U.S. Environmental Protection Agency
Region IX

California Regional Water Quality Control Board
Los Angeles Region

Review of Stormwater Best Management Practices at Large Construction Sites

August 2006

Review of Stormwater BMPs at Large Construction Sites

EXECUTIVE SUMMARY

The Los Angeles Region Water Quality Control Board (Regional Water Board) conducted a review and assessment of structural and non-structural BMPs at large construction sites. The primary purposes of this review included:

- Development of a set of minimum recommended BMPs for large construction sites, and
- Development of information to help the Regional Water Board in prioritizing active construction sites for inspections and permitting options.

Twenty four large construction sites were inspected in April 2005. Each inspector recorded observations of BMPs at the site, with the BMPs and common problems associated with those BMPs noted in section 2 of this report.

BMP recommendations for large construction sites are described in section 3. These recommendations address the key design, installation, and maintenance issues found to be commonly misapplied at large construction sites. The recommended BMPs are based on the California Stormwater Quality Association's *Construction Handbook*.

Finally, recommendations for how the Regional Water Board can more effectively address regulation of large construction sites are discussed in section 4. This includes recommendations for prioritizing large construction sites for inspection and options for addressing the high priority large sites, such as increased inspection frequencies, changes to the construction general permit, or even individual permits. Section 4 also addresses how to improve the notification system for active construction projects so the Regional Water Board would have a more accurate list of projects under construction.

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1.0 Introduction

1.1 Purpose

The primary goal of this project was to review and assess the structural and non-structural BMPs typically implemented at large construction sites (greater than 100 acres) and develop a set of minimum recommended BMPs. The primary focus of the review was on erosion and sediment control BMPs, although stormwater management and housekeeping construction BMPs were also included in the review.

The secondary goal was to assist the Los Angeles Region Water Quality Control Board (Regional Water Board) in prioritizing active construction sites for inspections and permitting options. Factors such as disturbed acreage, proximity to an impaired waterbody, slope, or other factors were considered. Minimum recommended BMPs for large construction sites were also identified.

1.2 Construction General Permit Requirements

Construction activity within the Los Angeles Region is required to comply with the State Water Board's NPDES General Permit for Storm Water Discharges Associated with Construction Activity (Construction General Permit) (http://www.swrcb.ca.gov/rwqcb4/html/programs/stormwater/sw_construction.html)

The Construction General Permit applies to storm water discharges from construction activity disturbing one acre or more, except for discharges on tribal lands, in the Lake Tahoe Hydrologic Unit, and construction performed by Caltrans which are all regulated by separate permits.

The Construction General Permit requires the development and implementation of a Storm Water Pollution Prevention Plan (SWPPP). Section A of the Construction General Permit describes the elements that must be contained in a SWPPP. The SWPPP should contain a site map(s) indicating the construction site perimeter, existing and proposed buildings, lots, roadways, storm water collection and discharge points, general topography both before and after construction, and drainage patterns across the project. The SWPPP must list BMPs proposed to protect recieving water quality and the location of those BMPs. Additionally, the SWPPP must contain a visual monitoring program; a chemical monitoring program for "non-visible" pollutants to be implemented if there is a failure of BMPs; and a sediment monitoring plan if the site discharges directly to a water body listed on the Clean Water Act Section 303(d) List of Water Quality Limited Stream Segments (http://www.swrcb.ca.gov/tmdl/docs/2002reg4303dlist.pdf) for sediment.

1.3 Inventory and Data Collection

1.3.1 Construction Project Inventory

Using the General Stormwater Permittees Regional Database, the Regional Water Board developed an inventory of all construction projects of greater than 100 acres within the Los Angeles Region. In order to secure local permits many projects submit Notices of Intent (NOIs) in advance of grading activities. The Regional Water Board, therefore, had to contact selected sites to determine if the project had begun grading. Regional Water Board staff determined that it was impossible to verify whether all selected sites were in active construction, so additional construction sites less than 100 acres were also selected to increase the universe of projects reviewed. In some cases, Regional Water Board inspectors recommended additional sites based on inspection findings. Projects currently required to conduct water quality monitoring were not inspected, therefore, water quality monitoring data has not been assessed for this review.

1.3.2 BMP Data Collection

With assistance from the Regional Water Board, Tetra Tech developed a data collection sheet for field staff to use in assessing BMPs at very large construction sites. Basic information about the site was collected in addition to information on BMPs. The BMP fact sheets contained in the California Stormwater Quality Association's (CASQA) Construction BMP Manual were used to in the development of the collection sheet.

