Purpose
The purpose of this plan is to provide a safe and effective means for relay pumping of water at incidents requiring extremely long hose lays.

Reference Terminology
- Source pumper is the apparatus at the hydrant/water source.
- Relay pumper is the apparatus in the relay.
- Attack pumper is the pumper at the fire.
- Intake pressure is the water pressure coming into the pump.
- Discharge pressure is the water pressure going out of the pump.
- After flushing, open hydrant slowly and completely, ensuring hydrant is fully open.
- Water Supply Group (Supervisor) is the officer in charge of coordinating the water relay.

Large Diameter Hose
- Hose must be laid slowly and straight to one side of the roadway.
    - DO NOT pull excess hose from the bed as it is being deployed. When the hose is charged with water, it will stretch out and become longer forming additional bends or curves that can increase friction loss.
- The supply hose cannot have twists, sharp bends, or kinks.
    - Be sure of this BEFORE the hose is charged with water. Once charged, it is very difficult to move due to weight.
- Vehicles must not drive over the hose. Driving over hose causes damage and stops the flow of water momentarily which can cause a water hammer or other pump problems to occur.
    - Coordinate with the IC to request PD to block the roadway or improvise a road block with fire apparatus or POVs to prevent vehicles from driving over hose.
- Avoid excessive pressures.
    - Extremely high pressures can cause the hose to rupture.
    - Discharge pressures shall not exceed 200 psi.
- Hose can be either forward or reverse laid between the fire scene, relay pumpers, and the water source.
    - Make sure there is ENOUGH hose to complete the lay.
    - Pumpers should be placed no greater than 800–1,000 feet from each other.
- Ensure all Storz connections are tight and locked.

Relay Pumping Operations
- When the hose lay is complete and all pumpers are connected, the source pumper starts flowing water to the relay pumper(s) / attack pumper at 50-75 psi to fill the “relay system.”
    - Hydrant pressure may be enough but must be monitored once hose lines/master streams begin flowing water.
- The relay pumper(s) and attack pumper must have the intake and discharge valves completely open and the pump engaged with the engine at idle.
    - Open unused discharge until water flows to remove air.

- Once water has filled the entire relay system and is discharging at the fire, the source pumper should increase its pump discharge pressure to approximately 100 psi, then increase incrementally as needed.
- Each succeeding pumper should increase its discharge pressure as required to deliver water at the minimum/maximum pressure to the next pumper.
    - Pumpers in the relay should maintain intake pressures between 20 psi MINIMUM and 100 psi MAXIMUM.
        - DO NOT use the "Preset" feature as this can cause a water hammer to occur.
    - Pressure less than 20 psi can cause pump cavitation. Pressure greater than 100 psi can make hose lines difficult to control, may affect optimal water flow, and cause intake relief valves to operate.
        - Maximum pump discharge pressure must not exceed 165 psi.
        - Note: Intake relief valves are factory-set at 125 psi.
- Water flow should be controlled at the attack pumper. NEVER stop the flow of water at the fire until the relay is properly shut down first.
    - Attack pumper must have a method to discharge excess water if/when lines are shut down.
- Allow time (approximately 20 seconds) for pressures to equalize within the system.

Relay Shut Down Procedures

- While still discharging water at the fire scene,
    - The attack pumper at the fire reduces engine RPM slowly to idle.
    - Repeat the sequence with relay pumper(s) back to the source pumper.
    - Next, slowly close the discharge valve(s) on the attack pumper.
    - Repeat the sequence with relay pumper(s) back to the source pumper.
    - Re-circulate water in each pump, or disengage pumps.
- If water supply is lost
    - Close the intake valve & open the tank-to-pump valve
        - Pull the primer valve as needed
    - Notify the Water Supply Group

