



MALCOLM

Dewatering

Deep Wells
Vacuum Wellpoints
Eductor Wells
Artesian Conditions
System Design
Water Treatment



Dewatering

Malcolm offers complete construction dewatering services, from site evaluation and system design through installation, operation and maintenance. Our unmatched experience, tools, and equipment fleet allow us to install dewatering systems in the most difficult subsurface conditions.

INSTALLING DEWATERING SYSTEMS

Installation is the most critical aspect of all dewatering systems. Improper installation techniques will render the most carefully designed system completely ineffective. Such dewatering systems can truly hamper the success of an overall project and its schedule. Malcolm is skilled at installing the widest array of dewatering systems, including deep wells, and vacuum wellpoints, eductor wells, recharge wells, and horizontal drains, in all types of subsurface conditions.

Our fleet of state-of-the-art, high-torque, hydraulic drill rigs, and our vast array of drill tools, allow us to easily install dewatering systems in sand, gravel, cobbles, boulders, and rock (fractured and in-tact). We also have two of the largest crawler-mounted drills ever made, as well as a number of limited-access and low-overhead drill rigs for those hard to reach areas.

MALCOLM DRILLING COMPANY

Since 1962, Malcolm Drilling Company has consistently provided the best in service to each of its projects. With a network of district offices, Malcolm has been able to accomplish effective, efficient, and successful results on underground construction projects all over the United States, and more recently, in the Pacific and South America. As an independent, family-owned business, Malcolm has been able to reinvest its capital in specialty equipment, allowing it to stay at the forefront of the industry, and continue to offer a wide range of services. Wherever your jobsite is located, and no matter how difficult the challenges are, Malcolm will provide you with the best dewatering solution for your project, at a competitive price.



3 Phase 480 volt electrical control distribution panels for dewatering pumps. Malcolm can provide different options when it comes to supplying power.

Deep Wells



Deep wells are best suited for high-permeability soils (sands and gravels) and high pumping volumes or head conditions. Based on site-specific subsurface conditions, deep wells are often the most efficient and cost-effective dewatering solution. In the case of coarse-grained sands, gravels and cobbles, deep wells are often the only possible answer. Malcolm has the expertise and equipment to install dewatering systems in the most difficult subsurface conditions. With our fleet of modern drill rigs and drilling tools, Malcolm is capable of installing wells through sands, gravels, cobbles, boulders and rock, as well as into artesian conditions (groundwater under hydrostatic pressures).

Deep wells can be equipped with electric submersible pumps (0.5–15 HP), which are typically connected via flex hoses to a common HDPE header piping that leads to the discharge location. These wells are typically installed outside the excavation; however, depending upon the shoring systems, these wells can also be installed and utilized on the inside of a cutoff shored system. Well spacing is dependent upon the subsurface conditions and the constructability, all of which are taken into consideration by the dewatering design and our field expertise.



OPPOSITE: Interior deep wells located along the inside perimeter of this cutoff shored excavation that extends 50 feet deep.

TOP LEFT: Rotary drill rig installing a temporary cased deep well to avoid potential caving.

TOP RIGHT: Typical connection for deep wells from well to header piping.

BOTTOM LEFT: Deep wells installed 50 feet on center; the pumps were leap-frogged as the pipe was installed and backfilled.

BOTTOM RIGHT: Installing 12-inch PVC well screen into a fully cased well.

