Decision Case: The Carbon County Ball Fields[1]

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ABSTRACT

Poor soil conditions, poor construction techniques, intense foot traffic, and limited budget often make it difficult to maintain a quality turfgrass cover on many municipal athletic fields. The Carbon County Ball Field complex was built in 1978 in Price, UT. During construction, the highly saline and shallow soil was severely compacted. By 1998, the turfgrass quality had deteriorated to the point where two of the fields were unplayable. Those responsible for the maintenance of the field tried numerous remedies, all of which failed. Roy Phillips, the county extension educator, was consulted about the condition of the fields. Mr. Phillips sought advice from Dr. Jeff Andersen, the Utah state extension turf specialist. Dr. Andersen agreed that the fields needed improvement and focused on the issues of salinity, compaction, drainage, and proper irrigation. This case was designed for use in an advanced turfgrass management course, and has proven to be useful in applying management options for an athletic field, especially when considering the typically high pH, saline conditions, and soils of the arid West. The students are asked to make recommendations that Dr. Andersen should present to the county commissioner and city officials. Recommendations should involve agronomic solutions that take into account the physical, economic, and social realities of the situation.

SOILS IN URBAN AREAS often present many challenges to turf managers, especially athletic field managers trying to provide athletes with a safe, wear-resistant playing surface. Building and landscape construction procedures often result in poor quality soil indicated by compaction, high soluble salt levels, low organic matter content, and nutrient deficiencies. Yet the users of the landscapes still expect top quality turf, even on areas that experience intensive use such as athletic fields. The Carbon County Ball Field softball complex in Price, UT, was no exception.

Price (pop. 21 000) is located in central Utah, approximately 165 km southeast of Salt Lake City. Coal mining and its associated support are the primary industries. The region is becoming urbanized and recreational facilities have been lacking. One of the more popular activities is softball as evidenced by numerous city and county leagues. Because existing facilities had been overused and limited the growth of the leagues, Carbon Recreation decided to use a portion of the Carbon County Fairgrounds for a new, four-field softball complex. The land was already owned by the county, was close to town, and would be near county maintenance facilities, making field maintenance more convenient.

[1] This journal uses SI units, according to the ASA-CSSA-SSSA style. Due to the circumstances of this case study, however, English units are used, either alone or along with SI units.

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THE CASE

Construction of the Carbon County Ball Field began in 1978 and consisted of moving soil from the west half of the site to the east half and regrading the area flat to create a relatively level terrace. Topsoil was not replaced after the grading. Road-building equipment was available from the county, and used for the earthmoving and shaping process. The fields were laid out with each field occupying one-fourth of a circle. Buildings and backstops were all at the center of the circle with the fields radiating out from the center. This created four fields designated as northwest (NW), northeast (NE), southwest (SW), and southeast (SE). Before sodding the outfield areas, a mixture 2.5 cm thick of horse manure and sawdust from the fairgrounds was applied and incorporated into the NW and SW fields because topsoil had been removed. None was applied to the east half. An irrigation system was installed by county crews consisting of an irrigation zone for each field and using gear-drive rotor heads (Toro 640). Drainage in the complex consisted of a trench filled with gravel and a drainage pipe around the perimeter of the complex. In addition, three drainage lines were installed in the NW field, one in center field, one in right field, and one in left field. Each drainage line emptied into the perimeter drainage system. The drainage system emptied into an adjacent irrigation water canal. Kentucky bluegrass (*Poa pratensis* L.) sod was purchased locally and transplanted to the fields. The soil layer on the sod was approximately 1.5 cm thick, and was similar in texture to the soil on-site. Ball games started a few weeks after the fields were sodded.

Approximately 48 games were played at the complex each week, plus practices, for 23 wk of the year. Over time, the turfgrass quality of the west half of the complex had declined steadily. The Kentucky bluegrass turf thinned, became severely stunted, and much of it died. Water began to pond, and a white crust on the soil surface became visible, especially in the outfield area of the NW field. Players began complaining about the poor quality fields and unsafe playing conditions.

Management of the Area

Since 1978, the Carbon County Ball Field has had several turf managers, including the fairgrounds manager and several directors from the city and county softball program. None had prior turfgrass management experience. Each one attempted to improve the irrigation system (to deal with uniformity problems and increase water output) and each had a different management program for the turf. Most of the past field managers felt many of the problems could be solved by simply laying new sod; poor areas were frequently resodded, but the problems never disappeared.

