Chapter 6 — Landscape characteristics and salinity mapping

Landform feature identification

Geological features and past patterns of weathering make some landforms more hydrologically sensitive and susceptible to salting than others. The important feature of sensitive landforms is the presence of some restriction to groundwater flow that causes the watertable to rise to near the soil surface, resulting in a discharge area with evaporative concentration of salts. Watertable salting commonly occurs in positions in the landform indicated as potential discharge areas in the diagrams accompanying the following descriptions (Figure 28).

Hydrologically sensitive landscapes often show evidence of past seepages or shallow watertables. If development in these types of landscapes changes the hydrological balance, salting may occur as a result.

Landforms occur in patterns in regions and can be compared readily within a region. Once identified, they are useful for indicating sensitive areas of the landscape which can be further investigated. Landform features will also determine which management strategies may be effective (discussed in ***Integrated management strategies*** page 93).

The advantage of using landforms to diagnose susceptibility is that landforms can be readily observed without undertaking detailed (and sometimes expensive) site investigations.

Sources of information

- Inspecting the property and other properties in the catchment is the most direct way of identifying landform features.
- In some cases, it may be easier to identify landforms on aerial photographs or topographical and geological maps. (Features on geological maps relevant to identifying landforms at risk of salinity are described in **Geology** page 42.)
- Landforms in some areas may have already been identified and discussed in land or soil survey reports.

Landform feature descriptions

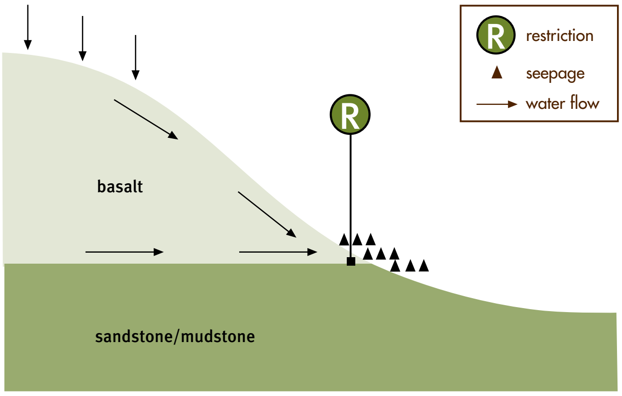
Basalt form

The most common landform associated with salinity in Queensland, this landform comprises both recent and highly weathered basalt flows overlying less permeable sandstones and mudstones at fairly shallow depths (Figure 28a). Basalt which is fractured, columnar or vesicular forms suitable groundwater recharge areas and transmission zones. Basalt gravels in old valley infill areas also form aquifers which readily transport water.

The restriction to downward water movement is provided by the underlying material which, being less permeable than the overlying basalt, restricts continued downward water movement. In addition, layering within the basalt and bole (previously weathered) layers provides regions of variable permeabilities which can contribute to salting.

Seepages or shallow watertables occur at the interface areas. The basalt form is characterised by both seepage and watertable salting with source waters (usually of low salinities) concentrated by evaporation. This form is evident on the eastern Darling Downs, central Queensland and on lateritised basalts in the Rockhampton and Kingaroy areas.

Figure 28a. Basalt form



Catena form

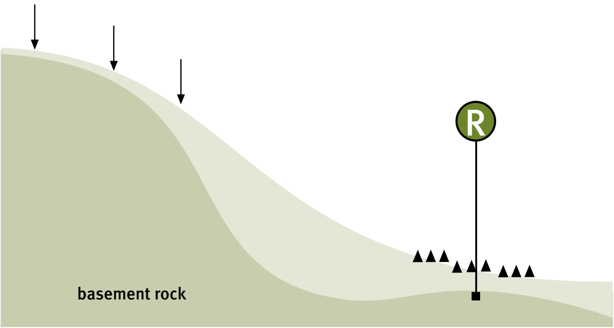
This form occurs where soil forming processes and wetness have resulted in a change in soil properties down a slope. The form comprises shallow soils in upslope positions overlying weathered parent material with soils gradually becoming deeper and heavier textured downslope extending onto flat heavy clay alluvial areas (Figure 28b).

Sodicity may be high at the base of the slope, further restricting permeability. More recent infills of clays at the bottom of the slope can restrict outflow. Soils at break-of-slope positions tend to be saline at some depth, indicating a past history of high watertables. Restricted drainage results in salt accumulation.

