Prepared for

East Bay Regional Park District
2950 Peralta Oaks Ct.
P.O. Box 5381
Oakland, CA 94605-0381

CHABOT GUN CLUB

INDUSTRIAL STORMWATER GENERAL PERMIT ADVANCED STRUCTURAL BEST MANAGEMENT PRACTICES CONCEPTUAL DESIGN REPORT AND IMPLEMENTATION COSTS

Prepared by

Geosyntec consultants

engineers | scientists | innovators

1111 Broadway, 6th Floor
Oakland, California 94607

Project Number: WW2006

14 October 2015

CHABOT GUN CLUB

INDUSTRIAL STORMWATER GENERAL PERMIT ADVANCED STRUCTURAL BEST MANAGEMENT PRACTICES CONCEPTUAL DESIGN REPORT AND IMPLEMENTATION COSTS

2950 Peralta Oaks Ct.
P.O. Box 5381
Oakland, CA 94605-0381

Prepared by

Geosyntec Consultants, Inc.
1111 Broadway, 6th Floor
Oakland, California 94607

Lisa Austin, P.E.
Associate

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF APPENDICES

1. INTRODUCTION

1.1 Report Objective

This conceptual design report evaluates various advanced treatment structural BMP alternatives for the Chabot Gun Club (CGC) including source control, runoff treatment control, and flow segregation best management practices (BMPs) that could be considered for advanced treatment options in the event that current BMPs do not meet the objectives of reducing or eliminating pollutants in stormwater discharges. The CGC is located within Anthony Chabot Regional Park, which is operated by the East Bay Regional Park District (EBRPD or District). Structural source control and treatment control BMPs were evaluated for the shooting ranges, consistent with United States Environmental Protection Agency (EPA) Region 2 guidance for outdoor shooting ranges and the California General Permit for Stormwater Discharges Associated with Industrial Activities (IGP).

Structural source control and treatment control BMP alternatives for the shooting ranges were evaluated against various criteria, such as pollutant removal effectiveness, feasibility of implementation, and capital and operations and maintenance (O&M) costs. Planning level cost estimates are included for the evaluated alternatives and conceptual design details are provided for the recommended shooting range structural BMPs. In addition, a conceptual design for a roadside ditch is provided as a flow segregation and conveyance BMP for road runoff.

Finally, to help understand the potential long term IGP compliance costs, this report makes some timing assumptions to provide estimates of the five- and 10-year BMP implementation costs for the CGC, as well as overall IGP compliance costs. The cost estimate is based on guidance developed by the State Water Resources Control Board (State Water Board) to calculate potential IGP compliance costs.

1.2 Regulatory Framework

The San Francisco Bay Regional Water Quality Control Board has placed the CGC under the IGP (Order No. 2014-0057-DWQ; NPDES No. CAS000001), issued by the State Water Board. The new IGP took effect on August 1, 2015 and replaces the IGP issued in 1997.

The CGC is best categorized under Standard Industrial Classification (SIC) code 7999 Amusement and Recreation Services, Not Elsewhere Classified. The District filed a Notice of Intent (NOI) and other required permit registration documents, including the

Storm Water Pollution Prevention Plan (SWPPP) under the current IGP on June 30, 2015, via the Stormwater Multi Application and Report Tracking System (SMARTS).

The IGP requires dischargers to implement the following activities:

- Eliminate unauthorized non-storm water discharges;
- Develop and implement a SWPPP that includes BMPs;
- Implement minimum BMPs, and advanced BMPs as necessary, to achieve compliance with the effluent and receiving water limitations of the IGP. Minimum BMPs include good housekeeping, preventative maintenance, spill and leak prevention and response, material handling and waste management, and erosion and sediment control. Advanced BMPs include exposure minimization, stormwater containment and discharge reduction, and treatment control BMPs;
- Conduct monitoring, including visual observations and analytical stormwater monitoring for indicator parameters;
- Compare monitoring results for monitored parameters to applicable numeric action levels (NALs);
- Perform the appropriate Exceedance Response Actions (ERAs) when there are exceedances of the NALs; and,
- Certify and submit all permit-related compliance documents via SMARTS.

At the beginning of a discharger's NOI Coverage, all dischargers have Baseline status for all parameters. A Discharger's Baseline status for any given parameter will change to Level 1 status if sampling results indicate an NAL exceedance for that same parameter. Level 1 status will commence on July 1 (or August 14) following the reporting year during which the exceedance(s) occurred. Level 1 requires assistance of a Qualified Industrial Stormwater Practitioner (QISP) to prepare a BMP evaluation report and update the SWPPP with revised BMPs. Thereafter, if stormwater monitoring results continue to exceed NALs, the facility will move to Level 2 status in the year following Level 1 status. Level 2 status requires the development of an Exceedance Response Action Plan by a QISP. Level 2 is where advanced treatment BMPs would be required to achieve IGP compliance.

Advanced flow- and volume-based treatment BMPs must be sized in accordance with the water quality hydraulic design criteria in the IGP. Generally, flow-based BMPs remove pollutants from a moving stream of stormwater through filtration, infiltration, or biological processes, and treatment measures are sized based on peak flow rates.

Volume-based BMPs detain stormwater for periods of time and treat pollutants primarily through settling and/or infiltration processes. The hydraulic design criteria in the IGP are as follows:

A. Flow-based BMPs: The Discharger shall calculate the flow needed to be treated using one of the following methods:

   i. The maximum flow rate of runoff produced from a rainfall intensity of at least 0.2 inches per hour for each hour of a storm event;

   ii. The maximum flow rate of runoff produced by the 85th percentile hourly rainfall intensity, as determined from local historical rainfall records, multiplied by a factor of two; or,

   iii. The maximum flow rate of runoff, as determined using local historical rainfall records, that achieves approximately the same reduction in total pollutant loads as would be achieved by treatment of the 85th percentile hourly rainfall intensity multiplied by a factor of two.

B. Volume-based BMPs: The Discharger, at a minimum, shall calculate the volume to be treated using one of the following methods:

   i. The volume of runoff produced from an 85th percentile 24-hour storm event, as determined from local, historical rainfall records (the 85th percentile storm depth for the CGC is 0.85 inches);

   ii. The volume of runoff produced by the 85th percentile 24-hour storm event, determined as the maximized capture runoff volume for the facility, from the formula recommended in the Water Environment Federation's Manual of Practice; or,

   iii. The volume of annual runoff required to achieve 80% or more treatment, determined in accordance with the methodology set forth in the latest edition of California Stormwater Best Management Practices Handbook, using local, historical rainfall records.

1.3 Report Organization

The remainder of this report is summarized as follows. Section 2 provides a description of: the CGC, including industrial activities, runoff patterns, soil, groundwater, and existing stormwater runoff quality; and the existing structural and erosion control BMPs provided for in the current SWPPP. Section 3 presents an evaluation of candidate structural BMPs that were considered. Section 4 discusses the source control and treatment BMPs selected for consideration based on the analysis of alternatives. Section 5 presents the conceptual design for the roadside ditch, which would function as a flow segregation BMP. Section 6 provides assumptions and estimates for the overall five- and ten-year potential IGP compliance costs for the CGC based on these BMPs.

