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OUTLINE

WATER RESOURCES ALLOCATION:
RECLAIMING MUNICIPAL WASTEWATER FOR AGRICULTURAL USE

By

Robert C. Kerr
MUSICK and COPE
Boulder, Colorado
May 1981

WATER RESOURCES ALLOCATION:
LAWS AND EMERGING ISSUES

THE UNIVERSITY OF COLORADO SCHOOL OF LAW

WATER RESOURCES ALLOCATION:
RECLAIMING MUNICIPAL WASTEWATER FOR AGRICULTURAL USE

Robert C. Kerr
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I. INTRODUCTION

A. Multipurpose Resources Management Systems

All too often natural resources are considered in isolation, whether one is considering resource development or resource conservation. In so doing the isolated "management" of one resource can result in the mismanagement of several others. For example, if trees are clear-cut on a hillside with no consideration for erosion protection then subsequent rainfall creates an undesirable impact on the soil resource.

A natural resource must be considered as part of an integrated interrelated matrix of processes. Every resource should be analyzed with an eye to using the resource in as many ways and as beneficially as possible.

Municipal wastewater, as a resource, is no exception. Untreated wastewater discharged into a stream system destroys a natural resource. If the same wastewater is given secondary treatment and then applied to agricultural land as the final step in the treatment process, several multipurpose resources management goals are achieved: (1) the stream is not polluted; (2) additional water is available for irrigation; (3) agricultural lands are kept in production; (4) energy and capital intensive treatment systems are not required; and (5) beneficial nutrients are available for use in irrigation.

B. Scarcity of Water

1. Western United States

Colorado, as much as any other state, manifests the many problems that result from a shortage of water. With an average rainfall of between 14 to 17 inches a year, the eastern slope of the Rockies in Colorado evidences the competing demands for water. Agriculture competes with a rapidly expanding population for the scarce water resource. Energy development on the western slope will put increased demands on an already overburdened resource. The need to manage the water resource on a multipurpose level,

coordinated with the use of other resources, is crucial to the state. The land treatment alternative provides a viable reuse solution to the water scarcity problem.

2. Eastern United States

Typically, water shortages are associated with the arid western United States. However, in recent years the combined effects of population growth, increased consumptive uses of water, pollution and drought conditions have caused a water shortage condition in much of the Northeast (On January 19, 1981, New York City declared a drought emergency). Under such conditions, the land treatment alternative will be as viable in moist climates as it is in the arid areas of the west.

C. Waste Treatment Systems

1. Waste Treatment Systems as Isolated Systems

Taken alone, the typical waste treatment system does advance a multipurpose resource management goal. Water once used for municipal purposes is treated and returned to a river system. However, waste treatment systems are generally viewed as pollution control measures and not as resource regeneration systems. Viewed solely as pollution control measures, waste treatment facilities are designed and operated in disregard for other resources. For example, capital intensive treatment plants may clean the water that is eventually discharged but in the process consume substantial amounts of energy which causes pollution elsewhere. Moreover, the disposal of sewage sludge may exacerbate water pollution at another location (e.g. a sanitary landfill).

2. Waste Treatment Systems on a Resource Management Continuum.

If waste treatment systems are viewed as interrelating with other resources, vastly different designs and operations are possible. While meeting the ends of pollution control, the integrated waste treatment system has the potential of furthering several other resource management goals as well. Waste treatment systems affect not only the water resource but can have an impact on the air resource, the land resource and the human socio-economic environment.

D. Land Treatment Systems

1. History

In its simplest form land treatment is nothing more than a waste treatment system that utilizes the application of wastewater to the land as one step of the treatment process. Land application is the oldest method used for the treatment and disposal of wastes and has been practiced for more than 2000

years. In Athens its use dates back to a period before the birth of Christ. In 1559 domestic sewage was applied to land in Bunzlav, Prussia and the operation continued for over 300 years. The practice was popular in England in the 1800's because of the simplicity of operation and increased crop yield.

Melbourne, Australia has used a land application system since 1893 that includes over 17,000 acres of land. In western Europe, the city of Brunswick, Germany treats an average flow of 11.9 million gallons per day on 10,625 acres. Approximately 173,000 acres of land are used for land application systems in the USSR. Land treatment is used in varying degrees in some 950 municipalities in the United States. One of the most successful is a project in Muskegon, Michigan.

2. Land Treatment v. Conventional Treatment

a. Constituents of Sewage

Sewage is approximately 99.94% pure water. The remaining .06% includes the following constituents:

(1) Organic Material - Any compound with carbon, hydrogen and oxygen is considered organic material. In sewage most organic material comes from the waste materials from our bodies. When organic material is discharged into streams it is decomposed by bacteria which consume oxygen in the process. The stream is left with an oxygen deficiency and cannot support aquatic life. Water which lacks oxygen also smells badly due to the hydrogen sulfide emitted by a type of anerobic bacteria that live in water without oxygen. The measure of organic material in sewage is called the Biological Oxygen Demand (BOD).

(2) Nutrients - Sewage also contains nutrients or natural fertilizers, in the form of nitrogen and phosphorus. Nutrients in water facilitate the growth of algae. The algae, in turn, die and by the process of eutrophication are consumed by oxygen using bacteria. This use of oxygen is called Nitrogenous Biochemical Oxygen Demand (NBOD). Nitrogen in the form of nitrate (NO_3) can also be a source of pollution to groundwater supplies.

(3) Living Organisms - Sewage contains numerous varieties of bacteria, many of which originate in the human intestinal tract. Most are harmless. A few species of pathogenic bacteria, however, are dangerous because of their potential to cause disease. Sewage can also contain viruses and parasites.

