



Water Rights Arrangements in Australia and Overseas

Annex I *Colorado*

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Inquiries about this document:

Media and Publications
Productivity Commission
Locked Bag 2 Collins Street East
Melbourne VIC 8003

Tel: (03) 9653 2244
Fax: (03) 9653 2303
Email: dhanek@pc.gov.au

General Inquiries:

Tel: (03) 9653 2100 or
(02) 6240 3200

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Abbreviations

AF	Acre-feet
BoR	Bureau of Reclamation
CGWC	Colorado Ground Water Commission
CPUC	Colorado Public Utilities Commission
CRS	Colorado Revised Statutes
CRWCD	Colorado River Water Conservation District
CRWPE	Colorado River Water Projects Enterprise
CWCB	Colorado Water Conservation Board
NCWCD	Northern Colorado Water Conservancy District
OECD	Organisation for Economic Cooperation and Development
PC	Productivity Commission
UCREFRP	Upper Colorado River Endangered Fish Recovery Program and San Juan River Basin Recovery Implementation Program
USGS	US Geological Survey

Preface

Water Rights Arrangements in Australia and Overseas is a study that forms part of the Commission's program of benchmarking the performance of economic infrastructure industries. It continues previous work undertaken into the arrangements for setting drinking water quality standards. The study compares the legal, organisational and regulatory arrangements for managing water rights, against accepted best practice principles.

This annex is one of twelve case studies prepared to assist readers understand the complex legal, organisational and management arrangements of the jurisdictions studied. Case studies were prepared for the Murray–Darling Basin, NSW, Victoria, Queensland, South Australia, the ACT, the Colorado River Basin, California, Colorado, Chile, Mexico and South Africa. These case studies should be read in conjunction with the main report.

Research for the study and each of the annexes was undertaken by the Economic Infrastructure Branch, with Dr Neil Byron as mentoring Commissioner.

Many persons and organisations have assisted in the preparation of this case study. The Productivity Commission would like to thank especially the staff of the Colorado Division of Water Resources and the Colorado Water Conservation Board. Further feedback from readers would also be welcome.

1 The water sector

Colorado is a western state in the United States that straddles the Rocky Mountains. It is bordered by Wyoming and Nebraska (to the north), Utah (west), New Mexico (south) and Kansas (east). Colorado is semi-arid with an average annual precipitation of 430mm. Such precipitation is subject to high annual variability and droughts are not uncommon. However, the Rocky Mountain region, which runs north to south through the centre of the state, receives an average of 1000mm or more each year usually in the form of snow. Most of the state's surface water is sourced from that region.

Colorado comprises three large drainage basins:

- To the east of the Continental Divide are the rolling grasslands of the eastern plains. The plains form the Mississippi drainage basin (comprising the Missouri and Arkansas basins) and feed the North and South Platte, Arkansas and Republican rivers.
- To the west of the Continental Divide is the Colorado Plateau. The plateau forms the Colorado drainage basin and feeds the Colorado River and its major tributaries (the Yampa, White, Gunnison, Dolores, and San Juan rivers).
- To the south of the Rocky Mountain region, water from the San Juan Mountains drains southwards into the Gulf of Mexico by the Rio Grande (see figure 1.1).

1.1 Surface water

The average annual inflow of surface water to Colorado is approximately 15.5 million acre-feet (AF) (19 100 GL), 69 per cent of which drains westwards to the Colorado river (CDWR et al. 1995). In contrast, over 80 per cent of Colorado's 4.3 million population live on the eastern side of the Continental Divide (COEDT 2001). Increasing irrigation and municipal demand for water in the drier east has encouraged extensive investment in infrastructure to divert water from the Colorado basin to the South Platte, Arkansas and Rio Grande basins. Almost 412 000 AF was drawn from the Colorado River basin — equivalent to ten per cent of state's consumption of irrigation water in 1993 (CDWR et al. 1995).

Figure 1.1 Colorado's river basins



Source: Colorado Water (undated).

The largest transmountain water diversion project is the Colorado–Big Thompson, administered by the Northern Colorado Water Conservancy District (NCWCD). The Colorado–Big Thompson Project, constructed between 1938 and 1957 by the US Bureau of Reclamation, comprises four power plants, twelve reservoirs, 35 miles of tunnels, 95 miles of canals, and 700 miles of transmission lines. It was designed to divert and store 310 000 AF (380 GL), although on average it diverts approximately 230 000 AF annually. The Colorado–Big Thompson Project supplies water to 29 cities and towns, over 100 ditch and reservoir companies, and 620 000 acres of irrigated farmland (Zimelman et al. 2002).

At least 93 per cent of surface water consumed in Colorado is used for irrigation. Municipalities accounted for only 3.2 per cent of total water consumption. While consumption of water by power generators was relatively small, 35.5 per cent of all surface waters was used to generate hydroelectricity (USGS 1988).

1.2 Ground water resources

While most of Colorado's surface water drains to the west of the Continental Divide, most of the state's ground water occurs in the east. Ground water in

Colorado is classified as tributary, nontributary, not nontributary and designated (see box 1.1). Designated ground water is mainly found the east while nontributary ground water is found throughout the state.

Box 1.1 Classification of ground water in Colorado

Tributary ground water is defined to be ground water that is hydrologically connected to surface water or required to fulfil decreed surface water rights. Such water is subject to the appropriation doctrine and is administered as surface water.

Nontributary ground water is defined to be ground water that is outside a designated basin 'the withdrawal of which within one hundred years, will not deplete the flow of a natural stream, at an annual rate greater than one-tenth of one percent of the annual rate of withdrawal' (§37-90-103 CRS).

Not nontributary ground water is defined to be ground water that is located in the Denver ground water basin that is outside the boundaries of the designated ground water area, and the withdrawal of which will, within one hundred years, deplete the flow of a natural stream at an annual rate greater than one-tenth of one percent of the annual rate of withdrawal (§37-90-103 CRS).

Designated ground water is defined to be ground water that is in a designated basin, which in its natural course would not be available for the fulfilment of decreed surface rights. It can constitute ground water in areas not adjacent to a continuously flowing natural stream wherein the ground water withdrawals have constituted the principal water use for at least fifteen years preceding the date of the basin (§37-90-103 CRS).

The main ground water sources in Colorado include the North and South Platte, the San Luis Valley and the Denver ground water basins. There are also numerous small nontributary ground water basins in western Colorado. Together these contain an estimated 490 to 500 million AF of recoverable ground water (Robson 1987).

The main uses for ground water are by the mining industry, which consumes an average of over 400 million gallons per day in 1985 of a total ground water consumption of 740 million gallons per day (USGS 1988). In contrast, livestock consumed 140 million barrels per day and irrigation consumed 130 million gallons per day (USGS 1988).

2 Legal framework

Colorado's legal framework is based upon several legal doctrines relating to water: the Doctrine of Prior Appropriation for surface water and tributary ground water; a modified Doctrine of Prior Appropriation for nontributary ground water in designated basins; and a permit system for nontributary ground water outside the designated basins.

2.1 Evolution of water law

The Doctrine of Prior Appropriation first began to appear in 1849, following the discovery of gold in California. Miners, settled on federal public lands and later farmers and other users, established the custom of water sharing based on the principle of *first in-time of use, first in-rights for the amount of water placed from the natural streams to beneficial use*.

The custom arose, in part, because the United States acquired new land as a result of the 1803 Louisiana Purchase and the 1848 Treaty of Guadalupe Hidalgo, but had little effective jurisdiction over the lands. Instead, local courts adjudicated over water conflicts. Court decisions supported the emerging doctrine (Getches 1997).

The Doctrine of Prior Appropriation was progressively recognised by the US Federal Government under the *Mining Act of 1866*, the *Placer Law of 1870* and the *Desert Land Act of 1877*. For example, the Mining Act expressly confirmed the rights of miners and appropriators of water and sanctioned appropriations of water and for the transfer of water across public lands (Getches 1997).

These acts allowed the legal interests in land and water to be separated (Hobbs 2001). Congress also ceded to the states and territories the legal jurisdiction to create property interests in the use of all available unappropriated waters on the public domain — subject to the right of the government at any time in the future to reserve then unappropriated water for federal purposes (Hobbs 2001).

Upon the confirmation of their statehood, many western states adopted the Doctrine of Prior Appropriation as their preferred principle of defining and allocating water rights (Hobbs 2001). In 1876, the doctrine was formally recognised in Colorado's Constitution. The Adjudication Acts of 1879 and 1881 sought to introduce more

orderly procedures into the administration of the Doctrine of Prior Appropriation for both surface and ground water. These acts were gradually expanded and modified to accommodate the growth in water use. For example, the over-appropriation of water in certain streams, resulted in the introduction of ‘conditional water rights’ in 1943 Adjudication Act.

The Doctrine of Prior Appropriation remained the principle of allocating ground water in Colorado until 1965, when the *Ground Water Management Act 1965* was introduced. It was recognised that strict application of the doctrine would lead to the depletion of ground water resources, because the doctrine did not distinguish between the stock of water in an aquifer and its recharge capacity. In its place, the Act adopted both a modified Doctrine of Prior Appropriation for designated ground water and abandoned the doctrine altogether for nontributary ground water.

2.2 Current legislative framework

The extraction and use of surface and ground water in Colorado are governed by the *Water Right Determination and Administration Act* (1969) and the *Ground Water Management Act* (1965). The control of point source pollution is governed by the *Colorado Water Quality Control Act*. The provision of environmental flows is also controlled by the *Water Right Determination and Administration Act* (1969). US Federal Government environment protection legislation, such as the *Endangered Species Act* (1973), also have a role in water right framework. Inter-jurisdictional water sharing is governed by a series of international treaties, interstate compact, and US Supreme Court decrees.¹ Separate provisions in the Colorado Revised Statutes govern the management of water delivery.

Surface water and tributary ground water

According to Colorado’s Constitution of 1876, water in its natural state is the property of the public and the state has the prerogative to assert sovereign interests for the regulation of water (Article XVI, s. 5; Getches 1997). However, the Constitution also guarantees individuals the right to appropriate water not appropriated by others or reserved by the US Federal Government (Article XVI, s. 5).

Appropriation is the act of diverting (extracting) water from a natural surface stream or ground, from a specified location and for a specified beneficial use. Applicants

¹ Inter-state compacts are agreements ratified by Congress under the compact clause of the US Constitution (Article I, §10, clause 3).

wishing to obtain legal recognition of their appropriation must file with the relevant water court in their water division. Applications are first made for conditional water rights. The appropriator must then proceed with the diversion or extraction of water and then apply it to one of the recognised beneficial uses. Following its application, the applicant must re-apply to the water court to convert the conditional water right or well permit to a perfected water right.

A successful application for a perfected water right confers to the party both a deed to the water and a priority for its use. The deed divests the water's title from the State of Colorado to the individual. The water right becomes the usufructuary and possessory right of the appropriator. The priority date indicates the seniority of the water right. It confers the right to draw water from the stream and protection against junior (later dated) rights.

Other ground water

The administration of ground water is described under the *Ground Water Management Act* (1965) and the *Water Right Determination and Administration Act* (1969). These acts recognise two management regimes for ground water that reflect the different natural recharge characteristics of aquifers, historical use patterns and degree of exploitation and potential future use. These include the:

- Modified priority-based permitting regime for designated ground water. The objective of the regime is to protect and maintain reasonable ground water pumping levels in designated ground water basins (§37-90-102 CRS).
- Non-priority based permitting regime for nontributary ground water. The objective of the regime is to encourage the beneficial use of water even if this allows for a reduction of the hydrostatic pressure and aquifer levels outside the designated basin (§37-90-102 CRS).