Each year between 1978 and 1996, about $10 000 was put into the complex. In any given year, little money was available for improvements, upgrades, and so forth. Most of the money was put into trying to fix the problems that were occurring. In 1996, the county decided they needed to try to fix the situation and further upgrade the facility.

Between 1996 and 2000, approximately $50 000 per year was spent, again for mainly trying to improve the field conditions, but also for maintenance such as upgrading shelters and concrete walkways. Typically, $20 000 has gone toward general maintenance, $20 000 for equipment, and $10 000 for repairs, according to Denise Nelson, assistant manager of the field.

Between 1996 and 2000, Roy Phillips, the Utah State University county extension educator for Carbon County was asked for assistance. Roy is the only extension educator serving Carbon County, and his expertise is in cropping systems and agricultural soils. He is also responsible for Master Gardener training, 4-H, and other extension programs conducted in his county. Like most county educators, Roy's time was spread very thin and he could not spend as much time as he would have liked working with the maintenance crews for the softball fields.

The Problem

By 1997, turfgrass quality of the NW and SW fields had declined to the point where the fields were unplayable. Based on the symptoms of the white crust forming on the soil surface, declining turf quality, knowledge that drainage was poor in the site, and background knowledge that soils in the region are typically high in soluble salts, Roy collected soil samples (Exhibit 1) and made fertilizer and other management recommendations. Roy felt the soils were low in P and K so he recommended four applications of fertilizer (equal ratios of N–P_2O_5–K_2O) each year and to apply them with small equipment rather than large truck-type spreaders, as had been done in the past. Roy recommended increasing aeration frequency to four times per year, increasing irrigation to leach salts, and to *rip* the NW field to reduce compaction. *Ripping* is a deep tillage technique to break up hard pan layers deep in the soil and is a practice most commonly done in crop production. Roy recommended applications of gypsum for the NW and SW fields at rates of 8967 kg ha^{-1} in the most affected sites and 4483 kg ha^{-1} in the rest of the NW and SW fields. He also suggested checking the working condition of the field drainage and adding laterals to the existing system. Finally, Roy recommended planting only tall fescue (*Festuca arundinacea* Schreb.), perennial ryegrass (*Lolium perenne* L.), or both in the NW and SW fields, or any place the salinity measurement was above 4 dS m^{-1} (mmhos cm^{-1}).

The fertilizer recommendations were followed for 1998 and 1999, but as the next field manager came in, Roy's recommendations were ignored. By 2001, Roy was becoming increasingly frustrated. The field managers continued to ask for recommendations but failed to follow his suggestions. In the meantime, turfgrass quality declined further. At this point, Roy decided to contact the Utah State University turfgrass extension specialist, Dr. Jeff Andersen, for assistance. Roy arranged a site visit that included an opportunity for Dr. Andersen to inspect the site, address the problems at the site, make recommendations for the field, and to make a presentation to the city and county officials. Roy thought that bringing in a turf or soils expert from a university may help convince the maintenance crews to follow appropriate recommendations.

Before Dr. Andersen's visit, Roy provided him with the following information:

1. Soil test results from samples taken in 1997, 1998, and 2000 (Exhibit 1). At some point between 1998 and 2000, sand was applied to the field in hopes of improving drainage. The addition of sand is evidenced by the change in soil texture from loam to sandy loam.
2. The soils in this area are classified as a Persayo-Chipeta complex. The Persayo soil is a loamy, mixed, active, calcareous, mesic, shallow Typic Torriorthent. The Chipeta soil is a clayey, mixed, active, calcareous, mesic, shallow Typic Torriorthent. The parent material of these soils is Mancos shale, a type of shale high in soluble salts. Characteristics and use limitations as presented in the Carbon Area, Utah Natural Resources Conservation Service soil survey description (Jensen and Borchert, 1988) are summarized in Exhibit 2.
3. The Mancos shale is unique in that salts are probably being liberated from the shale when irrigation is applied and

Exhibit 1. Soil test result summaries from 1997, 1998, and 2000.