(4) Toxic Materials - Toxic substances found in sewage include pesticides, heavy metals, oils and organic material that take a long time to naturally decompose (e.g. PCB's). Chlorine and ammonia are also toxic to shellfish and fish. Toxic substances can cause serious human health problems, including

cancer. Many drinking water treatment facilities are not designed to extract much of the toxic material that is now discharged into stream systems.

b. Conventional Types of Sewage Treatment

There are three mechanisms for removing pollutants from wastewater: physical processes which use the physical characteristics of the pollutants themselves, size and weight, to effectuate removal; biological processes which are the same as the natural biological decomposition of organic material discussed above but which are designed to accelerate the process in a controlled environment; and, chemical methods which rely on chemical reactions with pollutants to cause separation.

There are three stages of treatment:

(1) Primary Treatment - Primary treatment is designed to remove all those materials that will either float or settle. Sewage is first sent through a coarse screen and then allowed to stand in settling tanks. Sand, gravel, sticks, rags as well as approximately 35% of the BOD associated with suspended solids are removed in primary treatment.

(2) Secondary Treatment - The purpose of secondary treatment is to remove dissolved organic material, small suspended solids and to allow nitrification, the oxidation of ammonia (NH_3) to nitrate (NO_3). Most treatment technologies utilize biological mechanisms. These include the use of trickling filters, biodiscs, activated sludge, oxidation ditches and oxidation ponds.

(3) Advanced Wastewater Treatment Systems (AWT) - Increased pollutant removal, including nitrogen and phosphorus, is the goal of AWT. Phosphorus is generally removed by the addition of chemicals such as lime, alum, or iron compound which form a precipitate-coagulate that is then settled out. Nitrogen is more difficult to remove. In the form of ammonia (NH_3) nitrogen can be converted to nitrate by means of biological nitrification in the primary and secondary treatment processes. In AWT nitrates are changed into nitrogen gas through denitrification. Denitrification is accomplished by growing different types of organisms in the effluent under a variety of conditions. It is an expensive and energy intensive process that requires a great degree of operator skill. Physical and chemical techniques can also be used to remove nitrogen.

AWT also includes the further removal of suspended solids by the use of filtration through rocks and sand or microscreening by the use of very fine metal screens. Finally non-biodegradable organics can be removed by the use of activated carbon absorption or treatment.

c. Land Treatment

There are three techniques for the land treatment of sewage: irrigation, in which the pretreated effluent is used in agriculture; overland flow, in which effluent is run down gently sloping, grassy hillsides; and rapid-infiltration in which the pretreated effluent is discharged into highly permeable infiltration-percolation basins. From the standpoint of multipurpose resources management, the irrigation method is most advantageous.

Irrigation land treatment is an alternative to advanced wastewater treatment and in some cases can be used for secondary treatment as well. Sewage is collected and transported to a specific site where it receives primary and usually secondary treatment by conventional means. The treated effluent is then used for irrigation utilizing the techniques that are appropriate for the geographic location. A storage reservoir for the pretreated effluent serves as a regulating device allowing effluent to be used on the land only when needed.

Irrigation land treatment accomplishes very high removals of BOD, suspended solids, nitrogen, phosphorus, heavy metals, difficult-to-degrade organics and microorganisms:

- organic materials are quickly assimilated into the soil by a variety of decomposers, bacteria, fungi, worms, etc;
- many difficult-to-degrade organics, such as phenols and pesticides, can be assimilated by land treatment in a way that is not possible by conventional AWT;
- nutrients such as nitrogen and phosphorus are used by plants;
- low concentrations of heavy metals are chemically immobilized in the soil;
- soils effectively remove pathogens and microorganisms;
- most bacteria are removed in the first 1/3 inch of soil;
- viruses are removed by attraction to soil particles;
- the natural filtration process through soil layers removes most remaining pollutants;

A comparison of the percent removal and total costs of the various systems discussed above is contained in Table 1.

II. CHOOSING THE LAND TREATMENT ALTERNATIVE

A. System Integration

As outlined above, the land treatment alternative is an effective way to manage a variety of resources on a multipurpose basis. It is also an effective means of coordinating economic, political, legal and technical considerations as well.

TABLE 1

REMOVAL RATES AND ESTIMATED TOTAL COST FOR TREATMENT ALTERNATIVES

TYPE OF TREATMENT	POLLUTANT REMOVAL* (% removal)				TOTAL COST (Dollars/1000 gals)		
	BOD	SS	N	P	1 mgd	5 mgd	10 mgd
CONVENTIONAL SECONDARY							
Trickling Filters	80-85	70-90	25	15	.74	.66	.57
Biodiscs	90	90	80-95	85-95	.86	.69	.48
Activated Sludge	80-90	80-95	30	20	.80	.73	.63
Oxidation Ditch	85-95	80-90	30-70	20	.58	.37	.33
Oxidation Pond	60-90	65-80	15-60	40	.16-22		
CONVENTIONAL ADVANCED WASTE TREATMENT							
Activated Sludge & Phosphorus Removal	95	97	30	85-95	1.50	.77	.74
Activated Sludge & Nitrification	90	90	30	20	1.30	.76	.56
Activated Sludge & Biological Nitrogen Removal	90	90	80-90	20	2.10	1.30	1.25
Activated Sludge & Nitrogen & Phosphorus Removal	90	90	80-90	85-95	2.50	1.50	1.45
LAND TREATMENT							
Irrigation	97-99	97-99	80-95	90-99	1.10	.70	.68
Overland Flow	93-98	90-95	75-90	50-55	.97	.63	.60
Rapid Infiltration	95-99	95-99	30-80	70-99	.80	.48	.46

Source: Gravitz, Michael et al., ed. Shopping for Sewage Treatment, Environmental Policy Institute and Clean Water Fund, August 1980, at pages 16, 54 and 61.