2. SITE DESCRIPTION AND INDUSTRIAL ACTIVITIES

Information presented in this section is summarized from the SWPPP (EBRPD, 2015) and updated information provided by the CGC at the August 26, 2015 meeting and September 10, 2015 site walk and meeting.

The CGC is located at 9999 Redwood Road in Anthony Chabot Regional Park in Castro Valley, California (Figure 2-1). The site area per the Lease Agreement is 85.88 acres. The CGC stated that there are 65 acres within the perimeter of the fence line but that the operational area is not exactly delineated by the fence line. The CGC defines its operational area as extending from the roadside ditch (base of slope) to the fence line above (north of) the gun range backstops. The CGC slopes from east to west and the site elevation ranges from approximately 720 to 880 feet above mean sea level (msl).

The CGC is comprised of eight shooting ranges, one trap range, enclosed storage sheds (for storage of ammunition, equipment and targets), office buildings, a parking area, a meeting building, a lower storage and recycling area, and an upper storage area. The main buildings on-site are the range buildings (where people fire), the office buildings and the meeting building.

The majority of the site is unpaved (pervious). Unpaved areas where industrial activities occur include: 1) shooting Ranges 1 through 6, Range 8, and the Trap Range; and 2) dirt and gravel areas where storage and recycling activities occur. Details on shooting range activities are as follows.

Range 1. Range 1 is a rifle and pistol range. The range has targets close to the backstop which reduces the extent of bullet skip compared to the other ranges. This range has an artificial berm at the top of the backstop that prevents run-on from the north from entering the range.

Range 2. Range 2 is a rifle and pistol range. Range 2 has an unknown area of skip. This range has an artificial berm at the top of the backstop as well as a detention basin behind the range, which prevents run-on from the north from entering the range.

Range 3. Range 3 is a hand gun range. Range 3 has a wide shot fall area due to the bullet trajectory that produces skip that goes above the backstop. Runoff from the steep slope on the north end of Range 3 runs onto the range, however the drainage area behind the slope flows behind Range 3 to an area where run-on is prevented from entering the range due to an artificial berm.

Range 4. Range 4 is a rifle, pistol and handgun range. There is no artificial berm that prevents run-on from the drainage area behind the backstop. It has similar run-on characteristics as Range 5.

Range 5. Range 5 is rifle, pistol and handgun range. Range 5 is designed to shoot into the lower portion of the backstop, but there is some skip above the backstop as demonstrated by the shot-impacted trees above the range.

Range 6. Range 6 is a handgun range. This range used to function as a trap range and therefore the extent of the shot fall zone is 600 feet, consistent with the Trap Range.

Range 8. Range 8 is a rifle and pistol range. Most of the shot falls between the target pits and the number signs on the backstop. An artificial berm behind Range 8 prevents run-on from entering the range from the north.

Trap Range. Trap Range activities include shooting clay targets with shotguns. The shot fall zone is 600 feet starting at the center of the Trap House and extending to the area north of the backstop.

Pollutants of concern as identified in the SWPPP are lead, sediment (total suspended solids [TSS]), plastic, oil and grease and trash.

Runoff from the ranges that does not infiltrate within the ranges is conveyed to drain inlets in the ranges that connect to an underground storm drain that flows from east to west. Runoff discharges at two primary locations, Discharge Point 1 (DP1) and Discharge Point 2 (DP2) within Range 8 (see Figure 2-1). Runoff from Range 8 and the drainage area south of Range 8 that does not discharge through DP2 discharges as sheet flow. Runoff from the road along the CGC southern perimeter which connects to Public Gun Range Road is conveyed in a roadside ditch which has limited flow capacity (otherwise, road runoff sheet flows down the road). Runoff from all areas of the CGC ultimately discharges to an unnamed tributary to Grass Valley Creek. Grass Valley Creek discharges into Lake Chabot.

2.1.1 Soil and Groundwater

The CGC is underlain by Los Osos and Millsholm soils with moderate slopes (30 to 45 percent) (NRCS, 2015). These soils consist of low permeability silty loams and clay loams that extend down to between 22 to 30 feet. The corresponding hydrologic soil group is C/D.[1] This soil group indicates that BMPs that rely on infiltration of the water quality design storm would not be effective.

Range backstop soil pH measurements performed by Tim Bauters of Golder Associates on September 10, 2015 showed a pH range of 3.5 for the Trap Range to 7.6 in Range 2. Ranges with acidic backstop pH values[2] (i.e., less than 6.0) include Ranges 3, 4, 5, 6, 8, and the Trap Range. Acidic pH values could facilitate the dissolution of particulate lead and increase the concentration of dissolved lead in stormwater runoff originating from the backstops.

The CGC is located in the Castro Valley Groundwater Basin. The depth to groundwater is unknown. The CGC is underlain by bedrock. The presence of perched groundwater has not been observed. It is therefore assumed that shallow groundwater (i.e., less than 10 feet below ground surface) is not present at the site.

2.1.2 Existing Structural and Soil Stabilization BMPs

The CGC SWPPP includes minimum BMPs and more advanced BMPs (per the IGP definition of an advanced BMP). Details are included in the SWPPP. Minimum BMPs include good housekeeping, preventative maintenance, spill and leak prevention and response, material handling and waste management, and erosion and sediment control. Advanced BMPs include exposure minimization, stormwater containment and discharge reduction, and treatment control BMPs.

The primary existing structural BMP consists of storm drain inlet protection for the drain inlets in the shooting ranges (e.g., fiber rolls, zeolite filter socks). The primary erosion control BMP is application of EarthGuard® on the artificial berms, backstops, and other unvegetated areas of the ranges prior to storm events. The storm drain inlet BMPs were installed in fall 2014. Due to the lack of rainfall during the 2014-2015 wet season, there are limited data representative of post-BMP installation runoff quality. However, visual observations by CGC staff during the 2014-2015 wet season (per Tony Martinez of the CGC) has indicated EarthGuard® has been effective in reducing the turbidity of runoff from the ranges where the product has been applied.

---

[1] Group C soils have moderately fine to fine textures with slow infiltration rates. Group D soils are clay soils with very slow infiltration rates.
[2] The IGP instantaneous NAL for pH is 6-9 (pH values above or below the range do not meet the NAL).

2.2 Existing Stormwater Runoff Quality

The CGC has been subject to stormwater permitting requirements since 2009 and is currently in compliance. Historic stormwater runoff sampling locations that were sampled from February 2009 through December 2014 are identified in Table 2-1 and are shown on Figure 2-2. Location “DCP” is the previous IGP discharge sampling location and therefore has the greatest number of grab samples collected (12). The number of samples collected at the other locations range from one to four. The other sampling locations are informal grab samples that are not required by the IGP. These data were collected for informational purposes and do not represent water quality that discharges from the site. Table 2-2 summarizes the grab sample results for total and dissolved lead and total suspended solids (TSS). Table 2-2 lists the total number of grab samples collected and the average concentration for each location.

