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DRIP SUBSURFACE IRRIGATION SYSTEM FOR ROW LANDSCAPING

PROJECT IXFU 040-4 (7)

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U.S. Department of Transportation
Federal Highway Administration

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16. Abstract

This is the final report of the Experimental Project to evaluate a drip subsurface irrigation system for right-of-way landscaping. The experimental feature was included in project IXFU 040-4(7) on S.H. 40, west Colfax Avenue, Denver, Colorado. The system utilizes "Seep-ez" drip tubing and "Seep-a-trol" control system. The "Seep-ez" drip tubing is a perforated plastic tubing in two sizes, .275" and .375" O.D. The "Seep-a-trol" control system is an electric control which uses a "sensitizer" moisture detector to control the irrigating water supply. The irrigated sections included grass sod, median barrier planters with trees and shrubs, and tree pockets. After installation, the system was evaluated for two growing seasons. The system requires close maintenance attention because of its location. The effectiveness of the installation was reduced by pedestrian traffic across the median, which caused damage to the tubing and connections and displaced the mulch cover. This system should only be used where the irrigated areas are protected.

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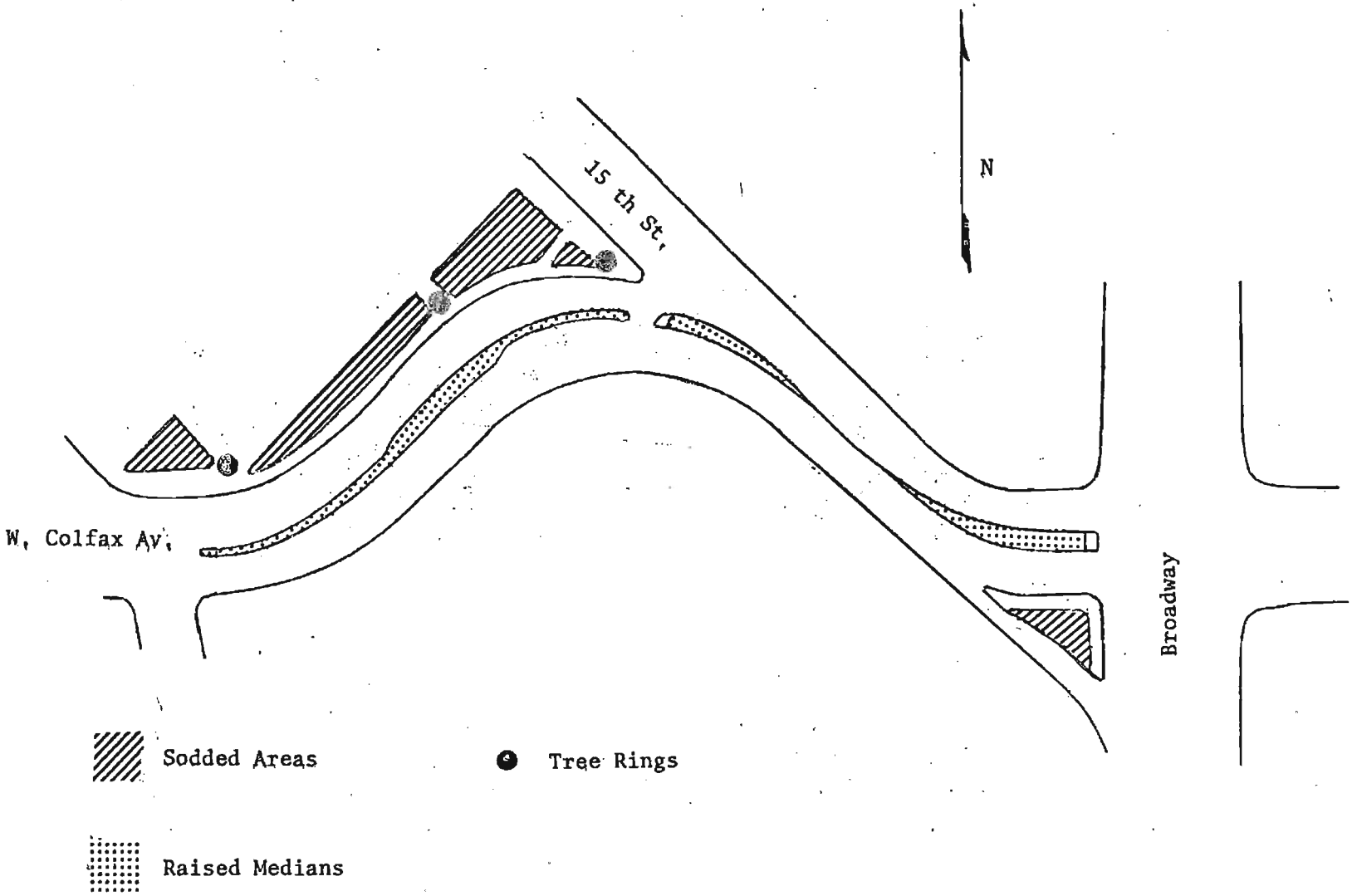
INTRODUCTION

This study was designed to evaluate the installation and performance of a drip subsurface irrigation method. This system was an experimental feature included in project IXFU 040-4(7). The project consisted of realignment of a section of West Colfax Avenue and landscaping, between Broadway and Bannock Street.