Inspections of the selected sites were conducted the week of April 4-7, 2005. After a kick-off meeting to discuss the BMP review process, four teams conducted the inspections. Each team was comprised of one Tetra Tech and one Regional Water Board inspector. The Regional Water Board inspector led each inspection and the Tetra Tech inspector collected BMP data (e.g., installation, maintenance, relative effectiveness) and created a photo log of the primary BMPs and water quality problems identified at each construction site. In addition, since monitoring data was not reviewed, BMPs were determined to be effective by visual inspection only using best professional judgment (BPJ).

2.0 Assessment of Best Management Practices

2.1 Basic Site Details

A total of 24 construction sites were inspected during the week of April 4-7, 2005.

The range in size of sites inspected included:

Greater than 100 acres:	10 sites
Between 50-100 acres:	6 sites
Less than 50 acres:	8 sites

The primary land use at each site consisted of the following:

Residential	11 sites
Commercial	6 sites
Industrial	4 sites
Other	2 sites (cemetery and landfill)
Linear	1 site

Most of the inspected projects were located in Los Angeles County; however, two inspections were conducted in Ventura County. The weather during the inspection week was clear, with no rain recorded during the week.

2.2 Construction Site Observations

A variety of BMPs were observed during the construction site inspections. Because of the large size of many of the construction sites visited, the inspectors did not attempt to collect information on the number of BMPs implemented at each site. Instead, visual observations were made about the types of BMPs implemented at each site, whether they were adequately maintained or effective, and which BMPs which were specified in the SWPPP, but were not installed.

The BMPs are categorized according to the CASQA Construction BMP Handbook. Where appropriate, references to the CASQA Construction BMP fact sheet are included.

2.2.1 SWPPP Observations

Almost all sites had a SWPPP available on-site (the only sites lacking SWPPPs were two of the smallest sites visited). The quality of the SWPPPs varied, and some had deficiencies such as missing signatures on the certification page or missing maintenance records. Other SWPPPs included maps that did not accurately reflect current on-site conditions or did not have appropriate BMPs. Most SWPPPs included the required maintenance/inspection logs, however many were not completed or up to date. Many projects did not adequately document inspections before and after a rain event.

One site used a laminated SWPPP site map in order to easily identify and modify the locations of BMPs at the site.

2.2.2 Erosion Control BMPs

Erosion control BMPs are designed to prevent erosion through the protection and preservation of soil. Sediment control BMPs are designed to remove sediment from runoff before it is discharged from the site. The sites inspected relied heavily on sediment controls rather than a combination of erosion and sediment control controls.

Slope Stabilization: The primary erosion control BMP observed was slope stabilization. The construction sites visited employed a variety of BMPs to stabilize slopes including jute netting, visquine, soil binders (BMP EC-5), Bonded Fiber Matrix (BMP EC-3), and hydroseeding (BMP EC-4). The effectiveness of these BMPs varied by site, with failures observed on slopes using each of these types of BMPs. The primary factor influencing effectiveness appeared to be regular inspections and maintenance, including reinstallation or application of the BMP if necessary.

Common Problems: Rilling and gullying were observed on slopes using all types of slope stabilization BMPs. The inspection teams did not observe geotextiles or mats (BMP EC-7) being used at any of the sites visited. Other types of erosion control BMPs such as structural controls to divert storm water away from denuded areas, were not observed.

2.2.3 Sediment Control BMPs

The following sediment control BMPs were observed at most of the construction sites:

Perimeter sediment controls: The inspection teams observed a variety of perimeter sediment controls in use, including fiber rolls (SE-5), silt fences (SE-1) and gravel bags (SE-6). For projects on relatively flat slopes, the BMPs were employed around the perimeter.

Common Problems: Many of the perimeter sediment controls were poorly maintained or could not handle the amount of sediment reaching them. Many of the observed sediment control BMPs were in disrepair and showed signs of recent failure from the extremely heavy rainfall during the 2004-05 winter season. Maintenance problems included inadequate removal of sediment from behind the BMP and failure to replace the BMP when damaged.

Storm drain inlet protection (SE-10): A variety of BMPs were used for storm drain inlet protection, including gravel bags, fiber rolls, and commercially-available products.