The new IGP includes annual and instantaneous Numeric Action Levels (NALs) for various parameters. The annual NAL for total lead is 0.262 mg/L. There is no instantaneous maximum NAL for total lead nor are there any NALs for dissolved lead. The annual NAL for TSS is 100 mg/L and the instantaneous maximum NAL is 400 mg/L. The NALs are a new benchmark in the current IGP and were not in effect when these data were collected.

While the historical data were collected prior to the new BMPs required in the most recent SWPPP, comparing the DCP and other sample locations to the current IGP NALs helps identify drainage areas that are potential sources of pollutants at the CGC that could trigger Level 1 and Level 2 status in the future, based on future monitoring. It should also be noted that some of the historical sampling locations are not representative of stormwater runoff flows and the results could therefore be biased due to the sample location and/or sampling methodology (e.g., DR07 and DR08 samples were collected from ponded water that collected in a depression in the road).

Table 2-2 shows that the average total lead concentration at the former discharge compliance point DCP was above the annual NAL, however the TSS concentration did not exceed the annual or instantaneous NAL. Other sample locations that exceeded the annual total lead NAL (based on the average concentration) are DR04, R4B (DR04 and R4B had the highest total lead concentration of all sample locations), DR05, DR07, DR08, R3A, R3B, CR8A, and DR20. CR8A and CR8B correspond to the new IGP discharge sampling locations DP1 and DP2.

Locations that exceeded the annual or instantaneous TSS NAL were DR04, DR05, CR8A, DR15, and DR20. DR20 had the highest TSS concentration of any location, based on four grab samples collected during the 2014-2015 wet season (October-December 2014). CR8A and CR8B correspond to the new IGP discharge sampling locations DP1 and DP2.

The fraction of lead in the dissolved form at the former IGP discharge compliance point DCP is about 22 percent. The amount of lead in the dissolved form ranges from 2.2 percent (at DR15) to about 88 percent (at DR07). The sample location DR08, which is just downstream of DR07, shows that about 49 percent of the lead is in dissolved form. These data are based on a limited number of samples (one grab sample for DR07 and two grab samples for DR08) and could also be affected by the fact that the samples were collected from ponded water. Historic locations CR8A and CR8B correspond to the new IGP discharge sampling locations DP1 and DP2 and the historic data show that about 16 to 24 percent of the lead is in the dissolved form. This indicates that lead at the compliance points is mostly in the particulate form and particulate lead should be the primary focus of runoff treatment BMPs designed to meet the NALs.

Particulate lead, which is associated with TSS, is substantially easier to treat in stormwater BMPs than dissolved lead because of the unit operations and processes fundamental to the removal of each form. Generally, removal of dissolved lead requires processes beyond settling, such as ion exchange, sorption, or biological treatment, and also requires longer residence times within the BMP for effective removal compared to particulate lead removal.

Treatment of TSS is a primarily a function of the particle size distribution, density, and concentration of suspended solids in water. Unit operations and processes that treat TSS include filtration and sedimentation. Generally very fine suspended particles (i.e., less than 25 microns in diameter) require coagulation/flocculation and/or filtration for treatment.

Table 2-1 Historic CGC Stormwater Runoff Sampling Locations

Location ID	Description of Sampling Locations
DCP	(Former) Downstream Compliance Point for IGP
BCP	Background Compliance Point
DR1	North Culvert above Trap Range
TR1	Trap Range drain inlet (DI)
DR04	Upstream of culvert southeast of Trap Range
DR05	Downstream of culvert southeast of Trap Range
DR07	Puddle in road to the south of the Trap building
DR08	Puddle in road to the downstream of the Trap building
R4A	Range 4 upstream DI
R4B	Range 4 downstream DI

Location ID	Description of Sampling Locations
R3A	Range 3 upstream DI
R3B	Range 3 downstream DI
DR10	Runoff that flows along the south drain along the road and parking lot.
R8	Range 8 DI
CR8A	Upstream range outfall, located south of Range 8
CR8B	Range 8 outfall
DR13	Runoff above Range 8 parking
DR15	Range 8 parking lot runoff
DR20	Brandon Trail culvert at Service Road

Note: See Figure 2-2 for the stormwater sampling locations

Table 2-2: Historic CGC Sampling Data Summary

Sample Location	Total Lead		Dissolved Lead			Total Suspended Solids (TSS)	
	Annual NAL = 0.262 mg/L		Annual NAL = N/A			Annual NAL = 100 mg/L Instantaneous NAL 400 mg/L	
	No. Grab Samples	Avg. Conc. (mg/L)	No. Grab Samples	Avg. Conc. (mg/L)	Avg. % Dissolved Fraction	No. Grab Samples	Avg. Conc. (mg/L)
DCP	12	1.59	12	0.127	21.6	12	37.7
BCP	2	0.0105	2	0.0056	55.1	2	14.0
DR1	1	0.250	1	0.071	28.4	--	--
TR1	1	0.064	1	0.011	17.2	--	--
DR04	1	22.0	1	0.580	2.6	1	1,100
DR05	2	2.85	2	0.695	42.9	2	106.5
DR07	1	0.580	1	0.510	87.9	1	72.0
DR08	2	0.420	2	0.190	49.4	2	62.5
R4A	1	0.029	1	0.0078	26.9	--	--
R4B	1	23.0	1	0.890	3.9	--	--
R3A	1	0.520	1	0.087	16.7	--	--
R3B	2	0.715	2	0.097	13.8	1	44.0
DR10	3	0.129	3	0.070	57.3	3	31.7
R8	2	0.175	2	0.077	47.3	2	12.7
CR8A	3	5.47	3	0.620	15.7	2	130
CR8B	1	0.170	1	0.040	23.5	1	6.0
DR13	1	0.082	1	0.0054	6.6	1	110
DR15	3	0.024	3	0.00026	2.2	3	251
DR20	4	0.267	4	0.0028	2.7	4	2,468

Notes: (1) Data were collected February 2009-December 2014. (2) NALs should only be applied to the discharge sampling location, which is DCP. Data were collected from the other sample locations for informational purposes only and do not represent the quality of runoff leaving the site. The NALs were not in effect when these data were collected.

3. EVALUATION OF ADDITIONAL ADVANCED STRUCTURAL BMPS FOR THE RANGES

3.1 Objective for Structural BMPs

In the event that existing structural and erosion control BMPs are not sufficient to keep CGC stormwater runoff concentrations from exceeding IGP NALs, the CGC would move from Baseline status to Level 1 status in July-August 2016. While in Level 1, if stormwater runoff concentrations continue to exceed NALs, the CGC would move to Level 2 status in July-August 2017. More advanced structural BMPs would be required if the CGC enters Level 2 status. This section presents structural BMPs that could be implemented to meet IGP NALs.