Areas to be irrigated consisted of 17,962 square feet of grass sod, three trees in tree pockets, and 93 trees and small shrubs plus ground cover in the narrow median barrier planters, see Figure 1. These areas are in the downtown section of metropolitan Denver that has high pedestrian and vehicle traffic. The use of pop-up or conventional fixed sprinklers was not desired because of inconvenience to pedestrians and motorists when windblown spray or misdirected sprinklers flood the roadway and sidewalks.

The irrigation system selected provides water to the root zones of the vegetation beneath the sod or under a layer of wood chip mulch. Deep root probes are used to irrigate the root zones of trees and small shrubs. "Seep'ez" is the product name for the drip tubing. Two sizes of drip tubing are utilized in this system. Size "A" is .275 inch O.D. and size "B" is .375 inch O.D. The tubing is perforated to allow the water to seep into the surrounding soil. "Seepatrol" is the name for the control system which uses a moisture "sensitizer" to control the automatic watering feature. The system is designed to control the irrigation manually, by electrical timer, or the automatic control. The system components were supplied by PEPCO, Highway 24, P.O. Box 965, Goodland, Kansas 67735.

The advantages of this irrigation system is to reduce water usage by reducing evaporation losses and to reduce maintenance costs as compared to above-ground sprinkler systems.



Project Site

Figure 1

INSTALLATION

In this system there are three ways to apply the irrigating water. Where the grass sod is installed, seep tubes are used and the tubing is placed on the prepared subsoil, then the sod is placed over the tubing. See Figure 2. For the trees and small shrubs, two, four, or six deep root probes are placed around the root zone. These root probes are made from a section of tubing and are connected to a supply manifold. See Figure 2. In the median barrier planter the seep tubes and deep root probes are used as previously described and the tubing is covered with a 4" layer of wood chip mulch. See Photos 7 and 8.

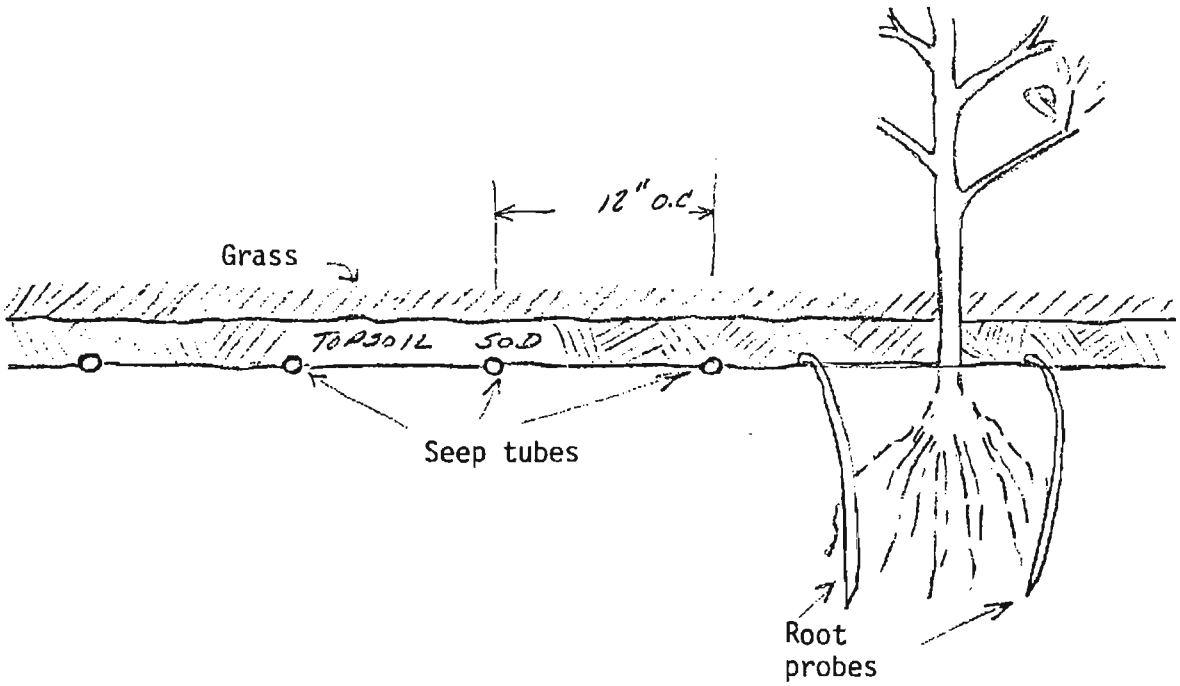
In the areas to be grass sodded, first the supply piping and electrical wiring lines were laid. The water supply pipes were placed below the frost line for winter protection. The subsoil was prepared and graded and the seep tubes and manifolds were laid in place and connected. The connections were joined using normal PVC techniques. Normal spacing for the drip tubes should be 12" O.C. and the slope drainage should allow the tubing to drain into the collector manifold. The tubing and connections were tested for correct irrigating flow and then the tubing was covered with the sod.

