channel1-3-05 Plan: Plan 01 1/4/2005
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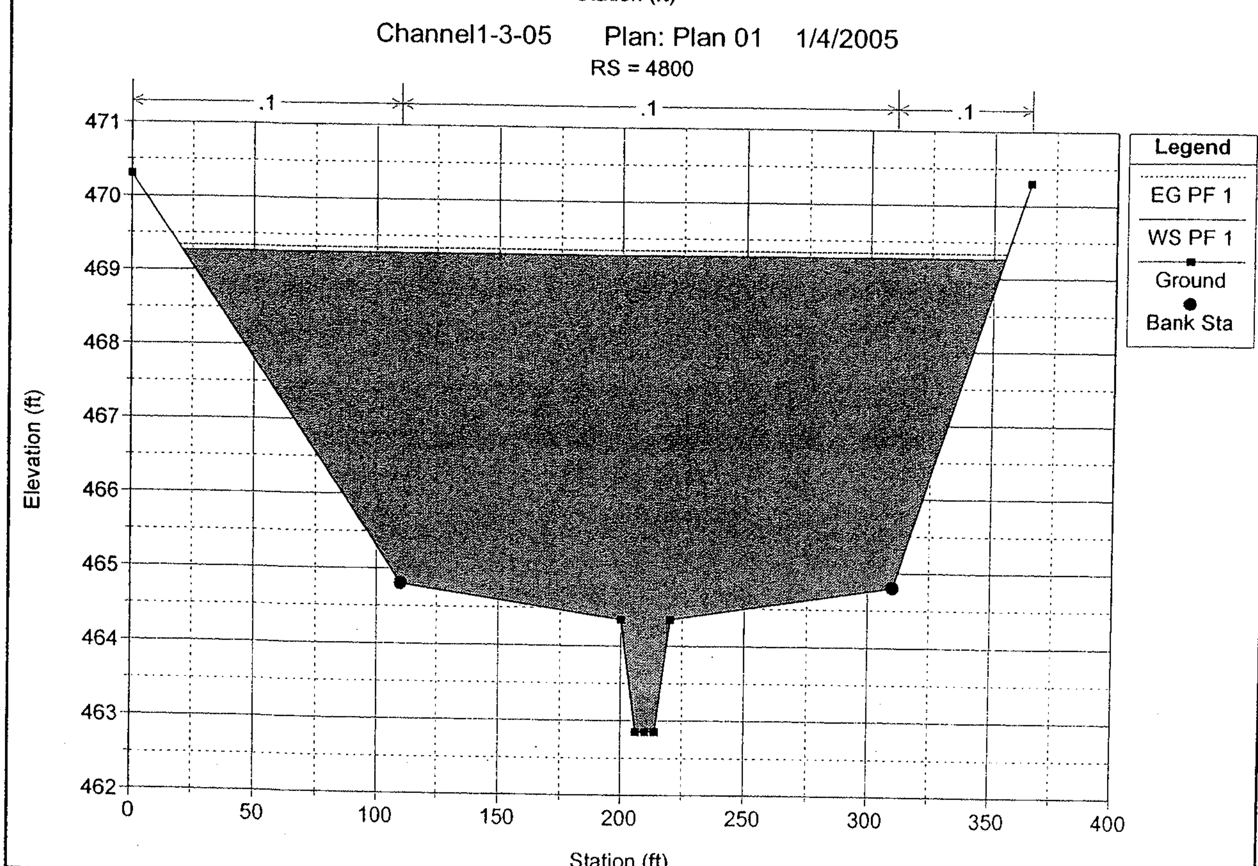
.1
.1
.1
Legend
EG PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)