Common Problems: Maintenance of the inlet protection was a common problem, with many sites failing to remove sediment from behind the BMP. When gravel bags were used for inlet protection, damage to the bags could allow gravel to enter the storm drain. Another common problem was failure to protect the entire width of the storm drain inlet, which negated the effectiveness of the BMP.

Gravel Bag Berms (SE-6)/Check Dams (SE-4): Gravel bag berms were primarily used in roadways as small check dams to slow stormwater flows and provide minor settling of sediment.

Common Problems: The most common problem observed was failure to repair damage to the gravel bags.

Sediment basins (SE-2)/Sediment Trap (SE-3): Sediment basins were employed by several larger construction projects, but were not universally applied at all large construction sites. Temporary sediment basins were the main BMP observed at several construction projects in the grading phase. The basins were constructed in an effort to prevent discharge from the construction site, but were not designed using runoff volume calculations for the watershed area. Sediment traps (for drainage areas less than 5 acres) were not used at most sites.

Common Problems: Many of the sediment basins observed were heavily silted and required maintenance. Because these inspections were conducted toward the end of the rainy season, construction operators might have been waiting until after the rainy season to clean out the basins. Also, construction operators indicated that cleaning out the basins during wet periods is difficult to do without getting equipment stuck. The sites relying solely on temporary sediment basins showed evidence of significant stormwater discharge with heavy erosion observed on non-stabilized slopes and silted channels. Relying on temporary sediment basins as the only construction site BMPs is unrealistic, especially for larger sites grading during the wet season.

Street sweeping (SE-7): Although street sweeping was not observed during the inspections, most sites inspected included a BMP in the SWPPP to regularly sweep streets near the construction entrance. Sweeping typically consisted of either a mechanical broom street sweeper or using laborers to sweep the street.

Common Problems: Small amounts of sediment were observed in the street at many construction exits.

2.2.4 Tracking Control BMPs

Stabilized Construction Entrance/Exit(TR-2). This BMP usually consisted of metal rumble strips placed at the entrance to remove mud from tires, but also included construction exits stabilized by rock.

Common Problems: Even with the use of tracking control, it was still often necessary to sweep the street in front of the construction site. Also, rumble strips and entrances stabilized by rock required periodic maintenance to remove excess sediment accumulation. It was observed on several sites that many construction vehicle tracks went around the rumble strips.

2.2.5 Non-Stormwater Management

Poor housekeeping on construction sites can increase the discharge of many pollutants such as oil and grease, paints, fuel, concrete wash out and other raw construction materials. The following non-stormwater management BMPs were observed at the sites inspected:

Vehicle and Equipment Maintenance (NS-10), Cleaning (NS-8), and Fueling (NS-9): Projects employed a variety of BMPs for controlling the discharge of pollutants in stormwater from vehicles and equipment. These included drip pans, spill kits, berms, and secondary containment.

Common Problems: Some leaking vehicles were observed, although drip pans were placed under parked heavy equipment at several construction projects. Fuel storage was not in secondary containment at one site.

2.5.6 Waste Management and Materials Pollution Control BMPs

Concrete Waste Management (WM-8): Construction operators used several types of practices to manage concrete wastes including plastic-lined detention formed using hay bales and a commercial roll-on container.

Common Problems: Inadequate sizing or location of the BMP was the most common problem. Also, some construction operators were not designating a contained area for stucco waste.

Material Delivery and Storage (WM-1): Construction operators used a variety of techniques to provide cover and/or secondary containment for materials. This included portable storage units, tarps, berms, and secondary containment units.

Common Problems: Because many construction sites lack adequate storage, materials with potential stormwater pollutants were stored without cover or secondary containment at some construction sites. This becomes more of a problem during the active building phase of projects.

Sanitary/Septic Waste Management (WM-9): Some construction operators used secondary containment around portable toilets.

Common Problems: Lack of secondary containment and improperly locating the portable toilets near a storm drain or in a drainage path. This is a problem when the portable toilet is drained, because some waste can spill.

Solid Waste Management (WM-5): Construction operators generally used large dumpsters or barrels for solid waste management.

Common Problems: Solid waste was primarily a problem only during the building construction phase. Clear signage and numerous waste containers helped to minimize the problem.

3.0 BMP Recommendations

The following are BMPs recommended by the Regional Water Board for large construction sites. These BMPs will commonly be applied to most large construction sites. Additional BMPs may be required at large construction sites depending on site conditions. Construction operators are referred to the California Stormwater Quality Association's *Construction Handbook* for a complete list of construction site BMPs.