Large capacity well permits for designated and nontributary ground water are adjudicated and administered by the Office of the State Engineer, the former under the authority of the CGWC (§37-90-104(6) *et seq.* and 105 CRS). Small capacity well permits in all areas are administered and adjudicated by the Office of the State Engineer. In some instances, ground water courts also have jurisdiction to adjudicate over applications for large and small capacity well permits.

As with surface water rights, applicants wishing to apply for a conditional well permit must file with the Office of the State Engineer. Applicants are required to notify their intention, divert the water and apply it to beneficial use before filing with the Office of the State Engineer to convert their conditional well permit to a final well permit.

A final well permit confers on the party both a deed to the ground water, and in the case of designated ground water, a priority for its use. As with water rights, although with some limitations, final well permits for designated ground water are usufructuary and possessory rights of the appropriator.²

Inter-jurisdiction water sharing arrangements

Colorado sits at the headwaters of six major rivers — the Colorado, the Rio Grande, the North Platte, the Republican, the Arkansas, and the South Platte — and numerous smaller streams and tributaries. A number of interstate arrangements were reached in order to resolve disputes involving the depletion (and pollution) of interstate waters (Getches 1997; see table 2.1).

Competition between jurisdictions over water has resulted in two major types of inter-jurisdiction water sharing arrangements: interstate litigation and interstate compacts. Colorado is subject to three United States Supreme Court decisions over the sharing of interstate waters — *Nebraska v. Wyoming* (325 US 589), *Wyoming v. Colorado* (309 US (1940), 259 US (1922)) and *Colorado v. New Mexico* (Hobbs 1997).

Colorado is a signatory to nine congressionally ratified interstate compacts with other states and the 1945 treaty between the United States and Mexico over the Colorado, Tijuana and Rio Grande rivers. The international treaty with Mexico is described PC (2003).

Water quality

The US federal *Clean Water Act* (1972) was passed to replace state regulation of pollution with a comprehensive national system involving federal-state sharing of responsibilities (Getches 1997). The goal of the act was to eliminate discharge of pollutants by 1985 and to ‘restore and maintain the chemical, physical, and biological integrity of the Nation’s waters...’ (33 USCA §1251-1376).

² *State Dept. of Natural Resources v. Southwestern Colorado Water Conservation Dist.* (Colo. 1983).

Table 2.1 Summary of compacts and litigations governing Colorado’s use of interstate streams

<i>Compacts</i>	<i>Signatory states</i>	<i>Important provisions</i> ^a
Interstate compacts		
Colorado River Compact (1922)	Arizona, California, Colorado, Nevada, New Mexico, Utah, Wyoming	Divide Colorado River Basin into upper (Colorado, Utah, New Mexico, and Wyoming) and Lower Basins (California, Arizona, and Nevada). Allocates 7.5m AF p.a. to each basin, and for lower basin to increase consumptive use by 1m AF. Mexico allocated surplus water above 15m AF and equal contribution from upper and lower basins.
La Plata River Compact (1922)	Colorado, New Mexico	Between December 1 and February 15, each state has unrestricted use of all water within its jurisdiction. Between February 15 and December 1, the water shall be apportioned as: Each state has unrestricted use on those days where the interstate station has a mean daily flow of 100 cfs or more. On all other days, Colorado must deliver to the interstate station half of the mean flow at Hesperus station, but no more than 100 cfs.
South Platte River Compact (1923)	Colorado and Nebraska	Nebraska entitled to the full diversion of waters above the division at Lodgepole Creek, and Colorado has exclusive use of all waters below that point. Between 15 October and 1 April Colorado has full has to all waters, less an adjustment for water diverted as a result of the South Divide Canal. Between 1 April and 15 October, Colorado will not permit any diversions in the Lower Section by Colorado appropriators whose decrees are junior to 14 June 1897 on any day when the interstate station shows a mean flow less than 120 cfs.
Rio Grande Compact (1938)	Colorado, New Mexico and Texas	Colorado is obliged to deliver at Lobatos the sum of the amounts set forth in the delivery schedules for the Conejos River and the Rio Grande, less 10 000 AF. If the Closed Basin is used to deliver water to the Rio Grande, the water must contain no more than 45 per cent sodium ions in the total positive ion count when total dissolved solids exceed 350 ppm. Colorado may accumulate debits (not exceeding 100 000 AF) provided these are held in storage. During January of any year, the Commissioners for Texas and New Mexico may demand the release of water from reservoirs.
Republican River Compact (1942)	Colorado, Kansas and Nebraska	Colorado is allocated 54 100 AF plus the entire supply of Frenchman Creek and Red Willow Creek in Colorado. Kansas is allocated annually 190 300 AF and Nebraska 234 500 AF. No provision for debits or credits.
Costilla Creek Compact (1944, amended 1963)	Colorado and New Mexico	Irrigation season set to 16 May to 30 September and storage season 1 October to 15 May. Colorado relinquishes water rights and changes decreed amounts. Duty of water to provide 1 cfs for each 80 acres of land irrigated. Water delivery schedule to be based on waters available. Prohibits direct flow diversions during the storage season.

Table 2.1 (continued)

<i>Compacts</i>	<i>Signatory states</i>	<i>Important provisions^a</i>
Upper Colorado River Compact (1948)	Arizona, Colorado, New Mexico, Utah and Wyoming	Of the Upper Colorado Basin waters, Arizona allocated 50 000 AF/year. Of the remaining water, jurisdictions are allocated: Colorado (52 per cent), New Mexico (11 per cent), Utah (23 per cent) and Wyoming (14 per cent). Apportionment is based upon the allocation of man-made depletions and beneficial use in basins, the measures and the limit of the right to use. Apportions other waters (including Little Snake River, Henry's Fork, Yampa River and the San Juan River).
Arkansas River Compact (1948)	Colorado and Kansas	Jointly operate John Martin Reservoir. During the winter storage period, all water shall be stored in the reservoir (except 100 cfs to be taken by Colorado). During irrigation season, maximum releases by Colorado are 750 cfs and Kansas 500 cfs (or 400 cfs during low storage). Concurrent releases shall not exceed 1250 cfs (or 1000 cfs during low storage). 1980 operation plan divides the waters volumetrically: 60 per cent to Colorado and 40 per cent to Kansas.
Animas-La Plata Project Compact (1969)	Colorado and New Mexico	Provides new Mexico with the right to divert and store water from the Project with the same validity and equal priority granted to Colorado water users of the Project, provided such uses are within New Mexico's allocation in the Upper Colorado River Compact.
US Supreme Court cases		
Nebraska v Wyoming (1945)		Colorado is prohibited from diverting from the North Platte River for irrigation of more than 145 000 AF per season in Jackson County. Colorado is prohibited from storing more than 17 000 AF for irrigation purposes. Colorado prohibited from exporting from the North Platte River more than 60 000 AF in any consecutive 10-year period.
Wyoming v Colorado (1957)		Colorado may divert from the Laramie River and its tributaries up to 49 375 AF, subject to a range of limitations.
Agreements		
Pot Creek MOU (1958)	Colorado and Utah	Agree for the establishment of a compact. Establishes a schedule of priorities for use in both states and defines a period before which direct flow diversions cannot be exercised.
Sand Creek MOU (1939, amend 1997)	Colorado and Wyoming	Recognise that Wyoming water rights are entitled to 50.68 cfs prior to diversions by Colorado ditches. Amended in 1997 to require delivery of 40 cfs to the border for a seven day period at the commencement of the irrigation period, and 35 cfs thereafter (if available and if needed) to Wyoming.

^a The table is not comprehensive and reference should be made to the full compact document

Source: CDWR (2000).

The *Colorado Water Quality Control Act* was established to reflect the requirements of the federal *Clean Water Act*. The act gave the Colorado Water Quality Commission the responsibility for setting water quality standards and regulations.

The provisions of the *Water Quality Control Act* have limited the application of control regulations, especially in relation to agriculture. For example, the Colorado Water Quality Control Commission cannot ‘supersede, abrogate, or impair rights to divert water and apply water to beneficial uses...’ which would ‘cause or result in material injury to existing water rights’ (§25-8-104 CRS). These provisions prohibit agricultural discharges being regulated in terms of allowable concentrations, because in doing so, irrigators may resort to diluting their discharges with water from their water right and this would constitute a material injury of that water right. Similarly, instream flow rights cannot be used for pollution program purposes (§25-8-104 and 205 CRS).

Instead, the preferred mechanism for controlling agricultural discharges is through incentives, grants and cooperative programs. Water conservation, water conservancy and soil conservation districts may recommend strategies for the control of agricultural nonpoint source control activities (§25-8-205 CRS).

3 Organisations

The administration of water rights in Colorado is largely the responsibility of the Colorado Division of Water Resources, the Colorado Water Conservation Board, the Colorado Ground Water Commission and the ground water management districts, and the Colorado water courts. Water quality policy and environmental protection is under the jurisdiction of the Colorado Water Quality Control Commission, the Colorado Division of Wildlife and the US Department of the Interior. The distribution of water and implementation of water quality control is the responsibility of various local organisations that include water conservancy and conservation districts, irrigation districts and ditch companies.

3.1 Colorado Division of Water Resources

The Colorado Division of Water Resources of the Department of Natural Resources (hereafter referred to as the Office of the State Engineer) operates under the direction of section 13, Article XII of Colorado's Constitution, specific state statutes, court decrees, and interstate compacts.

The office comprises two hundred staff, including the State Engineer, seven division engineers and numerous water commissioners (§37-92-202 CRS). The State Engineer reports to the Executive Director of the Department of Natural Resources (§37-80-113 CRS). Each division engineer reports to the State Engineer and provides support services to the water judges of their division.

The office is responsible for administering the state's well permits and for ensuring that the state's waters are distributed to water right and well permit holders. The office:

- Maintains records of stream-flows, diversions and extractions, water rights and well permits. It provides general supervisory control over measurement, record-keeping of the state's surface and ground water resources.
- Promulgates rules for the distribution of surface and ground water according to priority, for the delivery of water to ensure that the state meets its compact commitments, and for the operation of the Arkansas River Water Bank Pilot Program in consultation with the Colorado Water Conservation Board.

-
- Adjudicates over applications for and changes to well permits, including well permits on behalf of the Colorado Ground Water Commission.
 - Advises water courts on applications regarding a range of nontributary ground water and surface water matters, including applications for water storage rights and applications to export water from the state.
 - Provides technical advice to the Colorado Ground Water Commission and ground water management districts.
 - Monitors and enforces well permits and water rights, diversions and extractions, stream flows, and dam construction and safety.

The Office of the State Engineer has the authority to collect fees for filings of water rights and well permits, augmentation and replacement plans, approvals to export water from the state, examination and filing water and storage rights. In addition, the office charges fees for the issuing of maps and certificates, data, monitoring equipment use, and satellite monitoring services.

3.2 Colorado Water Conservation Board

The Colorado Water Conservation Board (CWCB) of the Department of Natural Resources operates under Articles 60, 90 and 92 of Title 37 the Colorado Revised Statutes. The CWCB's objectives are to assist in the development and protection of the state's water rights for the benefit of present and future inhabitants (§37-60-101 CRS).

