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Memorandum

To: Joni Kitson, Town of Epsom
Steve Couture, NHDES
Steve Landry, NHDES
Interested Parties

Date: December 14, 2007

Project No.: 5189200

From: Peter J. Walker, VHB
Randy Sewell, VHB

Re: Project Update
Suncook River Avulsion
Alternatives Evaluation

This memo provides an update on our team's progress on the assessment and suggested alternatives in response to the Suncook River avulsion. Since it has been some time since our first public information meeting, we are providing this report to you to keep you informed about the progress of our work, and to encourage you to contact us with any questions. We hope that the information contained here helps to keep you and your constituents informed on the status of the project.

FIELD WORK AND SUMMARY OF FINDINGS RELATED TO THE GEOMORPHIC ASSESSMENT

VHB, working with our partner, Parish Geomorphic, completed detailed field survey of the project area during July and August 2007. This work included about 30 cross-sections in the former and new river channels from NH 4/NH 9/US 202 south to the town beach just south of Short Falls Road. We also surveyed an undisturbed "reference reach" further upstream to provide comparative data as is common for geomorphic assessment. Below, we have summarized the key findings of the assessment. **Figure 1** provides a general view of the project location and **Figure 2** outlines our team's most significant observations on the geomorphology of the study area.

- **The river has been quite stable over the last 50 years.** Although the river is quite sinuous in places, a historic analysis of the meander belt width and migration rates determined that the river was, in fact, quite stable over the recent past. We estimated that the river has a migration rate of 4 cm/year calculated over 50 years. This is considered to be a very low rate of erosion given the width of the channel. The meander belt width was determined to be 318 meters which was largely due the very sinuous section downstream of Bear Island. This belt width did not change from the 1953 aerial photographs to those from 2003.
- **An active headcut was initiated by the avulsion and appears to be actively migrating upstream.** Pre- and post-avulsion assessment of channel grade depicts a channel that is undergoing active grade adjustment, with degradation (erosion) being the dominant process at and above the avulsion site. Severe degradation has occurred at the avulsion site, which means that the elevation of the new stream channel is up to 12 feet lower than the old channel bed. This channel degradation has moved upstream to a point north of the confluence with the Little Suncook (i.e., an active "headcut" is moving upstream). The bed in this reach appears to be as much as three feet lower than before the avulsion. This bed erosion has caused the collapse of an old stone bridge on the railroad grade crossing of the Little Suncook River and is cause for

concern for the existing NH 4 Bridge just to the north. Active headcutting is also evident at the confluence of the new channel and Leighton Brook.

- **The new channel is unstable and will continue to actively adjust.** Pre- and post-avulsion erosion and sediment transport calculations indicate that the new channel is unstable and likely to continue adjustment. Critical discharges were calculated for all reaches. The critical discharges required to move the median sediment size was less than 30 percent of the "bankfull discharge" (i.e., a flow that would be expected to occur once every 1.5 to 2.0 years) for all reaches of the newly defined Suncook River downstream of the avulsion site. This means that even relatively low flows are capable of moving streambed sediment from these reaches, and indicates that erosion will continue in this reach for some time.
- **Downstream of the avulsion, the primary adjustment process is one of aggradation (deposition).** Field work revealed that long reaches downstream of the confluence of the new channel and the old secondary channel are 50 to 90% filled with sediment.
- **Aggradation of fine material has raised the river bed such that the river bed is at the same elevation as the surrounding floodplain**. Aggradation north of Round Pond has forced flood flows to spread out onto the floodplain into areas that were once considered outside of the 500 year floodplain, as was observed to occur in April 2007. Flows were running in newly formed flood chutes adjacent to the municipal well at this time.
- **The current volume of sediment in the channel below the avulsion site raises the possibility that a secondary avulsion may occur.** This possibility is perhaps greatest below the confluence of the old and new channels, and above the large meanders at Short Falls Road, where only a small, vegetated berm keeps the channel in its present location. There is a high risk of large scale changes at this channel location.
- **The Old Channel and the Suncook above the NH 4 bridge are stable.** Critical discharges in the old primary channel and the Reference Site occurred at close to 100% of bankfull conditions, indicating that these channels remain stable (Reference Site) or were stable before the avulsion (Old Primary Channel). The erosion threshold calculated for the Old Primary Channel resulted in a higher critical discharge than for the Confluence Area. The Old Primary Channel contained much coarser material that was harder to move and resulted in a more stable channel overall. The New Channel cut by the avulsion consisted primarily of sand. This sand has been transported downstream and is what has resulted in the lower critical discharge and a less stable channel in the interim. As the channel continues to adjust to find a new dynamic equilibrium with this finer sediment, sediment transport will continue to be higher than pre-avulsion conditions.

Note that we are continuing to refine the geomorphic assessment so that it clearly provides the information needed to assess project alternatives and is presented in a way that is accessible to the public. A full report of the detailed technical findings of the assessment work is in progress and is expected to be issued in January.

ALTERNATIVES FOR ADDRESSING THE MAY 2006 SUNCOOK RIVER AVULSION

One key element of the study is identification of a range of alternatives. Based on our field work, as well as discussions with interested technical partners and members of public, we provide the following as a preliminary description of the alternatives that we plan to bring forward for further analysis. As the project progresses, we will provide a more detailed description of each alternative and will provide an analysis of the impacts and benefits of each of the alternatives.