	1997 (Univ. lab test)				1998 (Univ. lab test)				2000 (Private lab test)			
	SE	SW	NW	NE	SE	SW	NW	NE	SE	SW	NW	NE
Soil texture	--†	--	--	--	loam	silt loam	loam	loam	silt loam	sandy loam	sandy loam	sandy loam
pH	--	--	--	--	8.1	7.9	8.0	7.9	8.0	8.2	8.2	8.1
salinity, dS m^{-1}	1.3	7.4	19	1.3	0.7	2.4	8.7	1.6	6.9	5.9	2.0	1.4
P, mg kg^{-1}	2.5	3.8	29	3.7	18	24	38	15	9	32	13	10
K mg kg^{-1}	109	174	400	124	182	191	>400	174	120	230	105	105
SAR	1.0	7.2	18	1.0	--	--	--	--	--	--	--	--
Na, $cmol_c$ kg^{-1}	--	--	--	--	--	--	--	--	1.1	1.9	0.3	0.2
Organic matter, g kg^{-1}	--	--	--	--	--	--	--	--	14.5	21.0	17.0	17.0
Ca, $cmol_c$ kg^{-1}	--	--	--	--	--	--	--	--	14.9	10.3	9.4	10.0
Mg, $cmol_c$ kg^{-1}	--	--	--	--	--	--	--	--	3.7	4.2	2.4	2.4
Sulfate-S, mg kg^{-1}	--	--	--	--	--	--	--	--	99	99	99	99
Fe, mg kg^{-1}	--	--	--	--	--	--	--	--	19.3	37.2	17.7	18.3

† Data not available or determined.

drainage is poor. Irrigation may therefore increase the salinity and allow the salts to migrate up (through water evaporation) into the plant rootzone. As a result, salinity levels might be higher than those typically found in the surrounding unirrigated rangelands.

4. When Dr. Andersen asked Dr. Steven Moser, soil extension specialist, about the soil type and the situation at the Carbon County Ball Field, Dr. Moser responded with an email (Exhibit 3).
5. Roy had a difficult time getting information on the actual fertilization and irrigation program used. However, he was told that N was applied only in one spring application each year and estimated that the irrigation system was run 5 to 10 min, twice a day. Short, frequent watering times were used because water puddled at the surface during and after irrigations, especially in the NW and SW fields.
6. Realizing that the soils were high in salinity, Roy recommended the use of alkaligrass (*Puccinellia distans* [L.] Parl.), a salt-tolerant, cool-season grass species that has been used with some success on golf courses and some low-maintenance athletic fields in the Intermountain West. The areas were overseeded, but the resulting stand was somewhat thin and clumpy, due in part to the bunch-type habit of growth. The Kentucky bluegrass exhibited a bunchy and stunted habit as well. The condition of the turf resulted in a safety hazard to the players. The softball organizers and others in the county demanded a better playing surface and insisted that Kentucky bluegrass be used. This is the grass with which they were most familiar and is locally available as sod.
7. Another consultant/sales representative, Mr. George Tonneson, advised watering the area heavily to leach the salts; however, he was concerned that the water table was coming to the surface when the area was watered. He asked to have several monitoring wells drilled in the west half of the complex to check the movement of the water table. In

Exhibit 2. Summary of soil survey information for the site.

80 – Persayo–Chipeta complex. This map unit is on shale hills near Helper, Price, and Wellington. Slopes are 3 to 20%, 100 to 200 feet long, and concave to convex. Elevation is 5300 to 6100 feet. The average annual precipitation is 6 to 8 inches, the average annual air temperature is 48 to 50°F, and the freeze-free period is 115 to 140 days.

This unit is 55% Persayo loam, 3 to 20% slopes; 35% Chipeta silty clay loam, 3 to 20% slopes, eroded; and 10% other soils.† The components of this unit are so intricately intermingled that it was not practical to map them separately at the scale used.

Included in this unit are about 5% Killpack clay loam near washes and 5% Saltair silty clay loam in swales.†

The Persayo soil is shallow and well drained. It formed in residuum and alluvium derived dominantly from shale. The present vegetation in most areas is mainly galleta and shadscale. Typically, the surface layer is light brownish gray loam 3 inches thick. The underlying material to a depth of 12 inches is light brownish gray silty clay loam over weathered shale. Depth to weathered shale ranges from 10 to 20 inches. The lower part of the underlying material has few to common gypsum crystals.