The CWCB comprises fifteen members — six non-voting and nine voting. Non-voting members include the Attorney-General, State Engineer, Director of the Division of Wildlife, Commissioner of Agriculture, and the director of the CWCB (who is elected from within the board). The Executive Director of the Department of the Natural Resources is a voting member. The remaining CWCB members are state citizens appointed by the Governor with the consent of the Senate. The CWCB reports to the Executive Director of the Department of the Natural Resources.

The CWCB undertakes a range of activities including:

- representing Colorado in major international treaties, interstate compacts and U.S. Supreme Court decisions;
- entering into partnership with other government agencies such as the US Bureau of Reclamation (BoR) and the US Army Corps of Engineers, to develop water related infrastructure such as dams, channels and hydro-electricity power stations;

-
- encouraging the appropriation of water resources provided to Colorado in its interstate compacts, by fostering and encouraging the development of water user associations;
 - providing grants and low interest loans to develop water-related infrastructure for water user associations;
 - providing grants and low interest loans to protect Colorado water rights from US federal reserve rights applications; and
 - implementing a range of programs in fulfilment of the state's federal commitments such as the US federal *Endangered Species Act 1973* and the Colorado River Basin Salinity Control Program.

Since 1973, the CWCB has operated the Instream Flow Program. The objectives of the program are ‘...to correlate the activities of mankind with some reasonable preservation of the natural environment’ (§37-92-102 CRS). The CWCB has:

- exclusive ownership of instream flow and natural lake-level water rights in Colorado intended for environmental purposes;
- the authority to obtain instream flow and lake-level rights by appropriating, leasing, acquiring and receiving donated water rights;
- the authority to develop instream flow and lake-level rules, in coordination with other departments; and
- the authority to protect instream flow and lake-level rights in water court proceedings.

The CWCB also has the power and duty to investigate and determine the nature and extent of ground water resources of the state, and to study the effects of ground water extraction on both aquifer supply and surface flow of streams.

3.3 Water and ground water courts

The role and jurisdiction of the district water and ground water courts are authorised from various sources, including the Colorado's Constitution, the *Water Administration and Determination Act of 1969* and the *Ground Water Management Act 1965*.

Water courts are responsible for adjudicating applications for judicial recognition of water rights, nontributary ground water well permits, water storage rights, augmentation plans, to change a water rights and well permits, to initiate abandonment proceedings, and to adjudicate over ‘rights-of-way’ matters. Colorado

water and ground water courts are district courts and, as such, their decisions set binding legal precedents.

Each of Colorado's seven water divisions has a water court. There are also four ground water courts. Each water court has a water referee, water clerk and a water judge. Water clerks maintain records of all proceedings relating to water rights and the records of all proceedings of the water judge, and of all rulings and actions of the referee.

Water referees are appointed by water judges. Referees make rulings on applications for water rights, except when the matters are referred to water judges or when decisions are appealed.

Water and ground water judges are appointed by the Colorado Supreme Court. Water judges have jurisdiction to hear matters in which objections have been filed against decisions of the referee or where matters were referred by the referee. Ground water judges have jurisdiction over certain ground water basins, including appeals of decisions and actions of the Colorado Ground Water Management Commission and the enforcement activities of the Office of the State Engineer.

3.4 Colorado Ground Water Commission

The Colorado Ground Water Commission (CGWC) is authorised under the *Ground Water Management Act 1965* to manage and control the state's ground water in designated basins.

The CGWC comprises twelve commissioners, nine of whom are voting members and are appointed by the Governor and confirmed by the Senate. The non-voting members include the Executive Director of the Colorado Department of Natural Resources, the State Engineer, and the Director of the CWCB. Appointments are made for four-year terms. The CGWC's members are not salaried but do receive compensation for expenses incurred and a daily remuneration while on official business (§37-90-104 CRS).

The CGWC is authorised to:

- establish 'designated' ground water basins subject to a public hearing process;
- create ground water management districts and their boards within each designated ground water basin, subject to petitions for the creation of districts; and

-
- in consultation with ground water management districts boards, create and promulgate orders, rules and policy for the management of designated ground water.

The CGWC has delegated its authority to adjudicate the licensing, monitoring and enforcement of large capacity well permits in designated ground water basins to the Office of the State Engineer.

Ground water management districts

Ground water management districts are established under the *Ground Water Management Act 1965*. Ground water management districts are responsible for conserving ground water in designated basins.

Ground water management districts are established by the CGWC following a successful petition by taxpaying electors. A board of directors is elected by local taxpayers. Districts are political subdivisions of the State of Colorado and corporate bodies with all the powers of a public or quasi-municipal corporation. Board members are not salaried but do receive compensation for expenses incurred on official business.

The roles and responsibilities of ground water management districts include:

- developing comprehensive plans for the efficient use of water;
- promulgating rules and regulations for the purpose of conserving, preserving and protecting and recharging ground water; and
- in some instances, capping or closing wells and prohibiting the extraction of ground water.

District boards have the authority to collect an annual levy to finance their costs. Boards also have the authority to enter into contracts and to issue bonds, subject to majority vote of electors in certain instances.

3.5 Colorado Water Quality Control Commission

The Colorado Water Quality Control Commission (CWQCC), in the Department of Public Health and Environment, is responsible for developing state water quality policies and standards, under the *Colorado Water Quality Control Act*.

The CWQCC comprises nine members appointed by the Governor. Appointments to the commission are intended to achieve geographical representation to reflect the various interests in water in the state.

The CWQCC has extensive authority to regulate point and nonpoint sources of pollution, including the setting of water quality standards, promulgating regulations (including permit schemes) for point and nonpoint polluters, and promulgating regulations for the administration of federal and other loans and grants.

The Colorado Water Quality Control Division, in the Department of Public Health and Environment, is responsible for implementing the discharge permit program, and monitors and enforces regulations adopted by the CWQCC (§25-8-301 and 302 CRS).

3.6 US Federal Government agencies

Environmental protection is the responsibility of a variety of US Federal Government agencies, such as the Fish and Wildlife Service, the National Park Service, and the US Army Corps of Engineers. Their role is discussed in PC (2003).

3.7 Water districts

Water districts are privately and publicly managed entities that are responsible for managing the wholesale, and sometimes, retail distribution of water. These include publicly managed water conservation districts and the privately managed water conservancy districts (§37-45 *et seq.* CRS).

Water conservation districts are created by their enabling legislation. Water courts are vested with the authority to establish water conservancy districts. A board of directors manages both types of districts. In the former, the board represents the Board of County Commissioners of each county. In the latter, citizens from the relevant county are appointed by the water court. Districts are regarded as political subdivisions of the State of Colorado and are corporate bodies with all the powers of a public or municipal corporation.

There are three water conservation districts — Colorado River Conservation District, the Southwestern Conservation District, and the Rio Grande Conservation District — and almost fifty water conservancy districts.

The powers and responsibilities of water districts vary, but in general include:

-
- Entering into contract with private and public bodies to build and manage water supply infrastructure (dams, canals, pipelines, tunnels) and hydroelectric power.
 - Enter into long term and perpetual contracts with water users (individuals, public corporations, ditch companies, and water users' associations) to supply water.
 - Promulgate rules and regulations for the transfer (lease, exchange or sale) of water rights and water supply contracts between water users within the district.
 - Participate in the formulation and implementation of agricultural-related nonpoint source water pollution control programs required or authorised under federal law and the *Colorado Water Quality Control Act*.

The BoR has historically constructed much of the larger water storage and diversion infrastructure. It provided the up-front capital funding and water districts have served as the repayment entities (see for example BoR (1938)). The districts acquire the appropriated water rights from the project, the authority to operate and maintain the infrastructure and the authority to distribute water to water users.

3.8 Ditch companies and irrigation districts

Ditch companies and irrigation districts are associations of water users responsible for the distribution of water to their members. Ditch companies and irrigation districts often possess their own water right or enter into contractual arrangements with water districts to access water. Their responsibilities include:

- Entering into water supply contracts with water districts.
- Providing to their members the titles to land, local distribution infrastructure (such as ditches). Members usually enter into a contract with the company or district or hold shares with the company.
- Operating and maintaining the local water supply infrastructure.
- Distributing water to members and placing water orders to the water district on their behalf.
- Establishing rules for the trading in the company's stock in the case of ditch companies.
- Monitoring and enforcing water consumption within the ditch area (Nieuwoudt 2000; Getches 1997).

Irrigation districts operate as political subdivisions of the State of Colorado and are corporate bodies with all the powers of a public or municipal corporation. Ditch companies are incorporated under commercial law.

3.9 Municipal water companies

Municipal water companies, such as Denver Water, are responsible for reticulating bulk water to urban, and in some cases, rural customers. They are also responsible for sewage and wastewater treatment services.

Denver Water is a water utility fully owned by the municipality of Denver, but operates as a separate commercial entity. It is responsible for collection, storage, quality control and distribution of drinking water to the City and County of Denver. It also provides wholesale and retail water delivery services to persons in the non-metropolitan area (Denver Water undated(a)).

A five-member Board of Water Commissioners is appointed by the Mayor of Denver to staggered six-year terms. The board is responsible for ensuring a continuous supply of water to the City and County of Denver. The board is responsible for appointing a manager who is chief executive officer of day-to-day operations.

The board's objective is to ensure a continuous supply of water to the people of Denver and its suburban customers. Among other duties, the board is responsible for setting water charges and monitoring the cost and maintenance of the distribution system (Denver Water undated(b)).

The manager is the chief executive officer for Denver Water, secretary to the Board of Water Commissioners. The manager can recommend to the board new policies and changes to policies, and carries out all the policies and orders of the board.

4 Definition of water rights

Colorado's water rights can be summarised to include three broad types of rights: water rights, well permits and storage rights. Possession of water rights also confers a right-of-way. The following discussion applies strictly to water rights and well permits.

Many water users, however, do not hold water rights directly. Instead, they may hold water supply contracts or, if they are members of a ditch company, shares in the company. For example:

- The NCWCD holds a water right to Colorado River water by the Colorado–Big Thompson Project. Water users in the district can apply for perpetual 'allotment contracts' that specify a volumetric entitlement in terms of 'units' (each unit is equivalent to 1/310 000th of the project's water right) (Zimbelman et al. 2002; Nieuwoudt 2000).
- The Colorado River Water Conservation District (CRWCD) holds the water right to both the Colorado River (appropriated by the Wolford Mountain Project and Ruedi Reservoir) and some rights to the Eagle River (through shares of the Eagle Park Reservoir). Water users in the district can apply for short-term (one to five year) or long-term (40 year) water supply contracts specified in terms of AF (CRWPE undated(a) and (b)).
- Water rights may be held by ditch companies, where the rights are mortgaged to the property or to the ditch company's stock (§37-45-132 CRS). Members are issued with a land title or a voting share to the company.

4.1 Water rights and well permits

There are a range of water rights and well permits in Colorado. These include water rights to *surface water* and *tributary ground water*, large and small capacity well permits for *designated ground water*, large and small capacity well permits for *nontributary ground water*, well permits for *not nontributary ground water*, instream flow and natural lake-level rights, and federal reserve rights (table 4.1).