* BOD = biological oxygen demand; SS = suspended solids;
N = nitrogen; P = phosphorous.

1. Economic

Sewage treatment is an \$8 billion a year industry that has become focused on a limited set of conventional solutions. This single-sightedness has channeled vast economic resources in very specific directions. Such economic momentum is difficult to alter. However, waste treatment is an expensive proposition and as costs of conventional treatment systems rise, alternative methods will become more attractive. Not only is land treatment a cost effective means of waste disposal in and of itself, but it also relieves pressures on other valuable resources (e.g. water, fertilizer, agricultural land) which causes an economic multiplier effect with respect to these other resources.

2. Political

Politically, the most difficult element of implementing a land treatment system is educating the community and surrounding landowners of its viability. In the west, municipalities face an uphill battle in overcoming their competitor status when discussing any water related projects with farmers. Farmers are naturally concerned with the quality of the water available for irrigation. Citizens of the municipality are concerned about an alternative approach - land treatment lends itself to distorted information regarding health hazards, odors and the consumability of crops irrigated with effluent.

Land treatment necessarily is a process that involves several levels of government. Local, state and federal entities are usually involved. Since land treatment systems provide attractive economic incentives as well as the opportunity to accomplish a variety of other natural resource management tasks a land treatment project affords a unique opportunity for intergovernmental cooperation.

The land treatment alternative has the advantage of bringing together traditionally adverse political groups. A land treatment system that utilizes irrigation as the means of application requires farmers and municipalities to cooperate in a concerted effort.

3. Legal

Although any waste treatment system will have legal ramifications, the land treatment alternative can generate a project with sufficient latitude, such that legal problems, like political and economic considerations, can be dealt with on a cooperative and negotiated basis. A land treatment system involves several diverse groups and so minimizing legal roadblocks is usually to everyone's advantage.

However, because the land treatment methodology is not fully accepted, legal means can be used to frustrate the implementation of land treatment systems. This, in combination with the many legal requirements of federal, state and local water quality and land use laws, means that the legal element of a land treatment project can be a substantial part.

4. Technical

As has been set forth above, the technology to implement land treatment is available today. Unlike many "solutions" of our time, land treatment relies on less technology rather than more.

B. Evaluating the Land Treatment Alternative - A Study Approach

Within the context of the multipurpose resource management approach discussed above, the following is a checklist for evaluating the land treatment alternative. At every stage of the land treatment study a concerted effort should be made to evaluate the potential of integrating the land treatment alternative with other natural resource management objectives.

1. Review previous wastewater management planning efforts and the performance of existing facilities. This includes:

- a. Inventory of existing facilities;
- b. Review of any plans for expansion;
- c. Study of the needs of the area to be served taking into consideration future growth projections;
- d. Study of existing problems, such as:
 - (1) Compliance with requisite permits (e.g. NPDES);
 - (2) Sludge disposal;
 - (3) Ability to service projected population growth;
 - (4) Existing raw water supplies and demands;
 - (5) Operational deficiencies;
 - (6) Projected life of existing facilities

2. Identify regional goals and objectives:

- plans;
- a. Municipal comprehensive land use and zoning plans;
 - b. County comprehensive land use and zoning plans;
 - c. State policies regarding land use and sewage treatment (e.g. the policy regarding the conversion of agricultural land in Colorado);

3. Delineate potential land treatment sites on a regional level that will assist in the implementation of the regional goals and objectives.

4. Determine quantities of wastewater and sludge that could be managed at the potential sites and determine the quantities of wastewater that will be produced by the entity to be served.

a. Since land treatment by means of irrigation is limited by the assimilative capacity of the land irrigated, detailed studies of acreage, crops, growing season, soil characteristics, precipitation, methods of application, etc. will have to be made.

b. In determining the quantity of wastewater generated, the entity to be served must be defined (areas within and without municipal boundaries), existing and projected population determined and the capacity of existing transmission facilities quantified.

5. The legal considerations of developing a land treatment system must be identified. See subsection III, below, for a detailed discussion.

6. Selection of several specific sites for a more detailed feasibility assessment.

7. Preparation of conceptual system designs for the specific sites.

8. Cost/benefit analysis of land treatment systems at the specific sites which are then compared to cost/benefit analyses of conventional treatment systems.

9. Evaluation of site specific land treatment systems on the basis of achieving planning goals (local and regional).

10. Final site selection made.

11. Financing alternatives explored.

III. LEGAL CONSIDERATIONS OF THE LAND TREATMENT ALTERNATIVE

A. Federal Laws

1. Federal Water Pollution Control Act of 1972, as amended by the Clean Water Act of 1977, 33 U.S.C. §1251 et seq. (CWA).

a. Section 201 Grants Program (33 U.S.C. §1281)

Under §201(g) and §202 of the CWA, the Environmental Protection Agency (EPA), is authorized to award grants for the construction of publicly owned treatment works, for up to 75% of the eligible costs. Grants covering up to 85% of the eligible costs may be obtained for treatment works that employ "alternative" or "innovative" technology. (33 U.S.C. §§1281(g), 1282). EPA has determined that land treatment systems qualify as "alternative" technology. (40 C.F.R. Part 35, Appendix E).

- (1) Step I Grant - federal share of the eligible costs of preparing a "facilities plan"
- (2) Step II Grant - federal share of the eligible engineering studies necessary to design the treatment works
- (3) Step III Grant - federal share of the eligible costs of constructing the facility.
- (4) State priority list - procedures vary from state to state.
- (5) Interrelationship of Section 208 and the National Environmental Policy Act (NEPA). See Subsection III A.2., below.

b. Section 208, Areawide Waste Treatment Management (33 U.S.C. §1288).

