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MINES AND MINERAL DEPOSITS OF WESTERN AUSTRALIA digital extract from MINEDEX — an explanatory note

by D. B. Townsend, Gao Mai, and W. R. Morgan

GOVERNMENT OF
WESTERN AUSTRALIA

GEOLOGICAL SURVEY OF WESTERN AUSTRALIA

DEPARTMENT OF MINERALS AND ENERGY

GEOLOGICAL SURVEY OF WESTERN AUSTRALIA

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MINES AND MINERAL DEPOSITS OF WESTERN AUSTRALIA: DIGITAL EXTRACT FROM MINEDEX — AN EXPLANATORY NOTE

by

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Mines and mineral deposits of Western Australia: digital extract from MINEDEX — an explanatory note

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Abstract

This Record provides an update on the locations and estimated mineral resources of all mines and mineral deposits in Western Australia. The coverage of historic mine sites is far more extensive than previous data extracts from MINEDEX and, for the first time, historic (pre-1985) gold production data are available in digital format. The released data contain selected information on 17 561 sites, of which 11 410 are historic mines, 2111 are current (post-1985) mines, and 2266 are deposits, with the remainder being cross-reference, processing plants, port handling facilities, and exploration sites. A total of 703 sites, mostly mine sites, are classed as operating.

The extensive data are of value in project generation, evaluation of mineral potential, strategic planning, and in map production by geoscientists, mineral exploration companies, government agencies, and academic institutions.

KEYWORDS: Mines, mineral deposits, mineral resources, mineral production, mineralization, mining, digital data, data processing, computer applications, MINEDEX

Introduction

MINEDEX was developed in 1984 by the Western Australia Department of Minerals and Energy (DME) as a mineral resource inventory database (excluding petroleum), but has expanded to also serve as an administrative tool for parts of the Mining Act 1978, Mines Safety and Inspection Act 1994, Mines Safety and Inspection Regulations 1995, and their predecessors. MINEDEX provides a coordinated, project-based enquiry system for textual information on mine and site locations

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(coordinates etc.), notice of intent to mine, mineral resources, mine production, mining inspection data, and environmental reports. The database is comprehensive for developments from 1986 onwards for all mineral commodities, except basic raw materials extracted from private land, and petroleum. Petroleum data are restricted to production statistics. A digital extract of portions of the data within MINEDEX was provided by Townsend et al. (1996), with subsequent periodic updates of the digital data.

This Record is an update of Townsend et al. (1996), but also includes, for the first time, historic production sites, their tenements, and pre-1985 gold production statistics. Historic sites are regarded as those with pre-1985 gold production and pre-1989 production for all other commodities. The pre-1985 gold production information, including tenements, is derived from Department of Mines (1954) and gold production records of 1954–85 held by DME. These data were entered into the GOLDSTAT database of W. R. Morgan, which DME has acquired the permission to publish.

This Record also contains an expanded SITES – COORDINATES table, which now includes local government areas for a site and abbreviated site names (MAP_NAME) to be used as labels on maps, plans, and in Geographic Information Systems (GIS). Resources cutoff criteria, where available, have also been added to the dataset.

This Record describes how the data on the accompanying compact disc were derived and some of DME's business rules for these data.

Online searches of a more complete range of information in MINEDEX can be made from terminals in DME offices, and MINEDEX site localities can be viewed in TENGRAPH, DME's tenement graphics system. Access to TENGRAPH is obtained through the DME internet website, http://www.dme.wa.gov.au. The Atlas of Mineral Deposits and Petroleum Fields (Geological Survey of Western Australia, 1999) displays selected MINEDEX sites in a geological context, as well as containing indexes to mineral commodities and companies. Work is progressing on direct access to parts of the MINEDEX data through the DME website.

The database is established around a core of projects and sites, and contains information on:

- Ownership (corporate)
- commodity group (major mineral or group of minerals)
- site type and development status

- locality data (coordinates, map sheets, and graticular blocks)
- mineral resource estimates
- notice of intent for development
- mine operators and contact addresses
- tenements
- production statistics

Sites, to which most attributes relate, are the core of the MINEDEX system. The relationships between the key elements of MINEDEX are shown in Figure 1. These relationships provide the basis for the data files and table linkages (outlined in the next section) accompanying this text.