Each BMP includes several key design, installation and maintenance issues that the review team found to be commonly misapplied. Complete information on each BMP's application, design, installation, and maintenance is available in the *Construction Handbook*.

3.1 Overall Recommendations

Inspections and recordkeeping

The General Permit requires inspections to be performed "before and after storm events and once each 24-hour period during extended storm events to identify BMP effectiveness." For each inspection, the discharger is required to complete an inspection checklist that includes the inspection date, weather information, description of inadequate BMPs, observations of all BMPs, corrective actions required, and inspectors name, title and signature.

Maintenance

- Inspect stormwater conveyances weekly to assess the need for maintenance (Photo 1).
- Inspect all BMPs weekly to assess the need for maintenance.
- Conduct maintenance as expeditiously as possible (especially before anticipated storm events).

Photo 1. Failure to clean and maintain culvert.

Employee Education

- Provide basic stormwater training to employees and subcontractors (e.g., purpose of common BMPs, prohibition on illicit discharges and dumping to the storm drain, etc.)
- Provide more specific stormwater training to employees and subcontractors responsible for implementing the SWPPP (e.g., installation and maintenance considerations for specific BMPs).

- Periodically remind employees and subcontractors of common compliance problems using signs or tailgate sessions (Photo 2)

Photo 2: Employee education using signs.

3.2 Erosion Control BMPs

EC-1 Scheduling

- Work out the sequencing and timetable for the start and completion of each phase of construction such as site clearing and grubbing, grading, excavation, paving, foundation pouring utilities installation, etc., to minimize the active construction area during the rainy season.
- Verify that work is progressing in accordance with the schedule.
- Amend the schedule if progress deviates and take corrective actions.
- Schedule permanent erosion control measures for areas deemed complete during the project's defined seeding window.
- Schedule areas to be stabilized as soon as possible after the cessation of soil disturbing activities or one day prior to the onset of precipitation.
- Adjust the construction schedule when rainfall is predicted to allow for the implementation of soil stabilization and sediment treatment controls.
- Schedule major grading operations during dry months when practical.

EC-2 Preservation of Existing Vegetation

- Preserve existing vegetation prior to the commencement of soil disturbing activities in areas where no construction activity is planned or will occur at a later date.
- Protect areas to be preserved with temporary fencing.
- Prohibit heavy equipment, vehicular traffic, or storage of construction materials within protected areas.
- Trench as far from tree trunks as possible outside of the tree drip line or canopy.
- Verify that protective measures remain in place.
- Restore damaged protection measures.
- Retain protective measures until all other construction activity is complete.

Slope stabilization

(using practices such as soil binders, straw mulch, geotextiles and mats, polyacrylamides, etc)

- Conduct weekly inspections of slopes to ensure the selected BMP is effective and there are not any signs of failure.
- Maintenance should be conducted quickly to prevent rills from becoming gullies.

Photo 3. Slope failure at edge of visquine.

Photo 4. Rills/gullies forming along slope without erosion controls.

Photo 5. Slope stabilization with jute netting.

3.3 Sediment Control BMPs

SE-1 Silt Fence

- Trench and key in the silt fence (Photo 6).
- Do not use in areas of concentrated flow.
- Do not use as the only BMP at the base of long slopes (Photo 7).
- Install along the contour and turn ends up to ensure water ponds behind the silt fence.
- Inspect weekly and remove sediment when it reaches 1/3 the height of the silt fence.

Photo 6: Silt fence that was not trenched and keyed in. **Photo 7**: Silt fence at bottom of long slope.

SE-2 Sediment Basin

- When feasible, construct sediment basins before clearing and grading work begins.
- Do not construct basins in any natural or undisturbed stream (Photo 8).
- Do not install basins where failure of the structure will cause loss of life, damage to homes or buildings, or damage to public roads or utilities.
- Limit runoff to the basin from only disturbed areas and divert runoff from undisturbed areas away from the basin.
- Design basins per Section A of the State of California NPDES General Permit for Stormwater Discharges Associated with Construction Activities (General Permit).
- Remove sediment when accumulations reach one half the designated sediment storage volume.

Photo 8: Sediment basin with outlet standpipe.

SE-5 Fiber Rolls

- Anchor fiber rolls using wooden stakes at the end of each fiber roll and spaced 4 ft maximum on center.
- Stake fiber rolls into a 2 to 4 inch deep trench with a width equal to the diameter of the fiber roll.
- Do not use in areas of concentrated flow
- Do not use as the only BMP at the base of long slopes

- Remove sediment when accumulation reaches one-half the distance between the top of the fiber roll and the ground surface.