The CWA addresses the discharge of pollutants onto land, as opposed to water, through §208. This section requires that local §208 planning agencies develop procedures and methods to control non-point sources of pollution. Land treatment facilities should therefore be incorporated within the §208 areawide wastewater

management plan. A §208 plan, when approved, controls the award of grants under §201, and may affect permits under the NPDES program. See Subsection III.A.1.c., below.

c. Section 402 National Pollution Discharge Elimination System (33 U.S.C. §1342)

The CWA regulates the discharge of pollutants into navigable waters from point sources. Municipal wastewater treatment plants must receive a National Pollution Discharge Elimination System (NPDES) permit under §402 of the CWA when discharging effluent into a navigable waterway. A given land treatment system which physically appears to be a non-point source may in fact be a point source as defined by the CWA. Section 502 (33 U.S.C. §1362) defines "point source" as:

...any discernible, confined and discrete conveyance, including but not limited to any pipe, ditch, channel, tunnel, conduit, well, discrete fissure, container... from which pollutants are or may be discharged. This term does not include return flows from irrigated agriculture.

It should be noted that in Colorado the Attorney General has stated that irrigation ditches are subject to regulation under the Colorado Water Quality Control Act and hence the CWA.

d. Section 404, Permits For Dredged or Fill Material (33 U.S.C. §1344)

The U.S. Army Corps of Engineers has jurisdiction under §404 of the CWA to regulate the discharge of "dredged" and "fill" material into "navigable waters." The term "navigable waters" is defined in §502(7) (33 U.S.C. §1362(7)) to mean "waters of the United States." Court decisions have established that the Corps' jurisdiction extends to all waters which Congress has authority to regulate under the Commerce Clause of the U.S. Constitution. United States v. Ashland Oil & Transportation Co., 504 F.2d 1317 (6th Cir. 1979).

(1) The Corps' regulations define "dredged material" as "material that is excavated or dredged from waters of the United States" (33 C.F.R. §323.2(k)); "fill material" is defined as "any material used for the primary purpose of replacing an aquatic area with dry land or of changing the bottom elevation of a waterbody (33 C.F.R. §323.2(m))."

(2) There are three types of permits: (a) nationwide; (b) general; and (c) individual. Nationwide and general permits do not require a formal application to the Corps. A request for authorization however, should be filed with the appropriate District office in advance of the proposed activity. Activities within the scope of these two types of permits will be authorized subject to certain conditions specified in the regulations or in the general permit for that activity. It is important to determine whether the proposed activity is authorized by nationwide or general permit before an application for an individual permit is prepared and filed.

2. National Environmental Policy Act, 42 U.S.C. §4321 et seq. (NEPA).

NEPA requires that an environmental impact statement (EIS) be prepared on every "major federal action significantly affecting the quality of the human environment."

a. Relationship to CWA:

Upon receipt of an application for federal grant funds to finance a wastewater treatment program, the EPA will prepare an environmental assessment. If the result of that assessment demonstrates that there is no need for any further environmental review, a statement of no significant environmental impact will be issued. If the environmental assessment proves the need for further environmental review, an EIS will be prepared. The grant applicant will be expected to cooperate in gathering information needed for the EIS and where a land treatment program is at issue, may expect that detailed studies of the proposed land sites will be required. It should be noted that §404 does itself require an EIS, however, NPDES does not.

b. Grant Conditions:

The EPA will probably use grant conditions as a means of insuring elimination or reduction of any adverse environmental impacts identified in the EIS process.

3. Clean Air Act, as amended, 42 U.S.C. §7401 et seq. (CAA).

The CAA may have relevance to a given land treatment proposal insofar as the proposal may affect compliance with a state's implementation plan (SIP). A SIP is designed to allow a state to attain and maintain ambient air quality standards.

a. Relationship to NEPA and CWA:

A particular wastewater management program, if associated with increased treatment capacity, might encourage excessive urban sprawl and a corresponding increase in air pollution caused by auto emissions. An EIS will identify such pollution as an impact of the project, thereby leading to the imposition of specific grant conditions related to air quality.

In some cases this requirement can prove to be an advantage for a land application program. Although land application can provide additional capacity for urban growth in a fashion similar to a conventional system, it also preserves agricultural land near urban areas. It can, therefore, be used as a tool for directing growth into already established urban areas. Such actions tend to reduce urban sprawl and are an environmental benefit from the perspective of clean air. Furthermore, the preservation of agricultural lands provides a non-polluting air space for the assimilation of urban air pollution; the crops themselves serve as air purifiers.

b. Section 316(b) CAA, Sewage Treatment Grants, (42 U.S.C. §7616):

The EPA Administrator may withhold a sewage treatment works grant to a particular municipality in certain cases where the state does not have in effect or is not carrying out an approved SIP.