Permeability of the Persayo soil is moderately slow. Available water capacity is 2 to 3 inches. Effective rooting depth is 10 to 20 inches. The organic matter content of the surface layer is 0.5 to 1.0%. Runoff is medium, and the hazard of water erosion is moderate. Sheet erosion is active, and in many places shallow gullies are cut into the weathered shale. The hazard of soil blowing is moderate.

The Chipeta soil is shallow and well drained. It formed in residuum derived dominantly from shale. The present vegetation in most areas is mainly mat saltbush, Nuttal saltbush, and shadscale.‡ Typically, the surface layer is light brownish gray silty clay loam 5 inches thick. The underlying material to a depth of 17 inches is light brownish gray silty clay over weathered shale. Depth to weathered shale ranges from 10 to 20 inches.

Permeability of the Chipeta soil is slow. Available water capacity is about 1.5 to 3.0 inches. Water supplying capacity is 2 to 3 inches. Effective rooting depth is 10 to 20 inches. The organic matter content of the surface layer is 1 to 2 percent. Runoff is rapid, and the hazard of water erosion is high. Rill and gully erosion is active. The hazard of soil blowing is moderate.

Most areas of this unit are used as rangeland in spring and fall. A few areas are used for urban development.

The potential plant community on the Persayo soil is 35 percent grasses, 15 percent forbs, and 50 percent shrubs. Among the important plants are shadscale, galleta, Indian ricegrass, and bud sagebrush.

Management practices that maintain or improve the rangeland vegetation include proper grazing use, a planned grazing system, and proper location of water developments.

It is not practical to revegetate large areas of this soil because of the low precipitation and fine texture of the soil. For critical erosion control, small areas can be mechanically treated and seeded. Plants that may be suitable for critical area seedlings are those native to the unit and prostrate kochia.

The potential plant community on the Chipeta soil is 15 percent grasses, 15 percent forbs, and 70 percent shrubs. among the important plants are mat saltbrush, galleta, deserttrumpet, and bud sagebrush.‡

The suitability of this soil for grazing is limited because of the low precipitation and the relative unpalatability of the dominant plants.

Management practices that maintain or improve the rangeland vegetation include proper grazing use, a planned grazing system, and proper location of water developments.

It is not practical to revegetate large areas of this soil because of the low annual precipitation and the shallow depth to bedrock. For critical erosion control, small areas can be mechanically treated and seeded. Plants that may be suitable for critical area seedings are native plants and prostrate kochia.

This map unit is in capability subclass VIIe, nonirrigated. The Persayo soil is in the Desert Loamy Clay range site. The Chipeta soil is in the Desert Shallow Clay range site.

† Persayo, loamy, mixed, active, calcareous, mesic, shallow Typic Torriorthent; Chipeta, clayey, mixed, active, calcareous, mesic, shallow Typic Torriorthent; Killpack, fine-silty, mixed (calcareous), mesic Typic Torriorthent; Saltair, fine-silty, mixed, mesic Typic Salorthid.

‡ Mat saltbush, *Atriplex corrugata* S.Wats.; nuttal saltbush, *Atriplex gurdneri* (Moq.) D. Dietr.; shadscale, *Atriplex confertifolia* (Torr. & Frem.) S. Wats.; galleta, *Pleuraphis jamesii* Torr.; deserttrumpet, *Eriogonum inflatum* Torrey & Frémont var. *inflatum*; bud sagebrush, *Picrothamnus desertorum* Nutt.

(continued)

most of these wells, the level stayed at about 150 cm below the surface, while two had water at 75 cm. Neither level was affected by irrigation.

8. While the monitoring wells were being drilled, Roy noticed a severe compaction layer from a depth of 10 to 30 cm. Previously, this compaction layer was thought to be shale (see comments by Dr. Moser in Exhibit 3).
9. Water did flow out of the drainage system, but slowly. The salt content of this water was measured at 7.5 dS m^{-1} during spring of 2000.

Dr. Andersen visited Price and the Carbon County Ball Field early in March 2001 and met with the renovation committee consisting of Roy, the current grounds manager (recently hired and superintendent at the nearby Carbon Country Club), city and county parks maintenance employees, and George Tonneson, the consultant–sales representative. As Dr. Andersen walked the site, he found he could easily push a soil probe down 30 cm on the east end of the fields. But when he used the soil probe in the west side, where salt crusts were present and the turf was struggling, he hit a very hard layer about 5 to 10 cm below the surface. The layer actually made a hollow sound when tapped with a soil probe. This was the compacted layer noted earlier by Roy. To address the drainage issue, a civil engineer and friend of the current field manager recommended blasting or fracturing the underlying layer with explosives to improve drainage. (The town is at the heart of a large coal mining region so the use of dynamite is not unusual to its citizens.) Various recommendations came from the participants in the renovation committee including: application of gypsum to relieve compaction, topdressing with sand, deep tine aerification, the use of biostimulants, use of a sulfur burner, putting in additional drainage lines filled with gravel, and the use of organic fertilizers.