The change in hydraulic gradient creates a similar effect to a barrier to water movement. Salting results from infiltration of water into the soils and lateral movement through the weathered parent material or through more permeable soil horizons. Discharge occurs in the lower slope or break-of-slope positions where the heavier clays or geologic features (for instance, dykes) restrict water movement. In some situations, the weathered parent material can act as a confined aquifer contained by the less permeable soils above and the less weathered rock below.

This form is evident in the Boonah area in south-east Queensland, on the Burdekin River right bank and in many other small occurrences.

Figure 28b. Catena form

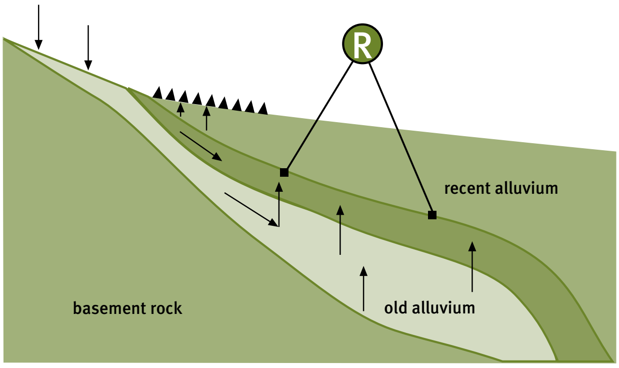


Alluvial fan

This form occurs where the coarser sediments of an old alluvial fan have been subsequently buried or partially buried by clays (Figure 28c). Subsurface water flowing from upslope areas or old stream channels enters the alluvia of the former land surface which acts as an aquifer for water transmission. Discharge areas occur where heavy clays, more recent alluvia, or finer sediments are deposited over the coarser materials at the margins of the alluvial fans.

The form is represented in central Queensland on Tertiary sediments, on the eastern Darling Downs on basalt, as alluvium associated with granites near Mareeba, and as old fans from stream breakouts in the Sarina area.

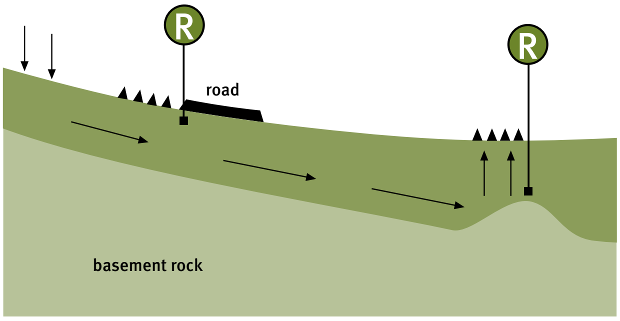
Figure 28c. Alluvial fan



Catchment restriction—roadway

This type of restriction occurs on heavy clay areas where roads and stock routes across alluvia have compacted the soils, particularly in wet periods. This reduces the water transmission properties of the soils sufficiently to raise watertables and cause salting upslope of the road (Figure 28d). This form is represented in the Lockyer Valley, Darling Downs and central Queensland.

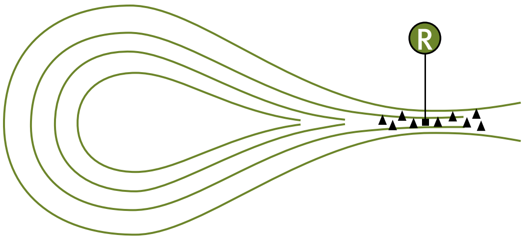
Figure 28d. Catchment restriction—roadway



Catchment restriction—natural

Rock bars or resistant sediments can restrict water flow in valley floors or where existing aquifers thin out. The catchment throat is often narrowed in width and/or depth. Discharge areas develop in the region upslope of the restriction (Figure 28e). This is particularly common in the Lockyer Valley, Boonah and Rockhampton areas. The McDonnell ranges in central Australia are a classic case of this form.