4. Resource Conservation and Recovery Act. 42 U.S.C. §6901 et seq. (RCRA)

RCRA mandates the establishment of a federal regulatory scheme controlling the management of hazardous wastes. Although certain constituents, if present in municipal sewage effluent, would make the effluent a hazardous or solid waste subject to regulation under RCRA, such effluent in most cases will be excluded from regulation under the act.

a. Section 1004(27), 42 U.S.C. §6903(27):

The definition of solid and hazardous wastes under this section excludes "solid or dissolved material in domestic sewage." This does not constitute an exclusion of publicly owned treatment works (POTWs) but only of sanitary wastes flowing through such works. Under EPA's interim final RCRA regulations (45 F.R. 33066, et seq., May 19, 1980), POTW's will not be subject to regulation under RCRA if their waste streams consist entirely of sanitary wastes. This exception will also include POTW's receiving mixtures of sanitary wastes and other wastes such as industrial wastes, so long as the wastes enter the facility through a sewer system.

b. Unmixed wastes:

The POTW exception, however, does not apply in those cases where the POTW receives hazardous wastes that are not mixed with sewer conveyed sanitary waters prior to their entry into the POTW. If a POTW receives and treats such unmixed wastes, it will be subject to RCRA.

c. Sludge:

In the case of all treatment works, public and private, sludge produced as a by-product of the treatment process is subject to regulation under RCRA if it meets any of the criteria of hazardous wastes.

d. Pretreatment Requirements:

An entity employing a land treatment management strategy for its wastewater effluent must insure that all hazardous material treated in its wastewater facility be subjected to pretreatment. An ordinance requiring pretreatment should cover not only normal industrial discharges into the municipal system, but also discharges resulting from the clean up of any spills of hazardous materials. This will not only prevent regulation under RCRA, but more importantly, will prevent any groundwater contamination under those lands to which the wastewater effluent is applied.

5. Safe Drinking Water Act, 42 U.S.C. §§300f et seq.
(SDWA)

The SDWA is designed to protect the quality of the nations drinking water through the application of federal standards to all public water systems. The standards consist of primary drinking water standards regulating contaminants that can affect public health, and secondary drinking water standards aimed at controlling contaminants affecting the cosmetic or aesthetic quality of water (e.g., odor, taste, appearance).

a. Reclaimed Water:

To the extent that a land application program includes a proposal to reclaim water for public drinking use following its use on the land, the program will be regulated by the SDWA. There are two aspects to this: first, when a wastewater management agency seeks to recover its own effluent for its own domestic or municipal use; second, when a land application program may affect the drinking of downstream (or subsurface aquifer) users in such a way as to cause violations of the SDWA.

b. Underground Drinking Water Sources

The SDWA provides for the protection of underground sources of drinking water through the regulation of underground injection of materials that could endanger underground drinking water sources. Complementary authority for similar regulation in the case of underground injection of hazardous wastes is also contained in RCRA. See the discussion of the Consolidated Permit Program below.

6. Consolidated Permit Program Regulations, 40 C.F.R. Parts 122, 123, 124 and 125.

The Consolidated Permit Regulations regulate permit applications for five permit programs: (1) Hazardous Waste Management Program under subtitle C of RCRA; (2) Underground Injection Control Program under Part C of the SDWA; (3) the NPDES Program under section 318, 402 and 405(a) of the CWA; (4) the Dredge and Fill Program under section 404 of the CWA; and (5) the Prevention of Significant Deterioration under regulations implementing section 165 of the CAA. To the extent these regulations become applicable to the programs listed above, a land treatment program must apply for requisite permits discussed above via the consolidated permit program procedure.

B. State Laws

1. State Water Quality Laws

Many states have taken over the NPDES, as well as the dredge and fill permit programs. For example, Colorado administers its own NPDES program. Colorado Water Quality Control Act, C.R.S. 1973, §25-8-101 et seq.

2. State Air Quality Laws

All applicable state law regarding air quality must be obtained (e.g. SIP requirements, construction permits). For example, see, Colorado Air Quality Control Act, C.R.S. 1973, §25-7-101 et seq.

3. State and Local Land Use Regulation.

A multitude of State and local land use regulations may apply to land treatment systems. Some of these include the following:

- a. Zoning, both municipal and county;
- b. Special use permits;

c. Disposal facilities, e.g., Colorado Solid Waste Disposal and Facilities Law, C.R.S. 1973, §30-20-101 et seq.;

d. Sewage treatment site approval regulations.

4. State Water Allocation Laws

States either ascribe to a riparian system, or an appropriation system, or some combination thereof, as a means of allocating the water resource. A land treatment system will usually affect the allocatory scheme and must therefore be considered.

a. Riparian Theories

(1) Law of Watercourse

(a) Theories: Natural Flow: The owner of riparian land is entitled to the natural flow of the stream past his land without diminution in quantity or deterioration in quality (English rule); enforceable even if no actual damages can be proved.

Reasonable use: Each riparian landowner has an interest in only so much of the stream as he can put to a reasonable and beneficial use, with due regard for the similar rights of other riparians to put the stream to reasonable uses; need to prove actual damages to the plaintiff and the unreasonableness of defendant's use.

(b) Reasonableness:

- the legality and beneficial nature of the purpose to which the riparian puts the water;

- the suitability of the purpose with respect to the stream;

- the social value of the proposed use;

- the hydrological characteristics of the water;

- quantity of water to be used; consider e.g., amount of water returned to the stream; riparian's stream frontage; size of the stream; nature of use; amount of land requiring irrigation;

- quality of the water when returned to stream; balancing of the social utility against the amount of pollution.

- alterations in the hydrologic regime.

(c) Remedies:

Injunction:

- to stop a particular activity;
- to stop an entire land treatment system.

Defenses:

- laches;
- coming to the nuisance;
- balancing of the equities: hardship to the defendant without an equivalent benefit to the plaintiff; e.g., land treatment of wastewater would take into consideration some of the following: location of place of application, dispersal of trace contaminants; jobs created/maintained; crops grown; revenue derived from crops; cost effectiveness; cost savings to community; clean water (CWA); lessening dependence on chemical fertilizers.

Money damages:

- value of land before and after damage;
- punitive damages.

Defenses:

- statute of limitations;
- real damages must be proved in reasonable use jurisdictions;
- punitive damages; malice standard; not likely in land treatment situations.

