Options for Discharging Water from Pump and Treat Systems

An Online Continuing Education Course for Engineers

Course Number: EN-2016

Credit: 2 Hours / 2 PDH / 2 CPD

Options for Discharging Treated Water from Pump and Treat Systems

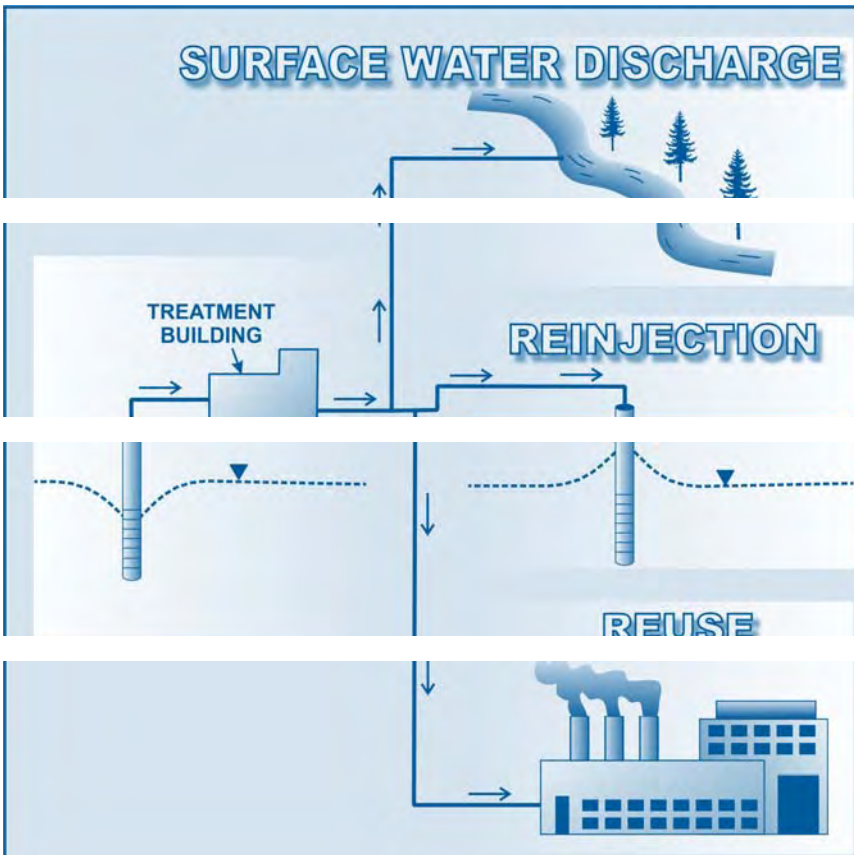


TABLE OF CONTENTS

A. INTRODUCTION

.....

This course presents information on available options for the discharge of water that results from a pump and treat (P&T) remedy. The target audience for this course includes engineers involved in the design and/or operation of P&T systems. Discharge options are typically evaluated during the remedy selection and system design phases of the remedy, and discharge alternatives could also be evaluated during routine optimization evaluations that are performed while the remedy is operating.

This course begins with a discussion regarding the potential value of treated water, followed by detailed descriptions of the following discharge options:

- discharge to surface water
- return of treated water to the subsurface
- discharge to a publicly owned treatment works (POTW) or other existing treatment plant
- reuse of treated water

The term operation and maintenance (O&M) is used throughout this course to describe the activities involved in operating and maintaining a P&T system. For the purpose of this course, "O&M" does not refer to any specific period of time or regulatory status associated with the remedy. For example, the Superfund program generally refers to the first 10 years of a Fund-lead P&T system as Long-Term Response Action (LTRA), and the subsequent period as "O&M". However, in this course both of those time periods are considered to be types of O&M. Also, this course discusses issues regarding permitting for various discharge options. It should be noted that for Superfund sites "permit equivalency" is generally established in lieu of an actual permit.

B. THE POTENTIAL VALUE OF TREATED WATER

.....

Significant quantities of water may be treated by a treatment plant associated with a ground water P&T remedy. For instance, each 100 gallons per minute (gpm) of remedy pumping would translate to 144,000 gallons per day, or more than 52 million gallons per year. Assuming a typical household might utilize 146,000 gallons per year (*AWWARF, 2005*), the water passing through one treatment plant at a rate of 100 gpm would be the equivalent to the amount of water consumed by approximately 360 households.

It is important to consider the value of the treated water when evaluating discharge options. In some cases, where ground water resources are limited, it may be important to return treated water to the subsurface so that adequate water levels are maintained, or to use the treated water directly for water supply. In other cases, significant costs savings and avoided energy use may be realized by reusing the treated water in place of other water supplies. Examples might include use of treated water for irrigating crops or as cooling water within a factory. In addition, treated water can be utilized to create or augment wetland habitats.