Figure 28e. Catchment restriction—natural



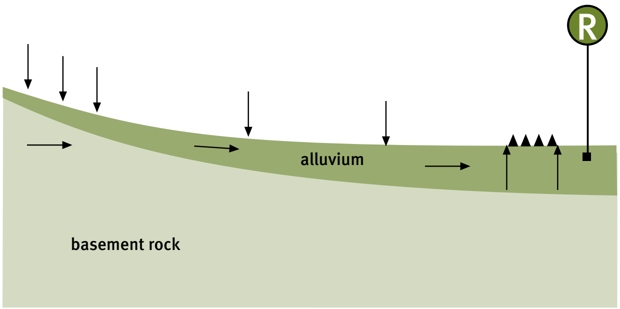
Alluvial valley

This is a particular form of catchment restriction where a geologic restriction to water flow out of a catchment results in the deposition of alluvium (Figure 28f). These valleys are usually associated with a very low hydraulic gradient. This form is evident in a number of alluvial valleys in Queensland where large historic salt loads have accumulated in down-valley areas in the unsaturated zone at the interface between shallow watertables and tree roots. Remobilisation of this historic salt causes the observed salting. Valleys with no incised drainage line are particularly prone to this type of salting process.

Water quality modelling in the Lockyer, Callide and Dee valleys indicates that in these systems the major process of salt accumulation is the extraction of water from capillary fringes of aquifers by deep-rooted vegetation. Accumulated salts are leached back into the aquifer system, increasing salinity. Additional geomorphic and geological restrictions to water flow can intensify these effects by raising groundwater levels. In these valleys, salinity gradients increase with distance from the head of the valley.

Where heavy clay alluvium has been deposited on top of permeable materials, salting may extend over large areas due to the upward movement of water under hydraulic pressure. This particularly occurs in granitic landscapes where the high proportion of sodium released on weathering results in sodic clays of low permeability in valley floors. Upward flow through this confining layer contributes to salting by evaporative concentration.

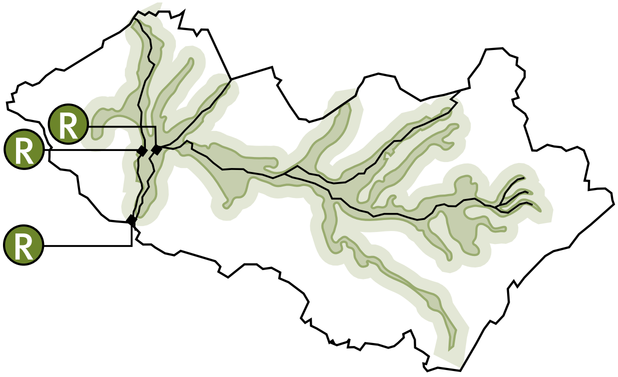
Figure 28f. Alluvial valley



Confluence of streams

At the junction of a minor stream with a major stream, the reduction in flow velocity and resultant deposition of suspended particles at the junction results in a greater proportion of clay in the sediments at this point with lower lateral permeability (Figure 28g). This occurs particularly in the smaller stream immediately upstream of the junction. This form is evident in the Boonah area and, in conjunction with the alluvial valley form, in the Callide Valley as well as in other areas.

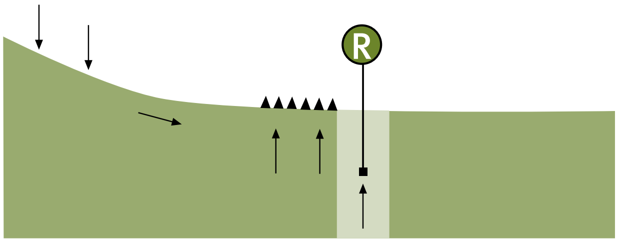
Figure 28g. Confluence of streams



Dykes

Geologic dykes can form areas of variable permeability in the landscape. Where less fractured or weathered dykes occur across the direction of slope, water movement downslope is interrupted and incipient or permanent salting areas develop (Figure 28h). This is most evident in the Burdekin and Mareeba areas in north Queensland on granites, and also in central Queensland.

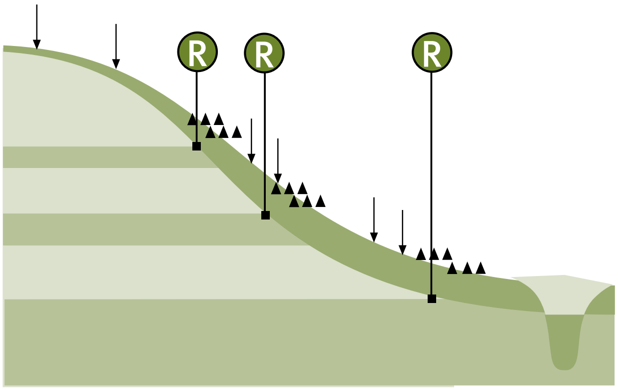
Figure 28h. Dykes



Stratigraphic form

Variable permeabilities in sedimentary rock layers can act as preferential flow paths or impermeable areas under increased water regimes. In this situation, small seepages and salted areas appear on hillslopes in response to variations in the permeability of different rock layers (Figure 28i). This form is evident in the Lockyer Valley and other areas on a variety of sedimentary rock types. Lateritic and ironstone cappings are variations of this form.

