

GUIDE FOR HYDROLOGIC AND HYDRAULIC STUDY REPORTS  
(In support of encroachment/watercourse permits or floodplain analyses)

*NOTE: The goal of producing a report is clear communication of analysis results. In other words, structure the report so that it can be easily and effectively reviewed.*

1. Executive Summary: A brief description of project scope, purpose and conclusions; please include a clear description of the project location and limits (using Assessor Parcel Numbers or a legal description of the parcels involved), location and vicinity maps, and overall site plan with a numerical and graphic bar scale.
2. Project Description: Scope, purpose, and background information and history that provides context for the project. This may include information on adjacent developments or earlier phases of a development.
3. Hydrology:
  - a. Hydrology report with Table of Contents clearly indicating the page numbers of the report sections including an executive summary, design assumptions/criteria, hydrologic model input and output results, Tc calculations, summary results tables, hydraulic calculations (basin, reservoir, stage/storage), routing results, and NPDES calculations, if applicable. The report should specify the methods and models used, assumptions, sources of information and data, which vertical datum was used (NGVD29 or NAVD88), and the calculated vertical conversion value (not an estimate or average) used for the location of the project. If the report is considered final, it should be stamped and signed by a California Registered Civil Engineer.
  - b. Statement of criteria and assumptions used for the study and the applicable agency (Example: Mitigate 100-yr developed condition peak flow to 10-year developed peak flow as specified by the City of Simi Valley). Provide a copy of the written policy.
  - c. Description of watershed and any special features in it, including undeveloped and developed hydrologic and hydraulic conditions. Provide recent aerial photograph(s) of the overall watershed and a closer image of the impacted subareas. Outlining the development area on the image is helpful.
  - d. Rationale if using other than the District Hydrology Manual.
  - e. Hard copies of the original source materials, if applicable, including hydrology map with subarea nodes, input and output.
  - f. Undeveloped and developed condition hydrology maps and tables showing subarea boundaries, node IDs used in modeling, Tc's, topography map, elevation contours, drainage system alignments and sizes, building locations and density, plot size, elevation datum, numerical and graphic scale, north arrow and other common map information included on engineering drawings. All information should be submitted in hard copy but should also be submitted in electronic format when feasible. Maps must be submitted in both hard copy and electronic (AutoCAD or equivalent) format.
  - g. Summary table of results clearly showing that the design has met the mitigation requirements.
  - h. Electronic files and hard copies of Exhibits from VCWPD Hydrology Manual used in the study.
  - i. Electronic copies of the Tc Calculator and VCRat input and output files used in the study in addition to any hard copy results provided.
  - j. Tc calculation documentation should show subarea boundaries and development type used in evaluation as well as various flowpaths and related subarea portions.

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- k. Hydraulic calculations used in the hydrology study. If a proprietary detention basin routing program is used, provide hard copy input and output and results summaries. If non-proprietary, provide electronic files in addition to hard copy input, output, and results summaries. Include construction drawings of the basins and all structural components and complete descriptions of the basin operations, particularly if a complex system is being proposed.
  - l. List of references for the information and model parameters.
  - m. File names must provide a clear indication of the contents of the file (ex. SAC-Alt1Q10ex.in; San Antonio Creek, Alternative 1, Q10 existing input file). Ensure the file name is stated in the header.
  - n. List of reference manuals, publications, and computer programs (with versions and dates) used.
  - o. When resubmitting a package in response to District comments, provide a cover letter clearly responding, comment by comment with the corresponding letter or number, how the originally reviewed report has been revised to address the comments and the page numbers indicating where the comments have been addressed. Provide the page numbers for any additional requested items and items provided to address a comment. A copy of the comments received from the District should be included in the package, if applicable.
4. Hydraulics:  
Provide detailed descriptions of the following:
- a. Project site conveyance features (canals, channels, basins, structures, etc.)
  - b. Model configurations
  - c. Model assumptions
  - d. Model parameters
  - e. Model calibration procedures
  - f. Copies of the original source material including input and output if revising an existing model (ex. Using FEMA HECRAS on Ventura River).
  - g. Tabulated results for different frequencies modeled, if applicable.
  - h. Sources of information for cross sections (ground survey, aerial topography, Lidar, other, with name of source, date of production, and datum). If combining multiple sources of information within each cross section or between cross sections, this information must be clearly described in the assumptions/criteria/summary sections as well as clearly marked within the cross section view.
  - i. Descriptions of channel properties and parameter assignments (e.g. characterization of surface features and vegetation and determination of roughness coefficients).
  - j. Consistent river station (RS) numbering, verifying that RS numbers in the model and the maps, plans, profiles, cross sections, and details are consistent, etc.
  - k. Plan view, profile and cross sections to scale as needed to clearly illustrate the results of the analysis. The hydraulic grade line (HGL) and energy grade line (EGL) must be shown on the profile view for 50-year storm events (Q50) and the HGL only for 100-year storm events (Q100). Provide the WSE on the cross sections. Provide numerical and graphic bar scales for all views and include numerical and graphic bar scales for the vertical scale on profiles, cross sections, and details. The horizontal scale for plan and profile should not be greater than 1"=40', the preferred vertical scale for profile is 1"=4', and the horizontal and vertical scales for cross sections should be 1"=10'.