Table 4.1 Selected aspects of Colorado water rights and well permits

Source of water	Surface water and tributary ground-water	Designated ground water	Nontributary ground water	Not nontributary ground-water	All natural rivers and lakes	All areas
Type of water right or permit	Water rights ^a	Small capacity well permits	Large capacity well permits in Denver ^b	Small capacity well permits in Denver ^b	Large capacity well permits in Denver ^b	Federal reserve rights
Coverage	excl mining	Domestic, limited stock and irrigation, commercial and fire-fighting	All users and uses permissible	Domestic, limited stock and irrigation, commercial and fire-fighting	All users and uses permissible	All users and uses
Specification	Vested property right. Protection against injury	Vested property right. Protection against unreasonable impairment	Vested property right. Protection against injury.	Vested property right. Protection against injury. AF and cfs	Vested property right. Protection against injury. Aquifer decline does not constitute injury. AF and cfs	Vested property right. Protection against injury. na
Record of title	AFand cfs	Appropriation date	No priority	Appropriation date	Appropriation date	Treaty, exec. order date etc
	Registry held by the Office of the State Engineer	Registry held by the Office of the State Engineer	Registry held by the Office of the State Engineer	Registry held by the Office of the State Engineer	Registry held by Office of the State Engineer	Registry held by Office of the State Engineer

^a Includes Colorado–Big Thompson ‘Units’ and other claims to water rights. ^b Denver ground water basin includes the Dawson, Denver, Arapahoe, Laramie–Fox Hills aquifers.

Table 4.1 (continued)

<i>Source of water</i>	<i>Surface water and tributary ground-water</i>	<i>Designated ground water</i>	<i>Nontributary ground water</i>	<i>Not nontributary ground-water</i>	<i>All natural rivers and lakes</i>	<i>All areas</i>
Type of water right or permit	Water rights ^a	Small capacity well permits	Large capacity well permits in Denver ^b	Large capacity well permits in Denver ^b	Large capacity well permits in Denver ^b	Federal reserve rights
Duration	Perpetual, subject to abandonment	Small capacity well permits	Large capacity well permits in Denver ^b	Large capacity well permits in Denver ^b	Large capacity well permits in Denver ^b	Perpetual
Exclusivity	Potentially subject to return flows	Not subject to return flows	Subject to abandonment. 100 year life of aquifer	Subject to abandonment. 100 year life of aquifer	Subject to abandonment. 100 year life of aquifer	Perpetual, subject to abandonment
Detached from land title and use restrictions	No quality	Conditions may be imposed to protect ground water quality	Conditions may be imposed to protect ground water quality	Conditions may be imposed to protect ground water quality	Conditions may be imposed to protect ground water quality	No quality
Divisibility & transferability	Fully divisible. Transfers subject to injury test ^c	Fully divisible. Transfers subject to unreasonable impairment	Fully divisible. Transfers subject to injury test	Fully divisible. Transfers subject to injury test	Fully divisible. Transfers subject to injury test	Fully divisible. Transfers subject to injury test

^a Includes Colorado–Big Thompson ‘units’ and other claims to water rights. ^b Denver ground water basin includes the Dawson, Denver, Arapahoe, Laramie–Fox Hills aquifers. ^c Colorado–Big Thompson ‘units’ and shares in common stock not subject to return flows. ^d Court adjudication not necessary for Colorado–Big Thompson water or common stock if transfers are within the district or ditch company area. Colorado–Big Thompson water may not be transferred outside district and ditch company stock may not be traded outside ditch area. ^e Water court adjudication not necessary for Colorado–Big Thompson water transfers within district and common stock within a ditch company’s area.

Coverage

Water rights and well permits are issued for a variety of purposes, including domestic household, municipal water use (including sanitation), irrigation and agriculture, industrial, recreational including in-channel recreation, fisheries or wildlife, and minimum instream flows. Well permits are also issued for mining purposes.

Instream flow rights for environmental purposes may only be held by the CWCB. Other bodies may appropriate instream water rights for recreation and power generation.

Conjunctive use of surface and ground water is possible in areas where there is a strong hydrological relationship between water sources. In this case, tributary ground water is treated as if it is surface water. Land use, including forestry activities, is not governed under water legislation.

Under Colorado law, hoarding of water rights for speculation is not recognised as beneficial use (Hobbs 1999).

The Colorado water rights arrangements extend to surface water not in a defined water course. Storage rights are required to harvest such surface water and a separate appropriation is required to put water into use.

Record of title

As noted earlier, the Office of the State Engineer is responsible for maintaining a registry of all rights and well permits, as well as maintaining records of surface water, ground water resources and keeping a record of loans and exchanges (§37-83-101 CRS).

The registry contains all the relevant information filed with the water courts and the Office of the State Engineer. The information includes: the name of the owner, the volume or rate of water to be extracted, the point of diversion, the beneficial use to which the water will be applied (including a description of the land in the case of irrigation), and a priority date. However, the titling of early water rights has been haphazard and is not complete. The Office of the State Engineer does not have a complete record of all legally recognised water rights.

Specification

The specification of a water right or well permit contains the following elements: a description of the volume of water to be received and a priority of the water right.

The water that can be extracted or diverted under a water right, instream flow right or well permit is typically specified as a volume during an irrigation season (such as AF per year) or an extraction rate (such as cubic-feet per second over a shorter period).

The volumetric entitlement of a federal reserve right must be determined by application to the water court. This amount is limited by the volume necessary to fulfil the purposes of the reservation (Getches 1997; Hobbs 1999).

Water rights are also defined in terms of their priority. Priority is defined both in purpose to which water is put and the date of appropriation:

- Highest priority is domestic water use. Waters intended for domestic use (for example, drinking) shall have preference over those claiming any other purpose (Hobbs 1997). Town water was treated as domestic water in terms of priority.
- Agricultural priorities are higher than all other priorities. Among agricultural priorities, preference is ranked on the basis of the year of appropriation. Junior (more recently appropriated) water right-holders must not encroach on the rights of more senior right-holders.

Well owners for nontributary ground water have equal priority in extracting ground water. In all other cases, the date of appropriation is used to determine the priority among those using the water for the same purpose, where the earliest dates have the highest priority among equal uses (§37-92-306 CRS).

The appropriation date applying for federal reserve rights is the date of the statute, executive order, treaty, or agreement, and not the date of the application or beneficial use of the water (Getches 1997; Hobbs 1999).

Conditional water rights, instream flow and lake-level rights and well permits for which beneficial use has not been applied, are subject to appeal by other water rights holders. After the application of beneficial use the rights and well permits are 'perfected' and cannot be taken without just compensation (Getches 1997). A perfected water right and final well permit confers to its owner a usufructuary possessory right to the water. The title to the right is a property right (table 4.1; Getches 1997).³

³ *Ft. Morgan Land & Canal Co. v. South Platte Ditch Co.* (1892).

However, in the case of a ground water well permit, the Office of the State Engineer may impose conditions and limit the taking of ground water.

Duration

All water rights, instream flow rights, and well permits for designated ground water have a perpetual tenure but are subject to an abandonment (*use-it or lose-it*) condition.⁴ Abandonment is generally defined to constitute a period of extended non-use (§37-82-101; Hobbs 1997).

- For a conditional water right or well permit, abandonment results from the failure to develop headworks or well within six years from the date of the conditional water rights or every one or two years for a conditional well permit (§37-90-105, 137; 92-103, 602 CRS).
- In the case of a perfected water right or well permit, abandonment results from the permanent discontinuation of the use of all or part of the water (§37-92-103 CRS).

Well permits for nontributary ground water and for all ground water in the Denver ground water basin are issued on the basis that, because the underlying aquifer is not readily rechargeable, the aquifer has an economic life of one hundred years (§37-90-137 CRS). Such well permits have an implicit maximum tenure of no more than one hundred years.

Exclusivity

A water right or well permit is exclusive, if at the margin, it ensures that the benefits and costs of accessing and using water accrue to the right or permit holder. Several approaches are employed in Colorado to ensure the exclusivity:

- provision of environmental flows;
- right to ‘no injury’ or ‘unreasonable impairment’ allows for limits (or conditions) to be placed on the rights of other water users, and can allow for civil remedies to be sought when water rights or well permits are injured; and
- controlling the construction of storages and infrastructure.

First, instream flow and lake-level rights are provided for environmental purposes, thereby protecting streams and lakes from over-appropriation. As mentioned earlier,

⁴ *Knapp v. Colorado River Conservation District* (1955).

these rights are held by the CWCB. The rights are transferable and possess the same legal characteristics as private water rights.

Second, under the appropriation and modified appropriation doctrines, water rights and well permits cannot be injured or unreasonably impaired by the exercise of another's water right or well permit. This allows water users a robust and flexible mechanism to minimise adverse third-party effects. Moreover, to ensure water right or well permit applications do not injure (or unreasonably impair) existing right-holders, the water court and the Office of the State Engineer have the authority to place a range conditions to protect vested rights (box 4.1).

Finally, the construction of water-related infrastructure that can potentially have detrimental environmental consequences is regulated by the US Army Corps of Engineers, under authority of section 404 of the federal *Clean Water Act*. These provisions are explained in PC (2003).

In principle, the Doctrine of Prior Appropriation seeks to ensure that water rights are exclusive and that no two rights share privilege of the same water (§37-82-101 CRS). However, the beneficial use doctrine requires that water cannot be wasted:

the use of that amount of water that is reasonable and appropriate under reasonably efficient practices to accomplish without waste the purpose for which the appropriation is lawfully made (§37-92-103 CRS).

This implies that water that is not consumed must be returned to the stream, to be appropriated downstream (§37-82-102 CRS). This has several implications:

- The upstream appropriator can reuse their return flows if this does not legally constitute a change of location, purpose, time of use or point of diversion, even if this reduces the volume of water available for junior appropriators downstream (Getches 1997).
- Water savings, through the introduction of water saving crops or more efficient irrigation practices, are not available to the appropriator without first applying to the court for a change to the water right, as this would constitute a change in the beneficial use of the water (Getches 1997).

Similarly, under the principle of adverse possession, water seeping from reservoirs, dams, ditches and canals may be appropriated by other users, although any repairs to the reservoir to avoid the loss extinguishes downstream appropriations (§37-82-102; §37-87-101 CRS).

Box 4.1 Terms and conditions to protect vested property rights

Surface water and tributary ground water

- Limits are imposed on the amount of water that can be diverted, the rate of extraction and the period for extraction. Conditions can also be placed on the uses of water, the point or method of diversion, the place where water may be stored and the place where a storage right can be applied (§37-92-301(2) and 305 CRS).
- There may be a requirement to revegetate land from which irrigation water was diverted to ensure that water would be maintained for environmental purposes (§37-92-204 CRS).
- There may be a requirement for junior appropriators to provide a minimum quality of water and continuity of flow where they are providing water to senior appropriators (§37-80-120 CRS).
- Other conditions may be imposed by the court where it is necessary to prevent injury (§37-92-305 CRS).

Nontributary ground water

- Conditions may be imposed on drilling, casing and equipping wells that are reasonably necessary to prevent the wastage of water, the pollution of an aquifer, or to prevent material injury to existing rights (§37-90-137 and 92-602 CRS).
- In the Dawson, Denver, Arapahoe and Laramie–Fox Hills aquifers, regulations may be promulgated to ensure that well permits do not injure water rights to natural stream flows (§37-90-137 CRS).
- The rates of extraction may be adjusted annually to conform to the actual characteristics of the aquifer (§37-90-137 CRS). The Colorado General Assembly may impose limits on the exercise of such rights to prevent waste, promote beneficial use and reasonably conserve ground water (§37-92-305 CRS).

Not nontributary ground water

- Augmentation plans may be required to prevent new applications for well permits from injuring water rights in the Dawson, Denver, Arapahoe, Laramie–Fox Hills aquifers (§37-90-137 CRS).