3.2 Site Constraints

The evaluation of structural BMPs considered the following site constraints:

- Infiltration constraints. The Natural Resources Conservation Service (NRCS) hydrologic soil group for the CGC is C/D,[1] which indicates that complete infiltration of the water quality design storm would not be feasible. Therefore, structural treatment BMPs should be designed to capture, treat, and discharge treated runoff to the stormwater drainage system.

- Site operational activities. Shooting activities significantly limit the ability to establish vegetation on the artificial berms and backstops and to some extent within the flat range areas (due to bullet skip). Shooting also affects the life expectancy of BMPs such as fiber rolls, where such BMPs could be intercepted by bullets. Visitors walking through extensive portions of the ranges to retrieve targets also limits the available area where above-ground BMPs could be sited, such as in the vicinity of current drain inlet locations.

Based on the site constraints, complete onsite detention of stormwater runoff so as to qualify for a “no discharge” finding was found to be infeasible as a structural BMP alternative. The IGP allows for a discharger to claim “no discharge” through the notice of non-applicability (NONA) process. To satisfy the NONA process, the facility must be engineered and constructed to contain the maximum historic precipitation event using the precipitation data collected from the National Oceanic and Atmospheric Agency’s website, or other nearby precipitation data available from other government agencies, so that there will be no discharge of industrial stormwater to Waters of the United States. For the CGC, a BMP would need to be designed to completely retain the maximum storm depth of 6.9 inches. Without the ability to infiltrate runoff, there is no feasible location to site a large enough retention basin, thus precluding the feasibility of this alternative.

3.3 Assessment of Candidate BMPs

Advanced structural BMPs evaluated included structural source control BMPs and flow- and volume-based treatment BMPs. Structural source control BMPs were considered for the gun range backstops, consistent with EPA Region 2 guidance for outdoor shooting ranges (USEPA, 2005). The purpose of source control BMPs is to minimize the runoff discharge of particulate and dissolved lead from the backstops. Various treatment BMPs were considered for treating runoff from the ranges. The following BMPs were evaluated (Table 3-1):

3.3.1 Structural Source Controls

The following structural source control BMP alternatives were evaluated:

- Lead Source Removal from Backstops and Soil Stabilization. Per EPA Region 2 guidance (2005) for operating shooting ranges, the upper 6 to 12 inches of soil would be removed from the backstops, screened, amended to control pH levels (to prevent acidic pH conditions, which would dissolve lead and stabilize metals), and put back in place.

- Add Gravel Layer at Base of Backstops to Impede Upward Migration of Water. Per EPA Region 2 guidance, capillary effects in the backstops cause upward migration of water, which can facilitate the dissolution of lead. A layer of aggregate would be installed underneath the backstops to break the capillary effects.

3.3.2 Structural Runoff Treatment Controls

The following structural treatment control BMP alternatives were evaluated:

- The Contech StormFilter Unit contains engineered media-filled cartridges that filter particulates and remove metals. The filter media in the cartridges can be customized to target site-specific pollutants. This BMP has been certified by the

Washington State Technology Assessment Protocol-Ecology (TAPE) Program[3] (there is currently no equivalent certification program in California).

- The Bio Clean Water Polisher utilizes an up flow media filter with built-in pre-treatment. The patented design provides double chambered separation to remove large to fine sediments from stormwater runoff.
- Bioretention functions as an engineered media and plant-based filtration device that also removes pollutants through various physical, biological and chemical treatment processes.
- An underground sand filter is primarily for extremely space-limited areas and consists of a three-chamber system. The initial chamber is a sedimentation (pretreatment) chamber that temporarily stores runoff and utilizes a wet pool to capture sediment. The sedimentation chamber is connected to the sand filter chamber by a submerged wall that protects the filter bed from oil and trash. Perforated drain pipes under the sand filter bed extend into the third chamber that collects filtered runoff. Flows exceeding the filter capacity are diverted through an overflow weir, which carries flow the storm water conveyance system.

3.3.3 Hydrology Assessment for Runoff Treatment BMPs

Five foot elevation contours were used to delineate approximate drainage areas for each of the ranges and for the roadside ditch in order to assess the required design for the structural treatment BMPs. Figure 4-1 shows the drainage area delineations and Table 3-1 below summarizes the acreage for each drainage area. The drainage area delineated for the roadside ditch is also included on Figure 4-1 and in Table 3-1; the hydrology assessment methodology used for the roadside ditch conceptual design is discussed in Section 5.

Table 3-1: Drainage Area Delineations for BMP Sizing

Drainage Area	Description	Area (acres)
A	Area draining to Range 8	0.36
B	Area draining to Range 1 and Range 2	3.19
C	Area draining to Range 3	1.38

[3] The TAPE program provides a peer-reviewed regulatory certification process for emerging stormwater treatment technologies. The TAPE program is administered by the Washington Department of Ecology (Ecology), with assistance from staff at the Washington Stormwater Center (www.wastormwatercenter.org/), which provides stormwater management assistance including guidance on certification of emerging treatment technologies.

Drainage Area	Description	Area (acres)
D	Area draining to Range 4	2.15
E	Area draining to Range 5	2.87
F	Area draining to Range 6	3.46
G	Area draining to Trap Range	7.63
H	Area draining to Roadside Ditch	24.8

Note: See Figure 4-1 for drainage area delineations

Flow-Based BMP Sizing

Candidate flow-based BMPs include the Contech StormFilter Unit and Bio Clean Water Polisher Unit. The rational method with a modified runoff coefficient, as described in the Western Alameda Hydrology and Hydraulics Criteria Summary (1989), was used to size flow-based BMPs.

The Modified Rational Formula is:

$$Q = i(C' \cdot A)$$

where:

Q is the design runoff flow rate in cubic feet per second;

i is the rainfall intensity in inches per hour. Per IGP requirements, two times the 85th percentile hourly rainfall intensity the 85th, as determined from local, historical rainfall records, was used for *i*. The rainfall intensity calculation is provided in Appendix A.1;

C′ is a runoff coefficient modified by slope and rainfall intensity; and

A is the drainage area in acres.

The modified runoff coefficient is calculated as follows:

$$C' = C + Cs + Ci$$

where:

C′ is the design runoff coefficient;

C is the basic runoff coefficient (based on percent imperviousness);

Cs is the slope adjustment factor; and

Ci is the rainfall intensity adjustment factor.

Design flow rates calculated for the downstream inlet in each drainage area are summarized in Table 3-2 below. Detailed flow calculations including runoff coefficients are provided in Appendix A.2.