Alternative 1 - No Action

This alternative involves doing nothing and let the Suncook River and tributaries achieve equilibrium through natural adjustment of their boundaries over time. (See **Figure 3**.) Potential consequences of implementing this alternative include the continuation of headcutting in the main river channel between NH 4 and the May 2006 Avulsion Site as well as in tributaries feeding the main channel from the east, such as Little Suncook River and Leighton Brook. Headcutting will continue to migrate upstream until bedrock or other erosion resistant feature such as roadway fill or a bridge foundation is encountered. As portions of the river channel become more incised (cut downward, thereby deepening the river channel) and cutoff from the historic floodplain, streambank erosion/failure will increase as the river seeks a new dynamic equilibrium at a lower elevation in the valley floor. The New Channel formed as a result of the avulsion will continue to adjust its highly erodible boundaries (sand/fine gravel) until a new self maintaining form (pattern, dimension and profile) is achieved. Depending upon the timing and magnitude of future runoff events, aggraded channel segments downstream from the New Channel will likely continue to fill with sediment forcing the river to cut a new path across the historic floodplain. This would obviously affect existing land use and may adversely impact the municipal well located in the vicinity of Round Pond.

Alternative 2 - Strategic Treatment of Degrading and Aggrading Stream Reaches

Alternative 2 involves leaving the newly avulsed river channel in its current position but address channel degradation and channel aggradation at strategic locations along the system. (See **Figure 4**.) For example, headcutting in the main channel between the NH 4 bridge crossing and the Avulsion Site could be controlled through installation of several rock cross vane structures in conjunction with channel shaping and grading to create "bankfull" benches. Likewise, headcutting in tributaries feeding the post avulsed river channel could also be adequately treated through installation of appropriately placed boulder grade control structures in conjunction with minimal grading and shaping of existing channel. Channel reaches in the "Confluence Area" exhibiting severe aggradation would be excavated to restore "bankfull" cross-sectional area and appropriate sediment transport capacity. Depending upon the ratio of total quantity of excavated sediment to floodplain disposal area it may be feasible to spread excavated material across adjacent floodplain areas if landowner permission were granted.

Alternative 3 - Alternative 2 plus Restoration of New Channel

Alternative 3 would implement Alternative # 2 as defined above and restore the remainder of the New Channel to its equilibrium endpoint through the application of Natural Channel Design principles. (See **Figure 5.**) This would involve determining and implementing the river's most probable stable form (dimension, pattern and profile), given existing hydrologic and sediment regimes as well as site geology. In other words, the "New Channel" would be configured with appropriate dimension, pattern and profile to convey all flows up to and including "bankfull," and be thoroughly integrated with the floodplain such that all flows exceeding "bankfull" would dissipate across the floodplain. This application would provide self-maintaining channel stability and minimize the production of excess sediment through the New Channel, which currently is highly unstable.

Alternative 4 - Restore the Suncook to pre-May 2006 Avulsion Position

This alternative would involve returning the main Suncook flows to the Old Primary Channel and making any necessary repairs to restore the two dam structures to pre avulsion condition, or complete removal of the dam structures. (See **Figure 6**.) This alternative would also involve placing and compacting earthfill in order to redirect the river and maintain flow through the Old Primary

Channel. Earthfill could be placed in one of two locations; at the Avulsion Site itself, or upstream approximately 700 feet from the Avulsion Site. Placement of earthfill at the upstream location would also involve excavating a cutoff channel to re-connect the Suncook with the Old Primary Channel. This excavation would generate about 25,000 (+/-) cubic yards of material, all of which could be utilized in closing the original flow path through the old meander bend. Placing earthfill in the location of the Avulsion Site would require approximately 10,000 cubic yards of material that may need to be hauled in from an off-site location.

Restoring the Suncook to its pre-avulsion position returns the full range of river flows to two stable channels: the Old Primary Channel and Old Secondary Channel. Removal of excess sediment, however, would still be required in the channel segment that runs between the outfall of the Old Secondary Channel and confluence with the Old Primary Channel in order to restore pre-avulsion capacity through this reach.

NEXT STEPS

While the geomorphic assessment and alternative concepts have not advanced as quickly as we had initially hoped, we do anticipate that the final report will be delivered on schedule in May 2008.

We are currently focused on: 1) finalizing the technical report for the geomorphic assessment, and 2) refining the conceptual alternatives (listed above) to develop conceptual engineering plans for each. We expect that these tasks will be complete in January, at which time we anticipate distributing additional technical updates. A proposed schedule for the remaining portions of the project is presented in the table below.

Project Schedule

EVENT	TARGET DATE
Revised Draft Geomorphic Assessment & Project Alternatives	January 3, 2007
Preliminary Evaluation of Alternatives (Internal Draft)	February 15, 2007
Meeting Notice & Public Draft Alts. Descript. & Prelim. Assessment	February 29, 2007
Public Meeting #2 - Alternatives Development and Preliminary Evaluation	March 19, 2007
Draft Restoration/Management Plan	March & April
Public Meeting #3 – Final Alternatives Evaluation	April 2008
Final Report Issued	May 2008

Note that our original plan had contemplated a public meeting at the "Alternatives Identification" stage, whereby we would report to the public prior to the completion of the alternatives analysis. Based on recent feedback, we have revised this approach slightly so that we will have time to present a full evaluation of the pros and cons, and a cost/benefit analysis for each alternative at the next public meeting. A final public meeting would be held to respond to comments of provide clarification of any final elements of the alternatives evaluation.