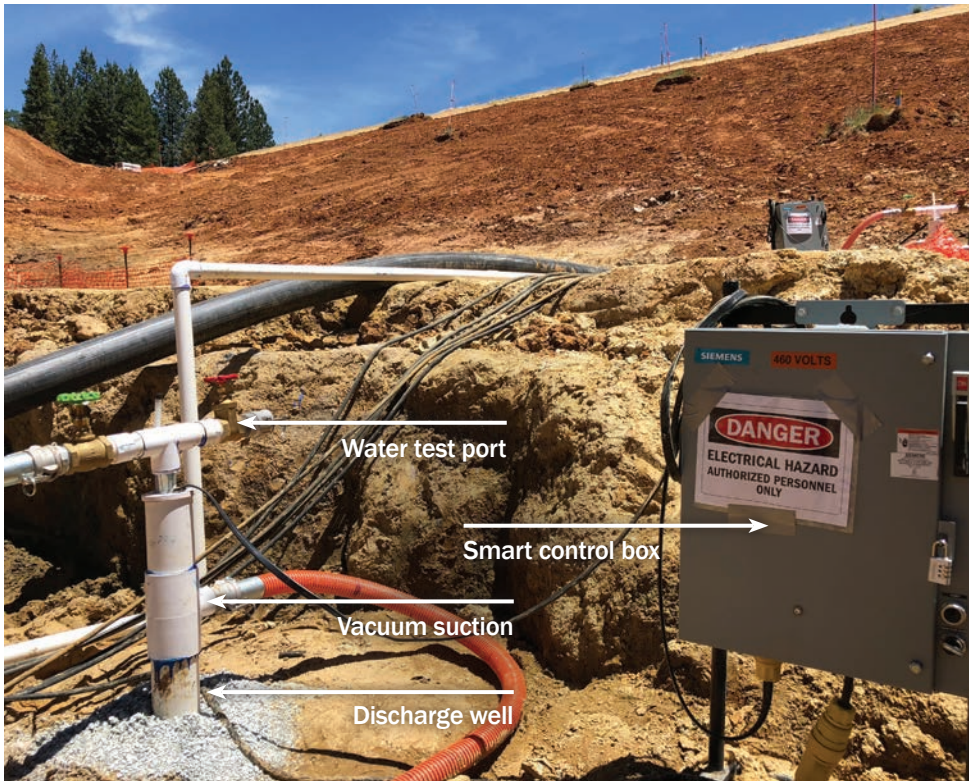


Deep Wells with Vacuum Assist



The deep well with vacuum assist is used in low permeability soils when typical wellpoint dewatering wells are too shallow to be used as a stand-alone method. The small diameter deep well is drilled and installed with a submersible pump, like a normal well would be installed. When the vacuum is introduced into the deep well, it is able to draw water from the low permeability soils to the screen, allowing the pump to lift it from the well. This system is much like an eductor system but it allows for less targeting of the low permeable

soils as they are encountered. These wells can be equipped with a 4 inch submersible pump ranging from 0.5 to 5 horse power (HP). The pumps can pump anywhere from 2 gallons per minute (GPM) to 150 GPM depending on the total dynamic head (TDH) of your system.



TOP LEFT: Four inch well with suction line, discharge, test port and smart control box allowing the well to run dry without damaging the pumps.

TOP RIGHT: Vacuum pumps provide suction to common vacuum header pipe, running to each well.

BOTTOM LEFT: Dewatering excavation on the downhill side of an earthen dam well are 25 feet on center; static water level prior to dewatering was 6 feet below ground surface.

BOTTOM RIGHT: Dual HDPE discharge header pipe used to convey the dewatering water from the wells to the discharge location. The header pipe was split to reduce the TDH allowing more water to be pumped from the wells.



Vacuum Wellpoints



Vacuum wellpoints installed every 8 feet successfully dewatered an 18-foot basement excavation.

Vacuum wellpoints are well suited for low to moderate permeability soils where layers and pockets of permeable materials are interbedded with silts and clays. They are generally 15 to 25 feet deep and are constrained by the limits of vacuum to lift water out of the ground. They typically have a 3-foot-long slotted well screen at the bottom and are most often spaced from 2 to 10 feet on center, depending on the soil types.

The installed common HDPE header pipe applies a vacuum to the series of individual wellpoints and transports the water from the wellpoints through the riser and swing joint hose assemblies to the pump and eventually to the discharge location. Filter sands are used to fill in the drilled holes outside the PVC wellpoints to decrease the entrance loss and prevent clogging of the well screens. These sands

also provide vertical drainage through the silt and clay layers. As shown in the drawdown image example, vacuum wellpoints have a tighter drawdown curve than deep wells and are a much better option for dewatering where the excavation ends in impermeable soils and groundwater will not move easily through.