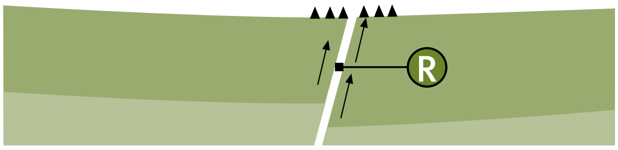
Figure 28i. Stratigraphic form



Geological faulting

Faulting can operate in a similar manner to dykes or alternatively can provide preferential upward flow paths for water (Figure 28j). The mound springs around the southern fringes of Lake Eyre and the seepage in the Yelarbon desert region are classic cases of the latter form of geological faulting.

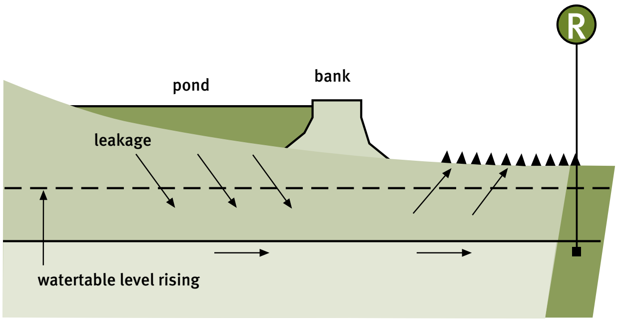
Figure 28j. Geological faulting



Dams

A dam can contribute to salting both upstream and downstream of the dam itself (Figure 28k). The dam also acts as a hydraulic barrier to groundwater flow. Upstream salting results from reduced hydraulic gradient of downslope flow caused by the raised water level of the dam. Downstream salting results from leakage of water, usually above a shallow, less permeable subsoil layer. This form is relatively common.

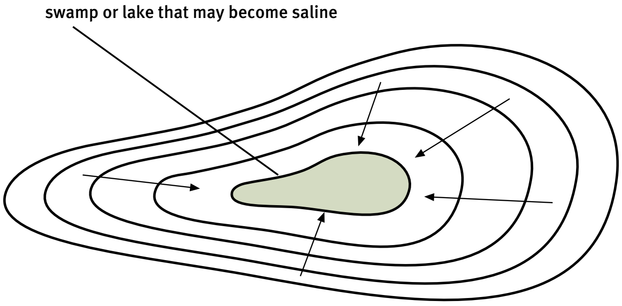
Figure 28k. Dams



Lakes (groundwater terminus)

Regions where surface water and groundwater terminate with limited outflow and hence flushing are generally salted due to evaporative concentration (Figure 28l). Lake Eyre and Lake Buchanan (near Jericho) in Queensland are two classic natural cases of this form. The salting in the centre of Wolfe Creek Crater, a meteorite crater in northern Western Australia, is due to long-term accumulation of salts from rainfall and weathering in an area of restricted drainage. The playa lakes of southern, western and inland Australia are natural occurrences of salt lakes that expand in response to land development.

Figure 28l. Lakes (groundwater terminus)



Geology

Most dissolved salts occurring in natural waters originate from the combination of salts in rainfall and weathering of rocks near the land surface. High salinities occur in many of the fine-grained sedimentary rocks (mudstone and shales). Also, and more importantly, geological structures can control water movement in landscapes. By identifying underlying geological formations, information is obtained which will facilitate the identification of landform features in the region (see the previous section ***Landform feature identification*** page 39).

Sources of information

- Regional geological maps are available. However, the boundaries of geological formations on these 1:250 000 maps may not be accurate enough to pinpoint salinity outbreaks, depending on the source of data. For this reason, these maps are valuable for a broad assessment of geological formations occurring in the area, providing a guide only in specific local areas.
- More detailed geological information may be available, particularly if properties in the area have been subject to detailed mineral investigations at some stage. If specific geological surveys have been carried out, these would be available on open file from the appropriate department. Previous investigations on the property, perhaps held by former land owners, may also be useful.
- Geological information relevant to the area under investigation may be listed with Queensland Spatial Information Directory (QSID), a computerised directory of land-related information.