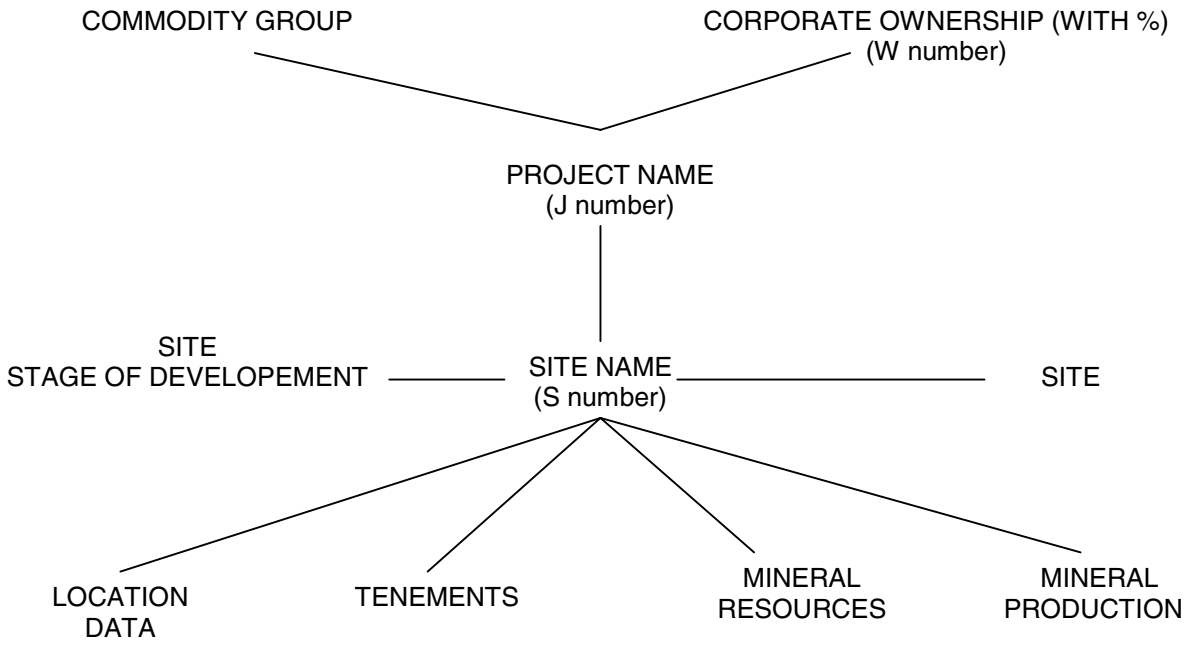

Figure 1. Simplified relationships between fields in MINEDEX

MINEDEX data released

The data supplied, with italicized key names, are summarized below:

- MINEDEX *site*s which include; mineral deposits, mines, processing plants, and associated mining infrastructure

- Mining or potential mining *project*s (a combination of sites with a common commercial ownership that share, or would share, a common mining infrastructure)
- *Commodity group* for each project
- Corporate *ownership* and percentage holding
- Site *type* and *stage* of development
- *Coordinates* (latitudes and longitudes, and AMGs)
- Local government authorities (LGA)
- Current mineral *resource* estimates and associated cutoff criteria
- Gold and silver *production* for pre-1985 gold mines
- *Tenement*s for historic production sites

The total number of records and the number of unique sites/values for each file are shown in Table 1. The released data contains selected information on 17 561 sites, of which 11 410 are historic mines, 2111 are current (post-1985) mines, and 2266 are deposits, with the remainder being cross-reference, processing plants, port handling facilities, and exploration sites. A total of 703 sites, mostly mine sites, are classed as operating.

Table 1. Summary information on the numbers of records and unique sites/values in the MINEDEX data released

Table subject	*Number of records*	*Number of unique sites or values*
Historic tenements	18 106	11 409
Pre-1985 gold production	12 090	9 493
Project owners	2 488	2 035
Resources	8 739	2 423
Resources cutoff criteria	2 551	1 047
Site coordinates	17 561	17 561

The compact disc accompanying this Record contains the above data structured into ten files:

- R2000_13.PDF — file containing the text of this report (Geological Survey of Western Australia Record 2000/13);
- TABLES.DOC — a text file containing a copy of index and look-up tables is reproduced in this Record as Appendices 1, 2, and 3;

- MINEDEX2.MDB — an MS ACCESS 97 database containing seven tables — SITES–COORDINATES, PROJECT–OWNER, RESOURCES, RESOURCE_CUTOFF, PRE–1985_GOLD_PRODUCTION, HISTORIC_TENEMENTS and MINERALIZATION_TYPE. These contain the same data as the six individual ASCII files described below;
- SITECOOR.CSV — a comma-delimited text file containing commodity group, project, site data and coordinates;
- PRJOWN.CSV — a comma-delimited text file listing corporate ownership and percentage owned;
- RESOURCE.CSV — a comma-delimited text file containing resource figures;
- CUTOFF.CSV — a comma-delimited text file containing resource cutoff criteria;
- HISTPROD.CSV — a comma-delimited text file containing pre-1985 tonnage of gold ore treated and gold and silver produced;
- HISTTEN.CSV — a comma-delimited text file containing tenements for historic production sites (pre-1985 for gold mines and pre-1989 for mines of all other commodities);
- MINTYPE. CSV — a comma-delimited text file containing style of mineralization for resources.

The data for these files can be linked as shown in Figure 2.

