Is Your Fire Department Efficient?

Presenter Background:

Charles Clark

Member Ohio Fire Chiefs Association's Technical Advisory Committee on Water Supply
- Currently Colerain Twp. FD Water Supply Officer
- Member Colerain Twp. FD since 1983
- Colerain Twp. Clerk/Fiscal Officer 1996-2016
- Government Teacher at Pickaway-Ross Career and Technology Center 1975-2009
- Member Colerain Twp. FD Water Supply Committee
The Ohio Fire Chiefs Association’s Water Supply Technical Advisory Committee—

- The Ohio Water Supply TAC is made up of fire fighters from all over Ohio who are interested in improving water supply at fire scenes.
- The committee promotes best practices in delivering water to a fire scene.
- They conduct tests to determine the efficiency of water movement equipment.
- Members travel around Ohio conducting drills on how to efficiently access alternative water sources.
- Ohio is a national leader in alternative water supply training.
- Other states use training programs developed by the Ohio Water TAC.

The Ohio Water Supply TAC is a reduced 1.5.0. RATING (Class 7) using alternative water sources (tanker shuttle) no fire hydrants; Water supply is 40% of water to earn a reduced 1.5.0. RATING (Class 7).

Case Study: Colerain Township Fire Department/Ross County

Founded in 1983, last township in county to form a fire department;

- By 1985 Colerain Twp. FD was the 3rd FD in Ohio to earn a reduced 1.5.0. RATING (Class 7) using alternative water sources (tanker shuttle) no fire hydrants; Water supply is 40% of water to earn a reduced 1.5.0. RATING (Class 7).

Home owners in the fire district have saved over $1.5 million in home insurance premiums.

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A humble beginning for Colerain FD. Class 7.5.0. Rating with just $17,000 invested in trucks!
Since its founding Colerain FD has continued to innovate in the area of water delivery to fire scenes. The Single Lane Water Supply Setup delivering 1,000 GPM on a narrow road.

Efficiencies to be explored in this presentation:

- Mechanical Efficiency;
- Manpower Efficiency;
- Financial Efficiency;

Why should elected township officials know about fire department efficiency? The buck stops here! You sign the check to purchase equipment that your emergency personnel will rely on for the next quarter century. Why should elected township officials know about fire department efficiency? The buck stops here!

Delivering 1,000 GPM on a narrow road.
A fire truck is a major investment. One fire truck can cost more than your whole fleet of Road Department vehicles.

Main pumper purchased in 2000
Total Purchase Price: $164,000

Road Department purchases since 2002:

- Large Dump Truck/Snow Plow
- Small 4X4 Dump Truck/Snow Plow
- Road Mowing Tractor
- Backup Loader

Total Purchase Price since 2002: $159,000

Colerain FD Truck Replacement Budget

(175 squad runs/year and 70 fire runs/year)

Truck replacement costs (starting prices) (2 fire stations):

- 2 Basic Pumpers @ $240,000 each: $480,000
- 2 4X4 EMS Squad @ $190,000 each: $380,000
- 1 Wildfire Truck @ $500,000 each: $500,000
- 2 Water Tankers @ $200,000 each: $400,000

Balance: $150,000

Colerain Township FD Truck Replacement Budget:

$58,000/yr x 20 yrs = $1,160,000

40% of 4.5 mill levy (6.5 mill voted) plus interest earned:

What would you do to balance this budget?
Federal Excess Property Program: 5,000 gal. Aircraft Refueling Truck.

Recycling at its best!

Narrow roads, old overloaded tankers = a recipe for disaster.
Do grants help balance your emergency vehicle budget?

What are some other options to get the most bang for your buck when purchasing emergency equipment?

Do we wisely spend grant money?

Colerain FD no longer seeks Federal Grants

Consider this: Federal Grants are most likely borrowed money. With a national debt of over $20 trillion, this money our government has borrowed will never be paid off. Our grandchildren’s grandchildren will simply pay the annual interest bill.

Colerain Twp./Ross County has set up a Fire/EMS Department Truck Fund. 40% of the tax levy (44 mills) is ear marked for emergency vehicle purchases by transfer to this fund. Also all interest earned by investments of Fire/EMS funds is transferred from the General Fund to the truck fund at the end of each year ($6,000).

Thanks to lean budgets in the recent years Colerain has built up a savings program to pay cash when a new vehicle is purchased. – not a proud legacy!