The geology of source rocks can often be determined from dissolved salts in the groundwater. Interpreting groundwater analyses is covered in ***Water chemistry and salt sources indentification*** (page 73).

Interpretation

Hydrologic features and landforms commonly at risk of watertable salting can be identified using readily available topographic and geological maps. Codes which appear on geological maps are listed and described in Table 13 as an aid to interpreting maps. General interpretation guidelines for identifying hydrologic units within a landscape and landscapes at risk of watertable rise and salting are provided in Table 14. More information about landforms commonly at risk (such as basalt forms and constricted catchments) is provided in ***Landform feature identification*** (page 39).

Table 13. Common descriptive codes appearing on geological maps.

Geologic time period	General codes	Description
Quaternary units (0–2 myr before present)	Q	undifferentiated Quaternary sediment
	Qa	alluvium
	Qb	beach ridges
	Qc	scree and gravel ± silcrete
	Qd	coastal/inland dunes
	Ql	lacustrine sediments or limestone
	Qm	mud flats
	Qr	sandy red earth ± gravel
	Qs	soil and/or silcrete ± residual sand and gravel
Tertiary units (2–7 myr before present)	T/Ts	undifferentiated Tertiary sediments
	Tb	basalt
	Tf	ferricrete
	Tl	laterite
Cainozoic units (0–65 myr before present)	Cz	undifferentiated Cainozoic sediments
	Cza	alluvial and/or deltaic sediments
	Czb	basalt
	Czd	coastal/inland dunes
	Cze	estuarine sediments
	Czg	unconsolidated sand and gravel
	Czl	laterite
	Czs	colluvial sands and silts ± duricrust
	Czy	silicified quartz sand ('billy')

Landscape salinity mapping

The mass and extent of salt in the landscape can be estimated and mapped using a number of remote sensing and contact and non-contact ground-based geophysical methods. Using these methods, areas of potential salinity hazard and salt loads likely to be mobilised under a wetter equilibrium can be identified.

Commonly used remote sensing methods include aerial photography, LANDSAT, Thematic Mapping (TM), airborne multi-spectral scanner (MSS), and airborne geophysics. These methods are listed and their applications, key strengths, data type and cost-effectiveness are discussed in Table 15 (page 45).

Ground-based geophysical methods commonly used for salinity and shallow groundwater investigations are listed and discussed in Table 16 (page 46). These include electromagnetic induction instruments (discussed in more detail following), magnetics, radiometrics and seismic refraction.

Electromagnetic induction instruments facilitate a rapid assessment of amount and extent of soil salinity. These instruments induce a magnetic field in the soil from a primary electric current in a coil held above the soil surface. The strength of the magnetic field is proportional to the electrical conductance of the soil as measured by secondary current induced in a receiver coil. The spacing of the emitter and receiver coils determines the depth of the reading. The depth response function is significantly more responsive at the soil surface. The advantages of using electromagnetic induction instruments are being able to obtain continuous readings and the lack of soil contact.

Three instruments developed by Geonics Inc. of Canada are commonly used (Table 17):

- EM-38, with sensing depth to approximately 1.5 m, suitable for relating surface soil salinity to plant growth
- EM-31, with sensing depth to approximately 6 m, more suitable for landscape salt and salting processes as well as providing a useful indication of surface soil salinity
- EM-34–3, with three coil spacings giving a maximum sensing depth of up to 60 m, useful for investigating landscape salt loads at deeper depths.

Table 14. Generalised interpretation of shallow groundwater and saline hazard areas from maps using geomorphic and geological features.