There were three trees planted in tree rings or tree pockets. After the trees were set in place, the root probes and supply manifolds were connected. The tree ring was filled with the wood chip mulch.

For the median barrier planter, the supply piping was laid below the frost level and the subsoil was graded to allow for the draining of the system. Next the trees and small shrubs were planted. The drip tubing and the manifolds were placed and connected. Since the medians were irregularly shaped, close attention to the spacing of the drip tubing was necessary. Optimum spacing of the tubing was 12" O.C., and the tubing should be no closer than 6" from the median walls. Where the median narrowed, bypass tubing (no drip holes) was used. See Figure 4. The system was checked for water flow, see

Photo 2, and the tubing was covered with the wood chip mulch. See Photos 7 and 8. A ground cover of Fleece flowers was planted through the mulch to help stabilize the mulch.

For the long runs of drip tubing, the large size "B" tubing was used to provide an ample volume of water. See Photos 3 and 4. For winter freeze protection, the manual drain valves allow the supply manifolds, drip tubing, and collector manifolds to drain into the drain chutes. See Photo 4.


12" o.c.
Grass
TOPSOIL SOD
Seep tubes
Root
probes

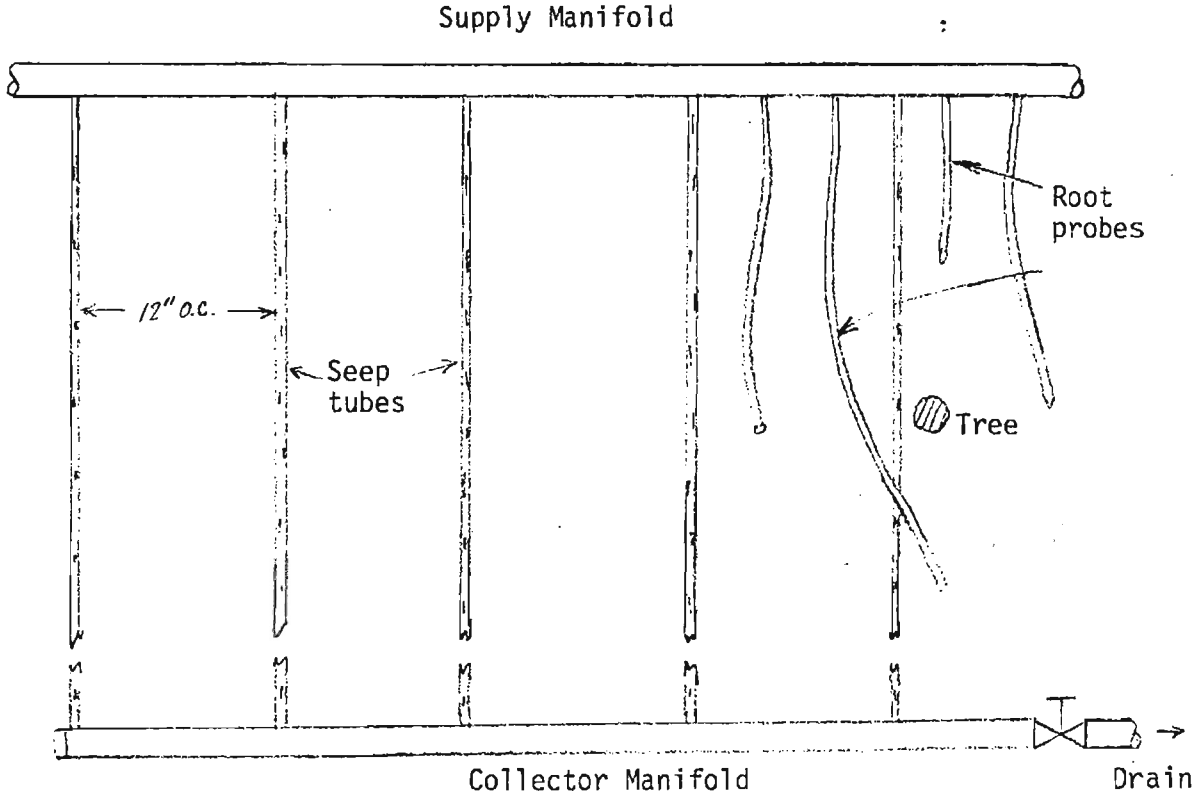
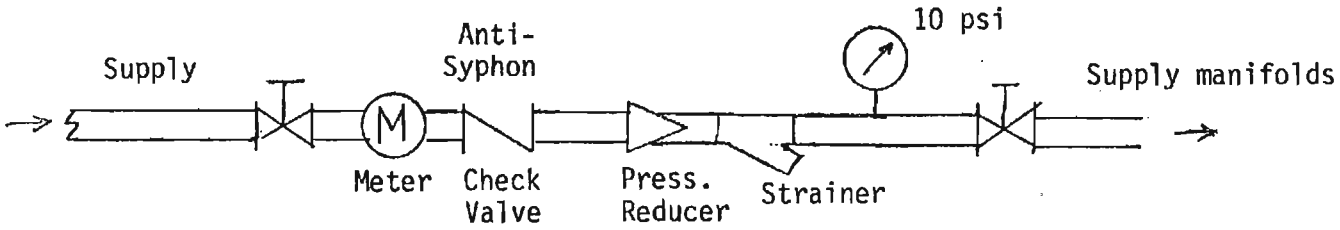
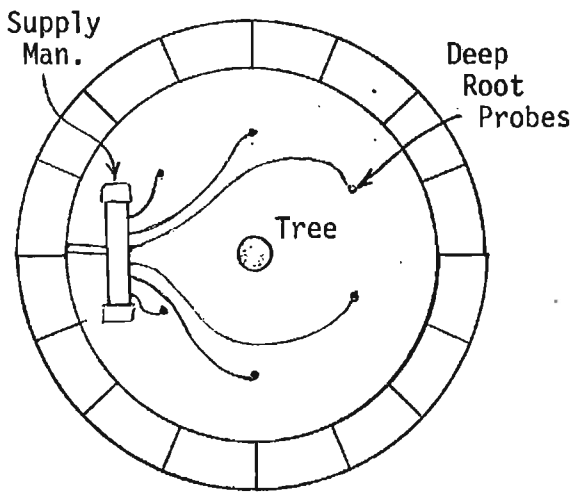
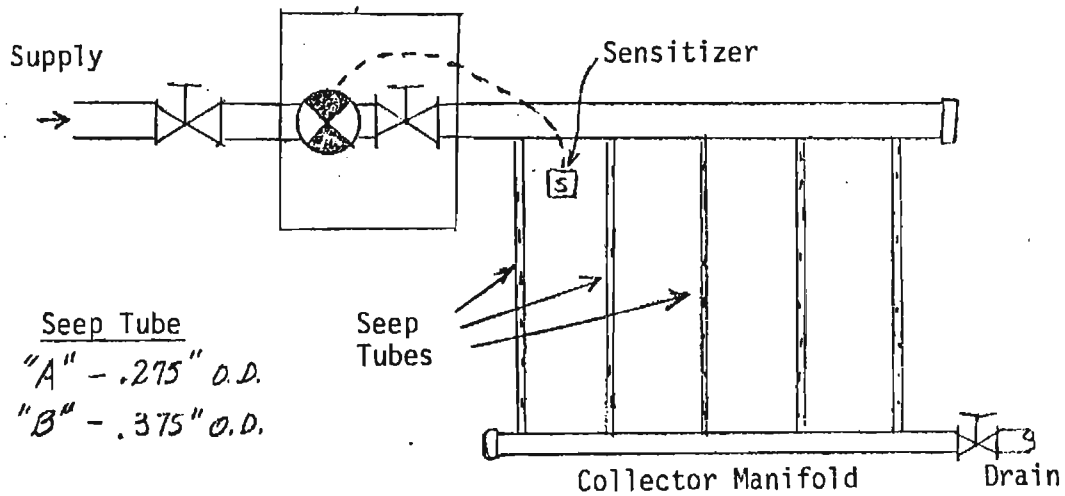