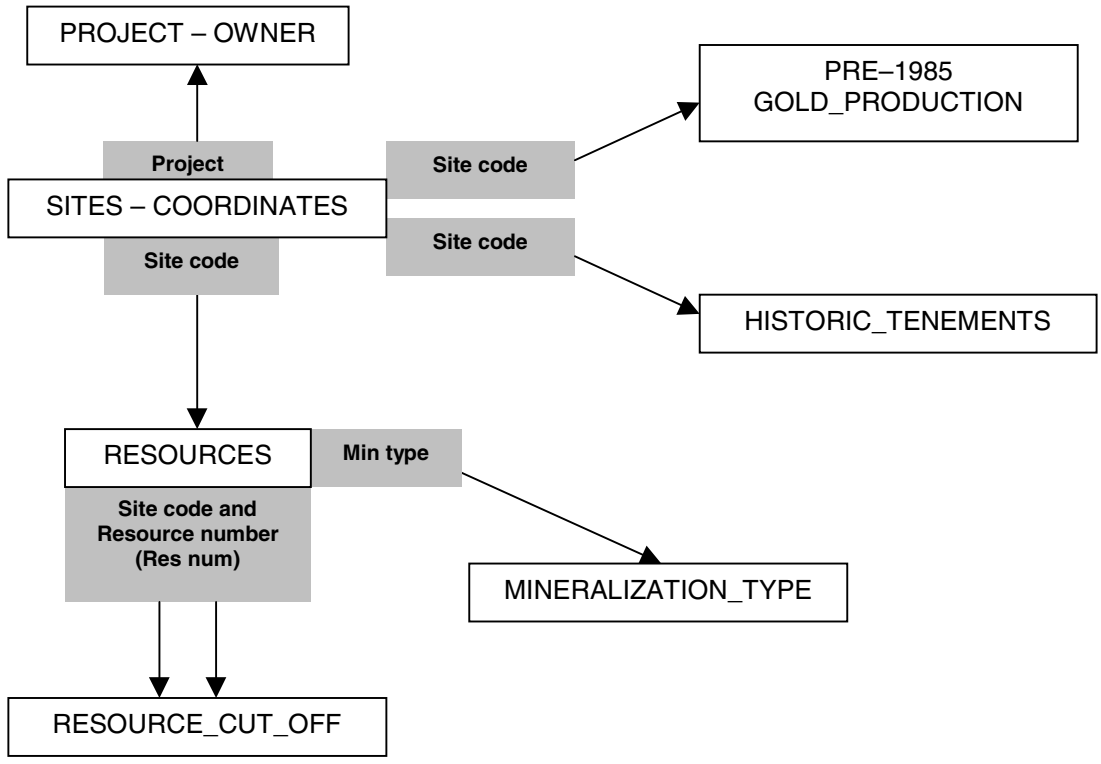

Figure 2. Key fields linking the MS Access tables and text files

Data coverage and currency

The data are comprehensive for all quarries, mines, and proposed mines that are DME's responsibility under the Mining Act 1978, Mines Safety and Inspection Act 1994, Mines Safety and Inspection Regulations 1995, and their predecessors. However, these mines must have started operations, or were operating, during or after 1985 (corresponding simply to the start of MINEDEX) in order to be included. All undeveloped sites (i.e. deposits) with resources or reserves estimated since 1985 are also included. The coverage of exploration sites, of which resources or reserves have not, or not yet, been estimated, is severely limited within MINEDEX and generally restricted only to the high-profile recent discoveries; these (where available) have been included in this dataset. No petroleum data are included in the dataset released. Historic mines (pre-1985 for gold and pre-1989 for all other commodities) are included, along with their locations and mining tenements at the time of production, where these are known. Production data are limited to pre-1985 gold mines.

The mineral resource estimates, project ownership, site type, and site stage of development are current at the date on the compact-disc label.

The historical data in HISTORIC TENEMENT (HISTTEN.CSV) and PRE-1985_GOLD_PRODUCTION (HISTPROD.CSV) will remain essentially unchanged, with the only exception being correction of errors or inconsistencies. Coordinates of historic or abandoned mine sites may change slightly as more accurate information is collected from field activities and office-based studies. The coordinates for many historic mines, in the absence of better quality data, are currently set at the centre of a historic tenement linked to the site; these coordinates are progressively being updated by DME.

Confidential data

Information on mineral resource estimates and locations acquired from confidential sources, such as statutory mineral exploration reports and other confidential reports submitted to DME, has been deleted from this dataset. Where confidential data exist, the status column in the SITES – COORDINATES and RESOURCES tables or SITECOOR.CSV and RESOURCE.CSV text files is flagged with a 'C', and the corresponding fields for locations and resources are blank. Where possible, some published resources are included in the RESOURCES table and RESOURCE.CSV

file, even though they may not be ‘up-to-date’. These will normally have an ‘N’ in the IN_TOTAL field (see the section below on **Totalling of resources**).