Critical areas commonly requiring identification			Landform commonly at risk	
Recharge areas	**Discharge areas**	**Salt sources**	**Basalt landforms**	**Constricted catchments**
Geomorphological indicators			**Geomorphological indicators**	
• elevated landforms (ridges, ranges, plateaus and upper slopes) • dunes • beach ridges	• toeslopes • permanent streams • permanent waterholes, lakes and swamps • playa lakes • areas of poorly incised drainage	• deeply weathered landscapes • inland drainage systems • coastal salt marshes • saline scalds	• weathered and/or dissected basalt caps on hills and plateaus • margins of elevated, red soil landscapes	• catchments with narrow, laterally restricted outflow • topographic highs at catchment outflow • broad, flat catchments with poorly incised drainage
Geological indicators			**Geological indicators**	
• rock outcrops in elevated landscapes—particularly basalt, sandstones and limestone • deeply weathered intrusive rocks—particularly granite and granodiorite • strongly jointed or fractured rocks • steeply dipping sedimentary strata • lateritised rocks (Ql, Tl, Czl) • sand and gravel units (Qa, Qb, Qd, Qr, Ts, Czg, Czs)	• clay alluvia in broad, flat valleys (Qa, Qc, Ql, Qs, Cza, Czs) • estuarine sediments and adjacent low lying areas (Cze) • margins of basalts in upper landscape positions • coastal mud flats (Qm) • peat deposits • playa and sabkha sediments (Qs)	• fine-grained sediments of marine origin • deeply weathered or lateritised rocks • estuarine deposits (Cze) • coastal mud flats (Qm) • carbonaceous sediments (such as coal and carbonaceous mudstones, siltstones and shale) • playa and sabkha sediments (Qs)	• margins of Tertiary basalts (Tb, Czb) and older, deeply weathered basalts in elevated landscape positions • margins of lateritised rocks in upper landscape positions (Ql, Tl, Czl)	• just upstream of 'pinched out' areas in broad Quaternary alluvium (Qa) • broad areas of Cainozoic sediments (Czs) as above • stringers of sediment along drainage lines with restricted linear extent • outcrop of basement (deeper) rocks at or near the land surface along drainage lines

Note: Source data for geomorphological indicators can be obtained from topographic maps and aerial photographs. Source data for geological indicators can be obtained from 1:250 000 geological maps and special purpose maps (for example, regolith maps, mineral exploration maps).

Table 15. Remote sensing methods commonly used for assessing shallow groundwater and salinity hazard. (Note: Prices quoted are indicative only at the time of printing. Actual costs will depend on availability of the equipment and the size and scope of the survey.)

Methods	Application and key strengths	Data type, information issues	Cost-effectiveness	Comments
Aerial photography (black & white, colour)	• provides information on soils, vegetation patterns, landform features, land use • suitable for farm and catchment planning, maintaining site history • high resolution, archival data readily available	• hard copy • may be digitised • generally not rectified • digital capture available in future • can be scanned	• cheap as archival data • expensive to capture data (suitable but very costly for monitoring if specific areas are required)	Aerial photographs are one of the most useful initial data sources for any investigation
LANDSAT Thematic Mapper (TM) or SPOT	• provides information on vegetation patterns, landforms and geological structure, land resources and land use • suitable for small catchments to regional scale applications • suitable for resource assessment, planning, validating models and monitoring • readily available, and archival data available	• digital raster data • 30 m per pixel (10 m SPOT panchromatic) • readily integrated with digital topography and geophysical data sets • needs ground truthing • needs specialist processing and interpretation	• moderate setup cost, very cheap unit cost (approx. $0.05/ha) • data are multi-use depending on processing used	TM data have been readily available in Australia since the mid 1980s and are still the most reliable satellite-based data for land management use
Airborne multi-spectral scanner (MSS)	• provides information on soil and vegetation patterns and land use • large number of bands, including thermal infra-red • suitable for monitoring • suitable for farm to catchment scale applications • rapid data capture	• digital raster data • approx. 2 m per pixel, large data set • needs calibration (for monitoring) • generally not rectified • difficulties joining (suturing) data from multiple flight paths • needs ground truthing • needs specialist interpretation	• moderate setup cost (approx. $10 000) • cheap unit cost (approx. 0.15/ha) • cost depends on availability of instrument	Application in Queensland has been limited
Airborne geophysics 1. Electromagnetic induction 2. Magnetics and radiometrics	• provides information on geological structure, rock types (by inference), salt accumulation, historic groundwater flow (by inference) • can provide depth information • suitable for catchment management and processes, shire and regional planning, major projects (irrigation/dams) • rapid data capture	• digital raster data • readily linked with other data sets • approximately 70 m per pixel • needs appropriate ground truthing • needs specialist interpretation (may not necessarily map salt, provides little indication of hydrological importance of structures)	• high setup cost (>$50 000) due to need for specialist contractor and processing • cheap unit cost (approx. $5/ha) • appropriate for major projects on high-value land (i.e. irrigation areas or dams) • cost could be shared if data are of interest to other clients (mining, environmental)	Airborne geophysics has been a traditional tool of the mining industry. Its application to salinity studies in Australia has had mixed success, but ongoing refinements to equipment, interpretive processes and data manipulation techniques are showing promise

Table 16. Ground-based geophysical methods commonly used for salinity and shallow groundwater investigations. (Note: Prices quoted are indicative only at the time of printing. Actual costs will depend on availability of the equipment and the size and scope of the survey.)