Photo 9. Fiber rolls on flat slope.

SE-6 Gravel Bag Berm/Check Dam (SE-4)

- Install gravel bag berms on level contours and butt ends of bags tightly.
- Turn the ends of the gravel bag barriers up slope to prevent runoff from going around the berm.
- Do not use in drainage areas that exceed 5 acres.
- Replace degraded bags every two to three months and sweep up spilled gravel (Photo 10).
- Remove sediment when accumulation reaches one-half the distance between the top of the gravel bag and the ground surface.

Photo 10. Gravel bag berm with broken gravel bags.

SE-7 Street sweeping and vacuuming

- Do not use kick brooms or sweeper attachments.
- Limit ingress and egress points to the construction project to minimize trackout and sweeping and vacuuming efforts.
- Maintain sweepers and adjust brooms to maximize efficiency of sweeping operations.
- Properly dispose of all sweeper wastes at an approved dumpsite.

SE-10 Storm Drain Inlet Protection

- Limit upstream drainage area to 1 acre.
- Do not use as the only BMP in the drainage area. Practice source control of upstream sediment sources.
- Determine the extent of potential runoff diversion caused by the storm drain inlet protection device.
- Select the appropriate type of inlet protection device necessary to protect the type of inlet.
- Repair and maintain all BMPs as needed.
- Remove sediment when accumulation reaches one-half the distance between the top of the BMP and the ground surface.

Photo 11. Unprotected storm drain inlet.

3.4 Tracking Control BMPs

TR-1 Stabilized Construction Entrance/Exit

- Use 3-6 inch diameter stones (do not use gravel) or an equivalent device to remove sediment from vehicle tires (Photo 12).
- Use a geotextile fabric underneath stones.
- Install perimeter fence or barriers to ensure vehicles use designated exits.
- Sweep the street periodically.
- Inspect weekly and remove/replace stone as needed.

Photo 12. Rumble pads for tracking control.

3.5 Non-Stormwater Management

NS-8 Vehicle and Equipment Cleaning

- Avoid cleaning vehicles and equipment on-site.
- If cleaning of vehicles and equipment on site must occur contain all wash areas to prevent pollutant discharges.
- Do not allow wash water to enter storm drains or other waterways.
- Do not permit steam cleaning onsite.
- Minimize the use of solvents.
- Train employees and subcontractors in proper vehicle and equipment cleaning procedures.

NS-9 Vehicle Fueling

- Train employees and subcontractors in proper fueling and cleanup procedures.
- Maintain spill kits at fueling areas.
- Clean spills immediately.
- Designate a contained fueling area away from storm drains and other waterways.
- Do not leave vehicles unattended while fueling.

NS-10 Vehicle Maintenance

- Use offsite repair shops as much as possible.
- If maintenance must occur onsite, use designated contained areas.
- Make spill kits and drip pans readily accessible adjacent to maintenance areas.
- Inspect onsite vehicles and equipment daily for leaks and repair immediately.
- Store used vehicle fluid waste within secondary containment equipped with overhead cover.
- Train employees and subcontractors in proper maintenance and spill cleanup procedures.

Photo 13. Leaking equipment requiring maintenance.

Photo 14. Secondary containment around vehicle.

3.6 Waste Management and Materials Pollution Control BMPs

WM-1 Material Delivery and Storage

- Designate construction site areas for material delivery and storage away from vehicular traffic and waterways.
- Provide secondary containment and overhead cover at the designated storage area.
- Maintain Material Safety Data Sheets (MSDS) for all materials stored.
- Storage of reactive, ignitable, or flammable liquids must comply with the fire codes.
- Hazardous materials stored onsite should be minimized.
- Maintain spill kits at designated storage areas.

Photo 15. Improper storage of drums without secondary containment or overhead cover.

WM-3 Stockpile Management

- Locate stockpiles a minimum of 50 ft away from concentrated flows of stormwater, drainage courses, and inlets (Photo 17).
- Contain all stockpiles using perimeter controls such as berms, dikes, fiber rolls, silt fences, sandbag, gravel bags, or straw bale barriers.
- Cover all stockpiles with visqueen or other impermeable materials (Photo 16).
- Repair and/or replace perimeter controls and covers as needed.

Photo 16. Stockpiles covered with visqueen.