Designated ground water

- In the Dawson, Denver, Arapahoe and Laramie–Fox Hills aquifers, rates of extraction may be adjusted to ensure that total extractions conform to the characteristics of the local aquifer (§37-90-107 CRS).
- Conditions and limits that are necessary to prevent waste of water and to protect the rights of other appropriators may be imposed (§37-90-108 CRS). These may include decreasing the rate of extraction, well location, time and type of use and the amount of irrigated acreage (§37-90-108 and 111 CRS).
- Ground water management districts may set rules that restrict the issue or limit amount of water that may be extracted from wells (§37-90-130 CRS).

In general, water rights and well permits are not subject to environmental conditions. Similarly, water rights or well permits are not subject to water quality conditions, except:

- that applicants for replacement or augmentation plans must provide an appropriate level of quality to senior appropriators;
- conditions may be placed on well permits to prevent contamination of both designated and nontributary ground water (box 4.1); and
- the discharge of pollution by a senior appropriator (such as mining waste), which impairs the beneficial use of a junior appropriator, does not constitute a beneficial use of the senior's water right (Hobbs 1997).⁵

Detached from land title and use restrictions

Water rights, instream flow rights, and well permits are in principle separable from land and possess their own deed of conveyance. Perfected water rights and final well permits can be sold, leased or exchanged separately, as if they are private property (Hobbs 1997).

Water rights in Colorado are nonetheless commonly tied to land, through a variety of contractual (mortgaging) arrangements. Water rights can be tied to:

- the defined area of a water district, irrigation district or ditch company that appropriated them;
- an individual water user's land title, as in certain BoR projects; and
- a ditch company's voting stock.

The separation of the water right from land title has implications for the transferability of the water right.

Divisibility and transferability

The volumetric component of a water right and well permit are in principle fully divisible.

The transferability of a water right depends on whether:

- the proposed transfer is permanent or temporary; and
- downstream users appropriate its return flows.

⁵ *Suffolk Gold Mining and Milling Co. v. San Miguel Consol. Mining and Milling Co.* (1897).

The Colorado Revised Statutes make explicit that the lease or temporary exchange of water right between irrigators does not require a water court adjudication. It is sufficient for the parties to inform the Office of the State Engineer. Generally, claims of injury cannot be made on the basis of the water assigned to a right-holder for that season.

A water user wishing to transfer a water right must refer the matter to a water court, if the proposed transfer would result in a change the rate of extraction and timing of use, the point of diversion or return, the beneficial use and the priority of use. A downstream appropriator who depends on the return flows of the upstream appropriator may object to a transfer, if the change in the water right would injure downstream user's right (§37-82-104 CRS).

Where water rights are held by associations of water users, members of those associations are not be permitted to trade those rights directly. Instead, they may transfer claims to the water rights (such as the stock of the company) within the defined area, subject to the approval of the district or company board.

Federal reserve rights, by their nature, exist for the fulfillment of their reservation's purposes. Thus private persons may only exercise reserved rights while fulfilling the purpose of the reservation (Getches 1997). Leasing of Indian water rights within the reservation is generally permitted, but not for sale or exchange, and no lease of water right can take place outside the reservation (Getches 1997).

Well permits for ground water are generally transferable within the aquifer, providing that the change in the point of extraction does not result in injury or unreasonable impairment of other users.

4.2 Storage rights

The right to store water, for later application to beneficial use, is recognised as a right of appropriation under Colorado's Constitution. No water storage facility may be operated in such a manner as to cause material injury to the senior appropriative rights of others. Storage rights also confer a right-of-way (§37-87-101 CRS).

A storage right confers the authority to fill reservoirs during the non-irrigating season from November 1 of each year until June 1 of the next year. A separate appropriation is needed for its beneficial use. Water for storage in reservoirs can be used only when not needed for immediate domestic and irrigation use. Thus, reservoir companies only have a right to store water, which must be consistent with the rights of others.

The owner of a reservoir has the right to take and store unappropriated waters. The owner also has the right to take waters that have been appropriated by others but that are not at the time needed by such prior appropriators for immediate use.

4.3 Rights-of-way

Any person owning a perfected or conditional water right is entitled to apply to a water court for a deed of 'right-of-way'. The deed confers to the appropriator the right to access ditches and canals through the lands which lie between the point of diversion and the point of use or proposed use or storage facility (§37-86-102 CRS).

This right entails the water appropriator to enter into negotiations with the land owner for access to construct the ditch, canal or dam. The appropriator cannot take private land for private use without compensation. The right only extends to the necessary structures and does not apply to the carrying of waste or surplus water. A right of way is an interest in real estate, which must be conveyed by deed (§37-86-103 CRS).

If a land-owner refuses to grant permission to his neighbour to dig an irrigation ditch across his land, the appropriator may proceed to condemn the land under the *eminent domain* laws of Colorado (§37-86-104 CRS).

5 Government involvement in water allocation

Government involvement in the allocation of water includes determining the broad mechanism by which water is re-allocated between uses and the means by which such re-allocations can take place.

5.1 Allocation mechanisms

Trading of water rights between individuals is the principal mechanism by which existing water rights are re-allocated between water users. As mentioned earlier, though a water right confers a usufructuary possessory right to take and use water, the actual title of the right is a property right that must be compensated. Consequently, the government does not have the authority to re-allocate water rights administratively between users.

According to the use-it or lose-it doctrine, water rights can be forfeited and the water must return to its natural state until it is again appropriated. Yet under Colorado's *Constitution*, citizens have a right to appropriate water that cannot be denied (Article XVI). Consequently, the government does not have the authority to re-allocate forfeited water rights to any other purpose except by re-appropriating such waters.

5.2 Resource planning

There is no formal process outlined in the Colorado statutes by which the government plans to determine how much water is to be allocated or re-allocated to non-consumptive uses, whether by market or non-market methods. There are two approaches by which the government of Colorado is involved in the allocation of water between consumptive and environmental uses.

First, there are separate administrative procedures that must be followed to determine whether a stream or lake is to be included in the CWCB's Instream Flow and Lake-level Program, and therefore, whether the CWCB is to appropriate,

purchase or receive donated water rights. This processes are described below (see chapter 6).

Second, many storages in Colorado are owned by the BoR. The BoR is subject to a number of US federal environmental laws, including the *National Environmental Policy Act 1969*, the *Clean Water Act 1972*, the *Endangered Species Act 1973* and the *Fish and Wildlife Act 1965*. These require the BoR to ensure that its distribution of water to right-holders does not harm the environment. As a result, there are a number of instances where the BoR with the US Fish and Wildlife Service, have entered into negotiations with Colorado water right-holders to ensure that water is provided to meet these US federal environmental requirements. The requirements and planning arrangements are discussed in PC (2003).

6 Administering water rights

There are three distinct levels of water rights administration in Colorado:

- The CWCB is responsible for reviewing applications for instream flow and lake-level rights for environmental purposes before these applications are lodged with the respective water court.
- The water courts, the Office of the State Engineer and the CGWC are responsible for approving new water rights and well permits, changing water rights and well permits, approving transfers of water rights and well permits, and a range of other related applications.
- Water districts are responsible for administering applications for new, changes to and transfers of water supply contracts within their defined area.

The US Army Corps of Engineers is also responsible for administering section 404 permits for the construction of water-related works. These applications take effect before any application can be made to a water district for a water supply contract or the water court for a water right. This procedure is described in PC (2003).

6.1 Administering surface and ground water

The administration of water rights and well permits include applications for:

- issues of conditional and perfected water rights, well permits and storage rights;
- changes to rights or permits;
- approval of augmentation and replacement plans;
- initiation of abandonment and reasonable diligence proceedings; and
- approvals to export water (transfer water rights or well permits) from the state (§37-92-302 CRS).

There are no restrictions on the transfer of water rights or well permits unless such as change involves a change to the use of the water, the point of location of extraction, the means of diversion, or location of the return of the water.

Augmentation and replacement plans are detailed programs, approved by water courts and the Office of the State Engineer, to replenish heavily or over-appropriated streams and aquifers (§37-90-111 CRS).

The Office of the State Engineer is required to compile a list every ten years of those water rights that have been deemed abandoned and to initiate proceedings into the water court (§37-92-402 CRS).

Similarly, the Office of the State Engineer is required to initiate diligence proceedings on conditional water rights and tributary ground water permits every six years (§37-92-301 CRS). Other well permits are subject to a diligence finding once every one or two years (§37-90-137, 92-602 CRS).

Applications

Applicants wishing to obtain a conditional water right or well permit must file with the referee of a water court or the Office of the State Engineer before commencing construction on the headworks or well. This assures the availability of water for the perfection of those rights (§37-92-302 and 90-137 CRS; Getches 1997).

Applications must also be made to the water court or the Office of the State Engineer to perfect a conditional water right or to finalise a conditional well permit. The applicant must demonstrate that the diverted water has been put to beneficial use.

All changes to water rights and well permits require the approval of a water court or the Office of the State Engineer respectively (§37-92-103 CRS). In the case of a well permit, changes also include the area of irrigation land served, and the location of the well.

Applicants must furnish:

- The name of claimant, or in the case of well permit, the owners of the land on which the well is to be located.
- A description of the watercourse or aquifer from which water is to be diverted.
- A legal description of the location of the proposed diversion or well.
- The volume of appropriation (measured in terms of AF per year).⁶
- The time of use and proposed maximum rate of extraction (measured in terms of cubic-feet per second or per minute).⁷

⁶ 1 acre-foot is equal to an acre under a foot of water, and is equal to approximately 1.23 megalitres.

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- The beneficial use to which the water will be applied. In the case of a large capacity well permit, this includes a description of the land to be irrigated.
 - In the case of a water right and designated ground water, the proposed date of application of beneficial use (§37-90-107 and 90-137 CRS).

In the case of an application for a well permit, the applicant must have an interest in the land overlying the proposed ground water (§37-92-305 CRS).

The Office of the State Engineer will charge a fee for the application of all well permits and changes to well permits, although well permits outside designated areas will attract a lower fee.

Consultation

On receipt of the application, the water court or the Office of the State Engineer will publicly announce the application by letter or advertisement. In the case of water rights, the water clerk publishes in a newspaper a monthly summary of applications.

Public notification allows persons to object or file statements of opposition to an application on the grounds of potential injury.⁸ The CWCB is bound by duty to lodge objections to any new applications for water rights that would injure the state's instream flow rights (§37-92-102 CRS). The Office of the State Engineer may raise objections to an application (§37-92-302 CRS).

The Office of the State Engineer is also required to file a report advising the water referee on the suitability application (§37-92-302 CRS).

Assessment

If an application to a water referee or the Office of the State Engineer is not contested, the water referee and the Office of the State Engineer will each investigate the viability of the application.

The water referee will grant a conditional water right and the Office of the State Engineer will grant a conditional well permit if the application will not 'materially injure' or 'unreasonably impair' existing rights. The type of test applied depends on the nature of the water source and the type of application (see box 6.1).

⁷ 1 cubic-foot per second is equal to 28.32 litres per second.

⁸ *Application of Turkey Canon Ranch Ltd*, 937 P.2d 631 (Colo. 1986).

Box 6.1 Test for injury of vested water rights

Material injury

The material injury rule is predicated on whether injury is caused to senior appropriators from the denial of the availability of water, whether in absolute volume, flow or timing.