(d) Land Treatment Implications:

Quantity: If wastewater, previously released to the stream, is now applied

to land, the pattern of flow of the watercourse will be altered; there will be a decrease in flow below the previous point of discharge:

- generally not a problem for land treatment;
- irrigation is considered a reasonable use;
- note: nonconsumptive vs. consumptive distinctions;.
- land treatment as "nonconsumptive" because it uses wastewater rather than the natural flow of the stream;
- function of downstream user; quantity of water needed downstream;
- note: Riparian rights attach only to water in the watercourse and not to any wastes previously discharged into the stream; therefore, the fact that those discharges are not applied to land and not discharged directly to the stream should not be legally significant.

Quality: Trace contaminants may drain into the natural watercourse and pollute the water:

- injunction against careless operation;
- if land treatment system is carefully operated but pollution still exists then entire system may be enjoined;
- balancing of equities;
- money damages: asserted by riparian landowner vs. nonriparians;
- money damages: need for proof of actual damages;
- proximity of watercourse to land treatment system;
- precipitation patterns;
- nature of downstream uses;
- parameter monitoring, e.g., pH, biochemical

oxygen demand (BOD), suspended solids, fecal coliform bacteria.

(2) Law of Surface Water

(a) Theories:

Civil Law Rule: The natural state of affairs should be disrupted as little as possible; exceptions: some improvements, agriculture, drainage to natural water-courses.

Common Enemy Rule: Surface water is a landowner's enemy and any means available may be used to prevent surface water from reaching the landowner's lands.

Reasonable Use Rule: Same criteria as the law of watercourses.

(b) Land Treatment Implications

Quality: Trace contaminants may remain on the land and be carried by surface waters to other land:

- same principles as apply to the law of watercourses, however right to use surface water is not a property right like the use of water from a watercourse.

Flow Pattern: If dikes or other structures are built to contain surface water on the land treatment site, the natural flow patterns of said waters will be altered:

- no right of lower property owners to surface waters.

(3) Law of Groundwater

(a) Theories:

Absolute Ownership Rule - Groundwater considered part of the land.

Reasonable Use Rule - Distinction made between the use of groundwater and the pollution of groundwater.

(b) Land Treatment Implications:

Quality: Trace contaminants may remain on the land and seep into groundwater supplies:

- same principles as apply to the law of watercourses;

- note: In absolute ownership jurisdictions liability may only obtain if malice or negligence is proven.

Hydrologic Effects: Effluent applied to land may seep into groundwater and raise the groundwater table; this may benefit groundwater users but hamper surface drainage.

b. Appropriation Doctrine

It is very difficult to generalize the various appropriation doctrines in effect in the western United States. In addition the terminology of riparian water rights, such as watercourse, surface water and groundwater are not as relevant as the terms tributary water, nontributary water, transmountain diversion, or storage water rights. The fundamental aspect of any appropriative system is a prioritized list of water users that operates within a hierarchy of beneficial uses.

For the purposes of this outline it will be assumed that the entity using land treatment has a valid and adequate water supply that is administered according to a given priority system. The question that must be addressed is whether the quantity and quality of water returned to the stream will adversely affect other vested water rights.

(1) Quantity

If an entity had historically returned its effluent directly to a stream after treatment, a change to a land treatment system would significantly alter the amount and location of return flows. Such a change would undoubtedly affect downstream appropriators. Whether downstream appropriators are legally injured is a question to be answered by the applicable appropriation doctrine. The change in the amount and location of return flow may necessitate an administrative or judicial change proceeding in which such questions of injury would be addressed. With regard to the location of the return flow, issues of greater complexity are presented if the wastewater is to be applied to land located in a different drainage basin than the original point of discharge.

In addition, appropriation doctrines recognize the right to use a given quantity of water for "beneficial" purposes. In some jurisdictions a water user is allowed one use, after which the water must be allowed to return to a stream system for use by others. Exceptions are made for various types of non-tributary water as well as for trans-basin waters. A question arises as to whether the subsequent use of effluent for irrigation purposes constitutes a second use of water, in addition to the original domestic use, or whether the irrigation use is merely an element of the treatment process of the domestic use.

Land treatment normally involves the use of a storage reservoir to regulate the flow of treated effluent going to agricultural lands. Depending of the time of detention, historic return flow patterns may be further altered with respect to the timing of return flows.

(2) Quality

Appropriation doctrines have developed as primarily allocatory schemes - who gets how much water. As a result, water quality considerations tend to follow patterns established in riparian states and fall outside the purview of strict principles of appropriation. Water quality goals are therefore achieved by separate water quality statutes (e.g. CWA or state equivalents). However, a given land treatment system may in the name of water quality principles, create conflicts with system of allocation in which the issue to be resolved is to what extent must doctrines of prior appropriation yield to water quality considerations.

IV. CASE STUDY - THE CITY OF NORTHGLENN WATER MANAGEMENT PROGRAM

Northglenn is an incorporated home rule city located in the northwestern area of Adams County on the northern fringe of the Denver metropolitan region. It is totally surrounded by other municipalities -- the City of Thornton to the north, east and south, the City of Westminster to the west. The total land area of Northglenn is 4,142 acres and the present population is approximately 33,500.

Northglenn was incorporated in 1969. At that time the city received its water supply and sewer services from the City of Thornton. Thornton had acquired its waterworks from a private company, Northwest Utilities, which had built most of the system in the late 1960's. Because of this situation, Northglenn was tied to Thornton's water management. From the time of incorporation, Northglenn had investigated various ways of establishing utility independence.