Photo 17. Unprotected stockpile in drainageway.

WM-4 Spill Prevention and Control

- Train all employees and subcontractors in spill prevention and cleanup.
- Make spill kits readily accessible.
- Do not bury or wash spills with water.
- Clean up leaks and spills immediately.
- Store and dispose of used clean up materials in sealed drums and dispose of properly.

Photo 18. Secondary containment under generator.

WM-8 Concrete Waste Management

- Design concrete washouts areas to contain all liquid and solid wastes.
- Locate washout areas away from storm drains, open drainage facilities, and watercourses.
- Train concrete suppliers on concrete washout practices.
- Do not wash out concrete trucks into storm drains, open ditches, streets, or streams.
- Install signs adjacent to washout pits informing equipment operators to utilize washouts.
- Clean out washout areas to maintain the designed capacity.
- Do not allow wash water to discharge from washout areas (Photo 20)

Photo 19: Commercial concrete washout.

Photo 20: Failed concrete washout.

WM-9 Sanitary/Septic Waste Management

- Locate sanitary facilities away from drainage facilities, watercourses, and from traffic circulation.
- Secure sanitary facilities to prevent overturning.
- Provide secondary containment around sanitary facilities (Photo 21).

Photo 21. Secondary containment around portable toilets.

4.0 Recommendations for the Regulation of Large Construction Sites

To improve permit compliance and the efficiency of the NPDES construction stormwater program, the Region Water Board could develop a system to prioritize construction sites. High priority sites could then be inspected more frequently, given more stringent permitting requirements, or both. Increased inspection frequencies could be conducted under the current construction general permit. More stringent permitting requirements would require either a reissued general permit or new individual permits issued to specific construction sites.

4.1 Prioritization Process

The Regional Water Board could prioritize large construction sites based on a number of factors to be determined in the office and the field. Ideally, all construction sites above a certain disturbed acreage threshold (e.g., 100 acres) would be inspected during the prioritization process.

Several factors could be assessed in the office upon submittal of an NOI. However, as information available in the office on each construction site may be of limited value, the Regional Water Board should conduct inspections to confirm or adjust the factors used to assign priority.

The prioritization process should be further defined by assigning weighted values to factors considered most critical (i.e. size, proximity to impaired waters, etc.). A "score" could then be determined for each site with values denoting degrees of priority (e.g. high, medium, low). The following factors could be included:

1) *Disturbed Acreage Threshold*
   Size of disturbed area is an obvious factor to consider in the prioritization process. Typically, the larger the disturbed area, the greater the potential risk to water quality. The Regional Water Board would need to determine the appropriate size threshold for prioritization (e.g., 100, 75, or 50 acres).

   Once this threshold has been established, this would be an initial factor used to prioritize projects.

2) *Federal/State Operated Sites*
   Localities typically do not regulate or inspect federal or state construction projects, therefore, these sites could be assigned a higher priority. However, the vast majority of these sites are significantly smaller than 50 acres.

3) *Historic Compliance Problems*
   The Regional Water Board could assign a higher priority to construction sites operated by a company with past notices of violation (NOVs) or other enforcement actions on the current or past projects. The Regional Water Board could create a numeric scale to assign a value relative the number of violations which have occurred.

4) *Projects with Steep Slopes*
Critical factors such as slope ratio and slope length in addition to the total number of acres with steep slopes effect the type and location of necessary erosion and sediment control BMPs. Slopes with a greater than 3:1 slope ratio and greater than 50 foot slope length could indicate a priority site. Projects with slopes that are adjacent to receiving waters or with storm drains/curbed streets at the foot of the slope could receive a higher priority.

Alternatively, projects on flat slopes typically experience less sediment movement during storm events and could be a lower priority for the Regional Water Board.

5) *Projects Adjacent to Waterbodies*
Projects adjacent to waterbodies impaired by sediment or other pollutants generated at construction sites are a priority. Also, construction adjacent to non-impaired waterbodies could be a priority because of the potential direct impact to the waterbody if controls are not implemented.

6) *Time of Active Grading.*
Projects with large disturbed areas undergoing active grading during the wet season pose a significantly higher threat to water quality than dry season grading.

7) *Projects with Multiple Builders*
Large projects with multiple builders on-site could represent a higher priority because of the mixed responsibility for implementing BMPs and amount of construction activity at the site.

4.2 Options for High Priority Projects

Once a process for determining the priority of projects has been established, there are several options for improving the implementation and effectiveness of BMPs on high priority projects.