Quality of water is not a cause of material injury, except where junior appropriators provide water to senior appropriators as part of an exchange program or replace water removed from an aquifer. The water judge is not required to consider environmental factors to determine whether to grant conditional water rights (§25-8-104 CRS).

The material injury rule applies to applications for water rights, tributary ground water and small capacity well permits (§37-90-105, 92-305, 92-602 CRS).

It also applies to applications for large capacity well permits in nontributary ground water, including nontributary ground water in the Dawson, Denver, Arapahoe and Laramie–Fox Hills aquifers. Material injury is strictly defined to mean any reduction in the amount of water that can be extracted, but it is not deemed to include the reduction of either hydrostatic pressure or the water level in the aquifer (§37-90-137 CRS).

Unreasonable impairment

‘Unreasonable impairment’ of existing rights is defined to include unreasonable waste of water resources, the unreasonable lowering of the water level, unreasonable deterioration of water quality, beyond reasonable economic limits of withdrawal or use (§37-90-107 and 107 CRS).

This rule is applied to large capacity well permits in designated ground water areas and designated ground water in the Dawson, Denver, Arapahoe and Laramie–Fox Hills aquifers, injury is defined as an ‘unreasonable impairment of existing water rights’ (§37-90-107 CRS).

The water referee will grant a perfected water right and the Office of the State Engineer will grant a final well permit if:

- water has been diverted, whether it has been used beneficially, and
- the appropriation did not injure senior water rights or unreasonably impair well permits (§37-92-305 CRS).

The Office of the State Engineer will accept an applicant’s affidavit that ground water has been put to beneficial use (§37-90-108 CRS).

As part of their decision, a water judge and the Office of the State Engineer may impose a range of conditions to protect vested water rights or well permits (box 4.1).

The water court will approve an application to export water from Colorado if the transfer:

- does not impair Colorado’s ability to meet its compacts or is expressly authorised by interstate compact;
- is not inconsistent with the reasonable conservation of the water resources of the state; and
- will not deprive citizens of the state the beneficial use of waters apportioned to Colorado by interstate compact or judicial decree (§37-81-101 CRS).

Ground water cannot be exported from the state unless it is credited as a delivery under an existing interstate compact (§37-81-103 CRS).

The Office of the State Engineer is authorised to collect a per acre-foot charge for water exported from the state (§37-81-104 CRS).

Appeals

When a water right application is contested, or if the water referee thinks it appropriate, the application is referred to the water judge of the court for adjudication. This initiates a public court proceeding and evidence and testimonies are taken from the interested parties. Similarly, when a well permit application is contested, the Office of the State Engineer initiates a public hearing process (§37-90-105 and 92-602 CRS).

Appeals against the decision of a water judge or the Office of the State Engineer are available to aggrieved parties. Appeals to the decision of a water judge are lodged with the Colorado Supreme Court (Hobbs 1999). Appeals to the Office of the State Engineer are governed by the *State Administrative Procedures Act* (§24-4-106 CRS). The Office of the State Engineer is required to reconsider its decision (§37-90-105 and 114 CRS). Appeals to the final decision by the Office of the State Engineer can be made to the water court (§37-90-115 CRS).

Decision notification and registration

Once a court or the Office of the State Engineer has confirmed a water right or well permit, it becomes perfected (‘absolute’) and the date of appropriation is based on the date of the original conditional water right or permit (§37-90-109, 92-602 CRS; Hobbs 1999).

In the case of a large capacity well permit for nontributary ground water, priority of use is not based on date of appropriation (§37-92-102 and 305 CRS). The annual

volume of withdrawal can be changed to conform to actual local aquifer characteristics (§37-92-305 and 90-137 CRS).

Following a judicial decree or the Office of the State Engineer's decision, the Office of the State Engineer updates its tabulation of water rights and well permits.

6.2 Administering instream flow and lake-level rights

There are two additional administrative procedures in Colorado governing applications for instream flow and lake-level rights. First, the CWCB is required to determine whether a nominated stream or lake-level is to be included in its Instream Flow Program — and thereby require the CWCB to appropriate, acquire or dispose of environmental instream flow or lake-level rights. Second, all persons applying to appropriate or acquire a water right for recreational instream purposes must first apply to CWCB.

Instream flow and lake-level rights — environmental purposes

Any person may apply to the CWCB for a reach of a stream or a water body to be included in the CWCB's Instream Flow Program (CWCB 1994). The Colorado Division of Wildlife, the Division of Park and Outdoor Recreation, the US Department of Agriculture, and the US Department of the Interior are each authorised to apply for instream flow and lake-level rights (§37-92-102 CRS).

The CWCB then invites public comment (in both preliminary and final reviews) on the proposed inclusion of the stream and changes to instream flow rights, and allows persons to object to the proposal. Persons that find the CWCB's decision could bring 'irreparable injury' to the environment, can file for a stay in the water court (§24-4-105 and §37-92-102 CRS).

The CWCB must assess whether the inclusion of the stream or lake:

- will preserve the environment to a reasonable degree;
- that there is a natural environment that can be preserved with its proposed inclusion; and
- that such environment can exist without material injury to water rights (§37-92-102 CRS). For a stream to be included in the program, it must pass these tests. At this point, the CWCB undertakes modelling and develops minimum flow rules.

If the proposal requires the acquisition of a water right, the CWCB must find that:

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- there is natural environment that can be preserved in whole or in part by the acquisition made; and
 - the acquisition can occur without material injury to water rights (CWCB 1994).

If an appropriation or acquisition can be made on these grounds, the CWCB must then file as normally with the water court.

Instream flow and lake-level rights — recreational purposes

Counties, municipalities, water conservation and conservancy districts seeking to obtain an instream flow or lake-level right for recreation purposes (whether by appropriation or acquisition) must first apply to the CWCB before proceeding with applications to a water court. The CWCB has the authority to set conditions to preserve the natural environment to a reasonable degree (§37-92-102 CRS).

In assessing the application, the CWCB will take into consideration whether:

- the in-channel diversion would impair the ability of the state to fully develop and place to consumptive beneficial use its compact entitlements;
- the reach of the stream required for the intended use is appropriate;
- there is access for recreational in-channel use;
- the in-channel diversion would cause material injury to instream flow water rights; and
- the diversion would maximise the utilisation of the state's waters (§37-92-102 CRS).

All such applications typically include a public hearing process, following which, the CWCB may recommend as to whether the application should be granted, granted with conditions or denied (§37-92-102 CRS).

6.3 Administering transfers in water districts

In many water conservancy and conservation districts, irrigation districts and ditch companies, the water right is owned by the entity itself and not by individual water users. Water users are instead issued with a share or supply contract for the water right. Such entities generally allow for the transfer of such instruments between their members.

The NCWCD is the sole owner of the water right from the Colorado–Big Thompson Project. During the original appropriation of the project's water, the contractual

arrangement restricted the water for a single type of use. Water rights were not issued to the return flows of the project's water in the district.

Even though Colorado's water rights system allows water from transbasin diversions to be used and reused, the transbasin water provided by the Colorado–Big Thompson Project is contractually restricted to a single use, with the return flows accruing to downstream water users (Zimbelman et al. 2002, p. 6).

Since there are by definition no return flows within the district and the project's water is limited to a single use, there can be no legal objections to permanent transfer of allotments or units within the district. Consequently, there are few transaction costs in administering the transfers of 'units'.

Applications for permanent transfers are routinely granted, as district staff are principally concerned with ensuring that the application is in compliance with established policies and procedures. Staff complete the necessary record checks to verify ownership and, in the case of irrigators, legal description. The board of the NCWCD typically then approves the changes and then forwards the application to the BoR for concurrence. Following the granting of BoR concurrence, the permanent transfer is completed.

7 Distribution management

Distribution management involves determining how much water is available and who is to receive it (water accounting), and coordinating the collection, storage and transportation of water to its various uses and users (water distribution).

7.1 Water accounting

Water accounting is the management of registries of water rights and accounts of water use, to ensure that there is an accurate record of the water rights issued to water users, and that the volume of water assigned and distributed to water right-holders accurately reflects both those rights and the hydrological characteristics of the resource.

Determining water availability and assigning water

The Office of the State Engineer has statutory responsibility for coordinating the collection of water resources data. In most cases, at the beginning of each irrigation season or water year, a water commissioner (appointed by the board of a water district) will assess the volume of water in storage for that season and will notify each water user as to which priorities are likely to be met (Getches 1997).

Similar provisions are established for the provision of ground water in designated ground water, where the Office of the State Engineer has the authority to exercise control in the distribution of ground water (§37-90-111 CRS).

In the NCWCD, water from the Colorado–Big Thompson Project is not allocated on a priority basis but rather shared proportionally among holders of allotment contracts. The water commissioner determines the volume of water available for distribution and announces the quota (or proportion of contracts) that will be met for the season. Factors considered in the announcement of the volume of water available for distribution include:

- the water currently in storage in the project’s diversionary infrastructure and in the East Slope reservoirs, forecast runoff into the system during the remainder of the season;

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- forecast temperatures and precipitation in the agricultural parts of the district;
 - the forecast volume of carry-over water in storage at the end of the current water year;
 - the status of the crops already planted and the need for irrigation water to ensure adequate moisture for germination; and
 - the general economics of irrigated agricultural products (Zimbelman et al. 2002).

The decision of the water commissioner is guided by procedures, rules and regulations of the NCWCD's board.

Managing water accounts

The water assigned to each right-holder is recorded in a water account, usually maintained by the storage operator. The volume in the account is then adjusted throughout the irrigation season or water year as water is drawn down, carried over or borrowed.

It is not clear which is the most commonly employed method in Colorado, although the NCWCD, the Fryingpan–Arkansas Project and the Arkansas River Banking Program each employ annual accounting methods with carry-over provisions (see BoR 2002a and 2002b). In these cases, the water accounts of water users are credited at the beginning of the water year. In the NCWCD, accounts are maintained to ensure that the delivered volumes do not exceed entitlement (Zimbelman et al. 2002).

Depending on the storage facility, water may be carried over into subsequent periods. While the storage operator can carry-over between periods, this is usually only after water rights have been met.

Accounting for water right transfers

Water rights can be transferred between supply systems, provided these are hydrologically connected. In Colorado, water rights are specific to a single supply system. When water rights are transferred, and following approval by a water court, the Office of the State Engineer adjusts the register of water rights.

Accounting for conveyancy losses

Conveyancy (evaporation and seepage) losses occur when water is transported down rivers and irrigation canals. Losses that occur when water is ordered but allowed to flow downstream rather than being used are also regarded as conveyancy losses.

In Colorado, the volumetric component of a water right is recalculated whenever it is traded. This adjustment takes into account the effects of conveyancy losses. The storage operator then proceeds to release the same volume of water as before, and the new water user receives the adjusted volume after accounting for net increases or decreases due to conveyancy losses — to do otherwise would injure the water rights of other users (§37-82-105 and 37-92-502 CRS).

In the case of the Arkansas River Pilot Water Banking Scheme, the scheme's manager must release the same 'gross' volume of water (referred to as 'consumable water') to the new water user. This volume comprises the volume of the user's water right and a specified volume for seepage, evaporation and other losses for the zone inhabited by the user (State Engineer 2002).

Arrangements for water shortages

Colorado does not have formal procedures to change water priorities or restrict water rights. Instead of employing administrative procedures to ration water during water shortages, water users purchase the necessary water. For example, to address drought years, some local governments have entered into long-term option contracts to purchase water from irrigators in dry years (Noonan 1993).