In early 1976, the Northglenn City Council began work on its water management program. Conceptually, the idea is very

simple. Water which is originally appropriated for irrigation use and which is stored in a reservoir until needed will be diverted by pipeline to Northglenn. The City will then treat the water for use in the municipal water system. Once used, the water will receive secondary treatment and will then be returned to the original irrigators for agricultural use. The irrigation phase of the plan will serve as the final or advanced sewage treatment process. Northglenn will "make up" the water that is consumed in the process and add 10% "new water" as "interest" on the borrowed water. (See Figures 1 and 2 for a schematic representation).

The Northglenn Water Management Program is a good example of a multipurpose resources management system as is evidenced by the following quote from the Northglenn Land and Water Resource Management Policy Statement:

(a) The environment is a single system with air, land and water interacting, affecting and being affected by the development which takes place in the system. In essence, everything is related to everything else.

(b) For planning purposes, the physical system is closed, because nothing - sewage, storm water runoff, or other wastes - can be eliminated. Everything must be some place.

(c) Pollutants and storm water runoff are resources out of place either in terms of time or location, but when properly located, pollutants take on measurable value.

There are four major elements of the Northglenn system which are all dependent on the use of a land treatment irrigation system: (1) water supply; (2) make-up water; (3) water delivery and collection systems; and (4) sewage treatment.

1. Water Supply

The principle source of supply for the Northglenn system will come from Standley Lake Reservoir which is owned by the Farmer's Reservoir and Irrigation Company (FRICO). The water stored in Standley Lake comes from early dated irrigation water rights which draw water from Clear Creek and its tributaries.

Northglenn will "borrow" approximately 7,500 acre-feet of FRICO's Standley Lake Water. This use of Standley water was made possible by an agreement between FRICO and the City of Northglenn. The water will be piped from Standley Lake to Northglenn using the head of the reservoir to pressurize the system. The water will be collected in a 120 acre-foot reservoir and fed through a water treatment plant.

2. Make-up Water

Approximately 35 percent of the water diverted from Standley Lake will be consumed, that is, actually lost to the eco-system and not returned to the sewage collection system. New sources of water are to be developed to make up this deficit. Several sources of supply are available:

- a. non-tributary groundwater;
- b. tributary groundwater; and
- c. urban runoff.

3. Water Delivery and Sewage Collection

Northglenn will utilize the existing water delivery and sewage collection system which was purchased from the City of Thornton. Several modifications to piping routes and facilities will be necessary to facilitate the plan.

4. Sewage Treatment

A land treatment irrigation system will be utilized. The collected sewage effluent will be transported to a treatment plant located near the agricultural lands to be served. The plant will give secondary treatment and the effluent will then be stored in a reservoir. The reservoir allows the treated effluent to be stored for up to nine months. During the irrigation season the effluent will be released to an irrigation canal and used for the irrigation of approximately 15,000 acres of land. The City itself owns 2000 acres which will be kept in farm production as an additional area for land treatment. The irrigation use of the effluent completes the final or advanced treatment of the effluent.

By using land treatment the City is able to borrow a water supply from the farmers. This substantially reduces the amount of water that the city must acquire outright to satisfy municipal demand. Without land treatment and the water sharing plan, Northglenn would have to purchase approximately 5000 acre feet of water rights either on the open market or by condemnation, causing conversion of valuable agricultural lands. In addition to the savings generated on the water supply side of the system, the City derives all the other benefits of land treatment discussed above, such as decreased capital costs in sewage treatment, less energy use, higher degrees of treatment, and preservation of agricultural lands. Probably the greatest benefit under the plan has been the cooperative union formed between a municipal water user and farmers.