Supply Manifold
Root
probes
12" o.c.
Seep
tubes
Tree
Collector Manifold
Drain

Figure 2



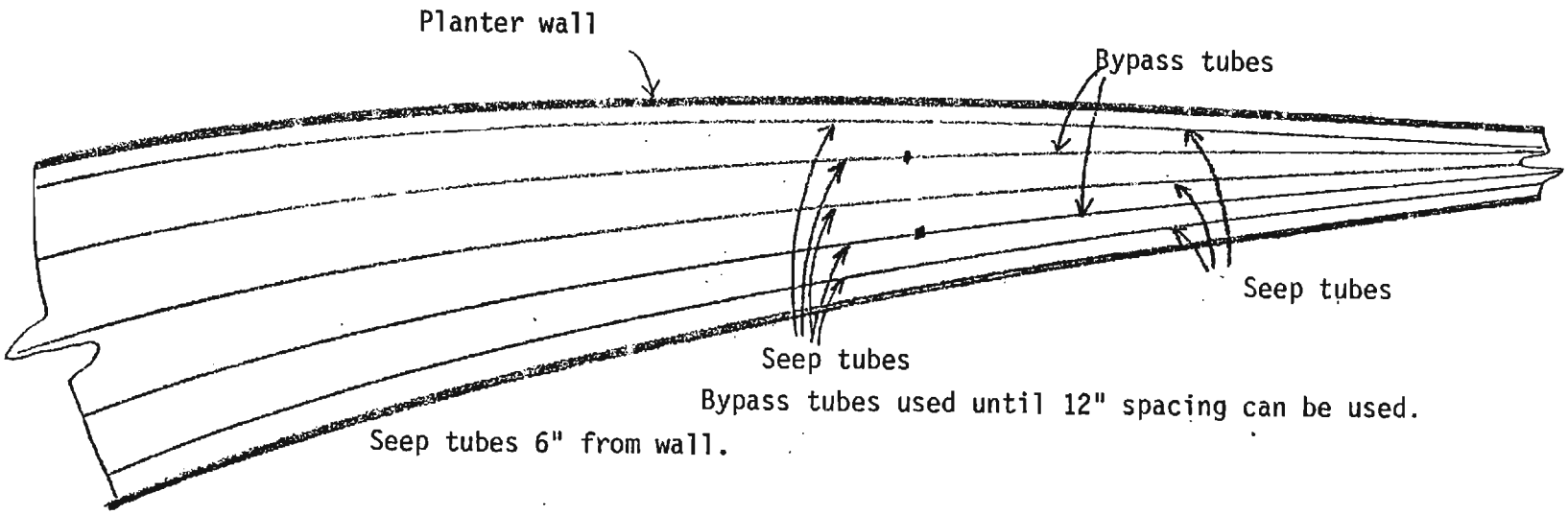


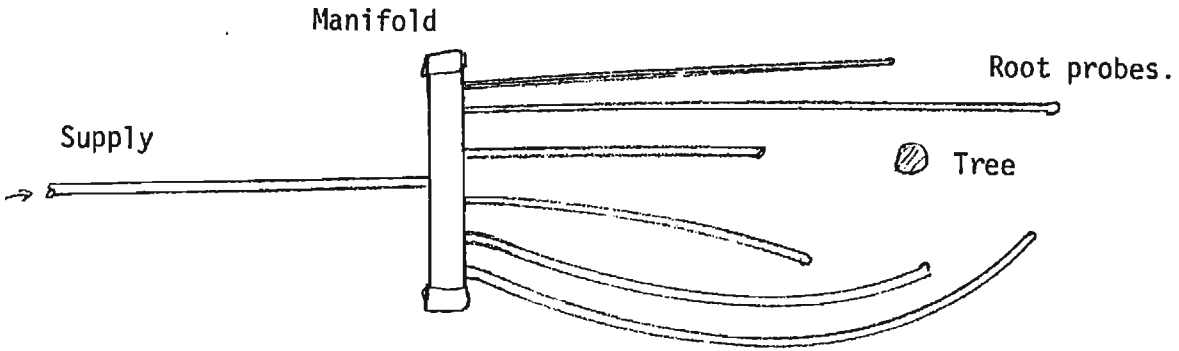
Tree Pocket



PIPING SCHEMATICS
Figure 3

MEDIAN PLANTER





PIPING SCHEMATICS

Figure 4

Photo 1
Water control vault showing manual and solenoid operated valves, and tee connections at header pipe.

Photo 2
Testing the system before covering the tubes with mulch. Shows tee connections at header pipe.

Photo 3
Narrow section showing lengthwise layout of tubing.

Photo 4
End of the irrigated section showing the tubing in place and the drain sump.

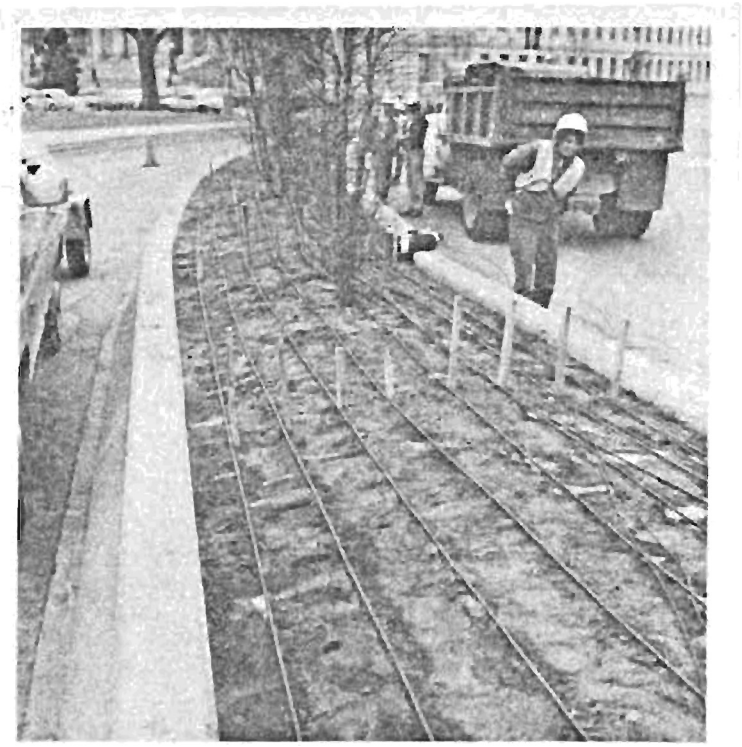


Photo 5
Shows layout of tubing for irrigation of narrow section .

The smaller tubing is for deep root irrigation of the larger trees and shrubs.