Channel1-3-05 Plan: Plan 01 1/4/2005
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.1
.1
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Legend
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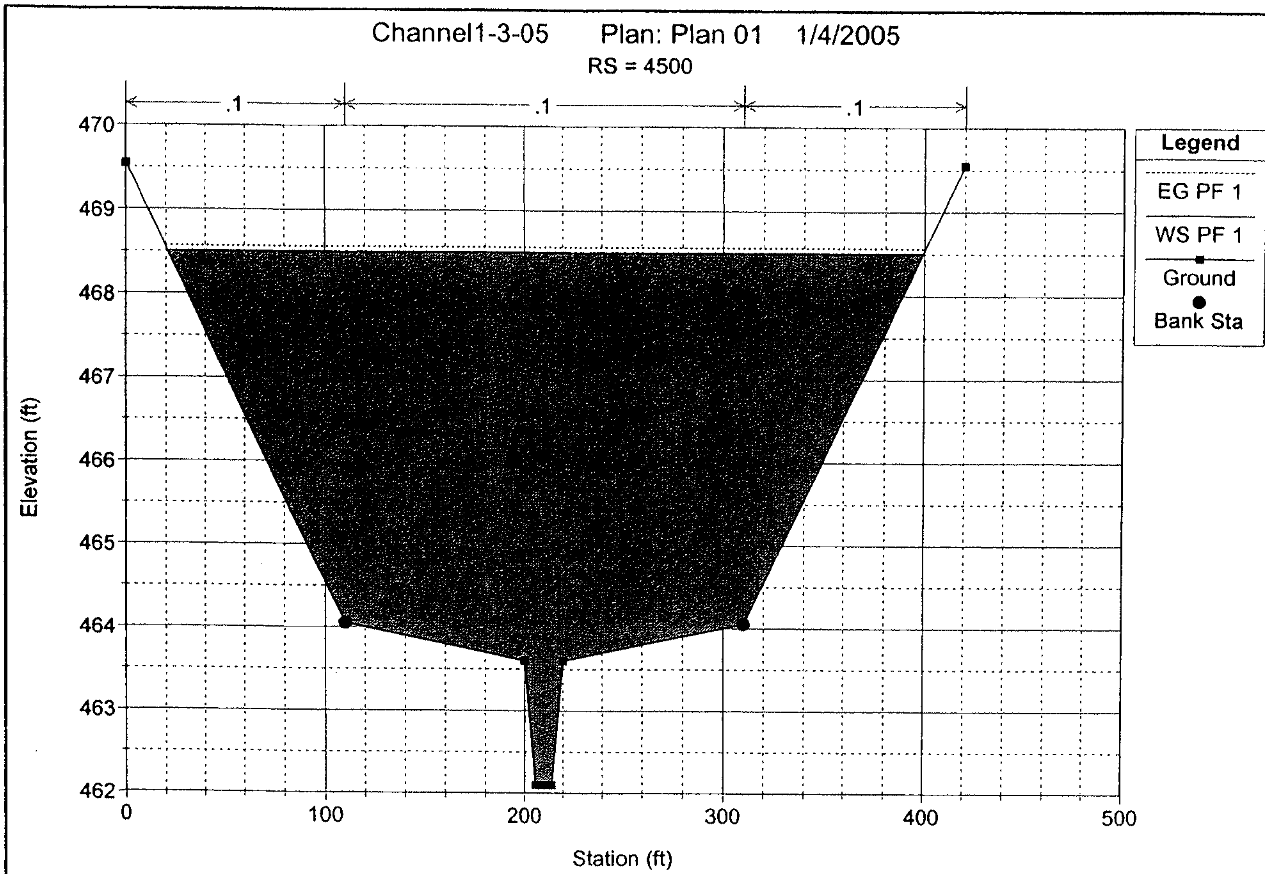
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)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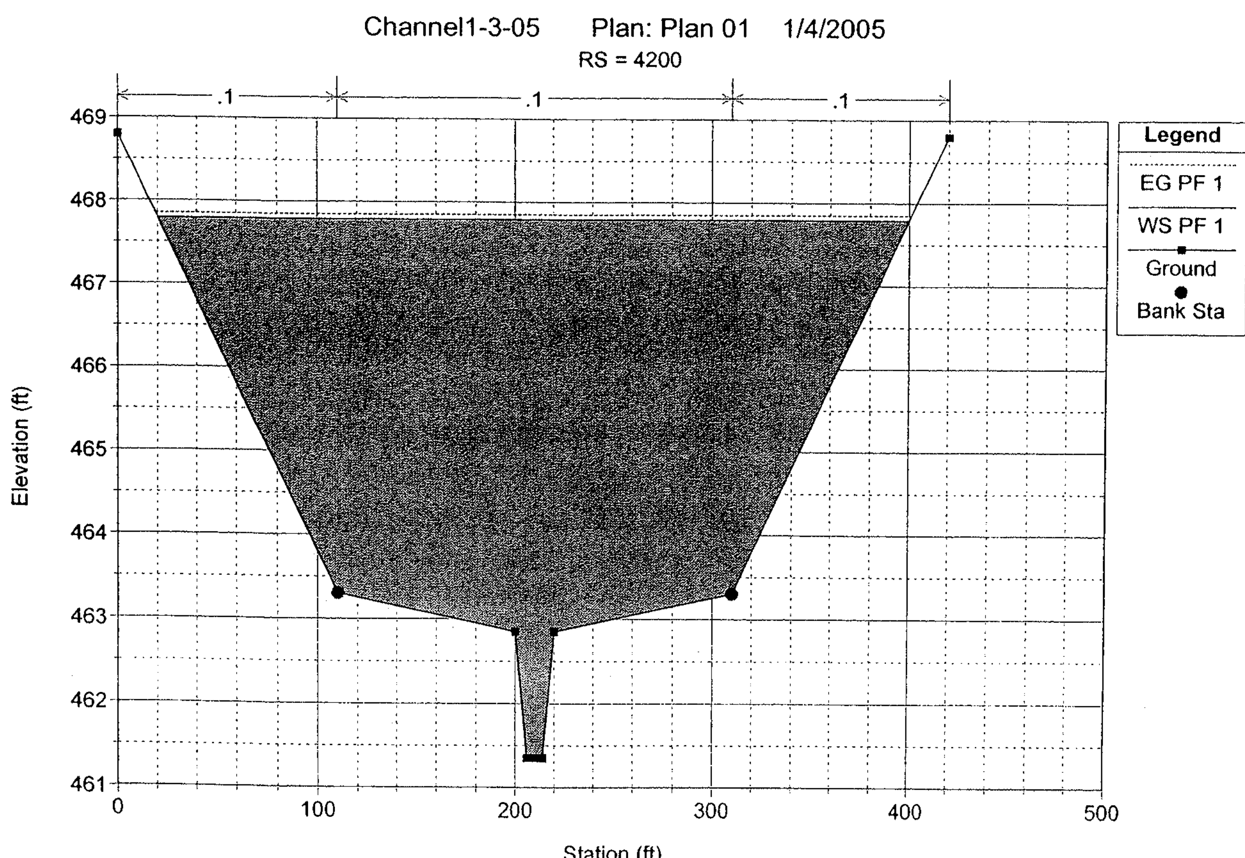
RS = 4500
.1
.1
.1
Legend
EG PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
470
469
468
467
466
465
464
463
462
0
100
200
300
400
500
Station (ft)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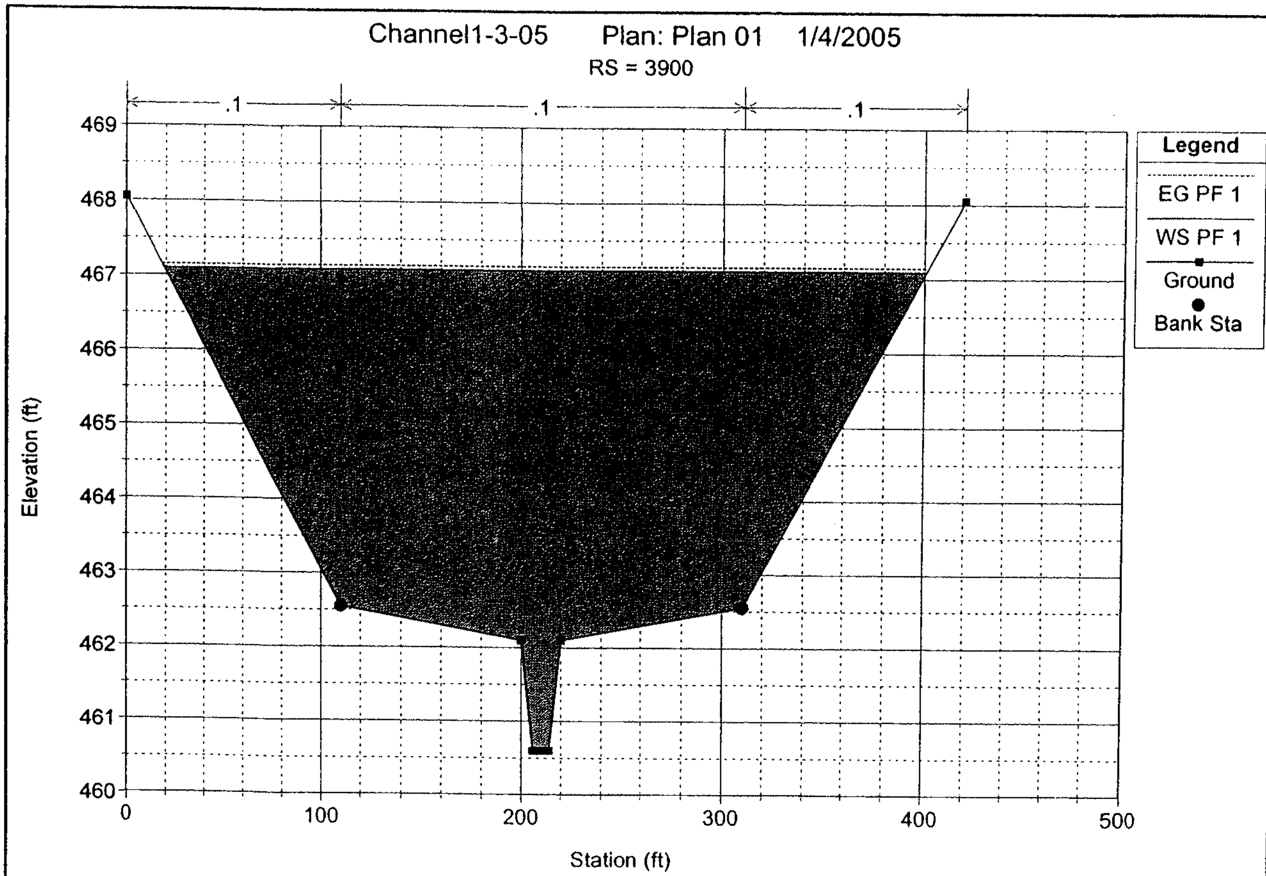
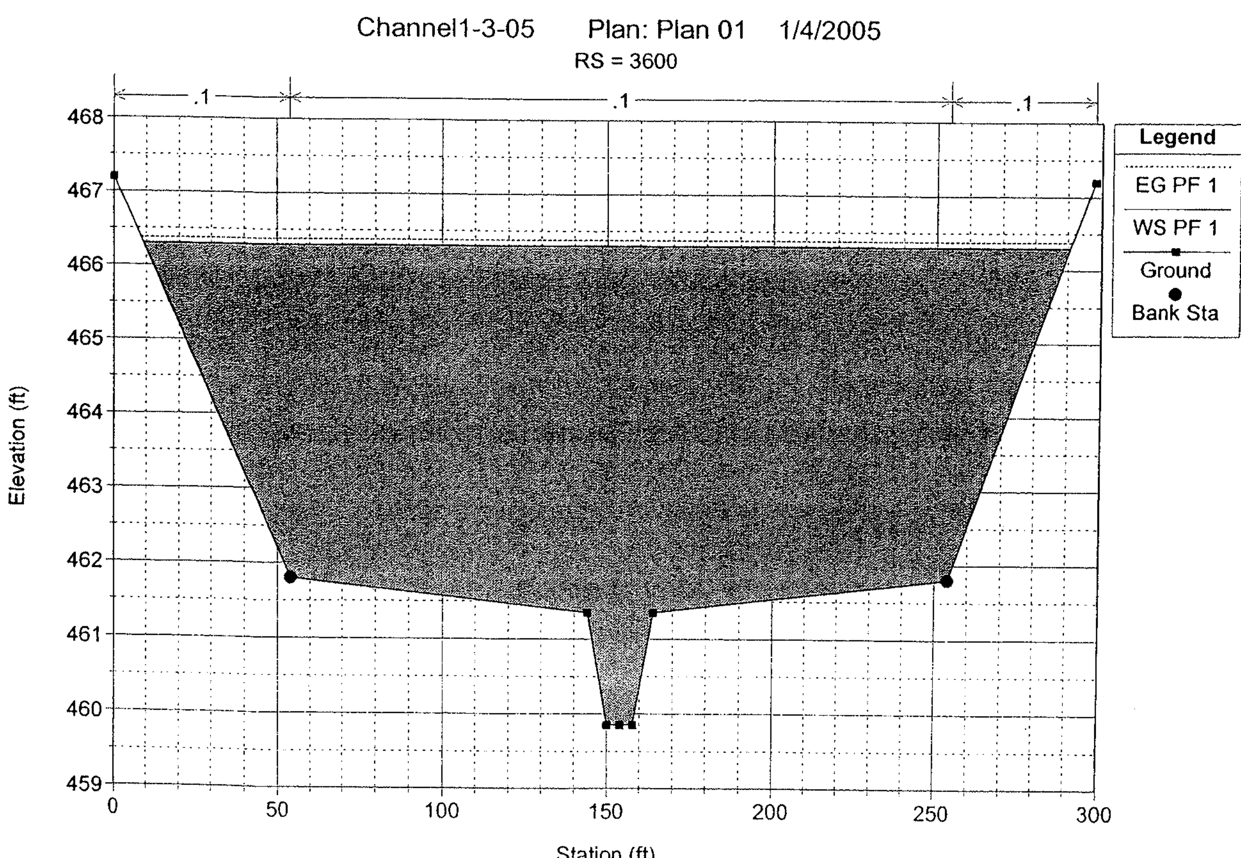
RS = 4200
.1
.1
.1
Legend
EG PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
469
468
467
466
465
464
463
462
461
0
100
200
300
400
500
Station (ft)



Channel1-3-05 Plan: Plan 01 1/4/2005
RS = 3900
.1
.1
.1
Legend
EG PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
460
461
462
463
464
465
466
467
468
469
0
100
200
300
400
500