4.2.1 Increased Regulatory Inspection Frequencies

The Regional Water Board could increase the inspection frequency for projects based on priority. For example, high priority project inspections could be conduced at least once every 30 days (dependent upon season, rainfall etc.) and/or within 48 hours of the end of a storm event of 0.5 inches or greater. This may require increased inspection staff time or a redistribution of existing Regional Water Board resources.

4.2.2 General Permit Options

The Regional Water Board could opt to enhance general permit requirements for high priority construction projects. As previously stated, construction activity within the Los Angeles Region is required to comply with the State Water Board's NPDES General Permit for Storm Water Discharges Associated with Construction Activity (http://www.swrcb.ca.gov/rwqcb4/html/programs/stormwater/sw_construction.html)
The Los Angeles Regional Water Board could amend this permit to include more specific permit provisions for high priority projects within the Los Angeles Region.

The Regional Water Board could choose from a variety of additional general permit provisions to improve compliance and BMP effectiveness on high priority construction projects. Options to consider for an amended Construction General Permit include increased self-inspection requirements, training and certification requirements for operators, more specific SWPPP requirements, submittal of the SWPPP to the Regional Water Board for review and approval, water quality monitoring, and enhanced notification requirements. In addition, numerical limits for total suspended solids (TSS) and turbidity, especially during dewatering activities, should be considered.

For example, the Construction General Permit currently requires construction operators to conduct inspections "before and after storm events and once each 24-hour period during extended storm events." Construction operators sometimes claim that significant gaps in their on-site inspection records is due to a lack of rainfall, which can be difficult for Regional Water Board inspectors to verify in the field.

The Regional Water Board could require that construction operators conduct inspections weekly, while still conducting inspections before and after a rain event. Also, the Regional Water Board could require that construction operators install a rain gage to record daily rainfall at the construction site. These records could be cross-checked with the inspection records to verify that inspections were conducted before and after rain events.

The following are additional examples of existing enhanced requirements in state construction general permits:

Minnesota Construction General Permit
This permit has additional BMP requirements when construction sites discharge to "special waters." These additional BMP requirements include buffer zones of at least 100 feet, covering slopes over 3:1 within 3 days after being worked, and temperature controls. The permit also include post-construction stormwater requirements, including the treatment of the first ½ inch of runoff from new impervious surfaces.
http://www.pca.state.mn.us/water/stormwater/stormwater-c.html

Georgia Construction General Permit
The State of Georgia requires the monitoring of turbidity in receiving waters or outfalls for most projects. Both an upstream sample and a downstream sample must be taken. In general, two sets of samples are required – the first 0.5 inch or greater rain event after clearing operations have begun, and another event at least 0.5 inches at least 90 days after the first sample. In addition, the permit specifies a violation if BMPs have not been properly designed, maintained, and installed and monitoring of receiving waters indicates an increase of more than 10 nephelometric turbidity units (NTU) for trout streams and more than 25 NTU for warm water fisheries. If an outfall is monitored, the permit contains a table of NTU limits for cold water and warm water fisheries that varies based on watershed area and disturbed acreage.

EPA Region 4 Construction General Permit
This general permit, applicable only on Indian Lands in EPA Region 4, requires monitoring when a construction project discharges stormwater to a 303(d) listed waterbody impaired for

total suspended solids (TSS) or other indicators of solids transportation such as turbidity, siltation, or sedimentation. These requirements are similar to the California General Permit monitoring requirements, except that monitoring for non-visual pollutants is not included.

Oregon Construction General Permit
This general permit includes a water quality standard for turbidity stating "no more than a ten percent cumulative increase in natural stream turbidities shall be allowed, as measured relative to a control point immediately upstream of the turbidity causing activity." However, monitoring requirements are not included in the permit.