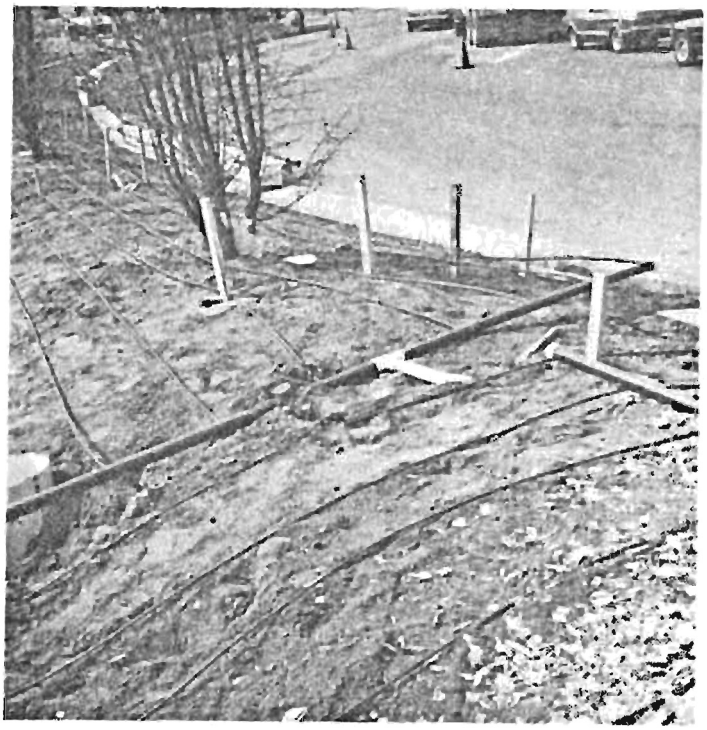


Photo 6
This shows the transverse layout for the tubing in the widest sections of the irrigated area.

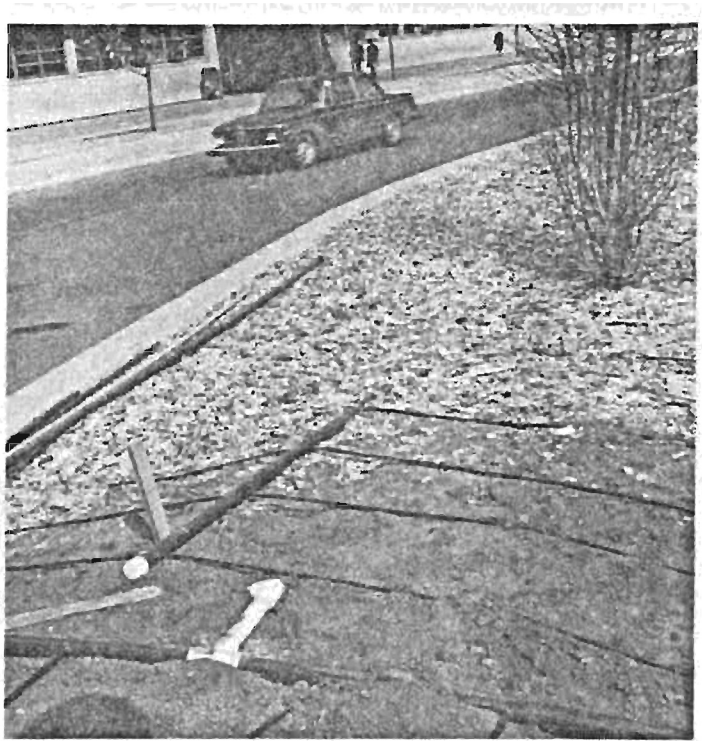


Photo 7
Partially covered tubing in the wide area with the transverse tubing shown.

Photo 8
Finished area showing tubing covered to depth with wood chip mulch.

EVALUATION

The Drip Sub-surface Irrigation system was installed in April 1981. The operation of the system and the monitoring of the vegetation growth was carried out for two growing seasons. Photographs and notes were made during the period and the study was completed in the fall of 1982.

During the installation, since most of the piping and tubing is laid on the prepared soil, there is very little digging and trenching required as compared to an above ground sprinkler system. The PVC piping and plastic tubing can be easily cut with hand tools, connections are made using PVC type cement. Before the tubing is covered the connections are checked and the system is flow tested. The sod or mulch covering is then placed and the pipes and tubing are not visible.

Soon after the system was put in operation there were many problems with the "sensitizers". The sensitizer switches would become jammed and this would lead to overwatering. This would allow water to run in he roadway or pool in the low spots. As a result the sensitizers were removed from the system and the system is controlled by electrical timers.

In the sodded areas the seep tubes would become clogged by compacted soil or foreign matter and the problem would not be noted until the grass began to dry up. The sod has to be disturbed to locate and correct the problem.

The system suffered some freeze damage due to the water not draining from the tubing properly. The placement of the collector manifolds and tubing would allow standing water to freeze and damage tubing. Most damage was to the connections at the collector manifold. Most of the irrigated areas are relatively level and proper drainage is difficult. Damage in the mulch covered areas is easy to locate and easy to repair.

A major problem in the median barrier planter section was the loss of mulch. During the wintertime the mulch is removed by wind action and pedestrian disturbance. The seep tubes and piping is uncovered and exposed to the elements. Some root probes were pulled out and connections were broken. This requires increased maintenance attention prior to using the system the next spring. Photographs on pages 11 through 13 show the loss of cover and exposure of the tubing.

In September 1981, at the end of the first growing season the growth and vitality of the vegetation was evaluated. The Fleece flowers were thriving well and had spread to cover approximately 50% of the mulched areas. The shrubs had a high percentage of survivability. The large trees the Red Oaks, had a survivability of about 80%. The dead trees after the first season were replaced by the contractor.