When Dr. Andersen asked the renovation committee what the quality expectations for this field might be, they all responded: "very high." The facility is used by a large number of people during the summer. The complex becomes a community meeting place. Citizens want to see and play on a nice field and they expect it to be safe for themselves and their children to play on. When the committee was asked about the period for improvements, the answer was less clear. The county has been trying to improve the fields for a few years and spending considerable sums of money in recent years. One person described it as a "money pit." With the large cost overruns on the project, closing the entire facility for significant amounts of time is politically difficult because the fields are tightly booked and players would be upset if the fields were closed again, especially since league season had just started for the 2000 season.

Obviously, everyone wanted a high quality and safe field. However, the county commissioner did not want to spend more money than necessary. The county was already significantly over budget on the project. What should Dr. Andersen recommend in his presentation to the group, and how should he present those recommendations while considering the economic and social realities of the situation?

Exhibit 2. Continued.

Limitations for recreation and reason for limitations.

Soil name	Camp areas	Picnic areas	Playgrounds	Paths and trails
Persayo	Severe: depth to rock	Severe: depth to rock	Severe: slope, depth to rock	Severe: erodes easily
Chipeta	Severe: depth to rock, excess salt	Severe: excess salt, depth to rock	Severe: slope, depth to rock	Severe: erodes easily

Limitations for wildlife habitat.

Soil name	Grain and seed crops	Grasses and legumes	Wild herbaceous plants	Coniferous plants	Shrubs	Wetland plants	Shallow water areas
Persayo	Very poor	Very poor	Very poor	Very poor	Very poor	Very poor	Very poor
Chipeta	Very poor	Very poor	Very poor	Very poor	Very poor	Very poor	Very poor

Limitations for building site development.

Soil name	Shallow excavations	Dwellings without basements	Dwellings with basements	Small commercial buildings	Local roads and streets	Lawns and landscaping
Persayo	Severe: depth to rock	Moderate: shrink-swell, slope, depth to rock	Severe: depth to rock	Severe: slope	Moderate: depth to rock, low strength, slope	Severe: thin layer
Chipeta	Severe: depth to rock	Moderate: shrink-swell, slope, depth to rock	Severe: depth to rock	Severe: slope	Severe: slope	Severe: excess salt, thin layer

Physical and chemical properties of the soils.

Soil name	Depth	Clay	Moist bulk density	Permeability	Available water capacity	Soil reaction	Salinity
	cm	g kg^{-1}	Mg m^{-3}	cm h^{-1}	cm cm^{-1}	pH	dS m^{-1}
Persayo	0–7.6	180–270	1.20–1.30	1.5–5.1	0.15–0.17	8.5–9.0	<8
	7.6–30.5	200–300	1.10–1.20	0.5–1.5	0.16–0.18	8.5–9.0	<8
	30.5+	--	---	--	--	--	--
Chipeta	0–12.7	280–470	1.15–1.25	0.2–0.5	0.11–0.16	7.4–8.4	8–16
	12.7–43.2	350–450	1.15–1.25	0.2–0.5	0.11–0.16	7.4–9.0	8–16
	43.2+	--	--	--	--	--	--

Exhibit 3. Email response from Dr. Steven Moser, Utah State University extension soil specialist, regarding soil conditions at the Carbon County Ball Field.

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 Subject: Re: Softball fields
    Date: Thu, 08 Feb 2001 08:28:10 -0700
    From: Steven Moser stevenm@usu.edu
      To: "Jeff Andersen" <jandersen@usu.edu>

Jeff:

I am somewhat familiar with the Price ball field issue. Roy and I have talked about it a few times. It is a difficult situation. This Manco shale shows up in many areas of eastern Utah and is a problem wherever it is close to the surface. The shale is very salty and I do not think it is possible to leach the salt out of it over time. Also, in some areas the shale is solid enough to be a barrier to rooting and water movement (leaching).