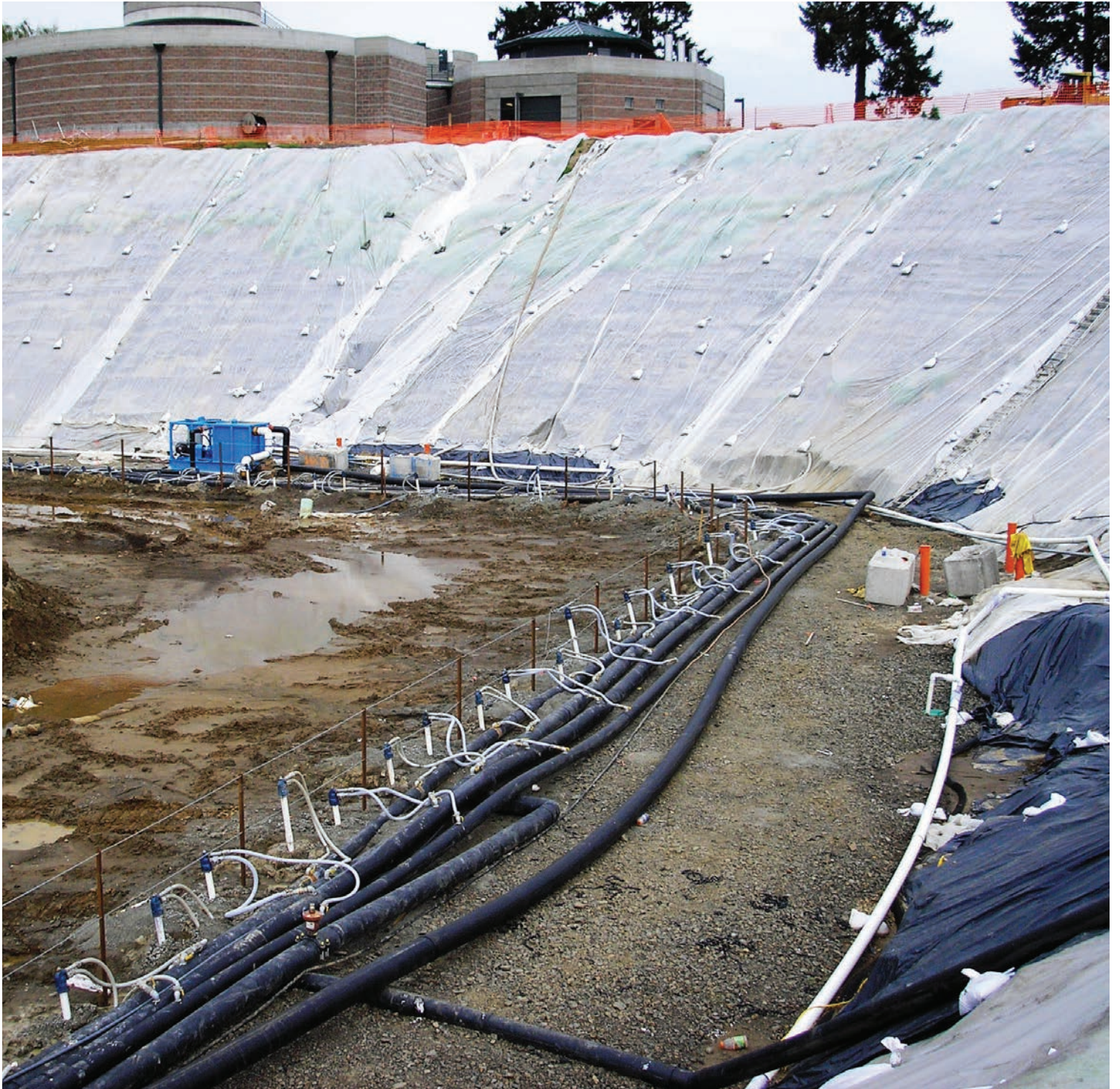
In scenarios where the excavations exceed vacuum lift limitations (15 to 20 feet), wellpoints can be installed through the shoring walls (battered) to maximize the vacuum system efficiency. These installations are similar to that of tieback installations through shoring walls. In these cases, the common HDPE header pipe and vacuum pumps can be hung on the face of the shoring walls to maximize the excavation footprint. Vacuum wellpoints can easily be integrated into all shoring systems, typically installed with the same equipment to help minimize costs.