The following sections provide details regarding various options for discharge of treated water. In each case, a section called "Sustainability Considerations" is included to highlight how the specific discharge option relates to the value of the treated water as a potential resource.

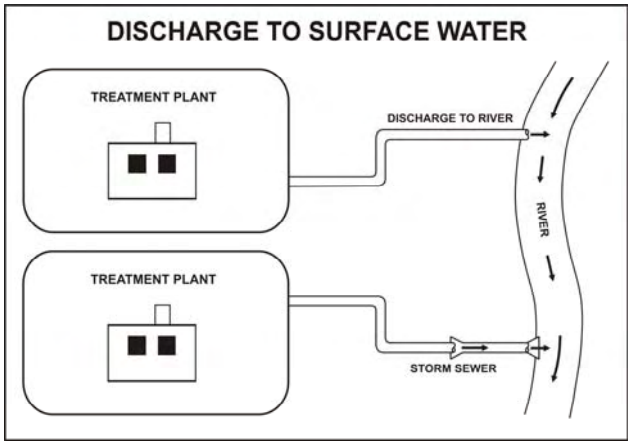
C. DISCHARGE TO SURFACE WATER

.....

General description

Under the National Pollution Discharge Elimination System (NPDES), treated water may potentially be discharged directly to a nearby surface water body or indirectly to surface water through a storm sewer. Figure 1 schematically illustrates this discharge option, and more information is discussed below. General advantages and disadvantages of this discharge option are provided in Exhibit 1.

Figure 1



System Design, Permitting, and Project Planning

EPA is authorized to implement the NPDES program (and associated permitting) but has authorized several States to implement all or part of the NPDES program in their own State. Information regarding the NPDES program can be found at the following website:

http://cfpub.epa.gov/npdes/index.cfm

For most ground water P&T systems, the NPDES permit includes effluent limits, monitoring and reporting requirements, and site-specific conditions. The permits are obtained by filing a standard application with EPA or the authorized State.

Exhibit 1

Discharge to Surface Water: Advantages and Disadvantages

Potential Advantages

- Discharge is typically not subject to a flow-based fee, but some storm sewer systems may charge a fee.

Potential Disadvantages

- Discharge standards are based on ambient water quality and may be comparable or more stringent than drinking water standards.
- Reporting may be more rigorous than for other discharge options. Environmental toxicity testing may be needed.
- Removal of natural constituents in ground water may required to discharge water.
- Access to a nearby surface water body or storm sewer is needed.
- Public may have negative perception of discharging treated water from a contaminated site to surface water.

The site-specific discharge limits are developed by EPA or the authorized State by considering standards based on available treatment technologies, water quality, and whole effluent toxicity (WET). Limits are typically derived for the following types of pollutants (in addition to WET):

- toxic pollutants (including the contaminants of concern)
- conventional pollutants (e.g., total suspended solids, pH, oil and grease, etc.)
- non-conventional pollutants (e.g., chlorine and ammonia)

Limits on temperature, dissolved oxygen, and flow rate may also be considered to address concerns regarding aquatic life and erosion control. The large variety of pollutants considered means that treatment criteria may be established for many constituents

that are not actually contaminants of concern at the site. As a result, discharge to surface water may require treatment of more constituents than would be required for other discharge options. Exhibit 2 provides a list of constituents that typically have a surface water discharge limit and would be relatively expensive to treat as part of a typical P&T system, yet may not be a contaminant of concern at many sites. If these constituents are in the extracted water at concentrations above discharge standards, additional treatment may be required. It is common for the site team to evaluate the life-cycle costs of such additional treatment and to compare these costs with the costs for other discharge options.

Discharge of treated water to surface water may change the surface water body from gaining (i.e., ground water discharges to the surface water body) to losing (i.e., surface water discharges to ground water). This change in system hydraulics could have a negative or positive effect on the ability of the P&T system to control contaminant migration. If the discharge from surface water to ground water occurs within or upgradient of the plume, it may cause the plume to spread or require a higher extraction rate to provide plume capture. However, if the discharge occurs downgradient, it may help prevent plume migration.

Exhibit 2

Discharge to Surface Water: Potential for Parameters that are not "Constituents of Concern" to Impact Costs

In some cases, parameters that are not considered to be constituents of concern at a site may nevertheless have a concentration limit associated with a permit for discharge to surface water. Examples might include the following parameters:

- iron
- manganese
- arsenic
- other metals (e.g., copper, nickel)
- pH
- ammonia
- nitrate and/or nitrite
- phosphate

In such cases, additional treatment costs may be incurred simply to meet the surface water discharge requirements for these parameters. As a result, other discharge options that do not have similar limits for these parameters may be more cost-effective.