Sites, coordinates, projects, and commodity groups

The SITES–COORDINATES table of the MS ACCESS database and the corresponding SITECOOR.CSV file contain data on commodity groups, projects, sites and group sites, site type and stage of development, site coordinates and local government authorities (LGA). An example of the table/file is given in Table 2.

Site type

It is emphasized that sites, to which most attributes relate, are the core of the MINEDEX system. Each site is linked to a project and therefore to a commodity group and owners (Figs 1 and 2). Sites are categorized into six main types: high-profile exploration areas, deposits, mines, plants, handling facilities, and transportation systems. An additional type (cross-reference site) is used for alternate names and to save information on individual mines that has been combined into a single operation. Deposits and mines are further subdivided into the method of (potential) extraction (openpit, underground, both openpit and underground, tailings, and low impact) and, where appropriate, sites are assigned a stage of development. The conventions used for site types are listed in Table 3.

Low-impact mines (ML) and deposits (DL) are or were operations or proposals that disturb surface materials only and normally do not extend into bedrock. These sites are or were operated by prospectors for short, intermittent periods but often can extend over a number of tenements in the area. Such low-impact mining includes dryblowing, processing alluvial and eluvial material through a small mobile plant, scraping and metal detecting, and costeaning and trenching. The minimum criterion for these low-impact mine sites (MLs) and deposits (DLs) to be included as a site within MINEDEX is the submission to DME of a ‘Notice Of Intent’ (NOI) to mine. Low-impact sites do not extend to include applications for removal of excess tonnages from tenements for exploration purposes.

Low-impact sites typically have a map display name that indicates the type of operation. The ‘Prospecting’ map display name is used for operations that do not use specialized machinery such

Table 2. Sample of contents of SITES–COORDINATES table/file

Commodity	*Project*	*Project code*[a]	*Site*	*Site code*[b]	*Map_name*	*Type*[c]	*Stage*[d]	*Stat*[e]	*Latitude*	*Longitude*	*AMG zone*	*Easting*	*Northing*	*Accuracy*[f]	*LGA*	*GP site*[g]
BAUXITE–ALUMINA	JARRAHDALE–KWINANA	J00777	KWINANA ALUMINA REFINERY	S01735	KWINANA AL	P	O	P	-32.19444	115.7769	50	384716.34	6437343.482	Y	KWINANA TOWN	
COAL	HILL RIVER–JURIEN	J00988	BRAZIER	S03672	BRAZIER	DB		P	–30.08667	115.2389	50	330279	6670292	Y	COOROW SHIRE	
COAL	HILL RIVER–JURIEN	J00988	WONGONDERRAH	S03674	WONGONDERRAH	DB		P	–30.53362	115.2675	50	333793	6620795	Y	DANDARAGAN SHIRE	
COPPER–LEAD–ZINC	TRILOGY	J02252	TRILOGY	S06514	TRILOGY	EX		P	–33.75583	120.2069	51	241300	6261400		NO SHIRE NAME GIVEN	
COPPER–LEAD–ZINC	ELVERDTON DUMPS	J02016	ELVERDTON DUMPS	S05322	Elverdton	MT	O	P	–33.627	120.1462	51	235269.14	6275534.587	Y	NO SHIRE NAME GIVEN	
COPPER–LEAD–ZINC	TEUTONIC BORE	J01287	TEUTONIC BORE DUMPS	S04275	TEUTONIC BORE	DT		P	–28.41026	121.1464	51	318423.969	6855940.687	Y	LEONORA SHIRE	
COPPER–LEAD–ZINC	LENNARD SHELF	J00638	PILLARA	S01545	PILLARA	MU	O	P	–18.3237	125.7732	51	793132.296	7971761.697	Y	DERBY–WEST KIMBERLEY SHIRE	
COPPER–LEAD–ZINC	LENNARD SHELF	J00638	BLENDVALE	S01419	BLENDVALE	X		P	0	0	0	0	0		DERBY–WEST KIMBERLEY SHIRE	
GOLD	BALAGUNDI / STOCKDALE	J02293	BULONG PROSPECTING	S16668	Prospecting	ML	O	P	–30.73804	121.7894	51	384113.722	6598790.29	Y	NO SHIRE NAME GIVEN	
GOLD	DARLOT	J00082	DARLOT PIT	S02876	DARLOT	MO	S	P	–27.88887	121.2675	51	329466.658	6913889.326	Y	LEONORA SHIRE	X
GOLD	DARLOT	J00082	FILBANDIT	S01015	FILBANDIT	X		P	–27.89528	121.27	51	329723	6913185		LEONORA SHIRE	
GOLD	DARLOT	J00082	MONTE CRISTO	S01115	MONTE CRISTO	X		P	–27.89166	121.2667	51	329389	6913580		LEONORA SHIRE	
GOLD	DARLOT	J00082	ZANGBAR	S01116	ZANGBAR	X		P	–27.89166	121.2667	51	329389	6913580		LEONORA SHIRE	
GOLD	BIG BELL	J00017	GOLDEN CROWN PLANT SITE	S05682	GOLDEN CROWN	P	S	P	–27.46693	117.8511	50	584093.03	6961545.478	0	NO SHIRE NAME GIVEN	G
GOLD	HISTORIC-GOLD-IN-TENGRAPH	J02334	MADAM BERRY	S07749	Madam Berry	MH	S	P	–30.70404	120.9201	51	300808.215	6601338.728	Y	NO SHIRE NAME GIVEN	
GOLD	YILGARN STAR	J01273	YILGARN STAR	S02852	YILGARN STAR	MB	O	P	–31.53444	119.6772	50	754190	6508046	Y	YILGARN SHIRE	X
HEAVY MINERAL SANDS	IRWIN	J02289	IRWIN HMS	S06649	IRWIN	DO		C						Y	IRWIN SHIRE	
HEAVY MINERAL SANDS	METRICUP	J02018	METRICUP	S05331	METRICUP	DO		C						Y	NO SHIRE NAME GIVEN	
IRON ORE	HAMERSLEY	J00534	DAMPIER PORT OPERATIONS / HI	S01266	DAMPIER	H	O	P	–20.67473	116.6997	50	468725	7713814		ROEBOURNE SHIRE	G
IRON ORE	HAMERSLEY	J00534	HAMERSLEY RAILWAY	S01596	HAMERSLEY RLY	T	O	P	0	0	0	0	0		NO SHIRE NAME GIVEN	
MANGANESE ORE	SKULL SPRINGS	J00761	SKULL SPRINGS	S01678	SKULL SPRINGS	DO		P	–21.86664	120.9833	51	291610.702	7580557.857	Y	EAST PILBARA SHIRE	

