## Appendix N Addendum

### Description of Modeling and Groundwater Recovery/Disposal Calculations and Cost Estimates for Hypothetical Remediation of Gamble Limited Admission Groundwater Areas

As previously noted in other proceedings with the Louisiana Department of Natural Resources (LDNR), submitting party have been asked to provide and consider remedial options addressed to restoration of conditions for groundwater, and that potential is addressed in anticipation of that request. Based on laboratory analytical results, elevated chloride related parameters potentially exist in the vicinity of select monitor wells installed in Limited Admission Areas 239274 and 240833 as noted in the Plan. Accelerated removal or reduction of these constituents would require active groundwater withdrawal. As noted below, any proposal for such a plan would require further feasibility study and analysis, and actual design and cost of such a system at this stage is inherently speculative. Although it remains premature, in order to address the requirement for discussion of an option, a plan contemplating active groundwater remediation has been prepared. The remedial objective for purposes of this discussion is compliance with applicable EPA Secondary Drinking Water standards, which are considered to be within the range of background conditions surrounding the Limited Admission groundwater area. This plan is not endorsed by the authors because it is not the most feasible option and because design and selection of such an option is premature; however, a pump and treat option is proposed in anticipation of regulatory requests and for evaluation as a possible contingency plan for remediation in the Limited Admission area.

**Modeling to Estimate Remedial Option**

The model hydraulic conductivity values were adopted from the aquifer test evaluations summarized in Section 3.5 of the Plan. The EPA Batch Flushing Model (BFM) equation was utilized to approximate the number of extracted pore volumes (*NPV*) of groundwater needed to reduce current chloride concentrations within the 1,000 mg/L chloride concentration contour in the Limited Admission zone to a target concentration. The BFM equation is given by $NPV = -R_f ln\left(\frac{C_f}{C_o}\right)$, where $R_f$ is the retardation factor (1.0 for chloride), $C_f$ is the final concentration and $C_o$ is the initial concentration. The BFM is a simplified expression that does not incorporate fundamental processes, such as advection and dispersion. However, it has been observed that the BFM often yields relatively good agreement with results from actual

groundwater recovery systems. The BFM is generally considered a scoping-level approximation. Within the identified chloride contours, the $C_o$ was 585 mg/L and the $C_f$ was 250 mg/L. The resulting NPV values were calculated as either 0.8 or 0.6 for the remediation areas.

The considered pump and treat plan includes a total of thirteen (13) recovery wells installed within the shallow water bearing zone, seven (7) in Limited Admission Areas 239274 and six (6) in Limited Admission Areas 240833, screened in the shallow water bearing zone and operating at less than 800 gpd continuously for an approximate maximum period of one (1) year. This is an overly idealized model considering both the limited yield as calculated in Section 3.5 of the Plan and the discontinuous nature of the shallow water bearing zone.

**Disposal of Recovered Water**

A key element of the feasibility of a pump and treat contingency plan is the method of handling and disposal of recovered groundwater. The elements of groundwater recovered from the Limited Admission zone are remnants of produced water or other non-hazardous oilfield waste (NOW) and upon recovery will contain a small fraction of their initial concentrations. Recovered groundwater will be disposed off-site.

**Cost Estimating**

HET has estimated the cost of establishing and operating the groundwater recovery and disposal system described above. The precise timing, function, and operation of such a system to achieve remedial goals will require completion of additional field evaluation as proposed. Based on calculations performed, however, a current estimate for installation and operation of this system over a period of one (1) year yields a total cost of $2,131,225.80. As stated above, this is an overly idealized model considering both the limited yield as calculated in Section 3.5 of the Plan and the discontinuous nature of the shallow water bearing zone. An itemized list of costs is attached.