Pipe Reaming
A variation of directional boring called pipe reaming can be used to replace existing clay, asbestos cement, non-reinforced concrete and PVC pipe. A reamer is pulled through the existing pipe which cuts the pipe into small pieces. The pipe pieces are flushed out the bore hole with the drilling fluid. A new HDPE or PVC pipe is pulled in behind the reamer.

Pipe reaming can often be used instead of pipe-bursting. The advantages of pipe reaming are lower cost, faster installation, no compaction of the surrounding formation and much greater upsizing capabilities.

Limitations
Directional boring can be used in a wide variety of conditions but is not the optimal method in all conditions. The most difficult ground formation for any method is un-consolidated soils (cobble). In some cases the un-consolidated soils can be grouted and then bored. Directional boring can be used for sanitary sewers but only when ground conditions permit a straight path.

Design Considerations
When designing a project for directional boring it is important to have accurate geo-technical data, sufficient space for the bore rig and support equipment and enough space for laying out the pipe on the other side. It is best to allow extended work-hours for boring operations and is essential for pull-back. Additional considerations may be required for specific projects. Pipe which can be used for directional boring installations includes HDPE, mechanical joint PVC and steel.

Costs
Directional boring has evolved steadily over the last 20 years and is now the preferred method on many installations due to its low cost and low impact on surroundings. It is generally less expensive than other methods such as microtunneling, jack & bore and open trenching in urban areas. In urban areas it can not only save a considerable amount on installation cost it can provide a tremendous amount of public goodwill.

For more information and for assistance on your next project:

Directional boring, commonly called horizontal directional drilling or HDD, is a method of installing underground pipes and conduits along a prescribed bore path from the surface, with minimal impact to the surrounding area. Installation lengths up to 6500’ have been completed and diameters up to 48” have been installed in shorter runs.

Applications
The process is used for installing telecommunications & power cable conduits, water lines, sewer lines, gas lines, oil lines, product pipelines and environmental remediation casings. It is used for crossing waterways, roadways, shore approaches, congested areas, environmentally sensitive areas and any area where other methods are more expensive.

Directional boring is used in place of other techniques for the following reasons: Less traffic disruption
Lower cost
Deeper installation possible
Longer installation possible
No access pit required
Shorter completion times
Directional capabilities
Safer for the environment

The Process
The process begins when a directional bore machine pushes a bore head connected to hollow pipe into the ground at an angle. As each joint of drill pipe is pushed into the ground a new one is added behind.
Most directional boring machines use drilling fluid (mud) with a few machines designed to use air or air and foam. Air & foam machines are used for rock. Drilling fluid is generally a mixture of bentonite clay and water, with additives used to improve performance. In softer soils the high pressure jet of fluid cuts through the soil, with the cuttings suspended in the fluid. As fluid is pumped down the hole the cuttings are carried back out to the surface where they are either allowed to settle out in a pit or removed mechanically in a cleaning system. Drilling fluid is classified as non-toxic and can be disposed of accordingly.

In softer soils, an angled bit is used and the pipe string is rotated, if necessary, to bore straight. To steer, rotation is stopped, the angle of the bit is aligned to the desired direction and forward thrust is applied. The directed jet of the drilling fluid and forward thrust cuts a new path.

In rock, a mud motor, which converts the hydraulic pressure of the drilling fluid into mechanical rotation, is used to rotate the bit and the drill pipe is not continuously rotated. Steerage is accomplished by aligning the angle of the mud motor to the desired direction.

Directional Bore Machines
Directional bore machines are rated by thrust and pullback force and rotary pressure. Sizes range from small machines with a few thousands pounds of thrust and pullback to the largest with over a million pounds of pullback force. Rotation is measured in pressure. Most machines are track or trailer mounted with a few smaller machines designed to be used in pits.

Locating & Guidance
The most commonly used equipment for determining the location of the bore head is called a ‘walk-over’ locating system. A sonde, or transmitter, behind the bore head registers angle, rotation, direction and temperature data. The information is then encoded into an electro-magnetic signal which is transmitted through the ground to the surface. At the surface a receiver is manually positioned over the sonde and the signal decoded and steering directions relayed to the operator of the bore machine.

When conditions do not allow a receiver to be positioned over the sonde or interference causes degradation of the signal, a ‘downhole system’ is used. The most commonly used type of downhole system is called a ‘wire-line’ and uses a wire to transmit the data up the inside of the drill pipe. At the surface the data from the wire is decoded by a computer to provide depth, angle, rotation, direction and other information. Gaining in popularity are newer downhole wireless systems such as the Polaris EM System which transmits the data through the ground by an electro-magnetic signal to a stationary receiver.

In cases where the ground is unstable, a washover pipe, or casing, can be pushed down the bore hole to prevent the collapse of the hole walls. Some systems use a dual pipe exclusively.

Upon reaching the exit point, the bit is detached and the end of the drill pipe is attached to a reamer or hole opener (for rock), if the bore hole must be enlarged. The reamer is pulled back while rotating the drill pipe to enlarge the bore hole, with as many consecutive passes as required. Drill pipe is added behind the reamer or hole opener so that there is always drill pipe in the bore hole.

When the bore hole is approximately 25% larger than the pipe to be installed, the end of the drill pipe is connected to a reamer attached to a swivel connected to the product pipe. Drilling fluid is pumped downhole to provide lubrication and the product pipe is pulled in while rotating the drill pipe & reamer. The swivel prevents rotation of the product pipe.

For some telecommunications or power cable projects, the drill pipe itself becomes the conduit and is left in the ground upon reaching the exit point. This type of installation is known as “drill and leave”.

Once the pipe is installed the exit and entry points are excavated if necessary and connections made as needed.