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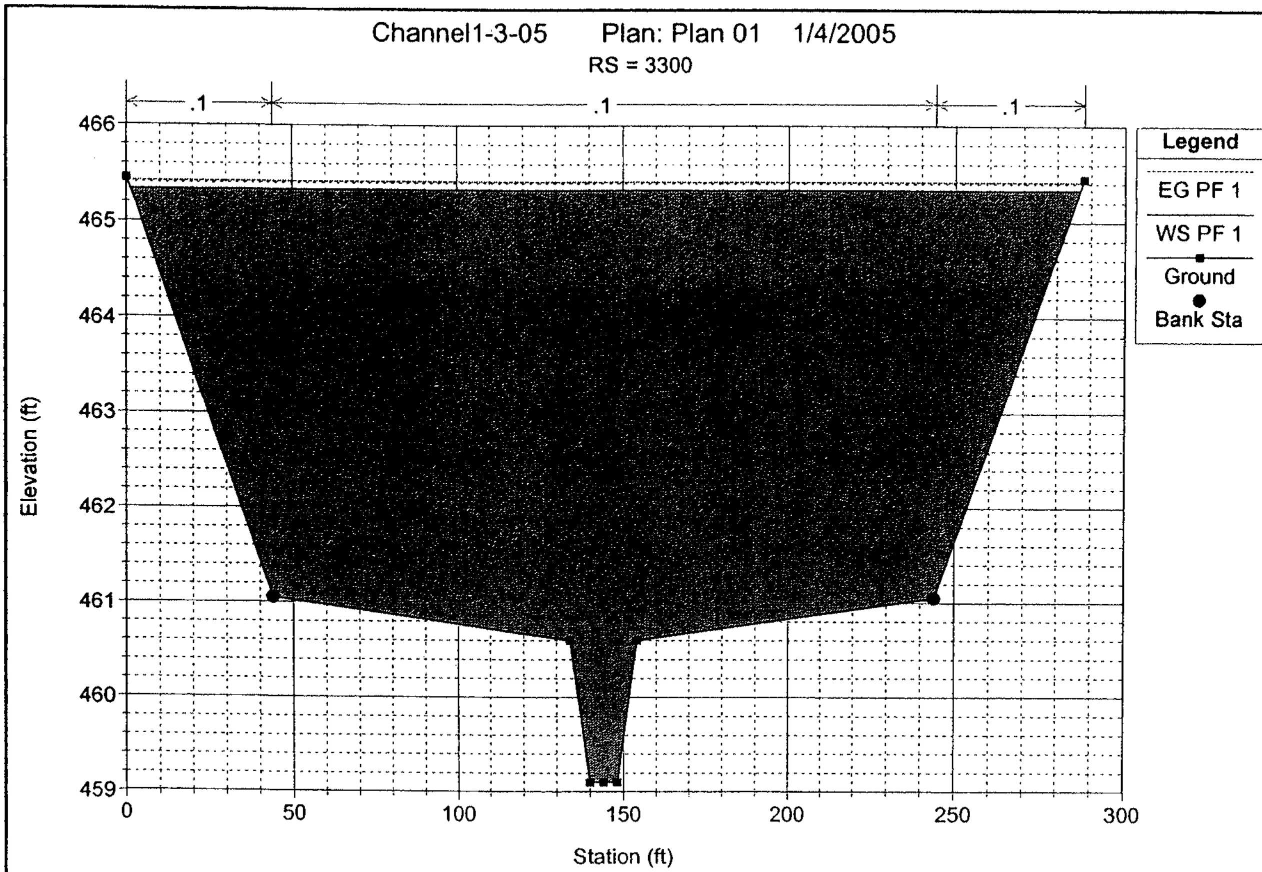
RS = 3600
.1
.1
.1
Legend
EG PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
459
460
461
462
463
464
465
466
467
468
0
50
100
150
200
250
300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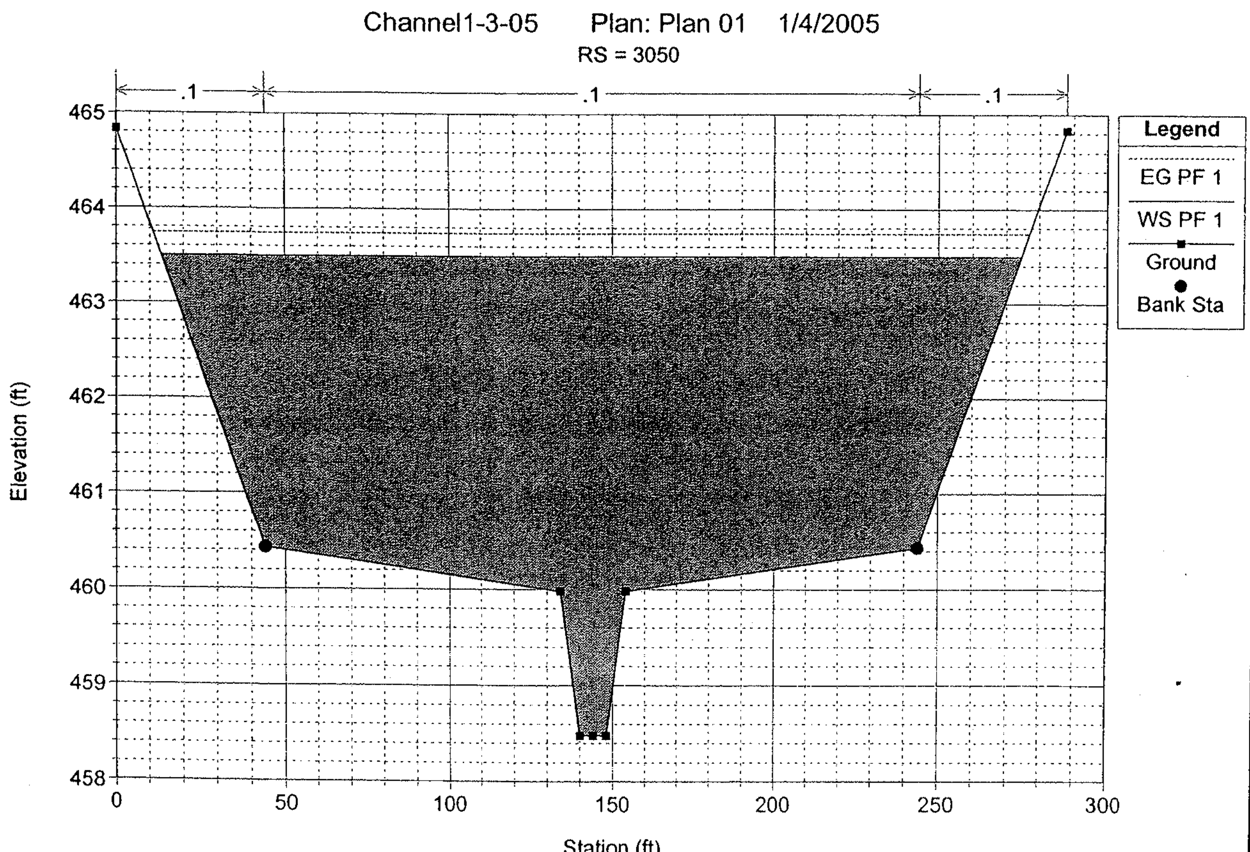
RS = 3300
.1
.1
.1
Legend
EG PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
466
465
464
463
462
461
460
459