Colerain FD pays cash for emergency vehicles!
Good neighbors complement each other; they don’t compete with each other.

Saltcreek Twp. FD
- foam system

Green Twp. FD
- one tanker
- ladder truck
- drafting butterfly valves

Colerain Twp. FD
- 3 tankers
- single lane water supply setup
- breathing air cascade system
- extra suction hose
- portable pump
- one tanker
- Harrison Twp. FD

Laurelville FD
- one tanker
- portable pump
- pumper/tankers

Harrison Twp. FD
- one tanker
- portable pump
- extra suction hose

Springfield Twp. FD
- drafting butterfly valves

Beloit and Jefferson Counties each have county-wide tanker task force groups.

Belmont and Hocking Counties

Ross County
- 2 tankers
- drafting butterfly valves
- ladder truck
- one tanker

Pickaway County
- Foam system
- Salt Creek Twp. FD

Hocking County
- Laurelville FD

Do you work with other government entities to provide the most efficient services?

They respond to fires together with automatic mutual response agreements. They train together (i.e., uniform dry hydrant fittings), and apply for grants together.
A super efficient tanker is a tanker that can do everything that a conventional gravity dump tanker can do plus much more!

Note: Wayne County in Ohio is already at this level of development.

5 efficient tankers @ 200 GPM each = 1,000 GPM. Compare to cost of fire hydrant system in your township.

Tanker Efficiency (Tankernomics)
3 Colerain Twp. FD Tenders:
1911: 2,800 gal. capacity; 2,520 gal. dumped during 1 min. critical dump time
1912: 2,800 gal. capacity; 2,520 gal. dumped during 1 min. critical dump time
1913: 1,725 gal. capacity; 1,553 gal. dumped during 1.5 min. critical dump time

6,593 gal./15 min. tender cycle time (4 mile round trip) = 440 GPM*  
*ISO calculation: 505 GPM on paper; Actual drill w/pumpers 290 GPM (48 GPM per person)

3 Morrisvale vacuum tenders with no fill pumpers actual drill: 646 GPM (215 GPM per person)

A fire tanker water shuttle can be compared to a NASCAR race with two pit stops per lap!

It's all about efficiency!

With limited manpower available at fire scenes we need to work as efficiently as possible.
We tried to build an efficient gravity dump tanker; designed to fill fast and dump fast.

We tried to build an efficient gravity dump tanker;

$200,000-$300,000 for nothing?

Can you afford to spend

80% is the same as one truck out of

2,400 gal. is only 80% of advertised
dumped per l.s.O.

2,400 gal. 90% actually delivered

30 gal. water spillage on road;

-30 gal. water spillage on front wall;

2,670 gal. actual delivered to fire scene;

-100 gal. tractor inner tube to cushion water pressure on front wall;

2,800 gal. actual tested volume

3,000 gal. nominal size

Our „Efficient“ Tanker:

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Commercial truck scales can give you precise measurements of water dumped from a tanker (one gallon water = 8.35 lb.)

We performance test pumpers once every year.

- Annual pump test required for I.S.O. rating.
- A 1250 GPM pumper must flow 1250 GPM.
- 1,000 GPM (80%) is not acceptable!
- 7,000 GPM (80%) is not acceptable!

We almost never performance test tankers!

- I.S.O. is going to 5 year inspection cycle. This is good. 15 years was too long.
- No tanker shuttle performance test. This is unfortunate – we gained many proficiencies from this exercise.

From this exercise, we gained many proficiencies.
Tankers in the future will be more efficient if they are able to side dump. Rear dump only. Notice the front wheel of the tanker is off the road way. If the truck would get stuck in a ditch how would it affect your water supply operation? How can this truck be inexpensively modified to side dump capability? (see next slide)
Rear dump only tankers can be retrofitted to side dump.

Tankers need to have efficient side dumping capability.

Comparison of dump valve sizes:

- 8” diameter round dump = 50 sq. in.
- 10” x 10” square dump = 100 sq. in.
- 14” x 14” square dump = 196 sq. in.

Got Big Water Associates: “Results show a clear out performance of a 10” square dump valve over the 8” round dump valve. 10” square dump should be minimum size.”
It's human nature to only rise to the level of minimum expectations.