Table 2. (continued)

Commodity	*Project*	*Project code*[a]	*Site*	*Site code*[b]	*Map_name*	*Type*[c]	*Stage*[d]	*Stat*[e]	*Latitude*	*Longitude*	*AMG zone*	*Easting*	*Northing*	*Accuracy*[f]	*LGA*	*GP site*[g]
NICKEL	KAMBALDA	J00551	LONG	S01301	LONG	MU	O	P	–31.17984	121.6761	51	373840	6549700	Y	KALGOORLIE–BOULDER CITY	
NICKEL	KAMBALDA	J00551	LUNNON	S01302	LUNNON	MU	C	P	–31.20868	121.6727	51	373560.291	6546499.894	Y	COOLGARDIE SHIRE	
NICKEL	MAGGIE HAYS – EMILY ANN	J01666	MAGGIE HAYS	S04369	MAGGIE HAYS	DU		P	–32.23694	120.5022	51	264646.131	6430551.045	Y	DUNDAS SHIRE	
NICKEL	MAGGIE HAYS – EMILY ANN	J01666	EMILY ANN	S06448	EMILY ANN	DU		P	–32.20351	120.4809	51	262548.987	6434210.019	Y	NO SHIRE NAME GIVEN	
OTHER	HISTORIC-NON-GOLD-NOT-IN-TENGRAPH	J02407	YINNIETHARRA BERYL / BURT	S18610	Yinnietharra beryl	MH	S	P	–24.825	116.2291	50	422101.233	7254200.35		NO SHIRE NAME GIVEN	
OTHER	HANNANS NORTH TOURIST MINE	J01349	HANNANS NORTH TOURIST MINE	S03201	HANNANS N	MU	O	P	–30.72919	121.4691	51	353435.575	6599397.374	Y	NO SHIRE NAME GIVEN	
OTHER	JANDAKOT PLANT / IMDEX	J00978	JANDAKOT PLANT / IMDEX	S02079	JANDAKOT	P	O	P	–32.12138	115.8425	50	390808.457	6445510.886	Y	COCKBURN CITY	
VANADIUM–TITANIUM	WINDIMURRA	J00793	CANEGRASS ZONE	S01767	CANEGRASS	X		P	0	0	0	0	0		NO SHIRE NAME GIVEN	
VANADIUM–TITANIUM	WINDIMURRA	J00793	WINDIMURRA PLANT	S17115	Windimurra Plant	P	D	P	–28.29332	118.5331	50	650330	6869333	Y	MOUNT MAGNET SHIRE	
NICKEL	MT KEITH / WMC	J00756	MT KEITH / WMC	S01667	MT KEITH	MO	O	P	–27.23138	120.5447	51	256855.407	6985541.143	Y	WILUNA SHIRE	
TIN–TANTALUM–LITHIUM	GREENBUSHES	J00530	GREENBUSHES TAILINGS	S01732	GREENBUSHES	MT	S	P	–33.87639	116.0619	50	413244.697	6251140.787	Y	BRIDGETOWN–GREENBUSHES SHIRE	
URANIUM	YEELIRRIE	J00398	YEELIRRIE	S00986	YEELIRRIE	DO		P	–27.18361	119.9031	50	787631	6989887	Y	WILUNA SHIRE	