0
50
100
150
200
250
300
Station (ft)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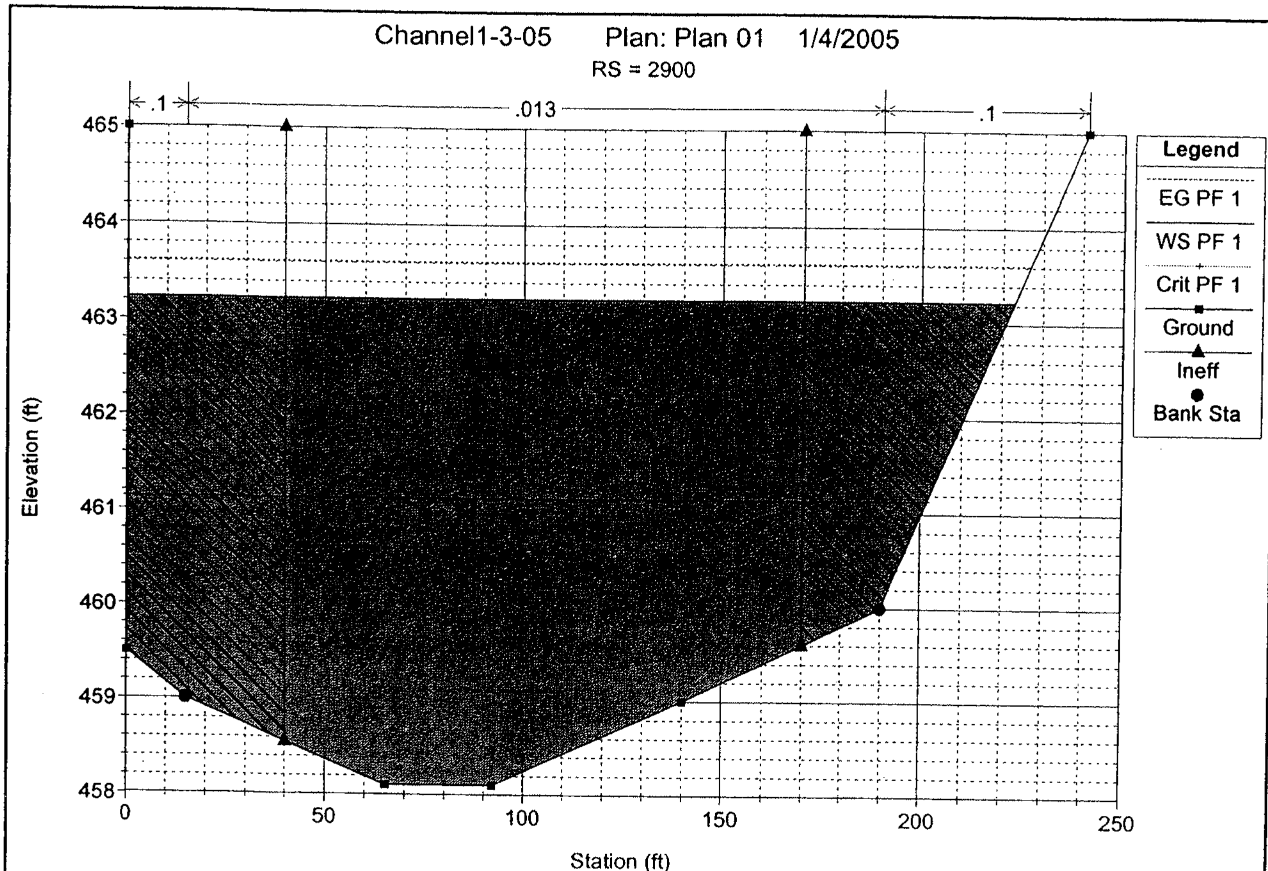
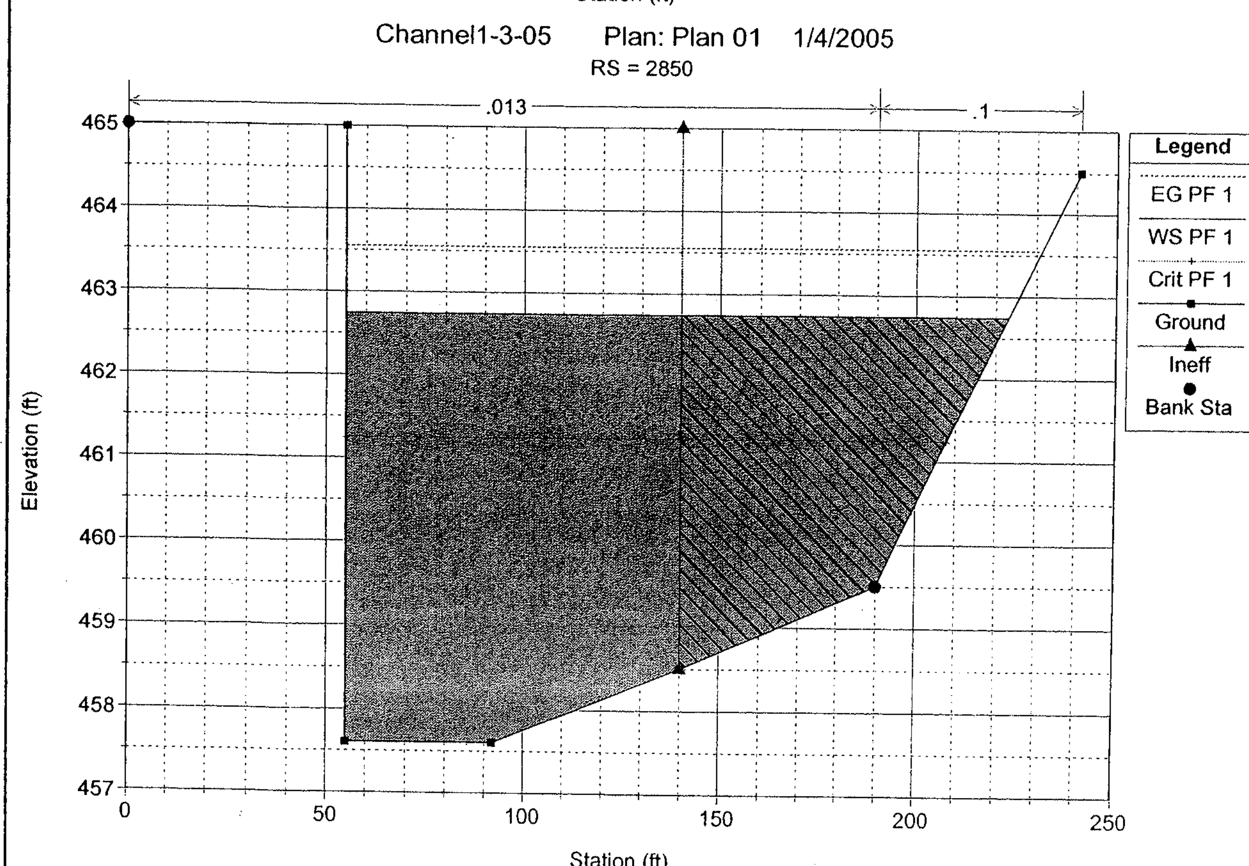
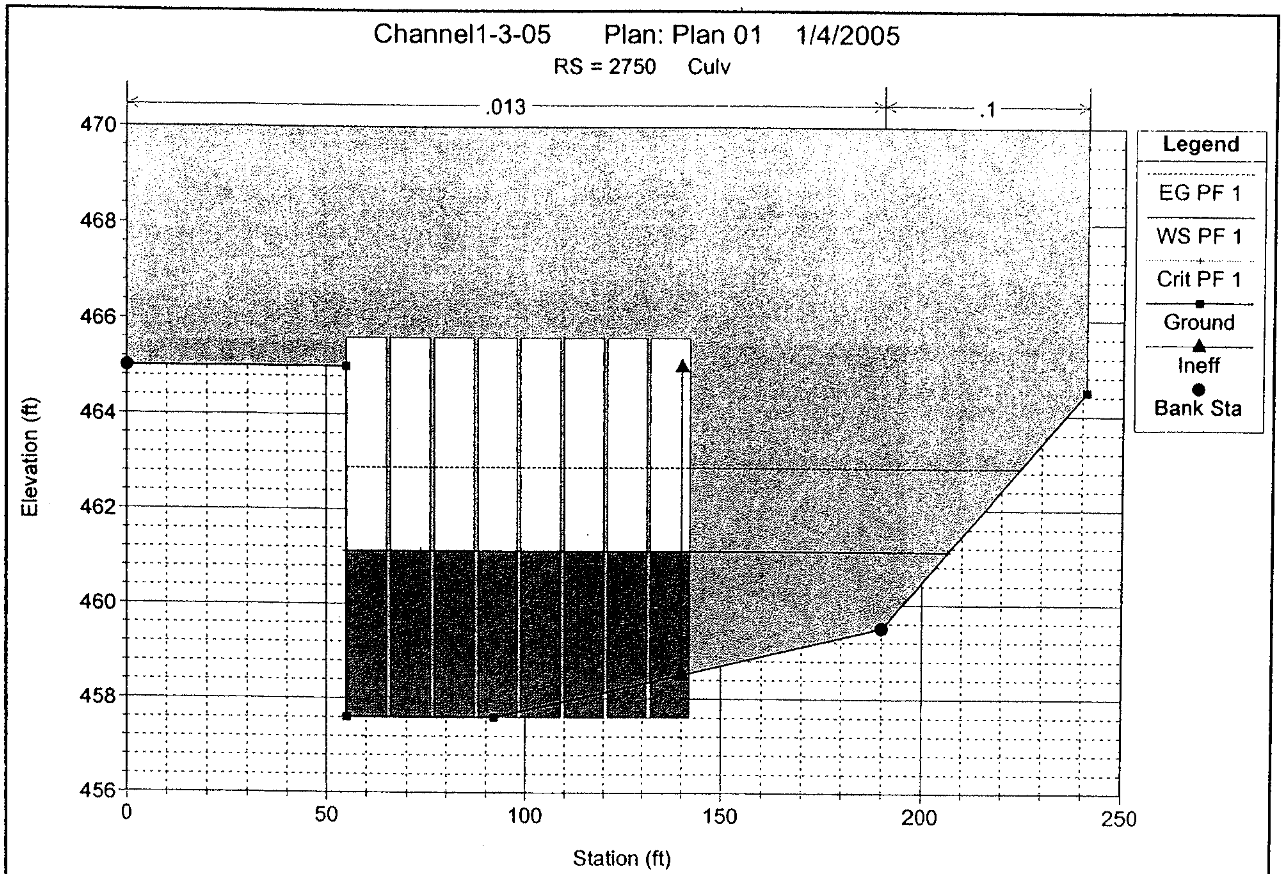
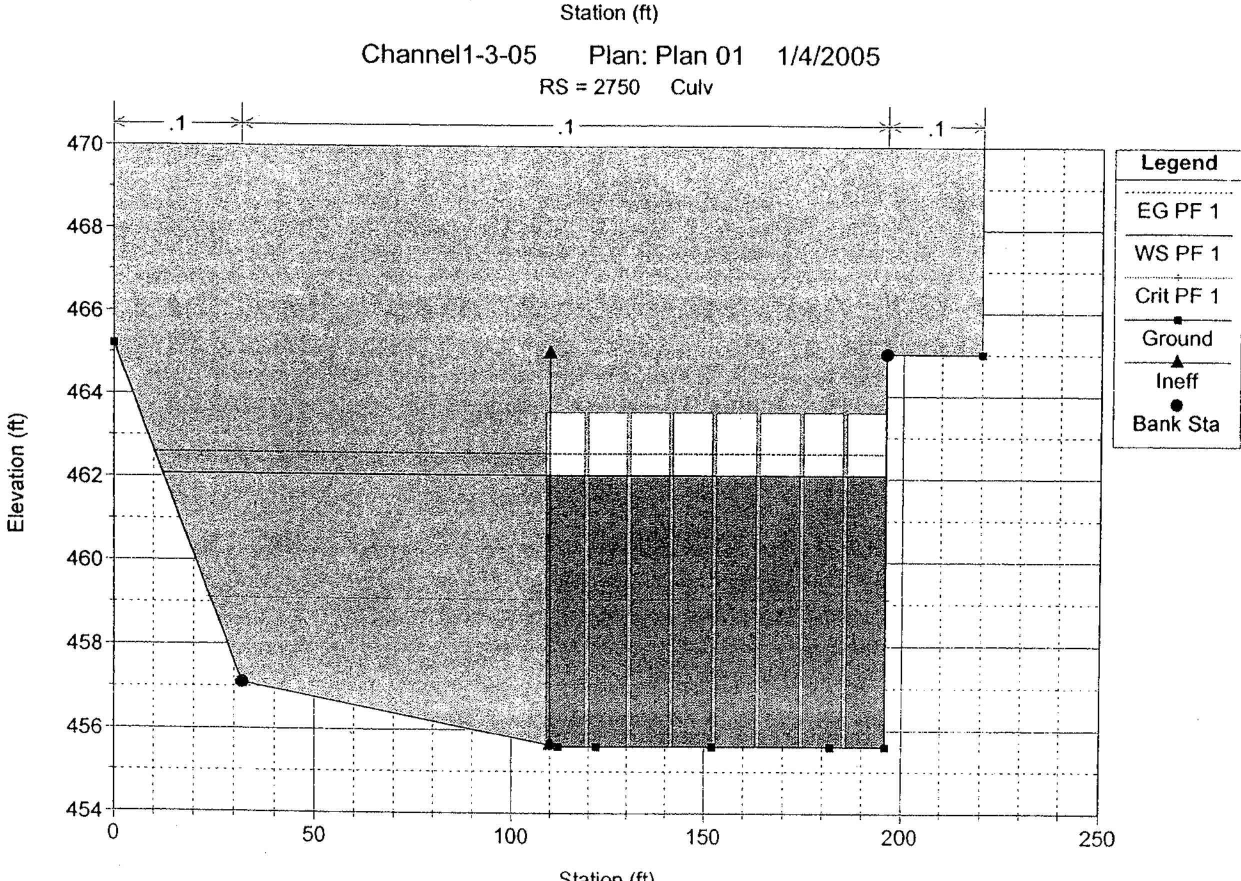
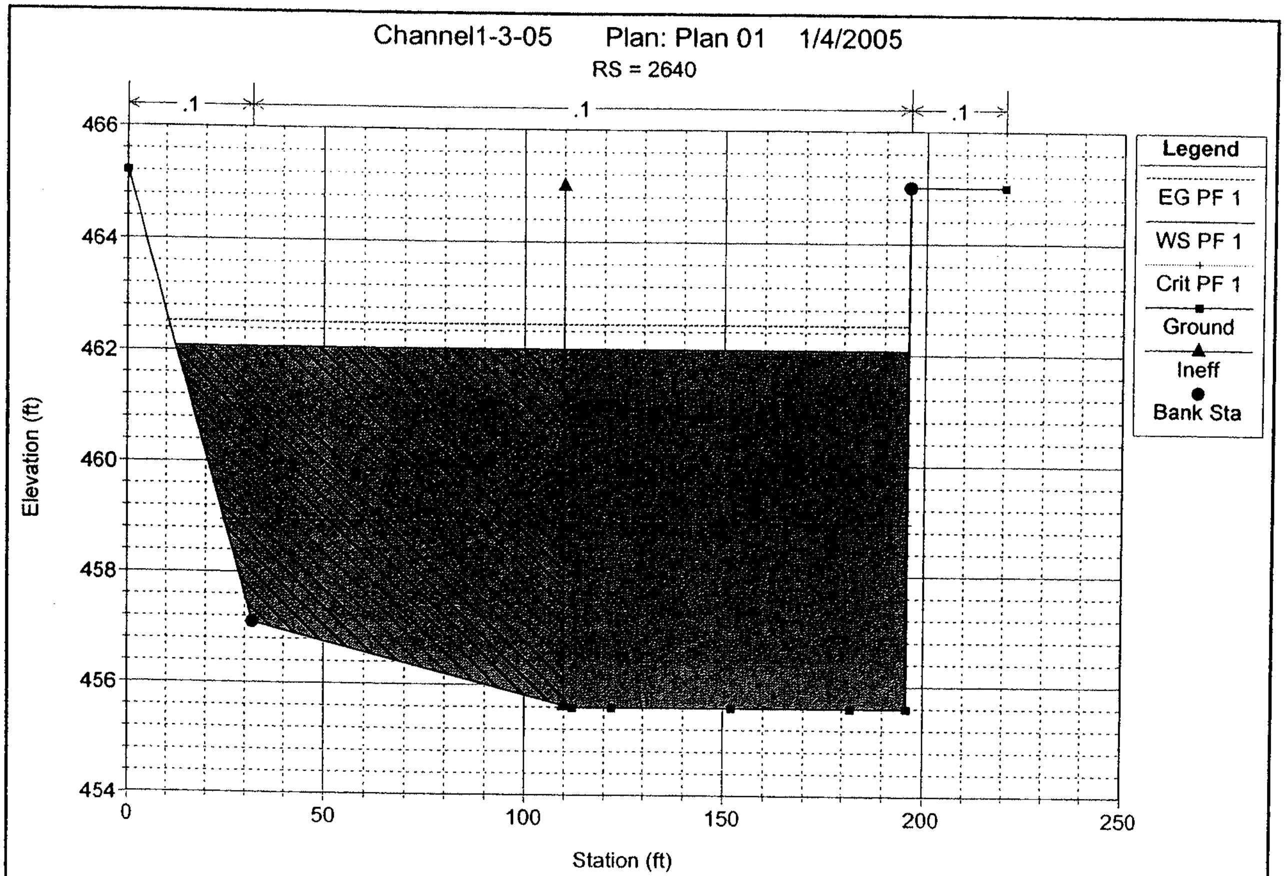
RS = 3050
.1
.1
.1
Legend
EG PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
465
464
463
462
461
460
459
458
0
50
100
150
200
250
300
Station (ft)