Table 3-2: Flow Rate Calculations for Range Drainage Areas

DI ID	Design Flow, Q (cfs)
R8	0.02
R1	0.10
R2B	0.10
R3	0.12
R4B	0.19
R5	0.26
R6	0.32
TR1	0.81

Volume-Based BMP Sizing

Bioretention was sized as a volume-based BMP. The California Stormwater Quality Association (CASQA) unit basin storage volume approach was used to size the BMP (CASQA, 2003). This approach is based on results of a continuous simulation model, the Storage, Treatment, Overflow, Runoff Model (STORM), developed by the Hydrologic Engineering Center of the U.S. Army Corps of Engineers. STORM was applied to long-term hourly rainfall data at numerous sites throughout California, with sites selected throughout the state representing a wide range of municipal stormwater permit areas, climatic areas, geography, and topography. STORM translates rainfall into runoff, then routes the runoff through detention storage. STORM produces unit basin storage volume curves for various runoff coefficients and BMP drawdown times as a function of the volumetric percent capture of runoff. Multiplying the unit basin storage volume by the percent imperviousness of the drainage area yields the required IGP BMP treatment volume.

The bioretention area was calculated as follows (Geosyntec Consultants, 2008):

Area (sf) = $(V_{design} \bullet l)/[(t \bullet k_{design}/12) \bullet (l+d)]$

where:

V_{design} design storage volume per the CASQA unit basin storage volume method

l	planting media depth (24 in);
d	ponding storage depth (18 in);
t	drawdown time (48 hours)
k_{design}	infiltration rate of planting media (0.13 in/hour).

Volume-based sizing calculations for bioretention are provided in Appendix A.3.

3.3.4 Evaluation Criteria

Structural BMPs were evaluated using the following criteria:

Treatment Effectiveness (TSS/Lead). Each BMP was evaluated for its ability to reduce TSS and total lead concentrations in stormwater runoff to concentrations below IGP NALs. This is based on BMP effluent quality as reported in the International BMP Database (www.bmpdatabase.org), effectiveness as indicated in EPA Region 2 guidance (2005), or professional judgment. For manufactured BMP systems, percent removal data reported by the manufacturer is not considered to be adequate performance data for evaluation of treatment effectiveness. This is primarily because percent removal data is affected by influent quality and does not provide information on whether the effluent quality from the BMP is expected to meet IGP NALs.

Implementation Feasibility. Implementation feasibility was rated as either “Moderate” or “Challenging” based on factors such as extent of soil movement and other site disturbing activities and long-term operation and maintenance requirements.

Capital and Annual O&M Costs. Conceptual level capital and annual O&M costs were estimated using site-specific information obtained from vendors and recent Geosyntec projects of a similar scope. A relative capital cost rating is provided in Table 3-3 based on the cost of each BMP evaluated:

$	25-50 percentile
$$	> 50-75 percentile
$$$	> 75 percentile

Basis of Cost Estimate. Assumptions including engineering contingencies that were included in the cost estimates are listed in this column of Table 3-3. Source control BMP costs for Lead Source Removal from Backstops and Soil Stabilization is based on Geosyntec’s best professional judgment.

Consideration as a Potential Solution. This column in Table 3-3 provides an assessment of whether the BMP should be considered for implementation based on a comprehensive evaluation of the above evaluation criteria.

Table 3-3: Structural Source Control and Treatment BMP Alternatives for the Ranges

Structural BMP Type	Structural BMP Description	BMP Treatment Effectiveness	BMP Implementation Feasibility	BMP Capital and Annual O&M Costs	Basis of Cost Estimate	BMP Consideration as a Potential Solution (Rationale)
Structural Source Controls for Lead						
Lead Source Removal from Backstops and Soil Stabilization	• Remove upper 6-12 inches of soil from the backstop. • Screen lead shot from removed soil (lead shot may be recycled). • Amend soil with lime-phosphate to raise pH and stabilize metals (if needed, based on soil pH). • Extend lime application to approximately 15 feet in front of backstop. • Spread/compact the stabilized soils onto the surface of the backstops.	• Expected to be an effective source control per USEPA Region 2 guidance (*Best Management Practices for Lead at Outdoor Shooting Ranges*, EPA-902-B-01-001, Revised June 2005).	**Moderate** • Involves large-scale soil excavation and management. • Soil removal activities would cause major disruption to range operational activities. • Requires 40-hour OSHA trained personnel. • Requires compliance with federal and state laws regarding hazardous waste.	**$$$ (relative to other costs in this table)** • Estimated $620,000 – $1,660,000 (average $1,140,000) • Annual O&M (Raking) $58,000	• Assumes 12 inches of soil is removed. • O&M costs assume surface raking of bullets; 4 people x 2 days/month; assumed CGC labor rate of $75/hr. • Costs do not include offsets from income received from lead recycling.	**This is a structural source control that should be considered.** **Selection based on age of berm, suggesting that there would be benefits to reconditioning the full surfaces of the berms.**
Add Gravel Layer at Base of Backstops to Impede Upward Migration of Water	Capillary effects in the backstops cause upward migration of water, which can facilitate the dissolution of lead. A layer of aggregate would be installed underneath the backstops to break the capillary effects. The work would entail: • Excavating into backstop area so that the excavation is 5 feet deep at maximum (depth into hillside varies based on slope). • Adding a 6 inch layer of gravel and geotextile material at base of backstop. • Amending excavated soil with lime-phosphate to raise pH and stabilize metals. • Reconstructing the backstops with the amended soil.	May reduce dissolution of lead by minimizing contact with acidic rainwater. Current site data indicate lead in site runoff is primarily in the particulate form and not the dissolved form. Therefore, this BMP is anticipated to have limited effectiveness for lead.	**Challenging** • Large excavation effort (3,000 cy). • Requires large import of gravel (600 cy) and lime. • Major disruption to range operational activities. • Backstops are comprised of the natural hillside, requiring shoring to complete construction and an assessment of long-term structural stability. • Requires 40-hour OSHA trained personnel.	**$$$** • Estimated $650,000 • No O&M costs in the long-term	Costs based on recent Geosyntec projects: • Excavation volume = 3,000 cy • Aggregate volume = 600 cy • $80/cy to excavate, stockpile, amend and re-compact • $35/cy aggregate delivered and installed • $15/sf x 10ft deep x 1600 ft. long = $170,000 shoring • 26% engineering and oversight • 20% contingency	This BMP was eliminated based on the difficulty of implementation on a natural hillside including structural stability challenges.