Water banks are also employed to facilitate temporary re-allocation of water rights between users. The Arkansas River Pilot Water Banking Act (§37-80.5-101 CRS) was passed in June 2001. The pilot is intended to:

simplify and improve the approval of water leases, loans and exchanges, including transactions, and increases the availability of water-related information. it is also the purpose of this pilot water bank to assist farmers and ranchers by developing a mechanism to realize the value of their water rights assets without forcing the permanent severance of those water rights from the land (§37-80.5-102 CRS).

Prospective depositors inform the storage operator and the Office of the State Engineer of the intention to deposit a water right into a water bank (State Engineer 2002).

The depositor informs the storage operator of the term duration of the deposit, the minimum acceptable price for the water right, and the volume of water right to be

leased, loaned, optioned or exchanged. Once a deposit agreement is settled, the water right is available for other persons to borrow.

The water bank then lists the deposited water right on its website and in its field offices. The listing contains the volume of water available, the stored location, the source of water, the minimum price and the historic use of the water right.

Other water users may then bid for that water right and the successful bidder enters into a lease, option or exchange agreement with the bank. The Office of the State Engineer then notifies the public of the proposed agreement and public comments are invited during a 30-day period. The Office of the State Engineer is responsible for approving agreements and may place conditions on the time, place or type of use that the available water right can be put to use to prevent injury to vested water rights — including dry-up provisions where available (State Engineer 2002).

The water bank charges fees to cover the administrative costs of operating the bank. Any water used in the water bank must be returned to its historic use after the terms of the lease, loan and option or exchange are completed.

7.2 Water distribution

Water distribution is the management of the network of natural and artificial channels to ensure that water is delivered to meet the needs of water users.

A key challenge for water distributors is to coordinate the distribution of water to ensure the timely delivery of water and to minimise congestion and flooding. Water users generally prefer to receive their water at certain times of the day, month or year, and these preferences often conflict.

Reservoirs release water under a number of criteria. These include to satisfy the needs of all downstream water rights, to meet minimum instream flows, for flood control or for long-term storage during drought years. Water is released according to the guidelines set forth when the project was authorised. These guidelines indicate which entity holds the water right, and whether water is to be leased or contracted (CRWCD, pers. comm., 18 March 2003).

Managing environmental flows

The principal mechanisms for managing environmental and other flows in Colorado are:

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- Instream flow and lake-level rights. These are water rights that are defined for beneficial environmental and recreational uses.
 - Conditions on junior water rights.

Instream flow water rights are defined in cubic-feet per second, for a river length and for a duration — whole or part of a year. They possess their own title and are transferable. For example, the instream flow right for Buckskin Creek (Middle Fork South Platte River, Park County), is for 5 cubic-feet per second over a 6.1 miles reach of the river between 1 January and 31 December. Most instream flow rights occur in unregulated streams in mountainous areas but also occur downstream of storages and in urban areas — such as the Boulder Creek and North Boulder Creeks in the City of Boulder (CWCB 2001).

Conditions are frequently placed during the initial application of a water right to ensure that its exercise does not injure senior rights (see chapter 6). The CWCB has the authority to place conditions on applications for recreational instream flow and lake-level rights, to ensure that these protect the environment to a reasonable degree (see chapter 6).

As at December 2001, the CWCB held 1361 water rights to maintain instream flows covering 12 900 kms and 475 water rights to maintain lake-levels of more than 102 000 AF (125 000 ML) (CWCB 2001).

Managing distributions for consumptive use

The management of water distributions to consumptive users varies widely within Colorado. Differences in approaches reflect whether distributors are responsible for delivering water to water right-holders or to other types of water users (for example, those holding water supply contracts or ditch company shares).

Water commissioners have the primary responsibility for ensuring that water is distributed to water right-holders. The water commissioner is responsible for opening, closing, adjusting and locking ‘headgates in accordance with the list of all appropriators in order of their priority in time’ (Getches 1997, p. 151).

Towards the end of the irrigation season, the water commissioner closes the headgates, starting with the lowest priority (most recent in time) (Getches 1997). Regulation of headgates does not involve any ‘notice or hearing, because it is purely a ministerial duty of the water commissioner’ (Getches 1997, p. 152).

To facilitate his activity, the water commissioner has the statutory authority to make the necessary observations of the flow and storage levels and to protect the water

appropriators (§37-87-103 CRS), and to discontinue the diversion that will cause material injury to more senior rights (§37-92-502 CRS). The water commissioner also has the authority to order a junior right-holder who has water in storage, to release that water to meet the needs of a more senior water user downstream (§37-80-120 CRS).

A senior appropriator not receiving their entitled water during the irrigation season (from 1 April to 1 November), may ‘place a call’ to have his priority met. A water right may not be met because of constraints in channel capacity or because junior water right-holders have exceeded their entitlement. The affected right-holder states in writing that on a certain date and time, the full amount of the entitled water was not received. The statement requests the water commissioner to curtail all upstream junior water rights until the senior’s right is satisfied.

Where a water right is held by a water district, irrigation district or ditch company, the distribution of water conforms with the operating guidelines of the district or company. The Colorado Revised Statutes provide some guidance as to what these responsibilities entail (§37-84-118 to 120 CRS).

Persons holding Colorado–Big Thompson Project allotment contracts can order their water on demand from the storage operator — although depending on the class of water user, there are certain restrictions on when water can be called. Municipal and industrial users that can take delivery of water directly from a reservoir or a pipeline are allowed to take delivery of water between November 1 to March 31. Others relying on the project’s canal system to deliver water are limited to taking water during the period between April 1 and October 31. The canals are not operable during the winter months November 1 to March 31 (Zimbelman et al. 2002).

Managing distributions for non-consumptive use

There are two approaches used for coordinating flows for consumptive and non-consumptive uses in Colorado:

- storage operators consult with prospective water users and estimate the net benefits associated with different release strategies; or
- water users negotiate and agree on a mutually beneficial release of water.

In Colorado, storage operators consult with consumptive and non-consumptive users and negotiate the release of water for both purposes. For example, the Green Mountain Reservoir’s operating criteria were developed by the BoR in consultation with its Managing Entities (BoR 2002a).

In Colorado, water users arrive at mutually beneficial releases of water for consumptive and non-consumptive uses. One common method is the use of water exchange agreements. For example, in the Green Mountain Reservoir in Colorado, water is lent by the Orchard Mesa Irrigation District to the federal Grand Valley Power Plant, which later returns it in sufficient time and volume for irrigation users (BoR 2002a). Such negotiations between consumptive and non-consumptive users over the availability of water are facilitated by the priority of the water right, which confers on its holder the right to timing of the flow.

8 Pricing

Pricing practices are central to efficient resource management. Important aspects of pricing include price regulation, pricing of water rights, pricing of water resource management, pricing of water infrastructure services and pricing environmental third-party effects.

8.1 Price regulation

The Colorado Public Utilities Commission (CPUC) is responsible for setting prices of privately-owned utilities that supply water to users other than their mutual members or stock-holders (CPUC undated(a)). The objective of price regulation is to safeguard against the monopoly nature of water delivery services, while seeking to ensure financial viability of the services (CPUC undated(a)).

Water conservancy districts are prohibited from selling water for use outside the district's boundaries. As a result, they do not fall within the regulatory control of the CPUC.⁹ Similarly, the board of a water district is not subject to the County Commissioner's Authority when setting rates for water it sells. That said, the enabling legislation provides guidance on the charges and taxes that may be levied on contracted water users and property holders in the district.

The prices for water provided by municipal water utilities are set by their boards of commissioners, often following a period of public consultation. For example, the rates for the Denver Water service area are approved by the Denver Board of Water Commissioners, after an extensive review of the revenue requirements and costs underlying any rate proposal. There is approximately a 30-day period for public comment prior to the date on which the board votes on the proposed rates. After Board approval of the rates, there is a 90-day period before the new rates become effective (Denver Water undated(b)).

⁹ *Matthews v. Tri-County Water Conservancy District*, 200 Colo. 202, 613, P.2d 889 (1980).

8.2 Pricing water as a scarce resource

Permanent and temporary trading of water rights in Colorado is the principal means by which the opportunity cost of water is being realised, particularly among irrigators. The extent to which water trading can elicit the scarcity value of water depends in large part on the impediments to trade and the transaction costs of obtaining approvals. As mentioned earlier, in many cases water users cannot transfer their water right of water supply contract outside the district or company area.

In addition to water trading, some utilities also charged water users directly for the scarcity value of water. In 2002, Denver Water introduced drought surcharges to its city and county customers. These additional temporary charges were intended to ‘encourage customers to use less water during the spring and summer months of the stage 2 drought’ (Denver Water undated(c)). The drought surcharge was calculated on the basis of how much water a customer used and was added to the normal invoice. Revenue from the surcharges was used to fund drought mitigation and forest fire expenses (Denver Water undated(c)).

8.3 Pricing water infrastructure services

Many of Colorado’s larger water infrastructure projects were financed by the BoR in joint-venture projects with local private and public-sector interests. Water districts were established to serve as the repayment entity.

According to the OECD, many water supply contracts in the western states of the United States were at times specified in perpetuity and in fixed nominal terms (OECD 1999). As a consequence, there has been an under-recovery of both current (operating and maintenance) and capital (depreciation and rate of return) costs. The CRWCD reported that its water use charges recovered the operating and maintenance costs of the project (CRWPE undated(a)).

The OECD also reported that it had been difficult to increase these charges because of:

- the binding long-term contracts between the BoR, water irrigators and irrigators; and
- resistance from irrigators because an increase in prices would penalise those who purchased land at prices in which access to subsidised water had already been capitalised (OECD 1999).

Municipal water utilities have demonstrated a higher level of cost recovery from water users. For example, Denver Water charged for its water infrastructure sufficiently to cover its operation and maintenance costs and to service its debt (Denver Water 2003). These costs include both depreciation and interest charges, but it is not clear how the fixed assets were valued.

Price structure

The pricing structure for water infrastructure service provision varies between water districts and between rural and urban areas. The general pricing provisions are given in the *Water Conservancy District Act* and the various water conservation district acts.

Water districts and municipal water utilities collect fixed and consumption-based charges for water supplied under contract. For example, in 2003:

- The NCWCD collected both fixed and consumption based charges (NCWCD undated(a)).
- The CRWCD collected only a consumption-based charge (CRWPE undated(a)).
- Denver Water collected both fixed and consumption-based charges. In addition, the consumption-based charge increased with the volume of water supplied (Denver Water undated(c)).

Where a fixed service charge was collected, the charge recovered the cost of meter reading and billing (NCWCD undated(a) and Denver Water undated(c)). The consumption-based charge was assessed on the volume of the water consumed or the amount of water under contract.

Generally, the prices charged by water districts and Denver Water varied according to the class of user and the user's location. For example:

- The NCWCD's consumption-based charges varied according to whether the user was a municipal authority, corporation, or individual water user (§37-45-122 *et seq.* CRS).
- The CRWCD's consumption-based charges varied according to whether the user was municipal and industrial users, agricultural users and out-of-basin (CRWPE undated(a)).
- Denver Water set charges according to the customer classes (residential, commercial and industrial), and whether the customer was located inside or outside of Denver City, or located outside Denver County (Denver Water undated(c)).

Generally, industrial water users attracted higher water infrastructure service charges than did agricultural users (Noonan 1993).