Channel1-3-05 Plan: Plan 01 1/4/2005
RS = 2900
.1
.013
.1
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Ineff
Bank Sta
Elevation (ft)
465
464
463
462
461
460
459
458
0
50
100
150
200
250
Station (ft)


Channel1-3-05 Plan: Plan 01 1/4/2005
RS = 2850
.013
.1
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Ineff
Bank Sta
Elevation (ft)
465
464
463
462
461
460
459
458
457
0
50
100
150
200
250
Station (ft)


Channel1-3-05 Plan: Plan 01 1/4/2005
RS = 2750 Culv
.013
.1
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Ineff
Bank Sta
Elevation (ft)
470
468
466
464
462
460
458
456
0
50
100
150
200
250
Station (ft)


Channel1-3-05 Plan: Plan 01 1/4/2005
RS = 2750 Culv
.1
.1
.1
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Ineff
Bank Sta
Elevation (ft)
470
468
466
464
462
460
458
456
454
0
50
100
150
200
250
Station (ft)



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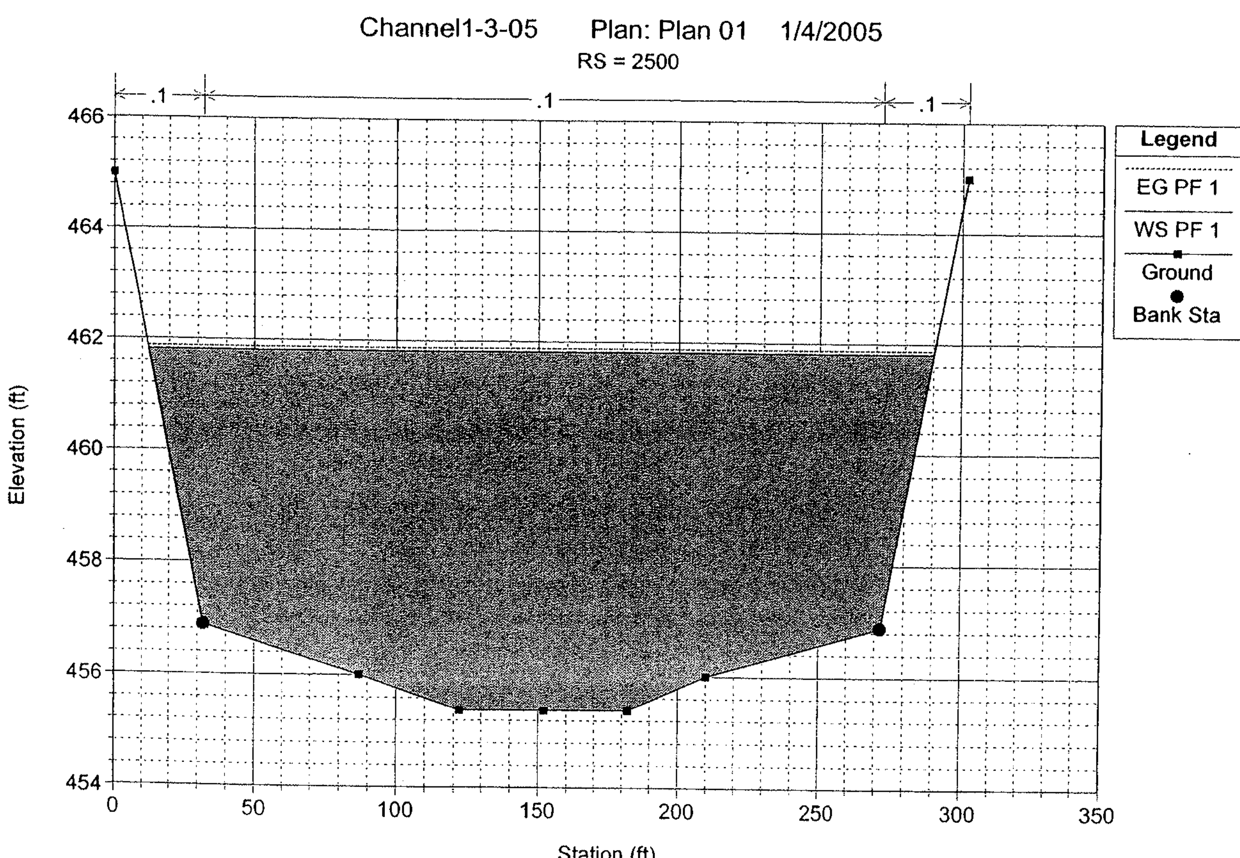
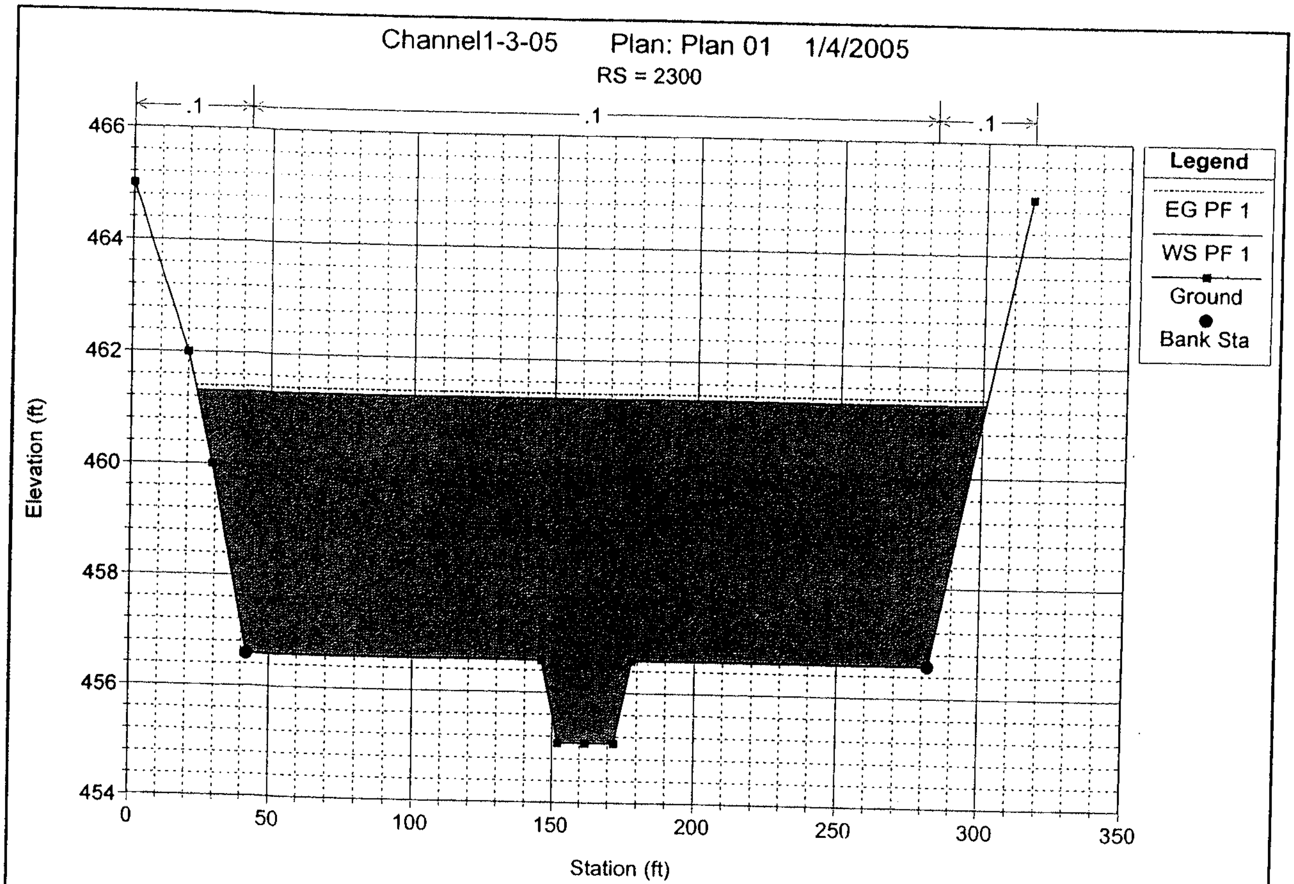
RS = 2640
.1
.1
.1
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Ineff
Bank Sta
Elevation (ft)
466
464
462
460
458
456
454
0
50
100
150
200
250
Station (ft)