A drainage system would help channel the water off if the shale is a barrier to leaching. In some areas, though, the shale is fractured enough to allow drainage. Ask Roy if the site has been irrigated and whether water ponds on the surface or seems to drain well under current irrigation or rainfall.

Since the shale is so close to the surface (only 4 inches of topsoil) the salt will migrate back into the topsoil very quickly. I think this is why they have not been successful to date in keeping the salinity level down. There are a few options short of installing the drainage system if drainage is not happening now, and bringing in some additional topsoil to increase rooting depth (probably a minimum of 12 inches of topsoil total to allow rooting and leaching). Water management would also be important if they go this route. Even with these measures I believe they would still need a salt tolerant grass since the problem will not be completely solved.

As I recall this is a typical situation. They built the field without first considering the shale/salinity issue, then started looking for an easy/cheap solution. There is no easy/cheap solution.
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Steven Moser, Assoc. Prof.
Extension Soil Specialist
Utah State University
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TEACHING NOTES

This decision case describes an agronomic situation not atypical of those encountered when maintaining turfgrass in the Intermountain West. Salts, high pH, low organic matter, relatively little topsoil, and other soils issues are common due to the arid climate. While the site was originally deemed unsuitable for other uses, it is asked to support a high quality, intensively used turfgrass surface. These are the main agronomic challenges of this site. The field must also be safe for those playing softball because the city or county is potentially liable for injuries, if they are due to the condition of the turf. The case also involves economic, social, and political factors that are encountered when dealing with municipally owned facilities: the need to consider on-going events scheduled on the facility, the economic realities of the situation, and potential conflict of interest where the sales representative/consultant is a friend and neighbor of many people on the renovation committee. Also, most of the people involved did not have the agronomic background to understand what maintenance an athletic field requires, although they think they did.

This real life case is intended to illustrate decision-making processes that are involved with managing publicly owned athletic fields with highly saline soil conditions. The case allows students to use agronomic or horticultural knowledge to address the problems while considering limitations imposed by economics. The situation also will require the decision maker to educate and prioritize the turfgrass management options to the city and county officials.

When discussing this case, agronomic factors to be considered include: field drainage, saline and sodic soil conditions, the effects of underlying soil parent material, turfgrass species choice, on-going maintenance, alternatives for renovation or rebuilding, and impacts of construction methods. Other factors that should also be discussed include quality expectations and a timeline for making corrections. Obviously, the county commissioner wants the fields to be playable immediately, but various solutions to the problem may take different lengths of time. For example, a complete tile installation to the field at needed spacing may take a field out of play for an entire season. In comparison, the use of slit drainage may allow play to resume in a matter of a few days, but it is more costly. The students should include arguments for why various procedures are important. The instructor should present relevant background information before introducing the case and have references available to students on the topics involved. Some suggested references are listed in the references section.

Discussion Questions

1. What is Dr. Andersen's objective in this dilemma? What about the county commissioner? This question is meant to illustrate that various decision makers and others involved may have different perspectives, which influence the final decisions. Dr. Andersen would hopefully be objective and base his recommendations on science with consideration for economics. He has no monetary stake in the decision. The commissioner may, however, be most concerned about economics and may overestimate the ability of the field to respond to inadequate management. One might call this the *it's just grass* viewpoint, meaning all grasses are the same and intensive management is not important. If Dr. Andersen senses this viewpoint from the commissioner and others, how should Dr. Andersen respond or present his recommendations?

2. How important is it to maintain the appearance and playability at the Carbon County Ball Field? In turfgrass management, decisions are sometimes based on appearance alone. Agronomic issues are sometimes ignored or not known. Athletic fields and other kinds of turf areas may have the additional expectations of providing a safe place for a game. Liability concerns may play a significant role in determining turfgrass quality expectations.

3. Does the Carbon County Recreation Department have public image issues that must be considered? Public image often plays a role in quality expectations. Especially in small communities, a softball complex can be a source of community pride or embarrassment. A quality complex, or a poor one, can also influence local tourist income for the city.

4. You may want more information to make a decision. Is this unusual? How would you deal with the lack of information? Demand more? Work with what you have? Is the information trustworthy? In consulting situations, it is common that information may be incomplete or unreliable. Decision makers need to act using the information available and adjust their plan as new information becomes available.