With the exception of one small area of the grass sod section, the grass sod was flourishing and doing well. In this bad area of sod, the soil had compacted around the seep tubing, and had stopped the drip action. The sod had dried out and the grass stopped growing. This problem was subsequently corrected.

In the raised median area where the mulch had badly eroded away exposing the drip tubing, the Fleece flower cover was sparse and the water from the drip tubing was rapidly evaporated.

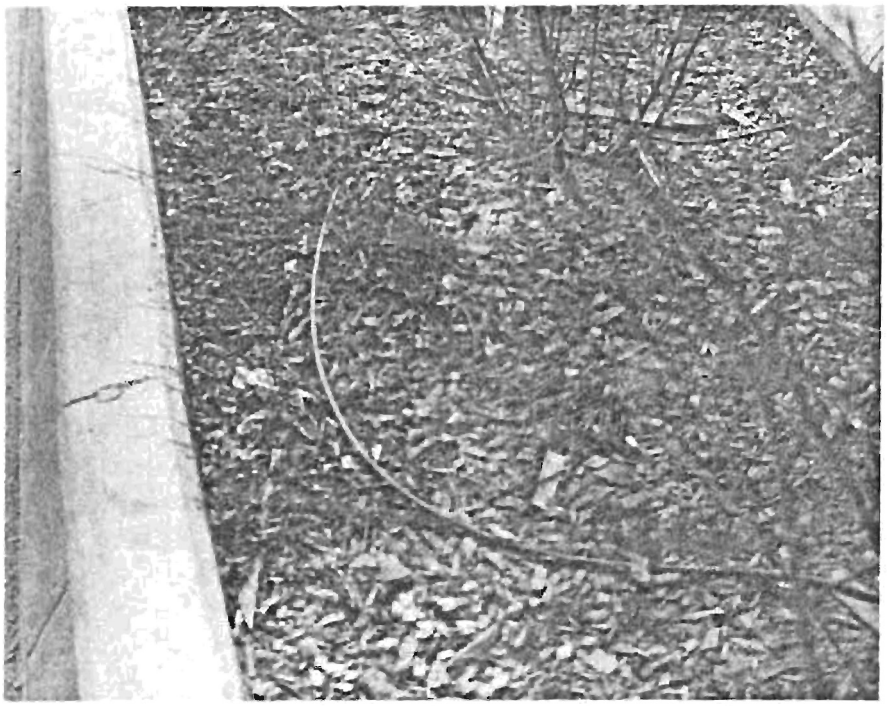
The remaining sections supplied by the drip system were flourishing well.

In September 1982 at the end of the second growing season, all the sodded areas were flourishing well. The Fleece flower cover in the median sections was almost 100%. One of the Red Oak trees in the sodded area was apparently dead.

Photo 9

This section of barrier median is subject to pedestrian damage. The mulch has been displaced and much tubing is exposed.

Photo 10



This root probe has been pulled from the ground and the mulch displaced.

Photo 11

Supply manifold and root probes exposed.

Photo 12

Tubing and manifold piping exposed. This area is adjacent to pedestrian walkway. The mulch has been stripped away.

Photo 13

Manifold and seep tubes lie exposed on surface.

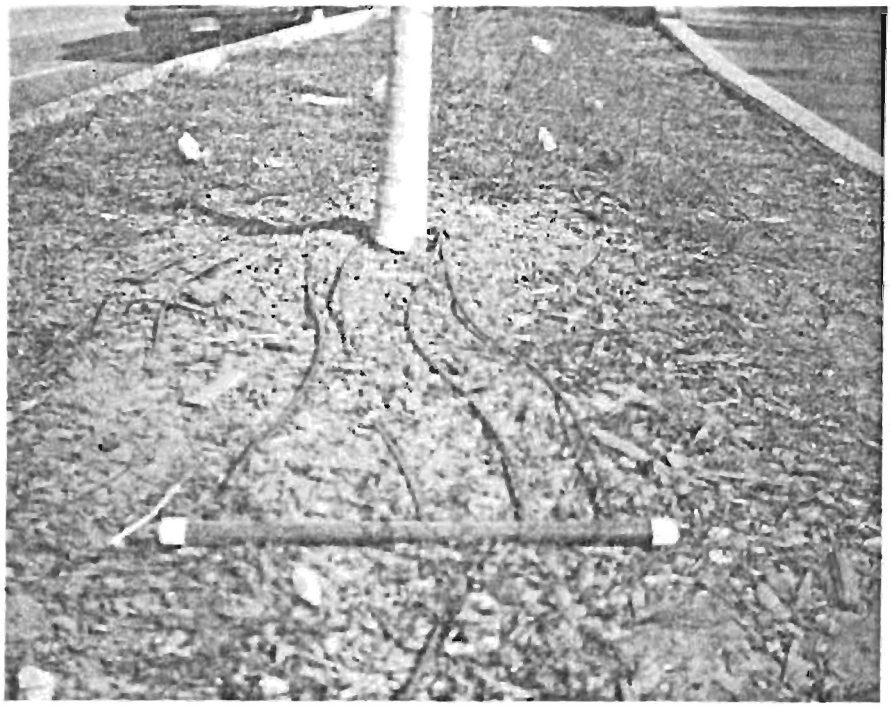


Photo 14

Root probes and supply manifold exposed. Mulch must be replaced and tubing covered.