TOP LEFT: Vacuum wellpoints installed through the shoring wall in order to reach excavation depth and still lift the water out of a deeper excavation.
BOTTOM LEFT: Vacuum wellpoint system hung on shoring wall.
RIGHT: Vacuum wellpoints closely spaced due to nearby river.



Eductor Wells

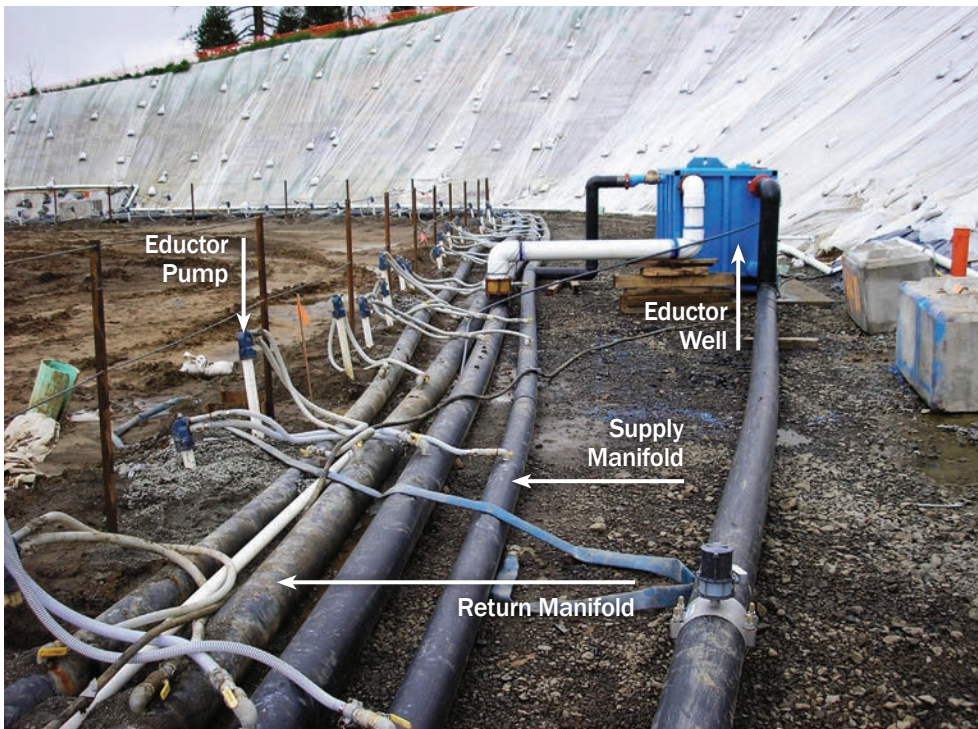


Eductor systems are most advantageous when dewatering deep excavations where the volume of water to be pumped is relatively small because of the low permeability of the aquifer. Like vacuum wellpoints, eductor wells are spaced 2 to 10 feet on center; however, unlike vacuum wellpoints, eductor wells do not have drawdown limitations. Installation of eductor wells is similar to vacuum wellpoints but eductor wells can lift water deeper than 25 feet.

The eductor system consists of an eductor installed in a PVC wellpoint screen/casing. The eductor is attached to the return riser pipe which is installed in the PVC wellpoint screen/casing (pressure riser pipe). The two riser pipes are connected to

separate parallel headers: one to supply water under pressure to the eductors from the eductor pump and the other for return of flow from the eductors to the eductor pump recirculation tank.

In operation, water under pressure from the eductor pump enters the eductor through the pressure nozzle and venture, causing a difference in pressure, which creates a vacuum that draws the groundwater through the well screen and flows up into the body of the eductor where it is entrained by the pressure water. Both liquids are mixed in the body of the eductor and are discharged against back pressure up to the ground surface.



OPPOSITE: Eductor well system installed around a proposed future excavation.
TOP LEFT: Eductor system manifold and pump.
BOTTOM LEFT: Eductor system manifold wrapped around 30-foot-deep excavation.
BOTTOM RIGHT: Eductor pumps and settlement tank.



Artesian Conditions Recharge Wells Limited Access



Large diameter artesian deep well producing 500 GPM 25' above ground surface.