- If you don’t issue strict performance specifications you will most likely get a tanker that performs at minimum levels.
- If your specifications only say “…tanker shall be equipped with a dump valve…” you’ll have to live with the performance of that piece of equipment for the next 25-30 years.
- We spend countless hours researching to write specifications for pumpers and then accept any tanker that might be in stock.
- In recent years there’s been more and more testing of several types of water supply equipment. There’s a wide range in efficiency found in most studies.

Can the side dump efficiently empty the water tank?
Double fill inlets contribute to quicker and safer loading of water.

Single fill inlet meets NFPA standards. It's cheaper to build with one.

Two side dumps—still has to deal with low head pressure as water drains out.

Double fill inlets contribute to quicker and safer loading of water.
In 1991 a gravity dump tanker was built and tested that could dump 99% of its water in under 90 seconds. The key is maintaining head pressure.

Building a trough in the bottom of the tank creates about .36 lb. additional head pressure. The flow from the trough is full until the tank has emptied to the point that water is only in the trough. How many inches of water won’t drain out of the crown or drainage slope built in the road. How many inches of water won’t drain out of the crown or drainage slope built in the road?

Why are gravity dump tankers not built like this? Tanks are built to your specifications. Would it cost more to build a more efficient tank? Would this tank be more top-heavy?

Why does I.S.O. only credit gravity dump tankers with delivering 90% of their capacity? Notice the thin sheet of water coming out of the dump valve. It can take as long as 3-4 minutes to completely dump all the tanks. Can tanks be dumped in under 2 minutes? Why aren’t gravity dump tankers built like this? Tanks are built to your specifications. Would it cost more to build a more efficient tank? Would this tank be more top-heavy?

Building a trough in the bottom of the tank creates about .36 lb. additional head pressure. The key is maintaining head pressure. In 1991 a gravity dump tanker was built and tested that could dump 99% of its water in under 90 seconds. Notice the crown or drainage slope built in the road. How many inches of water won’t drain out of the crown or drainage slope built in the road?
We need to have testing and strict performance specifications for all pieces of fire equipment. The least efficient jet siphons would consume 364 GPM each. If the dump site pumper was using jet siphons are only using 91 GPM each. Two highly efficient jet siphons to a fire scene through large diameter hose. Two highly efficient jet siphons are only using 91 GPM each. Two highly efficient jet siphons are only using 91 GPM each. The least efficient jet siphons would consume 364 GPM each. If the dump site pumper was using jet siphons are only using 91 GPM each.

Jet Siphon Efficiency. 1250 GPM pumper is pumping 1,068 GPM to the fire scene. It would only be able to pump 522 GPM to the fire scene if the dump site pumper was using jet siphons are only using 91 GPM each.
If we only had some way to force the remaining water out of these trucks.

A vacuum tanker pressurizes the whole water tank to efficiently force out all available water. When nothing but air blows out of the tank you know the tank is empty. A vacuum tanker is “0 loss.” The water tank is sealed traveling down the road – no water spillage resulting in ice buildup on the road.
A super (vacuum) tanker can do everything a conventional tanker can do plus much more.

Features include:
- The ability to self fill and dump on both sides and rear of the truck;
- 6 inch suction/pressure dump port
- Standard fire pump

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A super (vacuum) tanker can do everything a conventional tanker can do plus much more.
Laurelville Pumper 608 drafting through 33 ft. of 6 in. suction.

Demonstrator Vac. Tanker drafting through 48 ft. of 6 in. suction.

One highly efficient low level strainer/jet siphon for jet siphoning:
- two single lane draft tanks (6 ft. wide);
- one high 90 degree suction elbow;
- one 6 in. butterfly valve;
- one 6 in. butterfly valve;

Pressure dump/vacuum ports

The primer on a standard fire truck evacuates 20 cu. ft. per min. to prime suction hose.

Colerain FD’s Super (Vacuum) Tanker 1912 features a 1,000 GPM fire pump to achieve prime suction.

This explains why vacuum tankers can achieve prime through 123 ft. of 6 in. suction hose in just 26 seconds. Also if there is a slight air leak it is no problem for a super tanker.

The introduction of automatic air primers has so little effect on the distance a pumper can prime to draft.

1,000 GPM fire pump

Long Distance Drafting

Pressure dump/vacuum ports

The primer on a standard fire truck evacuates 20 cu. ft. per min. to prime suction hose.