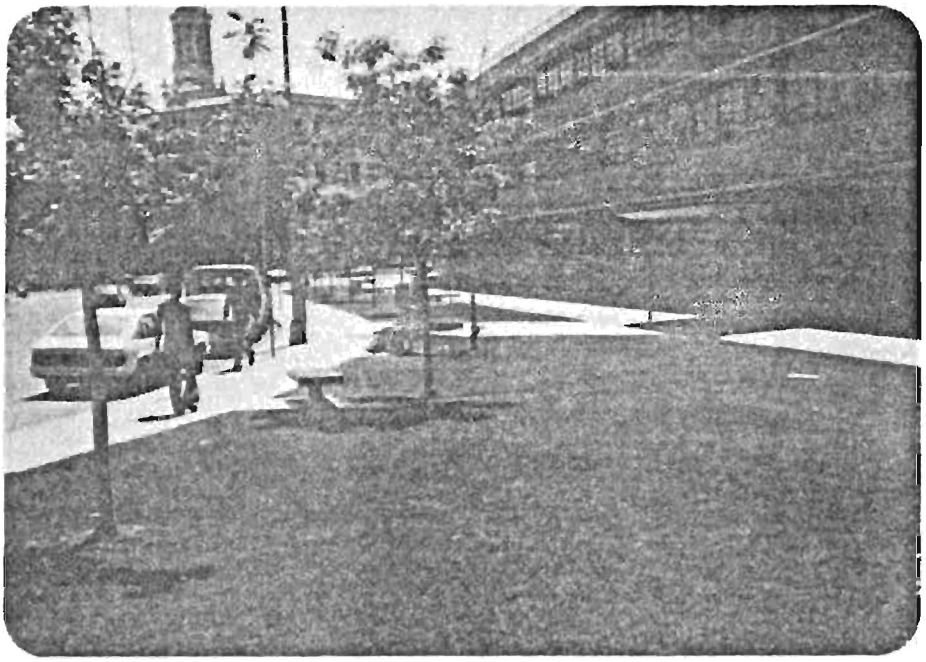


Photo 15

Grass sodded section after two growing seasons.

Photo 16

Median Barrier section after two growing seasons.

COSTS

The cost of the installation was bid as a "Sprinkler System" and as a one item Lump Sum bid. The cost of the "Sprinkler System" was $33,000.

This Lump Sum cost did not include the landscaping and did not include the supply piping upstream of the pressure reducer. See figure 3.

The water consumption comparison of this drip system to a conventional above ground sprinkler system was not feasible as the drip system was operated on a fixed timer and the "sensitizer" moisture demand control was not used. The water meter records in the Denver Water Department could not isolate water usage data for a similar above-ground sprinkler systems to give useful comparison figures.

This subsurface drip system provided sufficient irrigation water to provide good growth of the trees and sod.

The preparation of the subsoil bed is important to the proper operation of the drip tubing. In clay soils the addition of sand to the subsoil would prevent the compaction of the soil around the drip tubing.

CONCLUSIONS

The seep irrigation system as evaluated in this study offers the following advantages over the above ground type sprinkler system:

1. The irrigating water goes directly to the root areas of the vegetation.

2. Evaporation is greatly reduced. On windy days there are no erratic spray patterns. There is very little pooling of water or runoff into the streets or pedestrian walkways.

3. The system is a low pressure system and small leaks do not present much of a problem with erosion or flooding.

4. Low cost for repairs. Most repairs are to PVC piping or small seep tubing which is less costly than repairing sprinkler heads.

5. Most of the irrigated areas in this study are odd-shaped and narrow and do not lend themselves easily to above ground sprinkler systems.

6. Very little theft or vandalism as experienced with systems using above ground components.

Disadvantages of the system are:

1. The mulch covering the pipes and tubing is easily displaced by wind or pedestrian traffic. This exposes the piping to damage and deterioration by sunlight, and increases water losses by evaporation.

2. The perforations in the seep tubes are subject to blockage by debris or by compacted soil around the tubes. It is difficult to detect this blockage when the tubing is covered by mulch or sod.

3. Maintenance personnel must ensure adequate mulch cover is maintained over the piping and checks for leaks and blockages must be made frequently.

4. The failure of the "sensitizer" components of the "Seep-a-trol" system prevents the full use of the on demand automatic control that the system is designed for.

RECOMMENDATIONS

This Drip Subsurface irrigation system is recommended only where ROW landscaping requires irrigation and mulched beds can be protected from foot traffic and wind erosion.

The system is not recommended for sodded areas where heavy mowing equipment will be used.

On irregularly shaped areas where conventional sprinklers would overspray and adversely affect pedestrain or vehicular traffic agjacent, this subsurface drip system would be recommended.

It is recommended that further study be conducted in order to to:

1. Determine root growth incursion into the seep tubing.

2. Test various types of subsurface moisture detectors to improve the automatic "on demand" irrigation control.