When there are revenue short-falls, water districts and municipal water utilities have the authority to levy *ad valorem* taxes on taxable property in the district. In the case of agriculture, the base is the improved valuation of a property or its capital value. The collection of *ad valorem* taxes was not uniformly pursued:

- Taxes on property accounted for approximately 53 per cent of all revenue of the NCWCD in 2002. In contrast, fixed charges accounted for 20 per cent and consumption-based charges 21 per cent (NCWCD undated(a)).
- The Board of Water Commissioners of Denver Water has never levied *ad valorem* taxes from non-water users in the area to meet its financial obligations (Denver Water undated(c)). Approximately 87 per cent of all revenues were sourced directly from water users and a further 1.3 per cent were collected as a drought surcharge (Denver Water 2003).

8.4 Pricing water rights management costs

Water resource management costs are those associated with policy development towards water rights, planning processes (such as those associated with negotiating with US Federal Government agencies), the costs of administering, and monitoring and enforcing water rights.

It is not clear to what extent such costs are recovered by the users and beneficiaries of water rights. The Office of the State Engineer collects fees for the filing of water rights and well permits, as well as for other services, although the extent to which these recover these costs is not clear.

8.5 Pricing environmental third-party effects

It is not clear to what extent water users are charged for the environmental third-party effects associated with the storage or extraction of water. Water conservancy and conservation districts are authorised to recover at least some costs associated with natural resource management objectives in their respective area.

The recovery for natural resource management costs in large part depends on the scope of activities to be undertaken and the cost-sharing arrangements. As part of the Upper Colorado River Endangered Fish Recovery Program Activities, costs were incurred in:

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- restoring fish passages by providing access to historic habitat;
 - acquisition of water rights and investments in water savings;
 - modifications to non-native fish-breeding ponds to prevent escapes into the protected;
 - land acquisition and levee removals to restore floodplains;
 - propagating endangered fish and investing in stocking ponds; and
 - screening diversion canals to prevent endangered fish from being drawn from the river into the canal (UCREFRP et al. 2003).

The cost-sharing arrangements between the participating parties were:

- the US Federal Government (BoR), 46 per cent of the total costs;
- participating state governments, 17 per cent;
- hydroelectric power authorities, 17 per cent; and
- other sources, 20 per cent (UCREFRP et al. 2003).

Few costs were directly attributed to water users.

9 Monitoring and enforcement

The obligations, authorisation, enforcement procedures and penalties are contained in the Colorado Revised Statutes.

9.1 Monitoring procedures

In Colorado, compliance monitoring of water rights is undertaken by several agencies. In the case of:

- Surface water — water commissioners are responsible for monitoring and enforcing the diversion of surface water, and therefore compliance with water rights in their area.
- Ground water — the Ground Water Commission is responsible for monitoring and enforcing the diversion of ground water in designated basins. This function is delegated to the Office of the State Engineer.
- Instream flow and lake-level rights — the CWCB is responsible for monitoring flow conditions to ensure that appropriated instream flow and lake-level rights are being met and distributed within Colorado's appropriation system.

In general, legislation confers on the Office of the State Engineer the power to enter private property to inspect the means of diversion or extraction, transportation, storage and uses to which surface and tributary ground water is being used and to read meters and gauges (§37-90-110, 92-502 CRS). As mentioned earlier, this is routinely undertaken as part of a process of distributing water to users.

Water districts, ditch companies and irrigation districts are responsible for monitoring water use of their members and enforcing compliance to the entity's water right. Ground water management districts are responsible for monitoring extraction of ground water from their areas.

9.2 Enforcement procedures

Legislation provides the authority to the division engineers, water commissioners and the ground water commissioners to enforce compliance with water rights and well permits.

Legislation also authorises the CWCB to enforce the state's instream flow and lake-level rights. Like any water right-holder, the CWCB can request the water commissioner, or other delegate of the State Engineer, to ensure that water is being distributed in accordance with the state's priority system.

Legislation also describes the action to be taken when an infringement or misdemeanour occurs and what penalties to be applied. Essentially there are two broad levels of enforcement:

- ordering and directing behaviour of water users; and
- seeking immediate court action.

The division engineer can order the release from storage of any water found to be illegally or improperly stored, to discontinue out-of-priority diversions, and to require valves of flowing wells to be capped (§37-90-110 and 92-502 CRS). Similarly, the CGWC also has the authority to order the total or partial discontinuance of any diversion of designated ground water that is not being diverted to the permitted beneficial use (§37-90-111 CRS).

Depending on the seriousness of the offence, the state and division engineers and ground water commissioners may seek restraining orders or injunctions, via the Attorney-General. This can also include if the defendant refuses to abide by the orders and directions of the engineer or commissioner (§37-92-503 CRS).

Offences that warrant immediate court action by the division engineer or ground water commissioner include: the illegal opening of excavating wells; withdrawing ground water where this might injure the rights of other water users; falsifying records; and interfering with the operation of automatic self-registering device or other measuring recording device (§37-80-118, 90-110 CRS).

Legislation also identifies the range of penalties and include both fines and imprisonment. For example, for both illegal diversions of surface water and extractions of ground water, or falsifying or interfering with automated gauge self-registering devices, the offender may be fined up to \$US500 for each day for each offence (§37-80-118; §37-92-503 CRS)). A person violating a court injunction is guilty of contempt of court (§37-92-503 CRS).

There are numerous avenues for appeals against monitoring and enforcement procedures, both by the defendant and by third parties affected by the alleged behaviour of the defendant. For example, any party, including a ground water management district, adversely affected or aggrieved by any decision or act of the ground water commission or from the enforcement activities of the Office of the State Engineer may make an appeal to the district court (§37-90-115 CRS). Any person who has been damaged in his business or property by the actions of the defendant, may bring action in any district court (§37-92-504 CRS).

References

- BoR (Bureau of Reclamation) 1938, *Colorado–Big Thompson Project, Colorado: Contract between the United States and the Northern Colorado Water Conservancy District Providing for the Construction of the Colorado–Big Thompson Project, Colorado*, 5 July 1938 (Reprinted January 1997).
- 2002a, *Annual Operating Plan: Colorado–Big Thompson Project, Water Year 2001*, <http://www.usbr.gov/gp/aop/cbt/0102/toc.htm>.
- 2002b, *Annual Operating Plan: Fryingpan–Arkansas Project, Summary of Actual Operations, Water Year 2001*, <http://www.usbr.gov/gp/aop/fa/01/toc.htm>.
- CDWR (Colorado Division of Water Resources) 2000, ‘A summary of compacts and litigation governing Colorado’s use of interstate streams’, unpublished.
- CDWR et al. (Colorado Division of Water Resources and Colorado Water Conservation Board) 1995, *Senate Joint Resolution 94-32 Concerning the Management, Conservation, and Preservation of the Water Resources of the State of Colorado*, (Reproduced [http:// waterknowledge.colostate.edu/](http://waterknowledge.colostate.edu/) Accessed 19 April 2002).
- COEDT (Colorado Office of Economic Development and Trade), 2001, ‘Population and demographics’, August, mimeo, unpublished.
- Colorado Water (undated), *River Basins of Colorado*, <http://waterknowledge.colostate.edu/rivers.htm>, (accessed 8 September 2003).
- CPUC (Colorado Public Utilities Commission) undated(a), *Water Utilities: About the Water Section*, [http://www.dora.state.co.us/ puc/water/WaterAbout.htm](http://www.dora.state.co.us/puc/water/WaterAbout.htm), (accessed 10 August 2003).
- CRWPE (Colorado River Water Projects Enterprise), undated(a), *Application for Water Supply Contract*, Colorado River Water Projects Enterprise of the Colorado River Water Conservation District, <http://www.crwcd.gov/watmar/Application-April%202003updated.pdf>, (accessed 10 August 2003).
- undated(b), *Water Rights Descriptions: December 2002*, <http://www.crwcd.gov/watmar/WaterRightDesc2002.html>, (accessed 10 August 2003).
- CWCB (Colorado Water Conservation Board) 1994, *Statement of Basis and Purpose and Rules and Regulations Concerning the Colorado Instream Flow*

-
- and Natural Lake-level Program*, Amended September 13', Colorado Water Conservation Board, Denver.
- 2001, *Tabulation of Instream Flow and Natural Lake Water Rights: December 2001*, Colorado Water Conservation Board, Denver.
- Denver Water 2003, *Comprehensive Annual Financial Report, For the Year Ending December 31 2002*, Denver, Colorado.
- undated(a), *Who We Are and What We Do*, <http://www.water.denver.co.gov/whoweare/whoweareframe.html>, (accessed 7 August 2003)
- undated(b), *Denver Water: An Overview*, <http://www.water.denver.co.gov/whoweare/whoweareframe.html>, (accessed 7 August 2003)
- undated(c), *Welcome to the Rate and Drought Surcharge Information Section*, <http://www.water.denver.co.gov/whoweare/whoweareframe.html>, (accessed 7 August 2003)
- Getches, D. H. 1997, *Water law in a nutshell*, Third Edition, St.Paul Minnesota, West Publishing.
- Hobbs , Justice G. 2001, 'Clarifying State Water rights and adjudications', in *Two Decades of Water Law Policy and Reform: A Retrospective and Agenda for the Future*, Natural Resources Law Centre, University of Colorado School of Law.
- 1999, 'Colorado's 1969 Adjudication and Administration Act: Settling In', *University of Denver Water Law Review*, 3(1):1-25.
- 1997, 'Colorado water law: an historical overview', *Water Law Review*, 1(1):1-34.
- NCWCD (Northern Colorado Water Conservancy District) undated(a), *2004 Estimated Budget*, Northern Colorado Water Conservancy District Fund, http://www.ncwcd.org/finance/web_finance/current_bud/Cncwcd.pdf, (accessed 10 August 2003).
- Nieuwoudt, W. L. 2000, 'Water Market Institutions in Colorado with Possible Lessons for South Africa', *Water SA*, 26(1):27–34.
- Noonan, P. 1993, 'Findings on selected water resource policy issues in the United States of America. Report on Study Tour in September–October 1993', Queensland Department of Primary Industries.
- OECD (Organisation for Economic Cooperation and Development) 1999, *The Price of Water: Trends in OECD Countries*, Organisation for Economic Cooperation and Development, Paris.

-
- PC (Productivity Commission) 2003, *Water Rights Arrangements in Australia and Overseas: Annex G, Colorado River Basin*, Commission Research Paper, Productivity Commission, Melbourne.
- Robson, S. G. 1987, *Bedrock Aquifers in the Denver Basin, Colorado — A Quantitative Water-Resources Appraisal*, U.S. Geological Survey, Washington D.C, U.S. Government Printing Office. (Reproduced in <http://waterknowledge.colostate.edu/>. Access 19 April 2002).
- State Engineer 2002, *Rules Governing the Arkansas River Water Bank Pilot Program*, Division of Water Resources, Colorado.
- UCREFRP et al. (Upper Colorado River Endangered Fish Recovery Program and San Juan River Basin Recovery Implementation Program) 2003, *Program Highlights: 2001–2002*, Upper Colorado River Endangered Fish Recovery Program and San Juan River Basin Recovery Implementation Program.
- USGS (U.S. Geological Survey) 1988, *Estimated Use of Water in Colorado: 1985*, Water-Resources Investigation Report 88-4101, (Reproduced <http://waterknowledge.colostate.edu/> Accessed 19 April 2002).
- Zimbelman et al. (Zimbelman, D., Crookston, M. and G. Silkensen) 2002, *Water and Irrigation Management in the South Platte River Basin*, Northern Colorado Water Conservancy District, undated.