NOTES:
(a) The project code is a unique code to differentiate projects with the same or similar names and for linkages to other tables/files
(b) The site code is a unique code to differentiate sites with the same or similar names and for linkages to other tables/files
(c) Type of site
(d) Stage of development. There is no stage for deposits or for some plants
(e) Status of resource (published or confidential). Confidential resources are not available in this dataset
(f) Accuracy of location data. When blank, the coordinates have not been verified by DME staff
(g) Group sites are a combination of sites within a project

Table 3. Site types

Site type	*Code*
Deposit low impact	DL
Deposit openpit	DO
Deposit underground	DU
Deposit both (underground and openpit)	DB
Deposit tails (tailings and/or dumps retreatment)	DT
Mine low impact	ML
Mine openpit	MO
Mine underground	MU
Mine both (underground and openpit)	MB
Mine tails (tailings and/or dumps retreatment)	MT
Mine historic	MH
Process plant	P
Handling facility (mostly port operations)	H
Transportation system (roads and railways)	T
Cross-reference	X
Exploration	EX

as scraping and detecting. Although this is generally the case, not all sites comply with this rule and some low-impact mining and prospecting sites still have full names as for a normal mining site.

The mine both (MB) and deposit both (DB) classifications of site type were introduced to accommodate single deposits that may be developed both as openpit and underground mines, and for group sites (see below). An example of an 'MB' deposit is the Kanowna Belle gold mine, which started as an openpit but is now an underground operation.

Historic mines have a site type of 'MH'. They are mines that reported to DME gold production prior to 1985 or production of any other commodity prior to 1989. The data for small or sundry gold producers (i.e. annual production of fewer than 100 ounces) since 1985 are not yet in MINEDEX, but will be added progressively. These data will be made available as progressive updates of the accompanying digital data are released.

Handling facilities ('H') and transportation systems ('T') cover only those sites purposely constructed for handling or transporting mine products. Examples are the railway systems and associated shiploading facilities of the Pilbara iron ore industry.

The cross-reference ('X') site is essentially an alternative name for a deposit, mine, plant, transportation system, handling facility, or exploration site. For example, the Blendvale site in Table 2 has the 'X' site type because it was the previous name for the Pillara underground mine. In

some cases, mines are combined to form a single new mine — an example is the Filbandit, Monte Cristo and Zangbar pits that are now part of the Darlot pit (Table 2). The pre-existing mines are classified as cross-reference ('X') sites, whereas the existing site (Darlot openpit) is both a 'MO' site type individually as well as being an 'X' group site (see section below on **Group sites**).

Exploration sites (EX) are another recent addition to MINEDEX. There are no minimum requirements for these sites to be added to MINEDEX, and such sites tend to be restricted to the high-profile recent discoveries at which resources or reserves have not yet been estimated. Examples are Trilogy, Thunderbox, and Coyote. A second style of exploration sites contained within MINEDEX are those sites away from existing mining operations at which accidents have been reported to DME. The coverage of exploration sites within MINEDEX is severely limited, but these have been included (where available) within this dataset. More extensive information on mineral occurrences, including digital data, is available in recent reports and maps of the Geological Survey of Western Australia (GSWA). Examples include Cooper et al. (1998), Ferguson (1998, 1999), Flint and Abeysinghe (2000), Flint et al. (2000), Hassan (1998, 2000), Pagel et al. (in prep.), and Ruddock (1999).

Stage of development

All sites except deposits and cross-reference sites can have a stage of development of either under development (D), operating (O), care and maintenance (C) or shut down (S). All mines, and any other site, that have been under construction at any time must have a stage of development. When an infrastructure site is closed, it remains under care and maintenance (C) until it has been removed or decayed into ruin. On identification these sites are shut down (S), made into 'G' group sites (see below), and the site name ends with 'SITE'. An example is the Golden Crown Plant Site (Table 2). A blank stage of development field indicates the proposed construction did not proceed (or that the site type is for a deposit or exploration site).