5. Is the city/county able to afford the changes? This question requires the student to evaluate economic factors that may affect the feasibility of their recommendations. Most students are not familiar with the Price, UT, area; therefore, a discussion using economic restraints in their particular area may be more appropriate. (Students can be asked to prioritize actions to address the problems and obtain cost estimates for each activity. Students can also be asked to construct a timeline for the recommended activities.)

6. Could this situation have been avoided by more careful construction? If so, how? This question is included to have students consider how the current problems may have been prevented during construction and/or in management since, but still consider the minimal budget that was provided in the first 18 yr.

Recommendations Given and Outcome

A benefit of using decision cases in the classroom is that a number of potential solutions along with their respective advantages and disadvantages are discussed. Yet it may be useful at some point in the discussion for the instructor to report what recommendations were provided to the Carbon County renovation committee and what those outcomes were. It must be stressed, however, that Dr. Andersen's response is not necessarily the correct answer, especially in light of new technology that may have been introduced.

In Dr. Andersen's presentation, he focused mainly on drainage at the site, because of its importance to getting anything to grow satisfactorily on the site. If drainage is not improved, salt levels will only continue to increase, especially in the most affected areas. Tile drains could be installed if the field(s) is to be rebuilt or slit drains could be used to minimize disruption in the field. He recommended working with an irrigation–drainage engineer (one was on staff in the Price City Public Works Department) to design the system properly. Cultivation was also stressed, especially to break up the compacted layer that exists several inches below the surface. Deep tine aerification, especially those that fracture the soil, such as a VertiDrain unit, were recommended. These drainage solutions are somewhat costly, but were argued as necessary to have a field at all. The managers were recommended to do the worst affected areas first, followed by other areas to spread out costs.

Once drainage issues are addressed, irrigations to leach salts were recommended and less frequent irrigation to encourage deep root growth. Species choice was also discussed. Since Kentucky bluegrass is one of the least salt-tolerant turfgrass species, perennial ryegrass or tall fescue were recommended as better choices, both of which are significantly more salt tolerant, especially ryegrass. Alkaligrass might still be an option in those areas were salt content remains high. Applications of gypsum were recommended to address the high sodium levels in some parts of the field, if the drainage could also be improved.

After Dr. Andersen's visit, the county followed some of the recommendations from Roy Phillips and Dr. Andersen, but did not follow others. Two years after the visit, the NW field was tilled and reseeded with mixed success. Fertilizer recommendations were followed, as were those for irrigation, specifically to leach salts; however, the drainage system was not expanded. A plugged drain was observed in 2002, which when fixed resulted in a significantly increased flow. Water infiltration remained a problem in some parts of the fields. The irrigation system was improved by replacing irrigation heads and more labor was hired for field maintenance.

Use of the Case

When this case is used in a turfgrass science class, students should be given the case and supplemental readings (Carrow and Duncan, 1998; Carrow et al., 2001a, 2001b; Kotudy-Amacher at al., 2000; McCarty and Camberato, 2001; McIntyre and Jakobsen, 2000; Pace and Johnson, 2002) one or more weeks before class time. The instructor should assign a written report or an oral report, outlining a presentation to city officials on what needs to be done with the softball complex. In that report the student should also provide reaction to the solutions offered by the renovation committee. This report might also ask students to obtain cost estimates for their solutions such as the cost of drainage, deep tine aeration, amendments, and so forth. The students should also prioritize their recommendations in light of the economic situation of the city. The instructor should consider to what depth the answers should be written; the instructor could require general recommendations to the described problems or require the students to design drainage systems that are needed and details of other modifications to the site.

Our recommendation is that the instructor lead an in-class discussion using small groups, and start the discussion with one or more questions. Later, other questions can be discussed in small groups or as a whole class. There are probably several ways of dealing with the situation, so a consensus among the class may not be appropriate. The instructor could lead the discussion to possible solutions or could suspend the discussion and assign students to revise their reports based on the in-class discussion.

When this case has been used in classes, it has been especially helpful in learning to apply information on salt- and sodium-related issues. This case is also useful to those students who have not had experience managing turf or other crops in high pH (>7.8) and saline soils that are widespread throughout the western USA. The case also identifies the importance of up-front planning, proper construction, and use of soil survey information. Finally, this case has been especially useful to teach students how to educate people involved in a turf site about important agronomic issues, and to teach others how to address those situations.

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