NORTHGLENN WATER MANAGEMENT PROGRAM

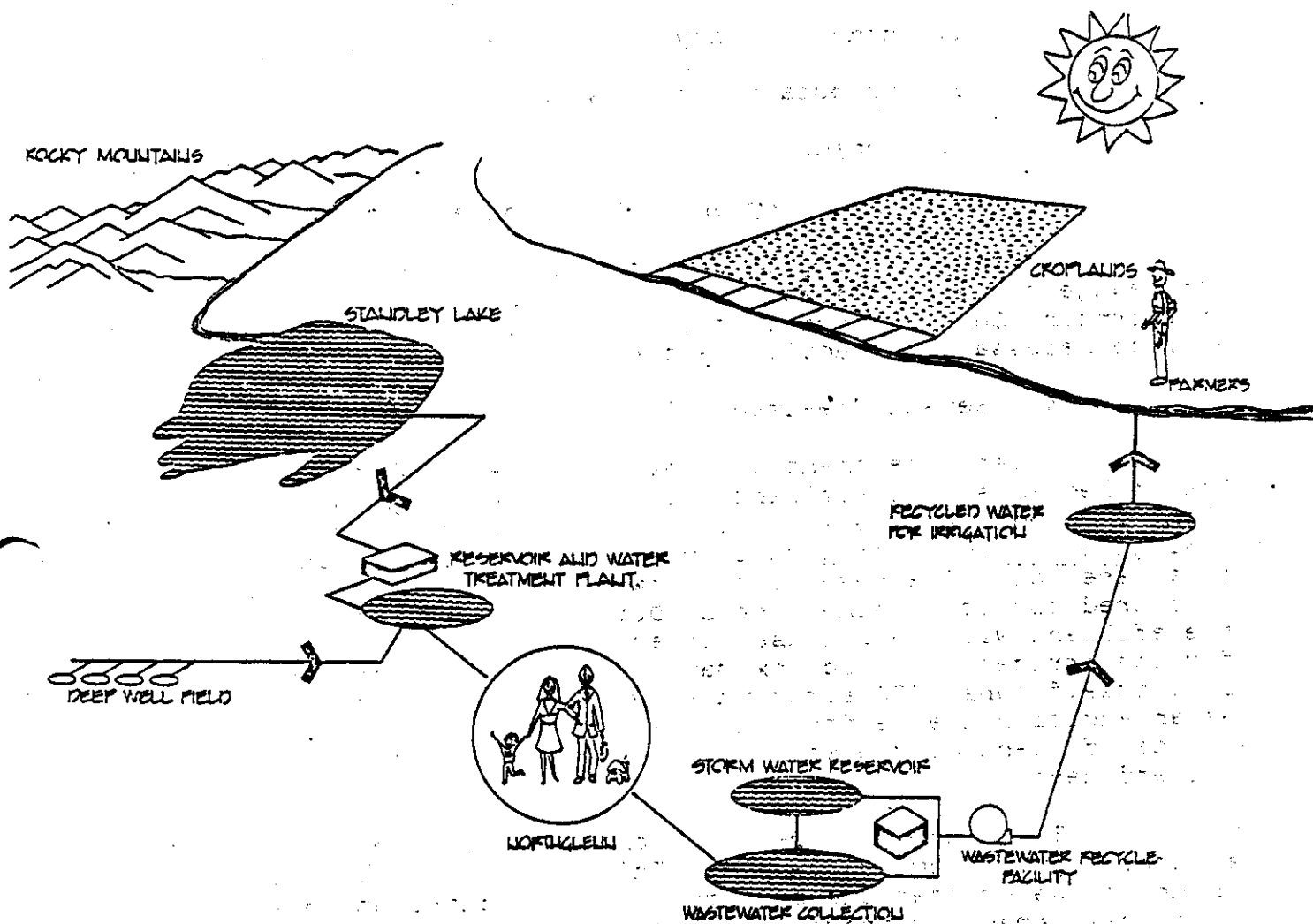


Figure 1

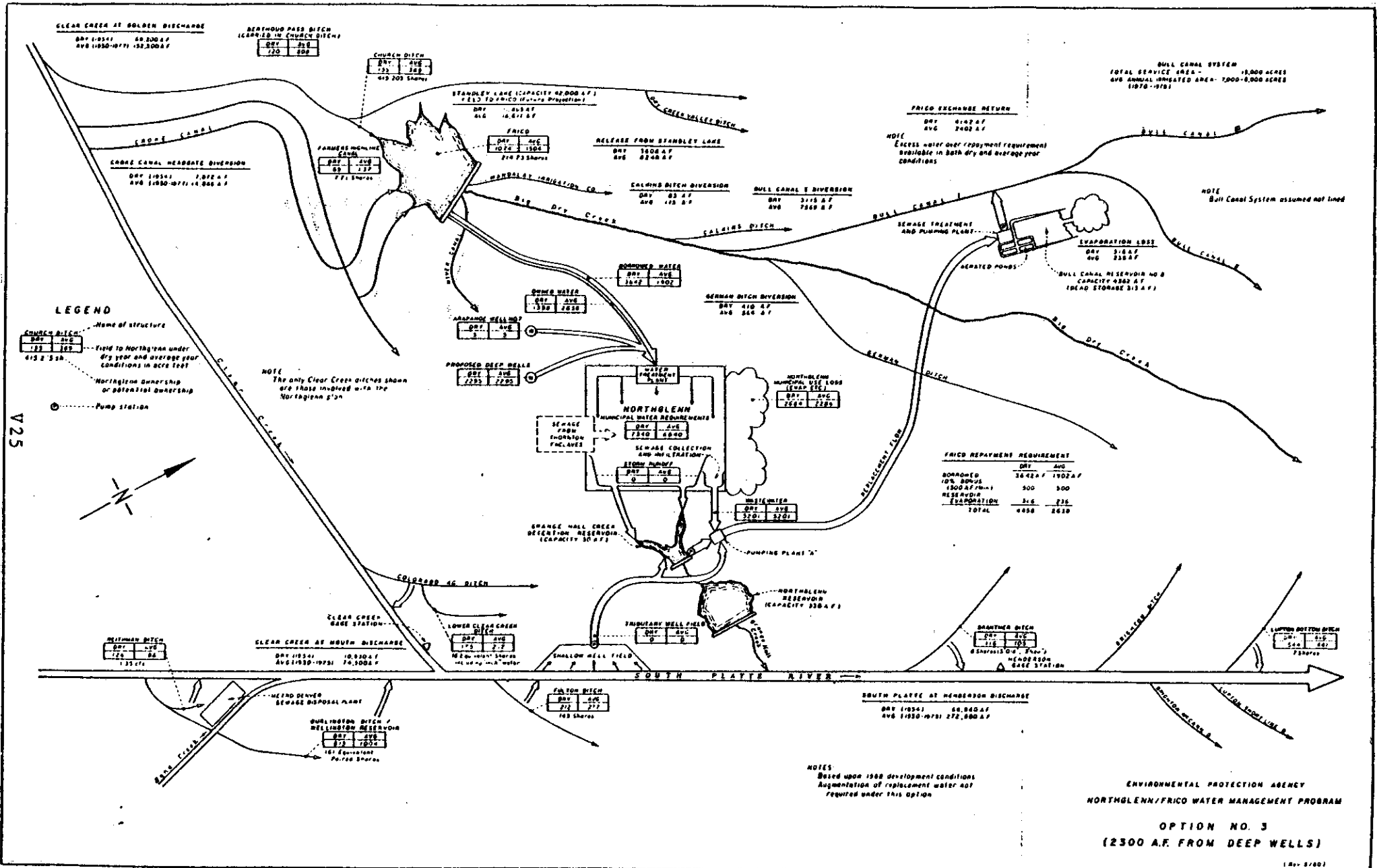


Figure 2