Methods	Description	Application and key strengths	Limitations	Cost-effectiveness	Comments
Electromagnetic induction (EMI)—EM 38	• coil spacing 1 m • effective depth 1.5 m • measures the apparent conductivity of the ground based on the strength of a secondary magnetic field induced in the ground from a primary field emitted by the instrument	• rapid site assessment • useful for surveying and monitoring small sites for salinity in the root zone • suitable for soil salinity surveys	• shallow depth penetration • readings are strongly influenced by soil properties, particularly moisture and iron oxides • monitoring use limited to large differences • field calibration desirable	• instrument costs approx. $8 000 • survey costs approx. $10/ha depending on sampling intensity • does not require specialist operator	• commonly used to assess tree planting sites • also used in cropping areas to determine salinity effects in the root zone • very useful as an extension tool for landholders and landcare groups
Electromagnetic induction (EMI)—EM 31	• coil spacing 3.7 m • effective depth 6 m • measures the apparent conductivity of the ground based on the strength of a secondary magnetic field induced in the ground from a primary field emitted by the instrument	• rapid site assessment • useful for site and catchment reconnaissance • suitable for mapping soil salinity, groundwater contaminant plumes and geological variation • can be used to locate gravel, buried drums, pipes and other objects	• readings are affected by clay content and soil moisture • awkward to use in heavily timbered areas • field calibration desirable	• instrument costs approx. $23 000 • survey costs approx. $10/ha depending on sampling intensity • can be mounted on a vehicle-drawn 'plastic' trailer for mobile surveys • does not require specialist operator, may require specialist interpretation of results	• commonly used for site survey and regional reconnaissance • may be used for depth profiling (2 depths) • mobile surveys offer benefits of larger data sets and greater accuracy • very useful as an extension tool for landholders and landcare groups
Electromagnetic induction (EMI)—EM 34–3	• coil spacing 10/20/40 m • effective depth 15/30/60 m • measures the apparent conductivity of the ground based on the strength of a secondary magnetic field induced in the ground from a primary field emitted by the instrument	• rapid site assessment • useful for regional reconnaissance and depth profiling • suitable for mapping weathering profiles and salinity, deep groundwater contaminant plumes, groundwater prospecting and vertical geological anomalies	• requires two operators • results can be strongly influenced by depth to bedrock, type of rock and degree of fracturing	• instrument costs approx. $17 000 • survey costs approx. $20/ha depending on sampling intensity • does not require specialist operator, but does require specialist interpretation of results	• commonly used for site surveys and regional reconnaissance • may be used for depth profiling (3 depths)

Methods	Description	Application and key strengths	Limitations	Cost-effectiveness	Comments
Magnetics	• measures the earth's magnetic field	• single person carry-pack • rapid reconnaissance • good for determining geological structures if minerals are magnetic or contrast in magnetism	• not capable of determining the hydrological effect of geological structures	• instrument cost exceeds $20 000 • surveys costs approx. $10/ha depending on sampling intensity • does not require specialist interpretation of results	• not commonly used for salinity investigations • could have greater application in areas of strong geological or structural control
Radiometrics	• measures the radioactive isotopes of potassium (K), uranium (U) and thorium (Th), and total isotope counts • ratios of these isotopes indicate the types of minerals present in the rocks and soil	• hand-held instrument • rapid reconnaissance • radios of three radioactive isotopes (K, U, Th) provide information for constructing pseudo-soil/geological maps	• best only as a tool to help interpret geological/soil units • measurements do not relate directly to conductivity or salinity	• instrument cost exceeds $15 000 • does not require specialist operator, but does require specialist interpretation of results	• not commonly used for salinity • has a high potential for use in soil mapping
Seismic refraction	• differentiates horizontal strata by timing the reflection of seismic shock waves; denser rocks (e.g. fresh basalt) return high velocity waves; less dense strata (e.g. weathered sandstone) return low velocity waves	• site surveys • good for determining the relative thickness of strata • may be used to identify watertables	• requires at least two operators • field set-up and operation are slow • not useful in moderately to steeply dipping strata or in rocks of strong structural control	• instrument cost exceeds $25 000 • requires skilled operator, particularly if explosives are used to initiate shock waves • specialist interpretation of results is essential	• not commonly used for salinity investigations • generally used for groundwater prospecting

Table 17. Operational parameters of EM instruments in common use.