Coordinates

Latitudes and longitudes and the metric Australian Map Grid (AMG) coordinates are given in the SITES–COORDINATES table of the MS ACCESS database and the SITECOOR.CSV file. Features of site-coordinate data are described below:

- All coordinates are based on the AGD84 datum. These will be updated to GDA94 in December 2000, at the same time as TENGRAPH converts to GDA94.
- Some 'X' (cross-reference) sites and group sites do not have coordinates recorded against them because they are not included in calculations of total mines and mineral deposits.
- A status field (STAT) has been included to indicate whether the coordinates are published (P) or confidential (C). Confidential coordinates have been deleted from the public dataset.
- A description of the accuracy of coordinate data is included, but this is a relative rather than absolute parameter. A 'Y' in the accuracy column indicates that the site location has been verified for display on DME's tenement graphics system, TENGRAPH, or on public tenement plans. This should give an accuracy of 100 m or better, depending on the data source. Note that MINEDEX sites are represented as point data even though on the ground the site usually represents a feature better recorded as a polygon, and often more than 100 m across.
- The coordinates for a site are located, where possible, in the centre of an identifiable surface expression of a site. It may not necessarily lay over the exact surface projection of an underground orebody, but instead is more likely to represent the portal of an underground decline, a headframe, or drillhole collar (for a deposit or exploration site).
- A display of MINEDEX sites is available through the TENGRAPH system and in atlas form (GSWA, 1999).

Local Government Authority

The Local Government Authority (LGA) is recorded in the LGA field for all sites except G and P group sites, most X, MH, T, EX site types, and some of the older MINEDEX sites. Programming changes in recent years in MINEDEX and TENGRAPH have resulted in this dataset being incomplete.

Group sites

The group site field (GP SITE) was created to combine sites within projects for either data monitoring or administration, or to accommodate the varied reporting styles of mineral resources and mine production. The two types of group sites are described below:

- The 'X' group site is for mines and deposits that were once separate entities but are now a single unit, usually as a result of expansion or merging of individual mines. All subordinate

sites of an ‘X’ group site have a site type of ‘X’. Totals of the number of mines and mineral deposits in the State include ‘X’ group sites.

- The ‘G’ group site is used to link mines, deposits, process plants, handling facilities, and/or transportation systems together for data reporting and management purposes. ‘G’ group sites are not used in totals.

  Examples of instances where group sites have been used are:

  - The Darlot gold project. The Darlot pit (‘MO’) is an ‘X’ group site since the separate pits Filbandit, Monte Cristo, and Zangbar merged into a single pit.
  - The Kambalda nickel project, which has 68 sites. The owners report mineral resources and production to their shareholders as totals for the project, not by individual deposit or mine. Thus a ‘G’ group site was generated in MINEDEX to accommodate these data under the single Kambalda Group. Furthermore, because this project is so extensive, additional subgroups, based on geographical location, are used in MINEDEX for data monitoring.

Projects

Projects in MINEDEX are defined as a combination of sites with common commercial ownership that are grouped together in an integrated operation. An example is the HAMERSLEY project; this contains seven mines, 45 deposits, six processing plants, a port handling facility and a 300–400 km transportation route (Hamersley railway), all of which are owned by Hamersley Iron Pty Ltd. These sites are required to extract, upgrade, transport to the coast and ship overseas the iron ore. Unlike the large iron ore projects that have a very large aerial extent, most projects are much smaller.

There are four special projects that do not meet the above criteria. These projects were generated for the initial capture of the locations and production data of historic mines, but will eventually be deleted when all these sites are distributed to other projects. The four projects are HISTORIC GOLD IN TENGRAPH, HISTORIC GOLD NOT IN TENGRAPH, HISTORIC NON GOLD IN TENGRAPH and HISTORIC NON GOLD NOT IN TENGRAPH. These projects contain a total of 11 410 historic mines.

Project owners

The PROJECT–OWNER table of the MS ACCESS database and the PRJOWN.CSV file contain the commercial owners and percentage held of a project. Table 4 provides an example of the PROJECT–OWNER table (PRJOWN.CSV). Where project ownership interest is unknown or the owner has an interest in one or more sites, but not the majority of the project, the '%' column is left blank.

Table 4. Sample of contents of PROJECT–OWNER table/file

Owner	*%*[(a)]	*Project code* [(b)]	*Project*
ANACONDA NICKEL NL	60	J00480	MURRIN MURRIN - CENTRAL BORE
GLENCORE INTERNATIONAL AG	40	J00480	MURRIN MURRIN - CENTRAL BORE
ANACONDA NICKEL NL	100	J02291	MURRIN MURRIN - WINDARRA
NORMANDY MINING LTD	44.444	J00026	BODDINGTON - HEDGES
ANGLOGOLD LTD	33.33	J00026	BODDINGTON - HEDGES
NEWCREST MINING LTD	22.222	J00026	BODDINGTON - HEDGES
COEUR D'ALENE MINES CORP	25	J00275	NEVORIA
ECLIPSE RIDGE PTY LTD		J00275	NEVORIA
SONS OF GWALIA LTD	75	J00275	NEVORIA
MOUNTFORD NORMAN LESTER		J01527	NEW BELLEVUE
CHITTY CHARLES GEORGE	100	J01527	NEW BELLEVUE
NORMANDY MINING LTD	90	J00177	KALTAILS
GOLD CORPORATION	10	J00177	KALTAILS
KINGSTREAM STEEL LTD	100	J00751	TALLERING PEAK - MID-WEST IRON AND STEEL
MINCOR RESOURCES NL	60	J01328	PANORAMA
SIPA RESOURCES LTD	40	J01328	PANORAMA
NORMANDY MINING LTD	37.5	J00009	DUKETON
JOHNSONS WELL MINING NL	37.5	J00009	DUKETON
DUKETON GOLDFIELDS LTD	25	J00009	DUKETON
RAMSGATE RESOURCES LTD		J00009	DUKETON
N M ROTHSCHILD AUSTRALIA HOLDINGS PTY LTD	100	J00010	BANNOCKBURN