Channel1-3-05 Plan: Plan 01 1/4/2005
RS = 2500
.1
.1
.1
Legend
EG PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
466
464
462
460
458
456
454
0
50
100
150
200
250
300
350
Station (ft)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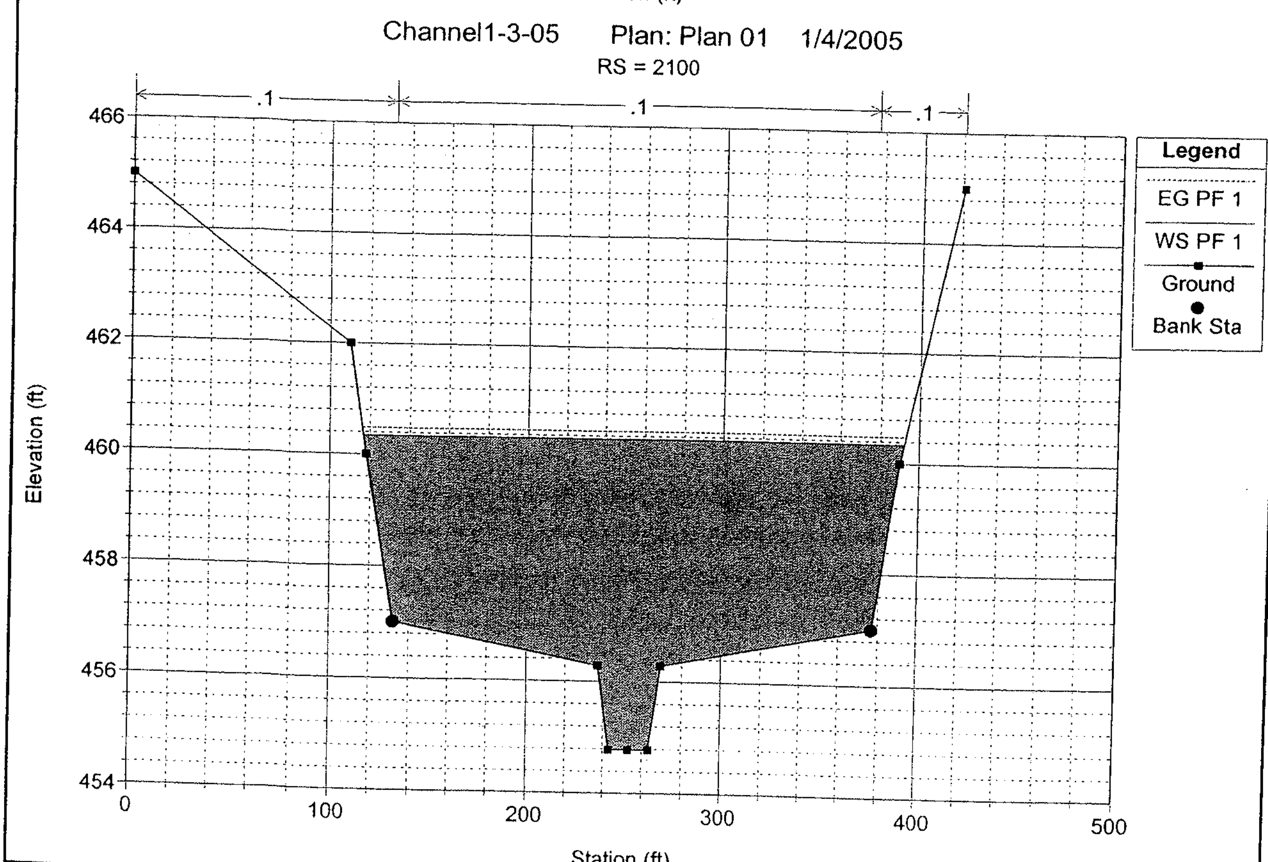
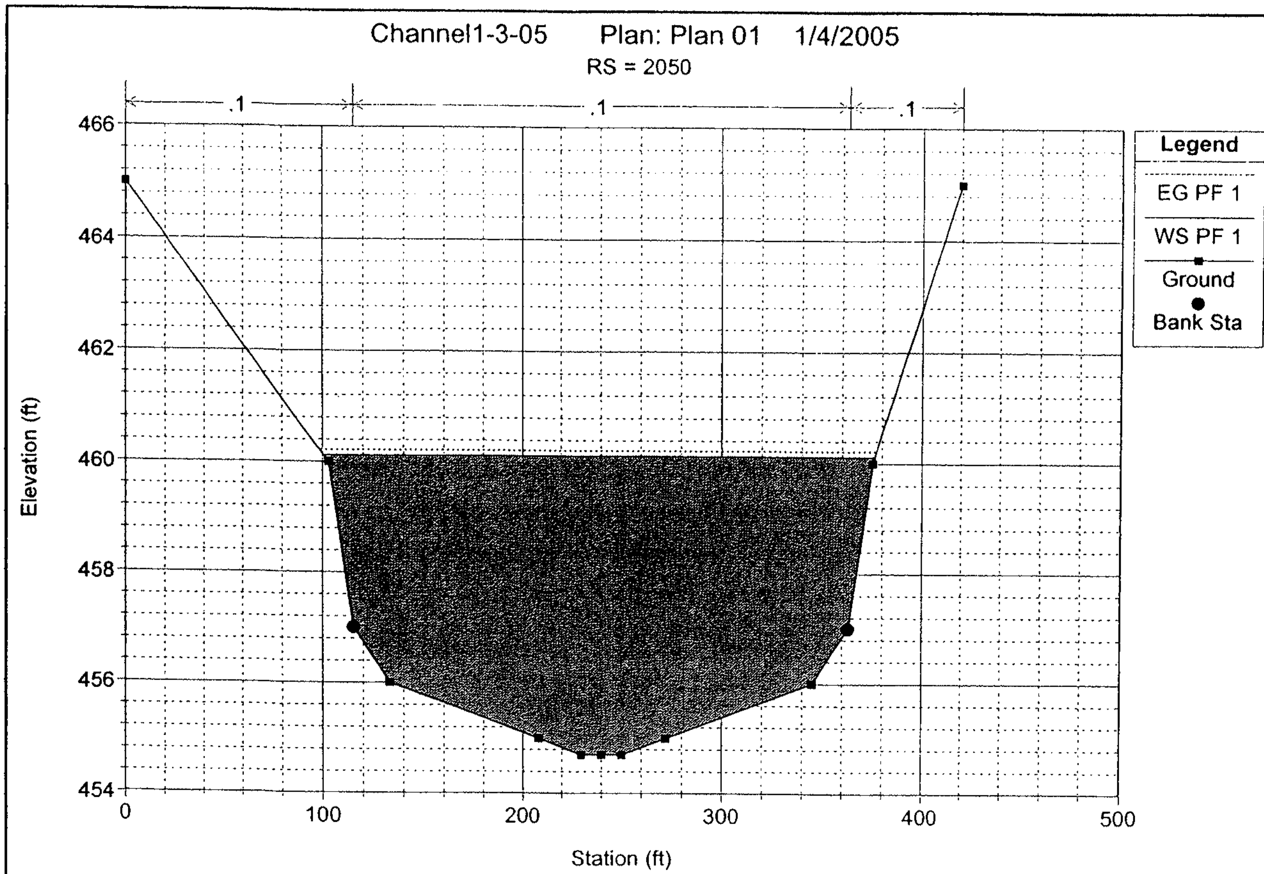
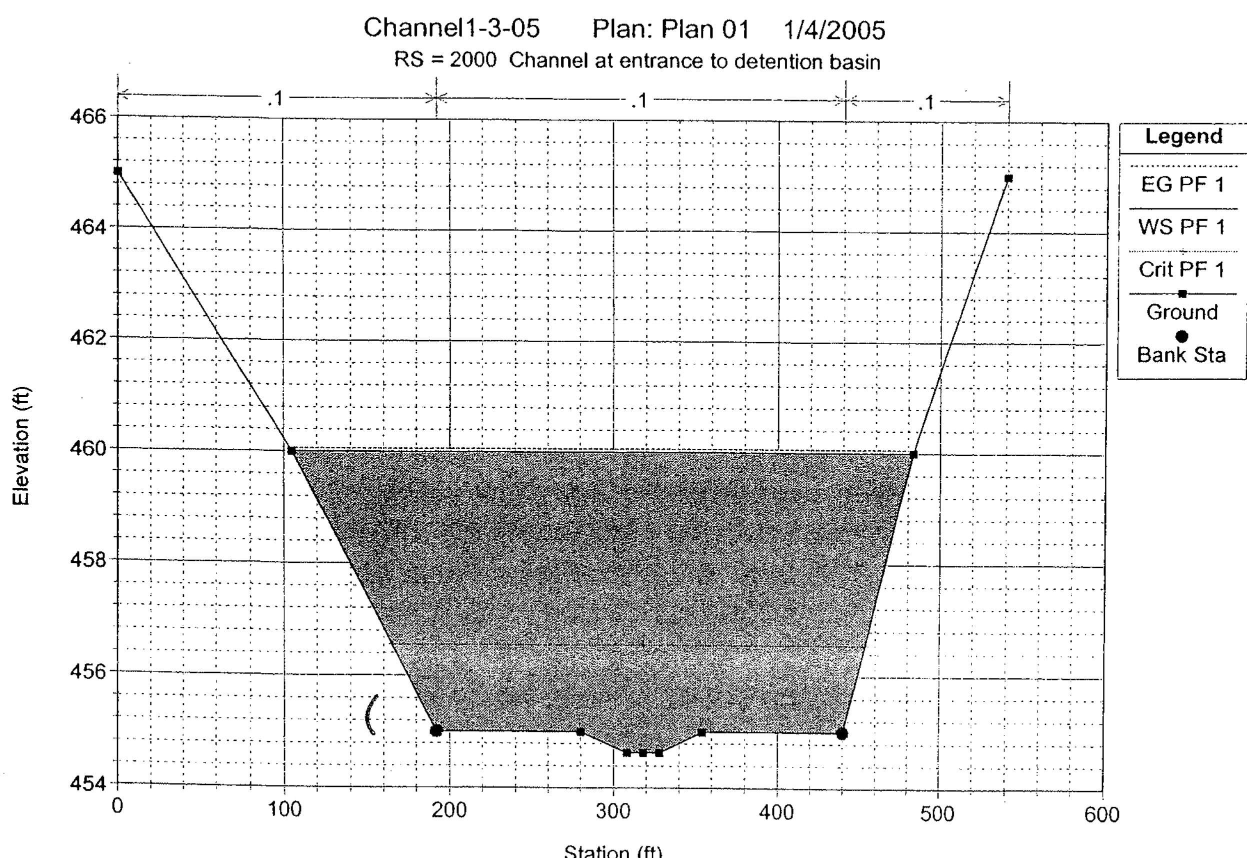
RS = 2300
.1
.1
.1
Legend
EG PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
466
464
462
460
458
456
454
0
50
100
150
200
250
300
350