Intercoil	Operating spacing (m)	Operating frequency (kHz)	Optimum depth penetration	
			Vertical dipole (m)	Horizontal dipole (m)
EM 38	1.0	14.6	1.5	0.75
EM 31	3.66	9.8	6	3
EM 34–3	10	6.4	15	7.5
	20	1.6	30	15
	40	0.4	60	30

Table 18. Typical values for EM 31 readings and their likely significance.
Note: This table applies to typical soils and landscapes and not to creeks, dykes, roads or other anomalies in the landscape.

Typical EM 31 reading (mS/m)	Likely material	Likely clay content (%)	Likely $EC_{1:5}$ of subsoil (dS/m)	Comment
10–20	Coarse sand	< 10	< 0.05	recharge area, well-leached
20–40	Earths	< 20	≤ 0.15	recharge area, leached
50–80	Light clays	up to 40	≤ 0.25	recharge area, leached and permeable
80–130	Heavy clays—sodic subsoils	45–60	< 1.2	transmission area, 'normal' slowly permeable soils with subsoil salt
80–120	Heavy clays—non-sodic, basalt in origin	40–80	< 0.6	low recharge, 'normal' slowly permeable soils
130–200	Surface salt and low salinity groundwater	variable	3–8 surface 0.5–1.5 subsoils	discharge area, may give a lower reading than expected due to thin depth of surface salt
200–300+	Surface salt and high salinity groundwater	variable	4–10 surface 1.5–3 subsoils	discharge area with higher subsoil salt content

Interpretation of EM 31 readings

Readings for EM instruments are given in mS/m, 100 times greater than the commonly accepted unit of dS/m for soil analyses. While these readings can be readily converted, the EM readings are of the bulk soil at the given water content and will not directly relate to the results of laboratory soil analyses. Table 18 provides typical indicative values for EM-31 readings based on field experience.

EM instruments are sensitive to clay content and mineralogy, soil water content, and the depth of bands of more conductive material in the ground. Some soils, for example 'brigalow' clay soils, have high salinity due to their very low deep drainage rates and do not as such indicate discharge areas. There is considerable information available in the literature about the use of electromagnetic induction instruments to quantify salinity in different profile layers and the effects of other factors on the readings. Ground truthing by taking soil samples is recommended for verifying EM readings, particularly if soils change across the landscape.

Landscape salinity hazard classification

There are a number of schemes for classifying land according to its salinity status. The guidelines developed by the Dryland Salinity working group of the Murray–Darling Basin Commission (1993) are used here. This classification scheme (Table 19) evaluates land on the basis of the current degree of salting as well as the degree of salinity risk under changed land use or land management conditions (based on watertable salting).

Table 19. Classes of salt-affected land (adapted from Murray–Darling Basin Commission 1993). Note: 'Watertable salting' refers exclusively to the process of shallow watertable-related salinity; 'Land' refers to land systems (recurrent patterns of geology, soils and vegetation) and associated surface and groundwater systems.

Class	Description
Not at risk	Land not predisposed to watertable salting regardless of land use or management
Stable	Land predisposed to watertable salting but unlikely to become saline under existing land use or management
At risk	Land predisposed to watertable salting which is likely to become saline under existing land use or management
Slightly affected	Land showing a reduction in non salt-tolerant plant vigour, some salt-tolerant plants, seasonally or permanently shallow watertable, and perhaps small bare areas
Moderately affected	Land showing a significant loss of non salt-tolerant plants, salt-tolerant plants are common, seasonally or permanently shallow watertable, bare areas up to about 5 m^2 in size, some erosion present
Severel affected	Land showing an absence of non salt-tolerant plants, permanently shallow watertable, large bare areas which are often badly eroded

While it is difficult to estimate severity by any universally applicable objective criteria, these classes offer a framework to describe what is happening or what may be expected to happen in an area. By using standard terms such as these, salt-affected areas can be mapped and described in different regions using comparable criteria.