The distance and terrain from the P&T system to the discharge point can also affect the practicability of discharge to surface water. The following parameters are generally favored when selecting this (and other) discharge options:

- a short distance between the P&T system and the discharge point
- minimal infrastructure between the P&T system and the discharge point
- a discharge point that is lower in elevation than the P&T system (allows for gravity discharge rather than forced pumping)

Sampling, reporting, and other ongoing costs generally play a minor role in determining if discharge to surface water is the most appropriate discharge option. The sampling and reporting, which is typically conducted on a monthly basis, is similar to that for other discharge options. In addition, there is usually no ongoing usage fee for discharge to surface water. However, such fees can be substantial when present. For example, discharge to the Thea Foss Waterway in Tacoma, Washington, is one example of where such a fee has been applied (*U.S. EPA 2001*). In that case, a fee of approximately $5,000 per month was applied to the 50 gpm of treated water discharged to the storm sewer, which increased the annual costs of the remedy by approximately $60,000 per year.

Sustainability Considerations

If the treated water is discharged to surface water in a manner that precludes the further beneficial use of that water, such as discharge to a creek that ultimately empties into the ocean, then the value of that treated water as a potential resource may be lost. In some cases, however, the treated water is discharged into a receiving body that serves as a reservoir such that the treated water will eventually be used for drinking water, irrigation, industrial purposes, or some other beneficial use. In these cases, the treated water displaces the use of water from other sources, and therefore helps conserve water as a natural resource.

Treated water can also be used to help restore or replace habitat that was previously lost due to contamination or that is lost due to other aspects of an environmental remedy. The reliable flow of treated water from a P&T system can be used to

Example 1

Discharge to Surface Water at a Rural Site

The site is a former chemical manufacturing facility in a rural setting. Some of the key site conditions relevant to selecting a discharge option are as follows:

- The site is not located near urban infrastructure that would allow for discharge to a storm sewer or POTW.
- Reuse of treated water for industry or agriculture is not viable.
- Due to remedy pumping, seeps that form[ed] small tributary to a near[by] longer flow, effe[ctively] riparian habitat.
- There is limited a[vailable] to the subsurface [for] plume capture.
- With the exception [of] contaminants of co[ncern] meets typical criter[ia] surface water.

Selected Discharge Option

The site team opted to dischar[ge to] area where the seeps historica[lly] discharge location has been de[veloped] erosion associated with a point[-source] this discharge option will repla[ce habitat] that would otherwise be destro[yed]. Ongoing costs associated with t[his option] consist of routine sampling of th[e water] association with an NPDES permit and regular filing of a discharge monitoring report.

establish flow in a creek or wetlands or to augment flow in a stream. In these cases, the treated water does not necessarily displace the use of other water or conserve water as a natural resource, but it does provide additional value through the created habitat.

Site teams can incorporate sustainable environmental practices by considering the fate of the treated water when screening discharge to surface water as a discharge option. Example 1 illustrates the use of surface water as an appropriate discharge location for a P&T system because it provides a cost-effective means of discharging treated water while creating a small riparian habitat that was displaced during other aspects of the environmental remedy.

D. RETURN OF TREATED WATER TO THE SUBSURFACE

.....

General description

Treated water can be returned to the subsurface through infiltration basins, infiltration galleries, or injection wells[,] as follows:

[An] infiltration basin allows treated water to [flow] through the ground surface in a [natural] area.

[An] infiltration gallery includes a subsurface [network of] perforated pipes in trenches that [distribute] treated water below the surface [of the] water table.

[An] injection well returns the treated water to [the] zone in either a water table [or a] deeper confined aquifer.

[These are] schematically illustrated on [the] and disadvantages for this [are] summarized Exhibit 3.

[Permitting], and Project Planning

[Discharge] of treated water to the subsurface generally requires a permit authorized by the State. It may also require a permit under the Underground Injection Control (UIC) Program, which regulates the injection of fluids into the subsurface through an injection structure where the depth is greater than the largest surface dimension or through a subsurface fluid distribution system. These structures typically include injection wells, shafts, dug holes, and infiltration galleries but would not include shallow infiltration basins. The injection structures covered by the UIC Program are divided into five classes, and Class V applies to the reinjection of treated ground water.

The U.S. EPA (*U.S. EPA 2005a*) notes that over 30 States have primacy for the UIC Program (i.e., have authorization to administer the UIC Program), and these States have generally incorporated the UIC Program into a broader program for reinjection. For example, New Jersey has primacy for the UIC