Colerain Vac. Tanker 1912 drafting through 63 ft. of 6 in. suction.

Demonstrator Vac. Tanker drafting through 48 ft. of 6 in. suction.

Lauraville Pumper 608 drafting through 33 ft. of 6 in. suction.

The average fire truck only carries 20 ft. of 6 inch suction. Why? The primer on a standard fire truck evacuates 20 cu. ft. per min. to prime suction hose.

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The primer on a standard fire truck evacuates 20 cu. ft. per min. to prime suction hose.
Excellent visibility for the driver when the vacuum tanker is side dumping.

Fill Site Comparison

How much more simple and efficient would it be for one person and one vacuum tender to deploy 1-2 sections of suction hose and haul over 200 GPM from this water source which was flowing 250+ GPM during this drill? How long would it take to set up this fill site with mutual aid departments? (35-40 min. after primary dispatch?) Compare this to 2 tenders; one pumper, 5 people, portable pump, dump tank, 6 sections of hose; hose holder; etc. How long would it take to deploy 2 sections of suction hose and haul over 200 gallons?

You must Goggle: “5,000-Gallons in 5-Minutes – Got Big Water” to see maximum efficiency! Explore the www.gotbigwater.com website – It’s outstanding!

No turbulence at the suction strainer.
Vacuum tenders? Two more suction lines could be extended to the pond—only two vacs. No waiting for vacs. to fill! Vacuum tenders are more flexible than conventional gravity dump tenders. They can pull out of line and access other water sources—effectively cutting the wait time of the conventional tenders.

What if these were all vacuum tenders? Two more suction lines could be extended to the pond—only two vacs. No waiting for vacs. to fill! Vacuum tenders are more flexible than conventional gravity dump tenders. They can pull out of line and access other water sources—effectively cutting the wait time of the conventional tenders.

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A tender shuttle is similar to a NASCAR race with two pit stops per lap (fill site & dump site) - the race can be won or lost in the pits. In NASCAR no one waits to pull into a pit stop (We'd never see several cars sharing the same pit crew.) Tenders should not wait to fill! This is a common problem at tender shuttles. When calculating tender efficiency, I-5.0. Consider: dump time, travel time, and fill time. They do not include wait time. What if these were all vacuum tenders? Two more suction lines could be extended to the pond—only two vacs. No waiting for vacs. to fill! Vacuum tenders are more flexible than conventional gravity dump tenders. They can pull out of line and access other water sources—effectively cutting the wait time of the conventional tenders.

Conventional gravity dump tenders waiting to fill at a fill site. This is a sign that more fill capacity is needed. A tender setting still is not moving water. A tender shuttle is similar to a NASCAR race with two pit stops per lap (fill site & dump site) - the race can be won or lost in the pits. In NASCAR no one waits to pull into a pit stop (We'd never see several cars sharing the same pit crew.) Tenders should not wait to fill! This is a common problem at tender shuttles. When calculating tender efficiency, I-5.0. Consider: dump time, travel time, and fill time. They do not include wait time. What if these were all vacuum tenders? Two more suction lines could be extended to the pond—only two vacs. No waiting for vacs. to fill! Vacuum tenders are more flexible than conventional gravity dump tenders. They can pull out of line and access other water sources—effectively cutting the wait time of the conventional tenders.

does not freeze at -13 degrees F. This is all we need to access this same spring fed water source that
Like most fires without a strong hydrant system the Hocking Hills Lodge fire was doomed because of a lack of adequate water supply. Our vacuum tanker was able to access a water supply within 4 mile round trip while conventional tankers were traveling 30 miles to secure water from hydrants in Logan (a one hour cycle time).

- **COST EFFECTIVENESS:** Vacuum tankers deliver more water delivered/dollar invested?

- **MANN POWER:** One person can have a vacuum tanker fill site set up and 2,000 gal tanker self loaded with water within 5 minutes;

- **ISO CREDIT:** Gee's credit for 100% of its water capacity from ISO — why are conventional (gravity dump) tankers penalized by ISO?

- **SAFETY:** Can safely and conveniently push 1500 GPM (at a safe low pressure) to a pumper for a direct attack on a fire.

- **WEAK INFRASTRUCTURE:** Can self-fill at 1,300 GPM from a dump tank at a hydrant flowing a gentle & steady 200 GPM.

