

RIVER GRAVEL AND FLOODING

- **Regulatory History**

- Commercial gravel mining from streams was a common practice prior to 1986.
- Hundreds of thousands of cubic yards were excavated annually peaking in the 70's to mid-80's.
- Practice widespread but particularly intensive in certain watersheds.
- Significant economic incentive existed for landowners to sell gravel from river-valued at up to \$2.00 per cubic yard.
- Commercial operations were prohibited by 1986 legislature.
- Gravel excavation for purpose of property protection continues.

- **1973 and 1976 Floods**

- 1973 and 1976 floods were the first statewide flood events since 1938 hurricane. Nearly two generations of Vermonters grew up without experiencing major storms and floods.
- Enormous expenditures of federal funds were made to repair streambanks and dredge stream channels.
- USDA began recommending periodic channel excavation to protect bank stabilization investments.
- Gravel mining developed into a perceived river management and property protection imperative enabled through the commercial value of the product, the recommendations of resource management professionals and regulatory permissiveness.

- **Gravel Mining and River Morphology**

- During period of most extensive mining, concepts of river morphology, sediment transport and stream stability were poorly understood.
- Contrary to professional judgement and public opinion, extensive mining contributed directly to the destabilization of river channels and increased bank erosion and flood related property damage.
- Virtually all technical references, scientific data, resource management publications and field observations in VT document the destabilizing impact of dredging and gravel mining on stream systems.

- **Sediment Transport and Stream Stability**

- All rivers have capacity to transport sediment due to the energy of water flowing downslope under the force of gravity.

- The stability of a given stream reach is, to a large extent, dependent upon the volume of sediment entering the reach being equal to the volume of sediment being transported through the reach.
 - If the gravel volume entering a given reach exceeds the gravel volume being transported through the reach, the stream bed will build up (aggrade) contributing to bank erosion and flooding.
 - If the gravel volume entering a given reach is less than the gravel volume being transported through or out of the reach, the stream bed will scour down (degrade) contributing to undermining of banks and erosion.
 - Mining or dredging operations that remove a significant volume of sediment available for transport throws the system out of balance. As the river continues to scour gravel out of a reach, an equal volume of sediment is not available to replace it because the material which would normally be available for replenishment has been mechanically removed. Increased erosion and instability is the result.
- **The Stable Form**
 - Under stress, i.e., mining, floods, watershed land use change, human encroachments silvicultural activities or removal of streambank vegetation, rivers may convert from stable to unstable forms.
 - Many VT rivers, particularly those most damaged in the past by mining and more recently by flooding, increasingly exhibit the unstable form.
 - Sediment transport capacity of a stream is directly related to the volume of flow and the channel shape and form.
 - In the unstable form, the ability of a stream to transport the sediment in the system is significantly diminished.
 - 75%-80% of sediment in unstable alluvial river systems is typically generated from bank erosion along the unstable reach.
 - Excessive erosion induced sediment loads create a vicious cycle in which the sediment transport capacity is reduced, the channel form typically gets wider and shallower and more erosion introduces more sediment into the system.
 - The unstable form may persist for decades and may never recover on its own.
 - Neither dredging nor armoring to protect adjacent property will restore the stable form.
 - **River Restoration and Flood Loss Prevention**
 - An unprecedented frequency of 9 regional floods from 1984 through to present has renewed public pressure to prevent floods through stream dredging or gravel mining.
 - Flooding and magnitude of flood loss suffered is a function of extreme meteorological events, climatological cycling or change, the rising level of human

investments and development within riparian corridors and the pervasive, unstable condition of river systems.

- River management, flood damage prevention and property protection efforts must be focused on restoration of the stable stream form and protection of stream corridors from incompatible forms of development. Attempts to control flooding through dredging or mining will only exacerbate the problem.
- River restoration to create stability, provide property protection, reduce future flood losses and improve resource values is technically feasible although somewhat complex.
- Adequate resources are unavailable at this time within the agency to implement river restoration based management.
- There is no coordinated nor comprehensive on-going effort to provide educational and technical guidance to communities in the identification of high risk areas for development within or along riparian corridors. Adequate resources are unavailable at this time within the agency to facilitate any significant efforts in this area.