Appendix K.2: Sediment Management Excerpt from South Orange County Hydromodification Management Plan

4 Sediment Supply Management Requirements

Permit Order R9-2013-0001 as amended by Order No. R9-2015-0001Section E.3.c.(2)(b) requires PDPs to avoid critical sediment yield areas known by the Copermittee or identified in the Watershed Management Area Analysis, or implement measures that allow critical coarse sediment to be discharged to receiving waters, such that there is no impact to the receiving water. As the locations of sediment yield areas are not known by the Copermittees and the Watershed Management Area Analysis has yet to be completed this section identifies the steps PDPs must take to or implement measures that allow critical coarse sediment to be discharged to receiving waters, such that there is no impact to the receiving water.

Sediment supply plays a role in the stability of alluvial stream channels. A change in coarse (bed material) sediment supply will cause instability in the channel manifested through general scour or aggradation. Lateral bank migration may also result from changes in sediment supply as the channel slope increases or decreases.

The delivery of bed material during construction may increase as land surface is cleared and the potential for erosion is increased. Once the land surface is urbanized, runoff may be discharged through closed conduits and lined channels. The potential for bed material transport may be reduced as compared to the pre-development condition. The purpose of this portion of the HMP is to maintain the pre-development delivery of bed material to receiving streams following urbanization. Bed material is defined as the sediment that comprises the bed and banks of the receiving stream. Bed material load is the material transported by the stream during runoff events. It is comprised partly of the bed load (material that moves along the bed by sliding or saltating) and partly of the suspended load, including particle size fractions in the channel bed sediments. Bed material load is a primary variable controlling stream channel morphology. Wash load is the portion of the total sediment load carried continuously in suspension by the flow, and generally consists of the finest particles. Changes in wash load are not likely to significantly affect the channel stability, and reductions in wash load are generally assumed to improve habitat function.

The resiliency of receiving channels to forestall changes in the watershed due to urbanization varies with the magnitude of the change and characteristics of the channel (bed and bank material, vegetation, channel cross section and slope). It is difficult to quantitatively predict the response in a receiving channel to changes in the fundamental variables described by Lane (1955) of discharge, bed material grain size, channel slope and sediment supply. Accordingly, the most effective approach to ensuring channel stability may be to avoid changes in the fundamental variables (Lane's relationship) during urbanization through the implementation of stream channel management guidelines. In the case of bed material sediment supply, this will be accomplished by avoiding development in areas that are a significant contributor of bed material load to the receiving channel.

The general approach to ensure maintenance of the pre-project sediment supply is a three-step process:

1. Determine whether the site is a significant source of bed material to the receiving stream.
2. Avoid significant bed material supply areas in the site design.
3. Replace significant bed material supply areas that are eliminated through urbanization.

In the event of a projected reduction in sediment supply, the project proponent shall investigate the feasibility of sediment management measures, including rerouting drainage pathways through coarse bed sediments onsite, otherwise maintaining pre-project bed material discharge from the site, or providing additional mitigation in site runoff. Specific guidance on sediment management measures will be provided in the Model WQMP for South Orange County.
An alternative compliance option allows the project applicant to model the site conditions and the receiving stream and provide additional mitigation in site runoff to compensate for the reduction (or addition) of bed material. An erosion potential management objective must comply with the HMP performance standard as defined in Section 4.1. This option may only be used if the general approach outlined above is deemed infeasible by the permitting authority, or if the project site design requires significant alteration of on-site streams.

4.1 Methodology

The project applicant must determine the location of the downstream alluvial receiving water that may be impacted by the project. Only the first downstream conveyance that is unlined (invert, side slopes or both) will be considered and will serve as the "assessment" or "receiving" stream for the project. The following methodology will be used to ensure that the project does not adversely impact bed material load to the assessment stream.

4.1.1.1 Step 1

A triad approach will be completed to determine whether the site is a significant source of bed material to the receiving stream and includes the following components:

1. Site soil assessment, including an analysis and comparison of the bed material in the receiving stream and the onsite streams;
2. Determination of the capability of the onsite streams to deliver the site bed material (if present) to the receiving stream; and
3. Present and potential future condition of the receiving stream.

A geotechnical and sieve analysis is the first piece of information to be used in a triad approach to determine if the site is a significant source of bed material load to the assessment stream. An investigation shall be completed of the assessment stream to complete a sieve analysis of the bed material. Two samples shall be taken of the assessment stream using the "reach" approach (TS13A, 2007). Samples in each of the two locations should be taken using the surface and subsurface bulk sample technique (TS13A, 2007) for a total of four samples.

A similar sampling assessment should be conducted on the project site. First-order and greater streams that will be impacted by the project (drainage area changed, stabilized, lined or replaced with underground conduits) will be analyzed in each subwatershed. One stream per

subwatershed that will be impacted on the site must be assessed. A subwatershed is defined as tributary to a single discharge point at the project property boundary.

The sieve analysis should report the coarsest 90 percent (by weight) of the material for comparison between the site and the assessment stream. The Professional Engineer shall render an opinion if the material found on the site is of similar gradation to the material found in the receiving stream. The opinion will be based on the following information:

- Sieve analysis results
- Soil erodibility (K) factor
- Topographic relief of the project area
- Lithology of the soils on the project site

The Professional Engineer shall rate the site as having either a high, medium or low probability of supplying bed material load to the receiving stream. This site soil assessment serves as the first piece of information for the triad approach.