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- l. When details are provided, most should be "To Scale", but those labeled NTS should still be consistent as to the relative scale between horizontal and vertical.
  - m. When unsteady models are used, provide a clear description of boundary conditions and inflow/outflow to and from the model.
  - n. When performing hydraulics on only a portion of the stream, the extents of the model revision must be of a sufficient length to tie into an identified upstream and downstream boundary with no discernible change to the water surface elevations (zero change).
  - o. Hydraulic model input, output, and summary tables in both hard copy and electronic format for all modeled frequencies. Each file must be named to indicate clearly the contents of the file. The file name should be stated as part of the header.
  - p. List of reference manuals, publications, and computer programs (with versions and dates) used.
5. Description of Modeling Alternatives/Scenarios: Provide a clear explanation of each scenario and the purpose behind it and the methods or data that make each alternative/scenario different from the others. Provide pros and cons for each alternative/scenario. Provide exhibits as applicable for clarity. After analysis of alternatives, please justify the selected alternative.
6. Scour Analysis Based on Sediment Transport and Geomorphology
- General:
- Provide a complete and concise description of the following:
- a. Purpose – to estimate the maximum vertical channel adjustment for the proposed project improvements
  - b. Description of the physical problem and the computational model
  - c. History and Assumptions -- include hydrologic characteristics and flood history of the stream and similar streams. Variations in channel properties from reach to reach should be described here.
  - d. Sources of data used, including photographs
  - e. Methods applied and any limitations. If multiple methods used, describe each scenario and limitations.
  - f. Evaluation
  - g. Plan view, profile, and cross sections to scale as needed to clearly illustrate the results of the analysis. If available, historical data, particularly for cross sections, should be provided, along with comparisons of the changes. The same scale criteria as stated in the Hydraulics Section are applicable here.
  - h. Soils types and properties (size, cohesiveness, etc.) for both bed and banks
  - i. Any other relevant information
7. Geomorphology Evaluation
- a. Review and evaluation of historical aerial photographs to identify areas along the stream that have been subjected to historical scour and subsequent infill. Overall analysis should be based on this evaluation of photographs along with a field assessment and geomorphic principles

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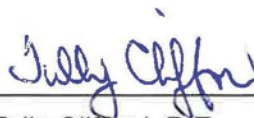
8. Sediment Transport Modeling
  - a. Methodology: HEC-6T sediment transport model or other accepted method
  - b. HEC-6T model (or equivalent) shall be correlated to available known historical and current spatial data such as high water marks, available survey data and topographic mapping
  
9. Scour Analysis
  - a. Methodology: HEC-RAS (for bridge scour), USBR, or other methodology based on published technical report, or a combination
  - b. Analyses and analysis type(s) (ex. contraction scour, general scour, bend scour, pressure scour, etc.)
  - c. Results and evaluation based on findings from geomorphology and sediment transport
  - d. Summary and conclusions
  - e. List of reference manuals, publications, and computer programs (with versions and dates) used.
  
10. Conclusions: A brief description of work performed and the results. Provide explanation of major assumptions, shortcomings, data issues, and any other pertinent information. If a particular design has been chosen to move forward from an alternatives analysis, provide a thorough basis and discussion for the choice and conclusions.

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Credits and Invitation for Ongoing Review:

This guide was compiled by Laurie Crain, Permit Engineer, with input from and review by Watershed Protection District staff. A draft of the guide was sent to consultants and customers who regularly work on permit projects for review in January, 2014. Based on comments received, final edits were made to the guide.

We hope that this guide will prove useful to you in preparing documentation to support your application for projects for considered for issuance of Watershed Protection District Encroachment or Watercourse Permits. We invite additional comments at any time. Please direct your comments to [Laurie.Crain@ventura.org](mailto:Laurie.Crain@ventura.org) or (805) 662-6821. Thank you.



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Tully Clifford, P.E.  
Director  
March 7, 2014