- **EQUIPMENT EFFICIENCY:** Can lap conventional tankers waiting in line to fill from a pumper during tanker shuttles.

- **WATER ACCESS:** Vacuum tankers allow access to water sources never before available when using standard fire pumps on conventional tankers; it is a portable dry hydrant system with all parts easy for one person to reach from the ground.

- **MANPOWER:** Our vacuum tanker was able to access a water supply within 4 mile round trip while conventional tankers were doomed because of a lack of adequate water supply. Our vacuum tanker was able to access a water supply within 4 mile round trip while conventional tankers were traveling 30 miles to secure water from hydrants in Logan (a one hour cycle time).

- **FUNDING:** Five vacuum tankers can usually deliver more water to a fire scene than hydrants on a rural water line! Compare the cost of 5 vacuum tankers to a system of fire hydrants. (1985: 500 GPM fire hydrant system = $10,000,000/twp.)

- **WEAK INFRASTRUCTURE:** Can self-fill at 1300 GPM from a dump tank at a hydrant flowing a gentle & steady 200 GPM.

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Vacuum tankers address many issues facing fire departments.
Avoiding tanker gridlock

Your County Auditor's website and Google Maps can be used to find water supplies that are not visible from the road. Measure lanes and water levels to ensure a safe delivery route. Pond, 600 ft. driveway, and Fire are marked on the map.
"Save" laying a hose line?

Use Large Diameter Hose to avoid tanker gridlock back a lane.

Many fire fighters hesitate to lay a supply line because they don't want to pick up hose after the fire. How much work and manpower during the fire is saved if you use the LDH supply line? Can another crew of volunteers help pick up hose? It only took 20 minutes to pick up 900 ft. during a recent drill.

What if a tanker gets stuck backing out the lane?
Why use larger diameter water transport hose?

When you double the diameter of a water line you quadruple the flow of water under the same pressure.

Maximum flow when pumping water back a 2,000 ft. lane to a fire scene:

- 2.5 inch hose = 250 GPM
- 3 inch hose = 400 GPM
- 4 inch hose = 800 GPM
- 5 inch hose = 1,400 GPM

When you double the diameter of a water line you quadruple the flow of water under the same pressure.

When you use larger diameter water transport hose?
Trucking water to a fire scene on a narrow road is a major logistical operation.

**The single lane water supply set up**

Rectangular dump tanks make it possible to keep the water supply set up in a single traffic lane. There are only two sections of jet siphon tube needed for this set up. Pumper drafts from 2 dump tanks. Only one pumper needed at the dump site. Rear dump tankers can dump when coming from either direction without needing to turn around. This set up can supply 800-1,000 GPM back the lane when using a 1250 GPM pumper.

First used by Colerain Twp. FD in 1994.

Can you think of other variations to this set up?
Manpower Efficiency

When Handling Suction Hose

(Alligator wrestling)

How many people are needed to unload suction hose from the standard fire truck?

The typical mutual aid pumper arriving to draft and be a water supply pumper might only be staffed by one fire fighter. How does that one person unload hose alone?
What if you stored suction hose on the truck where one person can reach the hose standing on the ground?

This vacuum tanker is capable of hauling up to 135 ft. (9 sections) – all accessible to one person standing on the ground!

The power fold down dump tank rack holds two dump tanks and can be modified to hold up to three sections of suction hose. The rack can be lowered for easy and safe access to the suction hose.

2 sections of suction hose in each of three compartments
3 sections of suction hose

What if you stored suction hose on the truck where one person can reach the hose standing on the ground?
How does one person hook together three sections of suction hose alone?

How long until this pumper is sending water to the fire?

How long do you have to wait for a third section hose to show up?

“Widen the road!

Or……”
…use 90 degree suction elbow to keep suction hose up close to the pumper.

This allows tankers and other traffic to drive past the pumper on a narrow road.

A 90 degree suction elbow helps make a tight turn to guide the suction hose down along the pumper to connect to a dump tank in the same traffic lane.
supply operations. Single lane water supply operations through the side wall of a dump tank flange to draft tank flange to draft to the dump tank flange.

The Porter-Kingston FD in Delaware County introduced the dump tank drafting flange to draft through the side wall of a dump tank during single lane water supply operations. Only one section of suction hose (no connecting two sections together) custom sized to fit your needs (13 ft.). 90 degree suction elbow can be preconnected to suction hose quickly.
The single lane water supply setup includes drafting from both sides of the pumper.