The second piece of information is to qualitatively assess the sediment delivery potential of the site streams to deliver the bed material load to the receiving stream, or the bed material sediment delivery potential or ratio. There is no documented procedure to estimate the sediment delivery ratio; it is affected by a number of factors, including the sediment source, proximity to the receiving stream, on-site channel density, project watershed area, slope, length, land use and land cover, and rainfall intensity. The Engineer will qualitatively assess the bed material sediment delivery potential and rate the potential as high, medium or low potential. The final piece of information is the present and potential future condition of the receiving stream. The Engineer shall assess the receiving stream for the following:

- Bank stability. Receiving streams with unstable banks may be more sensitive to changes in bed material load.
- Degree of incision. Receiving streams with moderate to high incision may be more sensitive to changes in bed material load.
- Bed material gradation. Receiving streams with more coarse bed material (such as gravel) are better able to buffer change in bed material load as compared to beds with finer gradation of bed material (sand).
- Transport vs. supply limited streams. Receiving streams that are transport limited may be better able to buffer changes in bed material load as compared to streams that are supply limited.

The Engineer will qualitatively assess the receiving stream using the gathered observations and rate the potential for adverse response based on a change in bed material load as high, medium or low.

The Engineer shall use a triad assessment approach, weighting each of the components based on professional judgment to determine if the project site provides a significant source of bed material load to the receiving stream, and the impact the project would have on the receiving stream. The final assessment and recommendation shall be documented in the HMP portion of the WQTR.

The recommendation may be any of the following:

- Site a significant source of sediment bed material – all on-site streams must be preserved.
- Site a source of sediment bed material – some of the on-site streams must be preserved (with identified streams noted).
- Site is not a significant source of sediment bed material.

The final recommendation will be guided by the triad assessment. Projects with predominantly "high" values for each of the three assessment areas would indicate preservation of on-site streams. Sites with predominantly "medium" values may warrant preservation of some of the on-site streams, and sites with generally "low" values would not require site design considerations for bed material.

The Engineer shall also assess if the receiving stream has been altered either for alignment, cross section, or longitudinal grade, or has degraded to the extent that an in-stream restoration project would be required to restore the functions and values of the stream bed. In such cases, the Engineer should discuss options for participating in an in-stream project in lieu of on-site design features to preserve bed material load.

Provision for waiver of sediment assessment. If any of the following are present, the site shall not be required to consider sediment component as a part of the HMP mitigation.

1. The site was previously developed and is being redeveloped.
2. There was no stormwater discharge from the site to a receiving water for the range of flows associated with the HMP.
3. The site discharges directly to a bay, estuary, reservoir, lake or the ocean, or through engineered channels to any of these receiving waters.

4.1.1.2 Step 2

If the analysis in Step 1 indicates that some or all of the site stream courses must be preserved as a contributor of bed material load to the receiving stream, the site plan shall be developed to avoid impacting the identified streams. The Engineer will designate streams onsite that should be avoided to preserve the discharge of bed material load from the site. The Engineer may consider the factors discussed above when determining whether a specific on-site stream course is a significant contributor of bed material load and should be preserved.

4.1.1.3 Step 3

If it is infeasible to avoid on-site streams that contribute significant bed material load in the design of the site plan, the drainage(s) may be moved and replicated elsewhere on the site, provided the Engineer will certify that the relocated drainage course has a similar potential to generate bed material load. The Professional Engineer will also certify that the revised drainage location is in substantially similar material as the natural stream location.

4.2 Alternative Compliance Methodology

The alternative compliance program may only be pursued if the significant replacement of bed material supply is deemed infeasible by the permitting authority, or if the project site design requires significant alteration of on-site streams. The infeasibility of the different sediment management measures stated in the general approach may only be demonstrated and documented by a Professional Engineer. The Professional Engineer may also demonstrate the expected feasibility of the alternative compliance methodology.

In such an eventuality, applicants may propose an alternative compliance methodology for bed material load mitigation from a project based on numerical modeling. The Engineer may propose adjusting the flow duration curve to maintain pre-project conditions in the receiving channel with the expected change in bed material load discharge from the site. This option may not be practical when the changes in bed material supply from the project are relatively small, due to limitations in the accuracy of modeling. The Engineer shall determine, using best professional judgment, if the alternative modeling approach is applicable.

The alternative modeling approach shall include the following:

1. Continuous hydrologic simulation for the project baseline condition and proposed condition over the range of flow values up to the pre-project 10-year event.
2. Sediment transport model of the receiving stream for the project baseline condition and proposed condition.
3. Analysis of the change in sediment bed material from the project baseline condition to the proposed condition
4. Explanation of method used to control the discharge from the project to account for changes in the delivered sediment bed material.
5. Summary report

An erosion potential (Ep) management objective will serve as the alternative performance standard for this option. As described in the modeling approach, hydromodification management measures will be selected and designed to maintain the Ep ratio within 10 percent of the target value in the receiving waters. The target Ep will be adjusted to account for changes in bed sediment supply. Studies have demonstrated that achieving an optimum capacity-supply ratio within 10 percent of the unity should ensure the dynamic stability of a stream while allowing the river to recover of some of the morphological detail that cannot be designed a-priori (USACE, 2001).

Site specific modeling is discussed further in **Appendix D**.

5 HMP and Local WQMP Integration

The HMP requirements including the HMP criteria, alternative compliance options and steps, and the sediment supply management methodology and steps will be incorporated into the Section 7II-2.4.2.2 Determine Hydromodification Performance Criteria of the Local WQMPs. The HMP alternative compliance and the alternative compliance for sediment supply management will also be integrated into the Section 7.II-3.0 Alternative Compliance Approaches of the Local WQMPs.

Guidance regarding the hydromodification technical feasibility study is integrated as part of the TGD. Section 5.4, "System Design to Address HCOCs" in South Orange County of the TGD has been updated to include the requirements of the HMP. The Permittees will use the revised Local WQMPs and TGD with the HMP requirements to incorporate requirements into the local approval processes and municipal ordinances.