Memorandum

To: All Citywide Consultants

PC: Marty Cristofaro, PE
Leonard Washington, PE

From: James F. Thompson, PE

Date: June 21, 2004

Re: Storm Drainage Design on all Citywide Projects

The City is in the process of changing its storm sewer design criteria. In the future, all such Citywide storm sewer projects shall be designed using HouStorm down to the inlet level to insure that street ponding does not exceed certain levels for a 2-yr. event (we are still checking the 100-yr. event as compared to the ROW line using more advanced methods). All consultants will be required to include hydraulic data sheets in their plan sets including drainage area maps, storm sewer and open ditch data sheets, and inlet computation sheets. The intent is to not have a 2-yr. event pond in the street – especially at the sag inlet locations – over the crown of the street. Notice that this has nothing to do with the storm sewer design itself. The 2-yr. HGL below the gutter line is actually a separate computational issue. The matter here is the capacity of the street to convey overland flow using Manning's spread flow equation and the ability of the inlet to capture this said flow. There are basically three fundamental calculations that need to be made and well documented:

1. The sizing of all storm sewers or open ditches based upon a 2-yr. storm event (controlling criteria: HGL shall not exceed gutter lines using soffit of outfall as the starting WSEL),

2. The proper grading of streets and spacing of inlets to control ponding width (or "spread") in the streets (controlling criteria: ponding spread shall not exceed the crown of the pavement – or a ponding width of 13.5 ft. in a standard 27 ft. F/F section), and

3. The sizing and number of inlets to control the total head on the inlets themselves in order to capture the incoming flow (controlling criteria: total head at any standard inlet with a 0.33 ft. depression – such as a BB inlet - shall not exceed 0.6 ft.).

The first calculation is standard and has been historically performed for all projects. The second and third calculations require the analysis of the inlet spacing and sizing. HouStorm (the City's derivative of TxDOT's WinStorm software for use on City projects – downloaded from the SWMP website) handles all three calculations, but the drainage areas must be broken down to an inlet by inlet basis. In other words, every inlet must have a unique drainage area contributing to it. This is exactly the method used by TxDOT on all of their projects. Notice this does not affect the mitigation portion of your project as that was performed for the more extreme event, in most cases the 100-yr. event, and mitigation measures were undertaken in that phase of the project. This discussion purely relates to the conventional 2-yr. storm design.

If you are at a point in your project development to perform the storm sewer design in this manner, at the inlet level within HouStorm, please do so. Again, this is how future street and bridge projects, as well as all future SWMP projects will be designed.

In the event that your project is substantially complete including the storm sewer drainage area map and the storm sewer hydraulic tables as well, then HouStorm can still be used to generate the hydraulic data sheets so that the format of the sheets and the data included on them will be consistent throughout all the storm sewer projects for the City. This can be achieved in two steps. In the first step, the storm sewer data (drainage areas, storm sewers, open ditches, etc.) can be input into HouStorm without any inlets and run to generate the hydraulic data sheet for the storm sewers and open ditches. In this case drainage areas are not broken down to an inlet by inlet basis. This is simply a mimic of your hand or spreadsheet calculations and should reflect exactly the same results from an HGL standpoint using the pipe soffit at the outfall as the starting water surface elevation. All drainage areas are routed to the manhole junctions thereby providing connectivity to the drainage system; hence, inlets are not modeled at this level. The critical elevation value at junctions should be set to the gutter line elevation in curb and gutter sections to flag violations of the 2-yr. HGL criteria. Restrictors will need to be modeled in HouStorm as equivalent lengths of conduit based upon the established guidelines[1] (for equivalent restrictor values, calculate the pipe size based upon a 10-ft. conduit length and use appropriate labeling and nomenclature in the model to identify the link as a restrictor).

Secondly, HouStorm shall be used again to create an inlet hydraulic data sheet to denote sizing, spacing, and proper street grading (numbers 2 and 3 above). For every drainage area, each inlet is input into the program with a flow that is proportional to the fraction of the drainage area that contributes to that inlet. In other words, the drainage areas are broken down and input only in the sense of the fraction of the flow contributing to an inlet. For example, if the flow from a drainage area had previously been calculated as 21 cfs and contained 3 inlets, and the contributing area within that drainage area for each inlet was 1/3, then each inlet would be input into HouStorm with an inflow of 7 cfs. After each separate inlet in the system has been input into HouStorm in this manner, the program can be run and used to generate an inlet hydraulic data sheet. This is a simplified way of checking your inlet capacities and insuring that you do not have excessive ponding at your inlets.

While modeling the inlets in HouStorm, separately from the trunk system, to generate an inlet hydraulic data sheet, no links are needed to be input – computation is performed for inlets only. When using the Drainage Area Drainage Input Form, input the *supplied discharge* as that proportional value of the contributing flow from the drainage area to that unique inlet. All *supplied discharge* values

[1] Thompson, James F., June 21, 2004; *Restrictor Modeling in Win/HouStorm and other Steady State Applications*.

within one drainage area (if multiple inlets are within the drainage area) should equal the total *Q* from that drainage area and should match the *Q* used in the storm sewer hydraulic data sheet. The re-input or dividing of the drainage areas are not needed and can in fact produce different results. Simply use the *supplied discharge* value to provide the flow to the inlet to be analyzed. Watch your inlet nomenclature! If you have a drainage area called D3, then a good manner in tracking the say three inlets contained in the drainage area would be D3-1, D3-2, and D3-3. This will make tracking the inlets very easy. Feel free to repeat the drainage area map with inlet nomenclature inserted if you feel this clarifies the documentation of your inlet hydraulic data sheet.

In any inlet analysis, regardless if it is performed separately from the storm sewer analysis or if it is included with the storm sewer analysis as one hydraulic model (as preferred), more inlets may be required to control the ponding depth and resultant spread. Due judgment should be used here. If, for example, there is a slight violation of ponding depth that would require the addition of other inlets away from the sag location thereby resulting in another block of street reconstruction, new waterline, new sanitary sewer, etc., then the benefit may not be worth the cost. On the other hand, the simple addition of another inlet around an end radius may be all that is needed to bring a sag location into complete conformance with the stated criteria. Again, due judgment must be used and this level of inlet analysis is an excellent method to check these critical features of the design.