Your pumper needs to carry four sections of suction hose (40+ ft.) instead of the N.F.P.A. minimum two sections (20 ft.) of the suction inlet on the pumper. Automatic air primers make it effortless to establish draft and immediately begin flowing water to the fire. A suction section is within 2-3 ft. of the suction inlet on the pumper.

It is easy to prime the fire pump when the dump tank has been filled. Water level in the truck while the suction lines are being hooked to the truck.

The single lane water supply setup includes drafting from both sides of the pumper.
Pumper Ordering Suggestions:

- Specify a 1500 GPM fire pump over 1250 GPM; great help on I.S.O. rating at minimal cost.
- Large pumps are needed for tanker shuttles.
- Specify automatic air primer; large pumps are needed for tanker shuttles.
- Great help on I.S.O. rating at minimal cost.
- Specify a 1500 GPM fire pump over 1250 GPM.

3 inch line. 3 inch only flows 552 GPM. 4 inch allows 1100 GPM to flow to pump. 3 inch meets N.F.P.A. standards; N.F.P.A. standards are minimum standards – you don’t want minimum performance!

Specify 40 ft. of large suction hose – not 20 ft. (N.F.P.A. min.)

12 Volt LED Lighting is a must even if you need to retrofit!

Generator on slide out tray and suction hose block traffic from going past pumper.
“Hydrant Hooked”

Many fire departments are “hydrant hooked.” They only use water from “flushing devices” (hydrants). They drive past excellent water sources and travel many miles to line up at weak flow hydrants. If you must use a hydrant as a water source, water can flow consistently and gently into a dump tank. A pumper can be used to draft from the dump tank to quickly fill tankers.
A vacuum tanker safely and gently drafting water from a dump tank fed by a hydrant.

This vacuum tanker can self fill at 1,300+ GPM.

Each section of water lines with respect to each other, material and poly tanks are limited to 1,000 GPM fill rates to avoid violating poly tank warranties. Slamming hydrants open and closed contaminates drinking water, breaks the connections apart and allows dirt and rocks into the water lines. Water hammer from slamming goes directly into tankers and then damages the impellers of fire pumps, damaging our neighbor’s drinking water. These abrasive materials go directly into tankers and then damage the impellers of fire pumps.

We must treat our domestic water lines with respect.
Vacuum tanker accessing water from a stream 30 ft. from the roadway.

Floating strainer has tray on bottom which keeps out rocks and dirt.

Can the typical fire truck access this stream?

The typical fire truck carries only 20 ft. of suction hose (N.F.P.A. standard).

The typical tanker will travel many additional miles to wait in line at a hydrant to refill its water tanks.

This tanker carries up to 90 ft. of suction hose. It can combine its inventory of suction hose with another tanker to reach even further.

Vacuum tanker suction hose primed in 26 seconds (over 2 min. with air primer).

Vacuum tanker drafting through 123 ft. of suction hose (portable "dry hydrant") in 2 min.

Pumper drafting through dry hydrant to fill conventional tankers.

1. Pumper drafting through dry hydrant to fill conventional tankers.
2. Vacuum tanker drafting through 123 ft. of suction hose (portable "dry hydrant").
3. Vacuum tanker suction hose primed in 26 seconds (over 2 min. with air primer).
4. 500 cubic ft. per minute pump used on vacuum tanker. Compare to 10 cubic ft. per minute pump used on standard pumper.

Vacuum tankers carry up to 90 ft. of suction hose. This allows them to combine their inventory with another tanker to reach even further.

The typical fire truck cannot access this stream. The vacuum tanker can access water from a stream 30 ft. from the roadway.
To fill conventional tankers quickly you usually need to use a pump. Do not exceed 100 p.s.i. pump pressure and a flow of 1,000 GPM to avoid doing damage to the poly water tanks.

Fire fighters using the manifold which distributes water need to be dressed in full protective gear. The next tanker filled can already be connected to be ready to quickly switch over so there is no delay in water flow into tankers. The next tanker filled can already be ready to be connected. The manifold which distributes water can be like the one pictured.
Future Contact:
Charles Clark
Colerain Twp. FD Water Supply Officer
Email: cdclark@horizonview.net
Cell Phone: 740-649-5727