Channel1-3-05 Plan: Plan 01 1/4/2005
RS = 2100
.1
.1
.1
Legend
EG PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)
466
464
462
460
458
456
454
0
100
200
300
400
500



Channel1-3-05 Plan: Plan 01 1/4/2005
RS = 2050
.1
.1
.1
Legend
EG PF 1
WS PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)



Channel1-3-05 Plan: Plan 01 1/4/2005
RS = 2000 Channel at entrance to detention basin
.1
.1
.1
Legend
EG PF 1
WS PF 1
Crit PF 1
Ground
Bank Sta
Elevation (ft)
Station (ft)

Worksheet
Worksheet for Trapezoidal Channel

Project Description	
Worksheet	Trapezoidal Channel - 1
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Discharge

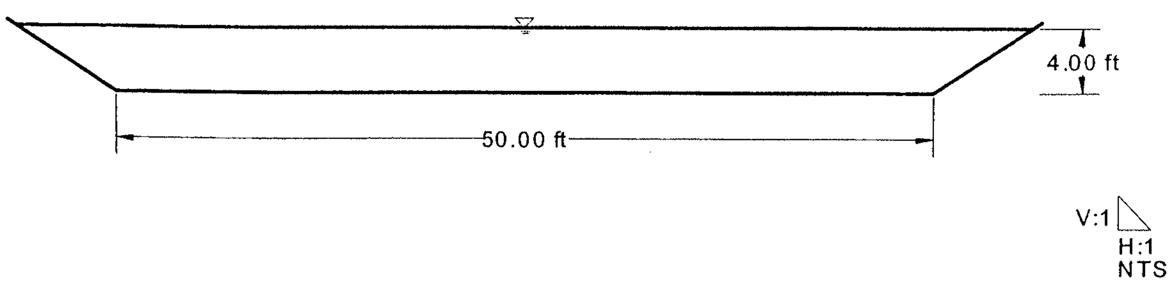
Input Data		
Mannings Coefficient	0.045	
Slope	0.006150	ft/ft
Depth	4.00	ft
Left Side Slope	1.50	H : V
Right Side Slope	1.50	H : V
Bottom Width	50.00	ft

Results		
Discharge	1,331.30	cfs
Flow Area	224.0	ft²
Wetted Perimeter	64.42	ft
Top Width	62.00	ft
Critical Depth	2.73	ft
Critical Slope	0.022466	ft/ft
Velocity	5.94	ft/s
Velocity Head	0.55	ft
Specific Energy	4.55	ft
Froude Number	0.55	
Flow Type	Subcritical	

Cross Section
Cross Section for Trapezoidal Channel

Project Description	
Worksheet	Trapezoidal Channel - 1
Flow Element	Trapezoidal Channel
Method	Manning's Formula
Solve For	Discharge

Section Data		
Mannings Coefficient	0.045	
Slope	0.006150	ft/ft
Depth	4.00	ft
Left Side Slope	1.50	H : V
Right Side Slope	1.50	H : V
Bottom Width	50.00	ft
Discharge	1,331.30	cfs



V. PROPOSED DRAINAGE FACILITIES

For most of the Mesa, drainage facilities are constructed as part of development or road projects, and include only facilities in the immediate vicinity of the projects. For the proposed future private development, no designs are available to show these future facilities. Caltrans has prepared plans for their SR-905 project, and those facilities are shown on the attached map.

The only Master Planned facility which needs to be constructed before development takes place is the Main Channel and Detention basin in the East Watershed. Details of this system are presented in Section VI.

VI. PROPOSED DRAINAGE ALTERNATIVES

The historical drainage on the Mesa, with its flat terrain and shallow swales for drainage paths, did not become a problem until development started taking place in the 1960s. This development started concentrating flows in culverts under roads and redefined some of the historical drainage paths. Some of the development solved problems in some areas, but impacted other areas by moving the problem downstream. One of these areas is the existing creek that parallels La Media Road and eventually crosses the border into Mexico. The frequent flooding along portions of this channel is a constraint to future development for some of the areas along the creek.

1. NO PROJECT

The alternative of doing nothing to improve the drainage along the main creek channel would prevent future development from taking place along portions of La Media Road. The existing creek is not deep enough to allow the adjacent properties to drain effectively. To provide continued access along the truck route during storms, if the channel is not constructed, the roads will need to be raised or alternative routes identified. The existing intersection of Airway Road and La Media Road floods after any significant precipitation. The adjacent roads are too low to allow significant flows to pass under them, so they flood frequently. If the roads are raised to allow more flow to pass under them, they will impact the already-developed adjacent property, parts of which would now be lower than the roads, creating even more difficult drainage issues for the properties.

2. CONCRETE CHANNEL

The 1999 Otay Mesa Drainage Study recommended a concrete channel from Otay Mesa Road to the Border Detention Basin. The recommended plan was a concrete channel along the east side of La Media Road until reaching Siempre Viva Road, where it crossed under La Media and followed on the north side of Siempre Viva to box culverts under Siempre Viva that connected to the Border Detention Basin. All of the concrete channel alternatives assumed that the existing creek with its habitat would continue to carry low flows. The 1999 cost for this alternative was $10.6 million, which would be approximately $14.9 million in 2005 dollars without land acquisition.

3. LA MEDIA CHANNEL AND BORDER DETENTION BASIN

The largest watershed on the Mesa is the East Watershed, which covers an area at 6.78 square miles (4,340 Acres). All of the flow from this watershed collects at a concentration point at a large culvert where it crosses the border with Mexico and flows under the airport access road and airport runway before flowing into the Tijuana River.

This portion at the Mesa is extremely flat, and the adjacent properties can not effectively drain into the existing small creek channel without raising the elevations of the roads and developments near the creek. To allow for future development and to accommodate runoff from proposed future projects, a new channel is required with inverts from 3 to 5 feet below the existing creek channel.

The proposed channel has a bottom width that varies from 240 feet at the new border detention basin to 200 feet from north of Siempre Viva Road to the Airway Road/La Media Road intersection. The side slopes will vary between 4:1 to 10:1. Heavy riparian vegetation will be allowed to grow in the channel and no annual maintenance will be required. Once the vegetation has matured, maintenance of dead or fallen trees may be required every few years. There will be a 12 foot wide access road on each bank. The Channel will contain the 100 year flood flow with mature vegetation growth.

From the Airway Road/La Media Road intersection, a 35 foot wide concrete channel along the east side of La Media Road will connect with the proposed Caltrans culverts which will be constructed with SR 905. The RCB culverts under the intersection will need to accommodate existing utilities in both roads, which may impact the intersection and the utilities.

The Border Detention Basin will be designed to attenuate peak flows from 5 year to 100 year storms. The outlet structure will be less than six feet high, and will not be under the jurisdiction of the State of California DSOD. The design of the outlet structure will be prepared with final plans for the project. The Detention Basin will be approximately 1700' by 1500' and cover an area of approximately 58 acres.

<u>Border Detention Basin</u>

Area:	58 Acres
Max. Water Depth:	6.0 Feet
Max. Storage Volume:	308 AF

The basin will be graded to appear natural. Natural vegetation will be allowed to grow in the basin and no annual maintenance will be required. A low-flow stream will be created through the basin. A Maintenance Assessment District may be created for maintaining the channel and detention basin.

The basin and channel will require the removal of approximately 915,000 CY of soil. It is assumed that this export will be used on adjacent properties to raise the building pad grades thereby limiting the haul distance. A preliminary cost estimate was prepared which reflects both the construction costs and the land acquisition costs. A Property Ownership Map which shows the ownership within the East Watershed is attached.