The permit can be accessed at:
http://www.deq.state.or.us/wq/wqpermit/GenPermits/NPDES1200C/NPDES1200CPermitDraft.pdf

Pennsylvania Construction General Permit
Monitoring is not required in this general permit; however, the State requires individual permits for any construction activity located in a high quality or exceptional value watershed.
The permit can be accessed at:
http://www.dep.state.pa.us/dep/deputate/watermgt/wc/Subjects/StormwaterManagement/GeneralPermits/default.htm

2004 Effluent Guideline – Construction and Development
EPA proposed a construction and development effluent guideline in June 2002 to supplement existing regulations addressing stormwater discharges from construction sites which contained three options. The first option would have amended the NPDES regulations to include inspection and certification requirements for operators of construction sites disturbing at least one acre of land. The second option would have promulgated an effluent guideline that contained additional requirements for construction activity disturbing at least five acres of land. EPA also proposed a third option to continue to rely on the existing regulations and programs in place at the federal, state, and local levels. EPA chose the third option to rely on the range of existing regulations and programs in place at the federal, state and local levels to control stormwater runoff from construction sites and not develop an effluent guideline. However, the development document cites a number of specific inspection and certification requirements that were considered as a part of the first option. The Regional Water Board could consider including similar requirements in an amended general permit. For example:

- Ccontractor inspections for high priority projects must be conducted every 7 or 14 days and within 24 hours of the end of a storm event of 0.5 inches or greater.
- Contractor inspections must be conducted and certified by qualified personnel. The Regional Board could require training or certification of all contractors performing self-inspections.
- A qualified professional must conduct an assessment of the site prior to groundbreaking to certify that BMPs have been implemented as described in the SWPPP.
- The inspection report must also contain a site map showing all disturbed areas, areas that have undergone temporary stabilization, areas with planned disturbance in the next 14 days, and areas that have not undergone active site work for the past 14 days.

- The inspection report must note approximate degree of sediment accumulation as a percentage of the sediment storage volume for sediment control practices.
- The operator is required to submit a summary of the site inspection activities on a monthly basis to the Regional Water Board.
- A final site erosion and sediment control inspection must be completed and certified before filing a Notice of Termination.

4.2.3 Individual Permit Options

Issuance of individual discharge permits for high priority construction projects could facilitate site-specific BMP, monitoring, and inspection requirements. Tetra Tech is not aware of any individual permits that have been issued to construction dischargers in California or other states. Construction activities are considered to be an industrial sector by EPA, therefore, would require the same standard template and permitting provisions, public notice, and collection and response to comments as other industrial storm water individual permits in California.

4.3 Develop a notification system for active construction projects

As discussed in section 1.3.1, because many construction projects must show proof of coverage under the State's Construction General Permit before local permits are issued, many projects appear on the NOI database long before construction begins. The NOI database also has a number of completed projects because the operator has not submitted a Notice of Termination yet. These problems make it difficult for the Regional Water Board to identify which projects on the NOI database are active construction projects with exposed soils. The NOI database contains estimated start and completion dates, but project delays can make these unreliable.

There are several options that could help the Regional Water Board to address this problem:

- The next Construction General Permit could include a requirement for the construction operator to notify the appropriate Regional Water Board when soil disturbance activities begin. This could be accomplished by:
  - Developing a new notification form
  - Requiring construction operators to submit a change of information form if the anticipated start date changes
  - Developing a web or email-based notification system for the operator to use when soil disturbance activities begin
- The Regional Water Board could require one of the notification procedures above only for large construction sites.
- The Regional Water Board could contact construction operators after the date of construction commencement indicated on the NOI to verify that the site has begun grading.
- The Regional Water Board could require high priority construction sites (e.g., those over 50 or 100 acres) to schedule an inspection to verify that all BMPs are installed before grading activities begin.

4.4 Advanced Treatment Incentives

The State Water Board sponsored a conference on advanced treatment for construction sites in October 2004 (http://www.waterboards.ca.gov/stormwtr/advtreatment.html). These systems essentially treat sediment-laden runoff from sedimentation basins using polymers, coagulants and/or filtration systems. Several manufacturers of these advanced treatment systems presented case studies of their products at the conference.

The Regional Water Board could provide incentives for high priority construction sites to provide advanced treatment. This approach would be especially advantageous during active grading when many large sites rely on sedimentation basins for sediment control. The Regional Water Board could approve the use of advanced treatment on a case-by-case basis with extensive requirements for monitoring and recordkeeping to help document the effectiveness of the practice. The monitoring should focus, among others, on the adverse effects of chemical additives to watercourses.

References

California Stormwater Quality Association (CASQA). 2004. *Stormwater BMP Handbook: Construction*. http://www.cabmphandbooks.org/Construction.asp

EPA. 2004. *Development Document for Final Action for Effluent Guidelines and Standards for the Construction and Development Industry*. EPA 841-B-04-001.

State Water Resources Control Board. 1999. National Pollutant Discharge Elimination System (NPES) General Permit for Storm Water Discharges Associated with Construction Activity, Water Quality Order 99-08-DWQ.