<table>
<tr><th>Structural BMP Type</th><th>Structural BMP Description</th><th>BMP Treatment Effectiveness</th><th>BMP Implementation Feasibility</th><th>BMP Capital and Annual O&M Costs</th><th>Basis of Cost Estimate</th><th>BMP Consideration as a Potential Solution (Rationale)</th></tr>
<tr><td colspan="7"><u>Structural Runoff Treatment Controls (Flow- and Volume-Based BMPs) for TSS and Lead</u></td></tr>
<tr>
<td>Contech StormFilter Unit Drain Inlets: R8, R1, R2B, R3B, R4B, R5, R6B, and TR1</td>
<td>• StormFilter unit containing engineered media-filled cartridges that filter particulates and remove metals.
• Precast or cast-in-place concrete vaults and/or catch basin retrofit units in series (the size of units and number of cartridges required is based on the flow rate for the drainage area).
• Vaults could be placed adjacent to the existing drain inlets on the ranges (moving downstream, each range would require a bypass for treated upgradient flows).
• Or one large unit could be placed in Range 1 (upstream of DP-1-refer to SWPPP figures) to treat all upgradient range runoff with a second unit located in R8.
• Various sizes and configurations exist to treat a range of flows. Can be designed as in-line or off-line systems. Our assumption is that flows greater than the water quality design storm would be bypassed.
• Various types of engineered media are available. A mixture containing zeolite is recommended for dissolved lead removal.</td>
<td>Meets IGP NALs

Media Filter (Manufactured Device) Average Effluent Quality from International BMP Database:
• TSS: 26.6 mg/L (NAL = 100 mg/L)
• Total Lead: 13.0 µg/L (NAL = 262 µg/L
• Dissolved Lead: 4.75 µg/L (NAL = none; see Total Lead)</td>
<td>Moderate

• The ranges can likely accommodate the vaults. A minimum head drop of 2’ to 3' ft. is required (inverts of existing sewer are unknown)
• Could install one large unit to handle all flows from TR1through R1 at the end of the storm drain pipe in Range 1 (depends on pipe inverts) with a second small unit in Range 8 (recommended).
• Flow from unpaved drainage areas may cause frequent cartridge changes if TSS loading is high.
• Annual maintenance is needed to remove sediment from bottom of unit and replace media as needed; work can be done under a maintenance agreement with Contech.
• Vacuum truck access to the vaults is required for maintenance.</td>
<td>$ - $$

• Estimate to install one large unit to treat the combined facility flow, plus a unit for Range 8: $265,000. As an alternative, estimate to install one unit in each range - $410,000 total
• Estimated $10,000 per year in maintenance cost</td>
<td>Assumptions (planning level costs provided by Contech):
<u>One Unit per Range:</u>
<table>
<tr><th>Range</th><th>Flow Rate (cfs)</th><th>No. of Media Cartridges</th></tr>
<tr><td>TR</td><td>0.81</td><td>24</td></tr>
<tr><td>R6</td><td>0.32</td><td>10</td></tr>
<tr><td>R5</td><td>0.27</td><td>8</td></tr>
<tr><td>R4</td><td>0.19</td><td>6</td></tr>
<tr><td>R3</td><td>0.12</td><td>4</td></tr>
<tr><td>R2</td><td>0.10</td><td>3</td></tr>
<tr><td>R1</td><td>0.10</td><td>3</td></tr>
<tr><td>R8</td><td>0.02</td><td>1</td></tr>
</table>
• Delivered price $195,000
• 50% purchase price for installation = $97,500
<u>One end of pipe unit, plus R8:</u>
• Delivered price $126,000
• 50% purchase price for installation = $63,000
<u>Both Options:</u>
• 10% engineer and oversight
• 10% misc. permits, erosion control, etc.
• 20% contingency</td>
<td>This is a runoff treatment control that should be considered.

Would require one end-of-pipe unit to treat ranges TR1 through R1 and a separate unit to treat R8.

Selection based on treatment effectiveness, implementation feasibility (including O&M performed by manufacturer) and cost.</td>
</tr>
</table>

Structural BMP Type	Structural BMP Description	BMP Treatment Effectiveness	BMP Implementation Feasibility	BMP Capital and Annual O&M Costs	Basis of Cost Estimate	BMP Consideration as a Potential Solution (Rationale)
Bio Clean Water Polisher Unit Drain inlets: R8, R1, R2B, R3B, R4B, R5, R6B, and TR1	• Bio Clean Water Polisher consists of a two-stage treatment unit for separation and media filtration. The separation chamber consists of two baffles that trap sediment and oil & grease. The last chamber contains an up flow media filter designed to remove particulates and other pollutants. • Uses media targeted at metal removal. • Various sizes and configurations for various flow rates. • Designed to bypass high flows.	Only manufacturer data available which indicates: • 85% removal of TSS • 72-98% removal of Total Lead • Unknown how effluent quality would meet NALs, given the above data	**Challenging** • Water polisher units have large depth requirements for installation (5 to 10 feet). Installation requires the unit to be levelled with the existing storm drain line. • Installation would cause large disruption to range operational activities. • One unit per drainage area would require the unit to be installed adjacent to drain inlet and the drain inlets to be retrofitted. • Could install one large unit to treat all flows at the end of the storm drain pipe, depending on pipe inverts, with separate treatment for R8.	**$ - $$** • Estimate to install one unit in each drainage area= $260,000 total • Estimate to install one large unit to treat the combined facility flow, plus a unit for Range 8= $235,000 • Annual O&M= $10,000 to $30,000	Assumptions (planning level costs provided by Bio Clean Environmental): One Unit per range: • Ranges 8, 1, 2, 3: 2.5ft x 4ft x 5 ft - $11,000/unit • Ranges 4 and 5: 3ft x 6ft x 6 ft - $14,500/unit • Range 6: 4ft x 6.5 ft x 6 ft - $18,000/unit • Trap Range: 8ft x 8 ft x 8 ft - $32,000/unit • 50% purchase price for installation = $61,500 End of pipe unit, plus R8: • Range 8 - $11,000/unit • Large end of pipe unit - $100,000 Both Options: • 10% engineering and oversight • 10% misc. permits, erosion control, etc. • 20% contingency O&M: • Media change out cost: $1,200 + vacuum truck, labor, plus profile and disposal = $4,000/unit per year	This BMP was eliminated based on difficulty of installation and lack of peer reviewed treatment effectiveness data to demonstrate compliance with NALs.