La Media Channel and Border Detention Basin

Preliminary Opinion of Probable Construction Cost

2/8/2005

Kimley-Horn and Associates

Construction Items

Item No.	Description	Quantity	Units	Unit Price	Cost
1	Excavation	822,500	CY	$2	$1,645,000
2	Airway Road culvert (6~5'wx5'h)	300	CY	$1,500	$450,000
3	La Media/Airway Road intersection culvert (6~10'wx6'h)	1,500	CY	$1,500	$2,250,000
4	Siempre Viva Road culvert (8~10'wx8'h)	1,490	CY	$1,500	$2,235,000
5	Detention Basin Outlet Structure	1	LS	$100,000	$100,000
6	Traffic Control	1	LS	$100,000	$100,000
7	Utility Relocation	1	LS	$150,000	$150,000
8	Street Repair	1	LS	$50,000	$50,000
9	Erosion Control	1	LS	$50,000	$50,000
10	Revegetation	1	LS	$600,000	$600,000
		Subtotal			$7,630,000
		Contingency	20%		$1,526,000
		Total			$9,156,000

Land Acquisition

1	Land Acquisition (outside MHPA)*	2,610,000	SF	$4	$10,440,000
2	Land Acquisition (inside MHPA)**	1,820,000	SF	$1	$1,820,000
		Subtotal			$12,260,000
		Contingency	20%		$2,452,000
		Total			$14,712,000

Total Cost (Construction and Land Acquisition) $23,868,000

Notes:
* Includes area of detention basin and channel south of Siempre Viva
** Includes entire area within MHPA boundary
*** Estimate does not include engineering, environmental, geotechnical, surveying, etc.

K:\095407000\Excel\[cost estimate.xls]Sheet1

VII. RECOMMENDED DRAINAGE DESIGN CRITERIA

Since the five watershed areas on the Mesa flow in every direction except east, they flow into different watersheds with different constraints and impacts. The runoff from the five watersheds will have different criteria for design of drainage facilities.

West Perimeter Watershed
This watershed consists of smaller Mesa-top watersheds with a total area of approximately 254 acres that drain to the west to three separate creeks in canyons and gullies. These creeks are carried under the SD&AE and Trolley tracks and through San Ysidro in buried storm drain systems. The storm drains under the tracks have hydraulic capacities of 30 cfs (18" RCP) and 125 cfs (36" RCP) based on the San Ysidro Boulevard Area Master Drainage plan prepared by BSI Consultants, February 15, 1996. Sub-basins OT3-7 and OT3-8 combine downstream into a single creek that flows to the 36" RCP. The current study estimates 140 cfs (Q100) will flow off of the Mesa into this sub-basin. This study does not address the capacity of the downstream system or include the hydrologic analysis for areas to the west of the Mesa, but clearly the 125 cfs capacity of the existing system will be exceeded. This area will need to be addressed in more detail during design of the upstream tributary development. Detention Basins are recommended which will reduce peak flows in the sub-basin to minimize impacts on the downstream system. These detention basins will reduce the peak, 50-year, and 100-year flow to predevelopment levels. Because of the unstable soils in this area, care should be taken that the proposed detention basins and relocated drainage facilities do not contribute to an increase in the risk of slides through increased saturation of the soil.

West Watershed
The West Watershed consists of smaller Mesa-top watersheds that drain into the tributary canyons of Spring Canyon. All of the flow from the watershed flows into Mexico at the Spring Canyon concentration point. Detention basins will be required to reduce the post-development peak flows to predevelopment levels for the 50-year and 100-year storm. If the detention basins concentrate flows at the upper edge of canyons, care must be taken to ensure that erosion potential is not increased downstream.

East Watershed
The East Watershed flows to Mexico at a single concentration point between Britannia and La Media roads. Requirements for the control of peak runoff from development in this watershed already exist. The "Notice" dated August 7, 1987 (page 2), sets criteria for detention basins and for storm drain sizing. As part of the future storm drain project in this watershed, a single detention basin will be constructed at the border. The construction of this basin will eliminate the need for individual on-site detention basins for subsequent development.

North Perimeter Watershed
These small watersheds along the northern edge of the Mesa flow into small canyons that flow into the Otay River. There are no peak flow attenuation requirements for flows from these watersheds. There may be water quality issues with the Otay River, and there may be erosion issues from storm drains on the Mesa. Only approximately 14 acres of Neighborhood 6 are in this watershed.

VIII. STORM WATER QUALITY REQUIREMENTS

Because of problems related to the poor water quality of storm water runoff from urban conveyance systems, the City requires that storm water Best Management Practices (BMPs) be constructed for all new projects. The storm water discharge contains pollution such as chemicals, trash, sediment, bacteria, metals, oil and grease. Construction projects which add impervious areas and change drainage patterns increase the discharge of these pollutants.

The Municipal Storm Water National Pollutant Discharge Elimination System Permit (NPDES Municipal Permit), approved February 21, 2001 by the San Diego Regional Water Quality Control Board (RWQCB), requires the City to implement regulations for constructing storm water BMPs for development projects.

In 2003, as part of the San Diego Municipal Code, the City published "Storm Water Standards – A Manual for Construction & Permanent Storm Water Best Management Practices Requirements." This manual is the reference document for all of the storm water issues encountered in development, including BMPs. Included in this report are Appendix C – Example Permanent Storm Water Best Management Practices, and the Storm Water Requirements Applicability Checklist from the City's Manual. Before preparing a drainage study, the "Storm Water Requirements Applicability Checklist" is completed. This checklist is used to determine the priority level of the project. Most of the projects on the Mesa will require Priority Project Permanent Storm Water BMPs and High Priority Construction Storm Water BMPs.

All projects subject to the priority permanent BMP requirements must include a "Water Quality Technical Report." From the manual, the report will include:

1. A drainage study report prepared by a civil engineer, hydrologist, or hydrogeologist registered in the State of California, with experience in the science of stream and river generated surface features (i.e., fluvial geomorphology) and water resources management, satisfactory to the City Engineer. The report shall consider the project area's location (from the larger watershed perspective), topography, soil and vegetation conditions, percent impervious area, natural and infrastructure drainage features, and any other relevant hydrologic and environmental factors to be protected specific to the project area's watershed.
2. A field reconnaissance to observe and report on downstream conditions, including undercutting erosion, slope stability, vegetative stress (due to flooding, erosion, water quality degradation, or loss of water supplies) and the area's susceptibility to erosion or habitat alteration as a result of any future upstream development.
3. A hydrologic analysis to include rainfall runoff characteristics from the project area including at a minimum, peak runoff, time of concentration, and detention volume (if appropriate). These characteristics shall be developed for the two-year and ten-year frequency, six-hour or 24-hour, type B storm for the coastal areas of San Diego County. The largest peak flow should be included in the report. The report shall also report the project's conditions of concern based on the hydrologic and downstream conditions discussed above. Where downstream conditions of concern have been identified, the drainage study shall establish that pre-project hydrologic conditions that minimize impacts on those downstream conditions of concern would be either improved or maintained by the proposed project, satisfactory to the City Engineer, by incorporating the permanent BMP requirements.

Appendix D of the Manual includes detailed guidelines for the Water Quality Technical Report.

There are numerous alternative permanent BMPs that can be used for each project. The alternatives include Site Design BMPs, Source Control BMPs, and Treatment Control BMPs. The Site Design BMPs are primary ways to reduce storm water runoff through means such as increased pervious areas, increased infiltration, use of natural channels, and appropriate landscaping. All of these except dry wells are applicable to the Mesa. Source Control BMPs are meant to control pollutants at their source before they enter storm water, and are all applicable to the Mesa. Treatment Control BMPs treat the storm water before it leaves the property, and include natural methods such as biofilters, detention basins, wetlands, and porous pavement, and mechanical methods such as filters and separators. The one Treatment Control BMP that is not applicable to the Mesa is infiltration, which is not very effective on the Mesa because of the clay soils.

Most of Otay Mesa drains to the south across the border with Mexico and eventually into the Tijuana River. A small portion flows north into the Otay River, and the far western part of the Mesa flows to the west through San Ysidro and then into the Tijuana River. The Tijuana River has been identified by the 2002 Clean Water Act as a "Section 303(d) Water Quality Limited" river. The pollutants of concern which are included in the attached pages from the USEPA, need to be listed, and the new development project's potential impacts on these pollutants need to be included in the project's drainage report.

Recommended Storm Water Policies

1. **Apply water quality protection measures to land development projects during project design, permitting, construction, and operations in order to minimize the quantity of runoff generated on-site, the disruption of natural water flows and the contamination of storm water runoff.**

    a. Increase on-site infiltration, and preserve, restore or incorporate natural drainage systems into site design
    b. Reduce the amount of impervious surfaces through selection of materials, site planning, and narrowing street widths where possible.
    c. Increase the use of natural vegetation and landscaping in drainage design.
    d. Avoid conversion of areas particularly susceptible to erosion and sediment loss (e.g.: steep slopes), and where unavoidable, enforce regulations that minimize these impacts.
    e. Avoid land use, site development, and zoning regulations that limit impacts on, and protect the natural integrity of topography, drainage systems, and water bodies.
    f. Maintain landscape design standards that minimize the use of pesticides and herbicides.
    g. Enforce maintenance requirements in development permit conditions.

2. **Require construction contractors to comply with accepted storm water pollution prevention planning practices for all projects.**

    a. Minimize the amount of graded land surface exposed to erosion and enforce control ordinances
    b. Continue routine inspection practices to check for proper erosion control methods and housekeeping practices during construction.
    c. Ensure that contractors are aware of and implement urban runoff control programs.

3. **Encourage measures to promote the proper collection and disposal of pollutants at the source, rather than allowing them to enter the storm drain system.**

    a. Promote the provision of used oil recycling and/or hazardous waste recycling facilities and drop-off locations.
    b. Follow up on complaints of illegal discharges and accidental spills to storm drains, waterways, and canyons.

K:\095407000\Drainage\Otay Mesa Drainage Study June 2006.doc

REFERENCES

This Water Quality Technical Report incorporates, by reference, the appropriate elements of the following documents and plans required by local; State or Federal agencies.

1. Municipal Storm Water National Pollutant Discharge Elimination System (NPDES) Permit

2. City of San Diego Storm Water Standards

3. Drainage Study for the Otay Mesa Community Plan

4. California Stormwater BMP Handbook, "Extended Detention Basin – TC-22" New Development and Redevelopment, January 2003

5. California Stormwater BMP Handbook, "Vegetated Swale – TC-30" New Development and Redevelopment, January 2003