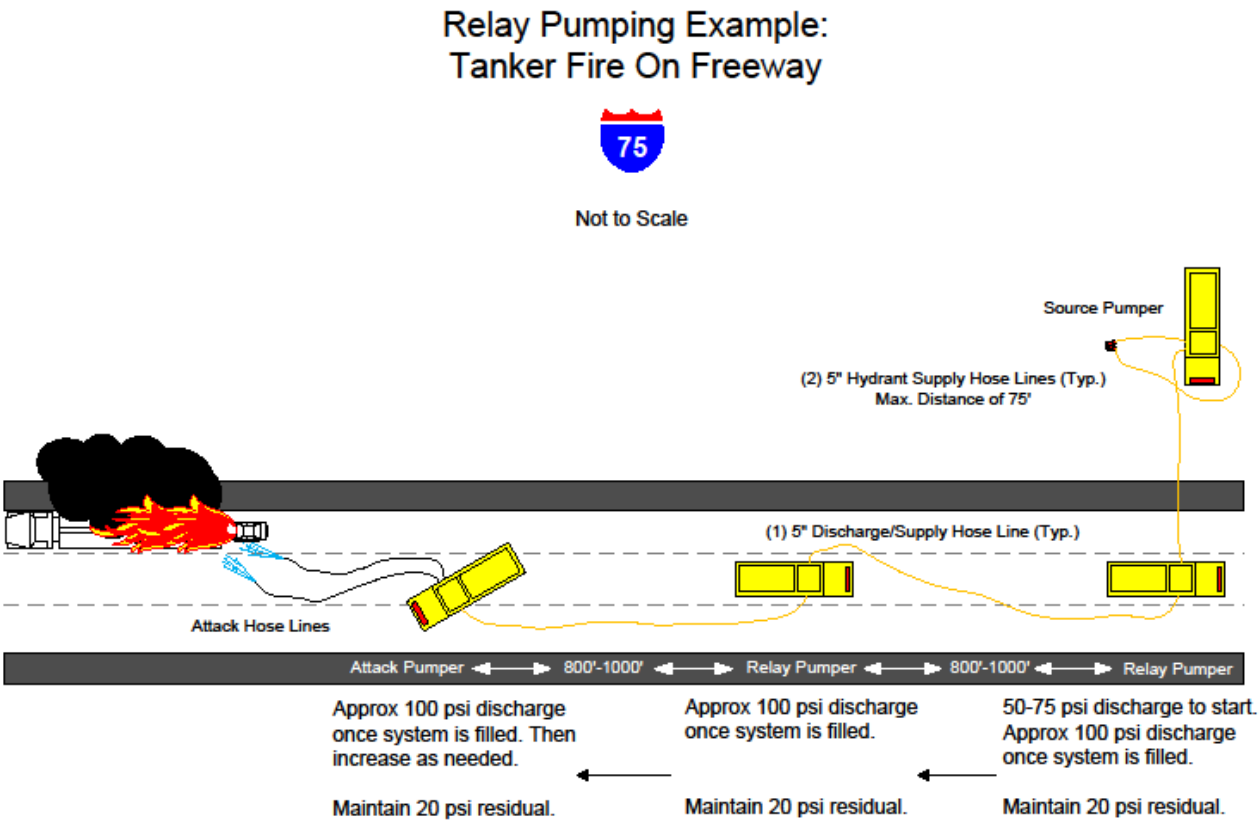
Friction Loss and Elevation Loss / Gain

- Friction loss is the loss of pressure due to friction which occurs in the hose, fittings, and appliances (nozzles).
- Elevation loss/gain is the loss or gain of pressure due to the weight of water and the effect of gravity.
    - When pumping uphill, increase pump pressure ½ psi per foot of elevation change above the pump.
    - When pumping downhill, decrease pump pressure ½ psi per foot of elevation change below the pump.
- As the flow rate increases, so does friction loss.
    - The faster the water flows, the more friction there is, and the greater loss of pressure.

Friction Loss (Rounded) in 5" Large Diameter Hose (LDH)

Flow Rate (GPM)	Loss Per 100' (PSI)	Loss Per 1000' (PSI)
250	0.5	5 psi
500	2	20 psi
750	4.5	45 psi
1,000	8	80 psi
1,250	12.5	125 psi
1,500*	18	180 psi

** Depending on water supply, relaying 1,500 GPM may be limited to 800 feet.*



Personnel Assignments

- Two apparatus operators are required at each pumper.
  - One person to operate the pump/monitor pressures.
  - One person (officer or senior firefighter) to operate the radio and to coordinate with other pumpers & the Water Supply Group on assigned talk group or tactical channel.
- Three command officers in the Command Post.
  - Incident Commander ("Command")
  - Water Supply Group Supervisor ("Water Supply Group")
    - For long relays, this officer may "drive" along the relay to oversee/verify connections and operations
  - Support/Command staff

Communications

- Use separate tactical channel and talk group.
  - Tac-X for fire attack (IDLH environment / close-range between crews, Staging & IC.
  - TRF_FDx for Water Supply Group / long-range between apparatus.
  - Attack pumper (Engine X) apparatus operator / radio on Tac-1 for fire attack & 2nd person / radio on FDx for water supply.
  - Relay pumper(s) (Ladder X, typically) & Source pumper (Engine Y) 2nd persons on FDx for water supply.
    - These apparatus operators do not require a radio.
  - Use full call signs:
    - Crews will be known as "Engine X Crew 1, Engine X Crew 2," Ladder X, Crew 3," etc., regardless of assignment.
      - Assignments are tracked on the accountability board and shared between Staging and the Command Post either face-to-face or by radio.
    - Water Supply Group Supervisor will be known as "Water Supply Group" on FDx talk group.
  - Apparatus communicate with the next-in-line apparatus.
    - Attack pumper 2nd person talks to relay pumper 2nd person.
    - Relay pumper 2nd person talks to attack pumper 2nd person and source pumper 2nd person (or next pumper-in-line providing water supply).
    - Source pumper 2nd person talks to relay pumper 2nd person.
    - All apparatus 2nd persons talk to Water Supply Group (supervisor) as needed.
      - If intake pressures are consistently below 20 psi.
      - If the pump has to be shut down for some reason.