Structural BMP Type	Structural BMP Description	BMP Treatment Effectiveness	BMP Implementation Feasibility	BMP Capital and Annual O&M Costs	Basis of Cost Estimate	BMP Consideration as a Potential Solution (Rationale)
Bioretention Sited in Front of Backstops or at Drain Inlet Locations	Bioretention functions as an engineered media and plant-based filtration device that also removes pollutants through various physical, biological and chemical treatment processes. • Systems would require raised underdrains above a gravel storage layer because site soils are C/D (reference: USDA NRCS). • Designed with a 6-12 inch ponding depth and a drain time of 72 hours (including drainage in gravel storage layer).	**Meets IGP NALs** Bioretention Average Effluent Quality from International BMP Database: • TSS: 21.3 mg/L (NAL = 100 mg/L) • Total Lead: 3.4 μg/L (NAL = 262 μg/L) • Dissolved Lead: 0.323 μg/L (NAL = none; see Total Lead)	**Challenging** • Bioretention areas are appropriate for impervious drainage areas and not pervious areas. This is because sediment loading from pervious areas will cause the system to clog and ultimately fail. • Clay and plastic debris on Trap Range would significantly reduce the effectiveness for that range; significant maintenance would be required to reduce the debris loading to the bioretention area. • Bioretention placed in front of backstops would require large pretreatment area to prevent high sediment loading from the backstops into the bioretention areas. This would limit the operational area within each range as guests could not walk through the bioretention area to check/position targets. • Bioretention sited at the current inlet locations would also significantly encroach into the operational areas of the ranges. • Excavation/installation may require 40-hour OSHA trained personnel depending on lead concentrations.	**$$** • Estimated cost to construct a bioretention areas at each range = $240,000 • Annual Maintenance Cost = $10,000	• Alameda Countywide Clean Water Program C.3 Volume-Based Sizing calculation for stormwater quality capture volume. • Santa Barbara Technical Guidance Manual for bioretention area surface area calculations. • International BMP Database data for 6 sites used to calculate an average cost per square foot of bioretention area.	This BMP was eliminated primarily because it would not be effective in pervious drainage areas such as the CGC ranges. Bioretention is designed to effectively treat runoff from impervious drainage areas.
Underground Sand Filter	An underground sand filter is primarily for extremely space-limited areas and consists of a three-chamber system. The initial chamber is a sedimentation (pretreatment) chamber that temporarily stores runoff and utilizes a wet pool to capture sediment. The sedimentation chamber is connected to the sand filter chamber by a submerged wall that protects the filter bed from oil and trash. Perforated drain pipes under the sand filter bed extend into the third chamber that collects filtered runoff. Flows exceeding the filter capacity are diverted through an overflow weir, which carries flow the storm water conveyance system.	**Meets IGP NALs** Sand Filter Average Effluent Quality from International BMP Database: • TSS: 17.0 mg/L (NAL = 100 mg/L) • Total Lead: 3.38 μg/L (NAL = 262 μg/L) • Dissolved Lead: 1.33 μg/L (NAL = none; see Total Lead)	**Challenging** • The system would experience significant clogging due to high sediment loading from pervious drainage areas.	**$$$** Estimated cost for installation/construction of sand filter at each range = $525,000	International BMP Database data for 6 sites. Costs were normalized based on the BMP drainage area (see Appendix A.4).	This BMP was eliminated primarily because of the potential for clogging and high maintenance requirements.

4. STRUCTURAL BMPS RECOMMENDED FOR CONSIDERATION

Based on the evaluation criteria described in Section 3, lead removal from the backstops was selected as a structural source control BMP and the Contech StormFilter Unit was selected as a structural treatment BMP for further consideration in the event that advanced treatment methods are required to meet IGP NALs. The flow segregation BMP of the roadside ditch is discussed in Section 5.

4.1 Lead Removal from Backstops

Per EPA Region 2 guidance (2005), lead source removal from backstops and soil stabilization would be performed by removing the upper 6-12 inches of soil from the backstops. The soil would be screened on-site and amended with lime to prevent acidic pH conditions (which can dissolve lead and stabilize metals), and put back in place. Figure 4-3 shows the approximate areas of lead reclamation. Calculations and cost estimates were prepared assuming 12 inches of soil removal and extending soil removal and amendment 15 feet beyond the backstops onto the ranges. Approximately 5,800 cubic yards of soil would be removed, screened and amended. Cost estimates are provided in Appendix C and are based on Geosyntec's best professional judgment. .

All soil-moving and reclamation activity work would need to be done in compliance with federal and state laws, including working safety laws.

Annual O&M would consist of raking the surface layers of the backstops with a yard rake into piles, removing large debris, and then sifting the soil using screens to capture lead.

4.2 Contech StormFilter Units

This BMP would involve installation of one underground end-of pipe unit to treat runoff from the Trap Range to Range 1, with a second underground unit to treat runoff from Range 8. Figure 4-2 identifies potential locations for the media filters and the unit specifications are provided in Table 4-1, below. Proposed media filter locations consider accessibility for BMP maintenance activities, which would be performed by Contech.

Media filter sizing calculations are based on the flow-based sizing calculations in Appendix A, per the methodology described in Section 3.3.3. Design schematics provided by Contech are included in Appendix B.

Table 4-1: Contech StormFilter Unit Specifications for CGC Range Treatment

Location	Design Flow Rate (cfs)	No. Standard Media Cartridges	Dimensions of Underground Installation
End of Pipe for Trap Range through Range 1	1.9	58	Pre-cast 10 x 24 foot underground vault
Range 8	0.02	1	Standard Catch Basin

Additional steps needed to move from conceptual design to final design are as follows:

- The Contech units would be designed to tie into the existing stormwater drainage system. Therefore, the existing stormwater drainage system should be surveyed to evaluate its integrity prior to routing drainage from the media filters.
- Working with Contech, additional monitoring to evaluate the particle size distribution and particulate and dissolved lead concentrations should be conducted to optimize the filter media section as various media blends are available to treat pollutants of concern. A media blend containing zeolite is effective for removing dissolved metals and perlite is effective for removing fine sediment.

5. ROADSIDE DITCH CONCEPTUAL DESIGN

The road along the southern CGC perimeter has a roadside ditch adjacent to the hillside that in some locations has capacity to convey runoff flows from the road. However in some locations along the road there is no ditch to convey flows. The objective is to design a roadside ditch with capacity to convey peak flow rates from the drainage area for the ten-year storm for the purpose of segregating road runoff from runoff that flows onto the ranges. This would function as a flow segregation BMP. EBRPD is currently managing a separate project to regrade the road to direct runoff to the ditch. The costs and analysis for regrading the road is not included in this report although the analysis in this report is consistent with the drainage area that would result from the road regrading project.

Per the Western Alameda County flood control criteria, facilities with a drainage area less than fifty acres shall be designed to convey the 10-year peak flow rate (Western Alameda County, 1989). Four design points along the ditch were selected to calculate 10-year peak flow rates. Peak flow rates at each of the design points are summarized in Table 5-1 below and correspond to locations shown on Figure 5-1. The rational method flow calculations are provided in Appendix D.

Table 5-1: Ditch 10-Year Peak Flow Rates

Design Point	Design Flow, Q (cfs)
H10	3.8
H20	19.0
H30	23.1
H40	25.6

The roadside ditch could be designed as a rock-lined or vegetated channel, depending on the District’s objectives. Both options were assessed to evaluate cost (capital costs are essentially equivalent although a vegetated ditch has a higher associated O&M cost). A conceptual cross-section schematic for the rock-lined ditch is provided in Figure 5-2 and a cross-section schematic for a vegetated ditch is provided in Figure 5-3.

The recommended plant list for the vegetated ditch is provided on Figure 5-3. The vegetation was selected in consultation with Bart O’Brien, Garden Manager, EBRPD Regional Parks Botanic Garden, and Charli Danielsen, Interim Manager, Native Here Nursery (California Native Plant Society nursery located in Tilden Regional Park). Selected plants are indigenous to Chabot and/or Redwood Regional Park and are the types of plants that will become well-established in a flow conveyance channel (primarily grasses and forbs). Costs assume plants would be grown by Native Here Nursery[4] and would be provided in D-40 pots, which are easier to plant than 1-gallon pots, which would reduce labor costs for installation. The vegetation costs include a 15 percent discount because the project is within the EBRPD system.