Artesian Conditions

In some locations, the existing groundwater is under hydrostatic pressure. If this hydrostatic pressure is sufficient to cause the groundwater to flow above the ground surface, this is known as a flowing artesian groundwater condition, and can pose significant challenges when constructing and operating dewatering systems. Malcolm's team can handle all types of artesian conditions to help ensure stable working conditions on your projects.

Recharge Wells

In general terms, recharge wells are the direct opposite of pumping wells. Malcolm uses recharge well systems in areas where there is a need to control the groundwater drawdown on the outside of an excavation, to reduce the settlement created by dewatering. The water is pumped from the dewatering well system and then piped into the recharge system located where the water is inserted back into the ground, bringing the static water level table outside the excavation back up to a manageable level.



Limited Access

Many projects have limited access and require specialized equipment, drilling techniques and experience. Malcolm has installed horizontal and vertical drains and dewatering wells within drainage galleries, access shafts, tunnels, and public spaces. Malcolm can safely bring its equipment into basements and drill under limited height or reach over retaining walls to drill wells in difficult locations. Limited access drills are designed for locations with access challenges and are not typically used on projects where a conventional drill can do the same job. Malcolm has the ability to perform all types of installations, and we can help plan the best solution for drilling in difficult areas.

TOP AND BOTTOM LEFT: Recharge well with automatic on/off switch designed to maintain water levels adjacent to subway.

TOP AND BOTTOM RIGHT: Installing 5-foot wide x 8-foot tall horizontal drains inside drainage tunnel for a dam; drains were up to 80 feet long with pre-packed 304 SS screens.

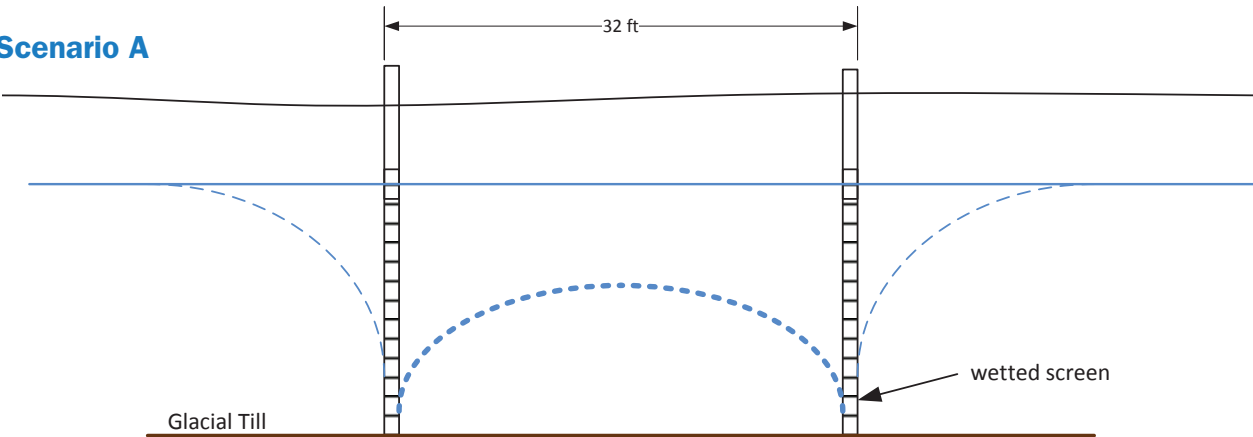


System Design

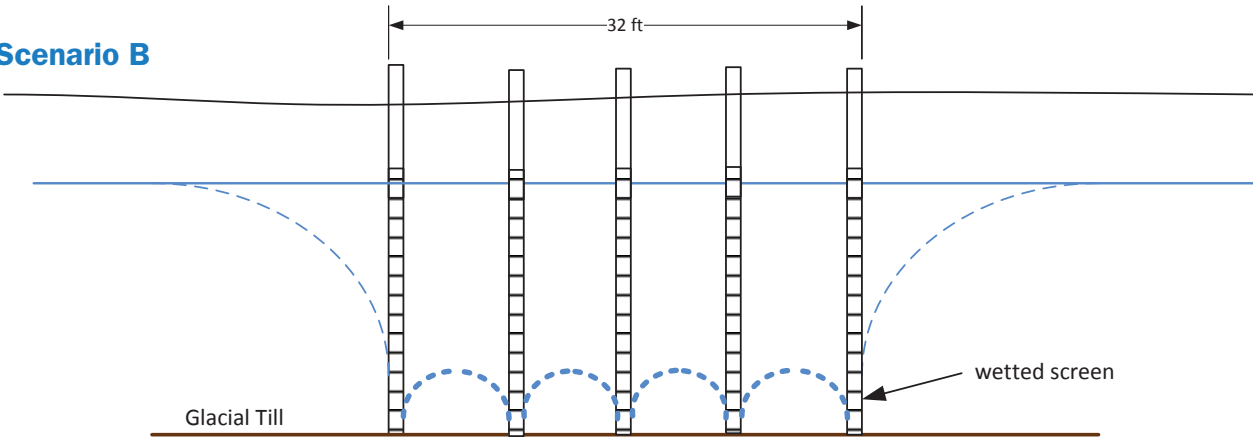
The objectives of a dewatering system will depend on many factors, and no two dewatering systems are the same. Malcolm has years of experience in dewatering projects throughout the United States and our complete design and installation services can help in even the most challenging underground conditions.

Careful design of dewatering and groundwater control systems is critical to keeping construction projects on schedule, and will allow for the implementation of innovative construction methods. Whether your jobsite requires passive or active groundwater control measures, Malcolm's team can design the most appropriate system to create the necessary subsurface conditions for your underground construction project

Scenario A



Scenario B



..... Coalesced or resultant drawdown between two wells

NOT TO SCALE

Water Treatment

Water treatment is often required to remove solids, volatile organics and other undesirable compounds before groundwater generated from dewatering operations can be properly discharged. Malcolm is capable of designing, operating and maintaining water treatment systems and assisting in the permit application process for your project. If treatment is

not necessary, but a settling tank is required, Malcolm can help with these situations as well. Malcolm's goal is to offer a turnkey dewatering/treatment system that will save your project time and money by managing and reducing your discharge and treatment needs.

TOP: Sand filters used for treating groundwater prior to discharge.
BOTTOM: Portable on-site water treatment system.





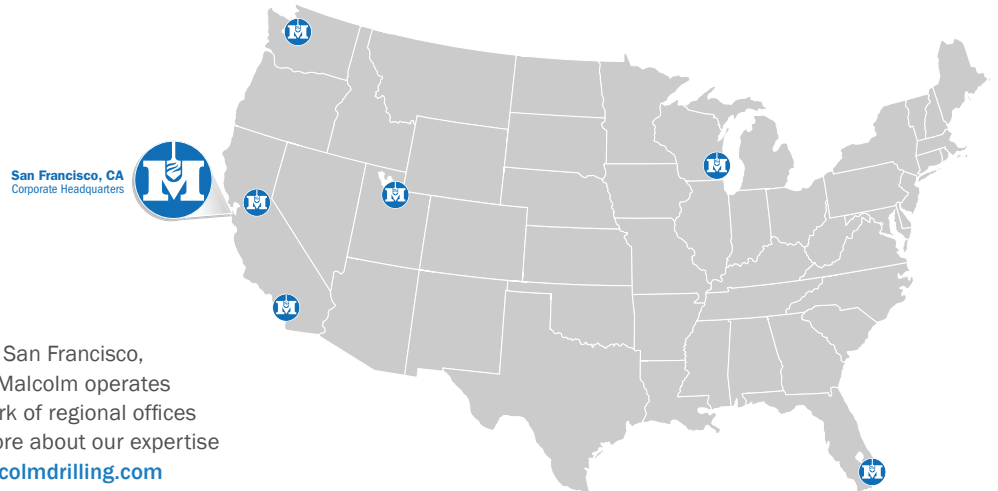
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Look to the Blue



FRONT COVER: Deep wells and well points installed in Richland, Washington.

BACK COVER: Deep well installation in Alaska.



Malcolm Drilling Company was founded in 1962 in San Francisco, California, which remains our headquarters today. Malcolm operates throughout the United States, maintaining a network of regional offices to serve our clients across the country. To learn more about our expertise and for a complete list of locations, visit: www.malcolmdrilling.com