Seeding the ditch and trying to establish germination and growth with supplemental irrigation is not recommended. According to Bart O'Brien, there is no EBRPD recommended seed mix and Native Here Nursery does not have seeds available for sale (but could be paid to collect seeds from the local area if desired). Native seed mixes from elsewhere would not acclimate as well as plants that are local to the area and in extreme cases, could be deleterious to the local ecotypes. Native Here plants are grown amongst the trees in Tilden Park and with minimal irrigation and fertilization, are grown outside as opposed to in a greenhouse and are exposed to the pathogens local to the area (these factors increase the survival rate). Moreover, planting plants as opposed to seeds has a higher success rate for establishing the desired vegetation density prior to the wet season and allows for the plants to immediately begin stabilizing the soils in the ditch.

Supplemental irrigation would be required until the vegetation is established; thereafter the vegetation is expected to survive and thrive under normal rainfall conditions (although supplemental irrigation of established vegetation may be required in drought years). Annual maintenance activities would include cutting back grasses prior to the start of new growth (prior to the rainy season), weeding (by hand without chemical application), adding/replacing vegetation as needed to maintain the desired vegetation density, and removing sediment where it affects ditch flow capacity or buries the crowns of the plants.

Cost estimates to construct the ditch are provided in Table D.6 in Appendix D. A cost summary for the rock-lined and vegetated channel options is provided in Table 5-2, below.

[4] Native Here Nursery requires six months to one year of lead time to propagate the number of plants required for the project.

Table 5-2: Ditch Construction Cost Estimate

Item	Rock-Lined Channel Cost	Vegetated Channel Cost
Soil Excavation and Stockpiling	$24,500	$24,500
Soil Characterization and Disposal	$73,200	$73,200
Rock-Lined Channel Materials and Installation	$52,240	--
Vegetated Channel Materials and Installation	--	$30,530
Project Management, Remedial Design, Construction Management	$38,984	$33,340
Total (with 20% contingency)	$227,000	$194,000

6. POTENTIAL IGP COMPLIANCE COSTS

This section provides the five- and ten-year cost estimates associated with implementing the advanced structural BMPs discussed in this report, as well as comprehensive IGP compliance costs. IGP compliance cost estimates were developed based on an analysis conducted by the State Water Board in September 2013 for the Final Draft of the IGP (SWRCB, 2013). The State Water Board analysis included a cost report and spreadsheet summarizing discharger compliance costs. Cost components include permit fees, SWPPP revisions, BMP implementation and oversight, monitoring, and reporting. The State Water Board cost items and table were modified by Geosyntec to reflect the requirements of the final adopted IGP and to incorporate CGC-specific costs for items such as recommended advanced structural BMPs, training, and facility good housekeeping that were not captured in the State Water Board estimate. Additional site-specific assumptions for the CGC include the following:

- The roadside ditch will be constructed in Year 1.
- Soil screening and stabilization and installation of Contech StormFilter units will take place in Year 2.
- Backstop lead reclamation activities were assumed to occur once every 10 years
- Ten-year costs assume the existing IGP remains in effect throughout the 10-year period although the IGP officially has a five-year permit term.

The ten-year cost was estimated by assuming the five-year cost increases by three percent per year using the following equation (Lindeburg, 2015):

$$F = P(1 + i)^n$$

where:

F = future value;

P = Present value (i.e. 5-year cost);

$(1 + i)^n$ = compound amount factor (1.1593);

i = effective interest rate (3.00%);

n = number of compounding periods (5 years).

Implementation cost estimates are summarized in Table 6-1 below with detailed spreadsheets provided in Appendix E.

Table 6-1: Summary of Implementation Costs and Assumptions

Year	1st Year	2nd year	3rd year	4th Year	5th year	1-5 YEAR TOTAL	6-10 YEAR TOTAL	10-Year Total
IGP Compliance Costs[1,2]	$137,000	$176,000	$131,000	$131,000	$131,000	**$700,000**	**$819,000**	**$1,500,000**
Roadside Ditch	$210,000[3]	$0	$0	$0	$0	**$210,000**	**$0**	**$210,000**
Backstop Source Removal	$0	$1,140,000	$0	$0	$0	**$1,140,000**	**$0**	**$1,140,000**
Media Filter Design & Installation	$0	$265,000	$0	$0	$0	**$265,000**	**$0**	**$265,000**
Annual O&M of Structural BMPs[4]	$0	$0	$68,000	$68,000	$68,000	**$200,000**	**$232,000**	**$430,000**
TOTAL COMPLIANCE COSTS	**$350,000**	**$1,580,000**	**$200,000**	**$200,000**	**$200,000**	**$2,500,000**	**$1,100,000**	**$3,600,000**

1. The average annual IGP compliance cost is $141,000.
2. Excluding ditch construction and O&M, backstop lead source removal, media filter installation and O&M.
3. Average of vegetated and rock-lined channel cost estimates.
4. Annual media filter maintenance ($10,000) and annual raking of backstops ($58,000).

7. REFERENCES

California Stormwater Quality Association (CASQA) 2003. Stormwater Best Management Practice Handbook: New Development and Redevelopment. January.

East Bay Regional Park District, 2015. Stormwater Pollution Prevention Plan for East Bay Regional Park District Chabot Gun Club. Prepared by Geosyntec Consultants. June 30, 2015.

Geosyntec Consultants, 2008. City of Santa Barbara Storm Water BMP Guidance Manual. June 2008

Lindeburg, Michael R., 2014. Civil Engineering Reference Manual, 14th edition.

State Water Resources Control Board (SWRCB), 2013. 2013 Update of Report on the Compliance Costs for the Final (2013) Draft Industrial General Permit (IGP). September 6, 2013.

United States Department of Agriculture. Natural Resources Conservation Service (NRCS), Web Soil Survey. http://websoilsurvey.nrcs.usda.gov/. Accessed 18 June 2015.

USEPA Region 2, 2005. Best Management Practices for Lead at Outdoor Shooting Ranges. EPA-902-B-01-001. Revised June 2005.

Western Alameda County, 1989. Hydrology and Hydraulics Criteria Summary for Western Alameda County. Revised August 7, 1989.

FIGURES

APPENDIX A

Hydrology Assessment for Gun Range Structural BMPs

APPENDIX B

Engineering Calculations and Design Schematics for Structural Treatment BMP-Contech StormFilter

APPENDIX C

Engineering Calculations for Structural Source Control BMP-Lead Source Removal from Backstops

APPENDIX D

Engineering Calculations for Roadside Ditch

APPENDIX E

Industrial General Permit Compliance Costs