NOTES: (a) If percentage owned is unknown, this field is blank
(b) The project code for linking owners to projects in the MS ACCESS SITES–COORDINATES table and SITECOOR.CSV file

Project ownership should not be confused with the different concepts of project operator and tenement holder.

Project ownership is forever changing with complex joint ventures and farm-in arrangements, making it difficult to monitor project ownership with a high degree of accuracy. The percentage owned is taken to represent what the partners state they are proposing to earn. If a partner withdraws, the percentage owned reverts to the previous owner. For the low-impact sites, ownership reverts to the tenement holder if the tenement changes hands and reverts to 'No Current

Owner' if the tenement dies. Information on project ownership should be regarded as indicative only.

Commodity groups and minerals

A commodity group is a major mineral or combination of minerals that would be produced if mining were to take place. For example, COPPER–LEAD–ZINC is a commodity group because copper, lead and/or zinc typically occur together. NICKEL, as the commodity group, includes not only nickel, but also can include copper, cobalt, platinum group elements and gold as byproducts. MINEDEX contains 45 commodity groups, plus a catch-all category of 'OTHERS'. Commodity groups and associated minerals are listed in Appendix 1. The 'OTHERS' commodity group was created for special cases where no ore is produced or for a project that cannot be allocated to a single commodity group. Examples include such items as tourist mines, gas pipelines, ports, and non-specific mineral-processing plants.

Each project is linked to only one commodity group (but one commodity group can have many associated projects). Minerals have been attached to commodity groups for the purposes of resource estimations and production figures. A mineral may appear in more than one commodity group.

Mineral resources

The RESOURCES and RESOURCE_CUTOFF tables of the MS ACCESS database and RESOURCE.CSV and CUTOFF.CSV files contain current mineral resource estimates and associated cutoff criteria for all mines and deposits throughout the State. However, as for confidential locations, confidential resources have been deleted from the dataset released. Examples of these data are given in Tables 5 and 6. A total of 8811 records are contained within the tables/text files on resources, related to 2425 unique sites. Cutoff criteria are less common, with 2579 records related to 1050 sites.

The SOURCE and DATE fields record an abbreviation for the source of the resource figures and date of the resource calculation. In many cases the date is the date on which the source was published (for example, date of release to the Australian Stock Exchange). Resources remain in

Table 5. Sample of the contents of RESOURCES table/file

Site[a]	*Site code*	*Res num*[b]	*Cat*[c]	*Type (res)*[d]	*Min type*[e]	*Stat*[f]	*In total*[g]	*Tonnage (Mt)*	*Grade*		*Mineral*	*Cont. metal*[h]		*Source*[i]	*Date*[j]
Telfer Group	S00717	7	IND	MIN	AUEPI	P	N	0.94	1.6	g/t	Au	1.504	t	AR NEWCR	30/06/95
Telfer Group	S00717	5	INF	I/S	AUEPI	P	Y	5	0.76	g/t	Au	3.8	t	AR NEWCR	31/12/94
Telfer Group	S00717	3	MES	MIN	AUEPI	P	N	0.26	2.3	g/t	Au	0.598	t	AR NEWCR	31/12/93
Telfer Group	S00717	4	MES	I/S	AUEPI	P	Y	0.02	2.3	g/t	Au	0.046	t	AR NEWCR	31/12/93
Telfer Group	S00717	8	MES	MIN	AUEPI	P	Y	5.8	0.83	g/t	Au	4.814	t	AR NEWCR	30/06/95
Telfer Group	S00717	6	IND	I/S	AUEPI	P	Y	4.8	2	g/t	Au	9.6	t	AR NEWCR	31/12/94
Speewah Main–ABC	S01902	3	IND	I/S	FVEIN	P	Y	0.41	24.2	%	CaF_2	0.099	Mt	PROSP EL	23/08/93
Speewah Main–ABC	S01902	2	MES	I/S	FVEIN	P	Y	1.87	25.8	%	CaF_2	0.482	Mt	PROSP EL	23/08/93
Speewah Main–ABC	S01902	1	INF	I/S	FVEIN	P	Y	1.59	13	%	CaF_2	0.207	Mt	PROSP EL	23/08/93
Greenbushes Spodumene	S01731	5	DEM	MIN	SNPEGM	C	Y								
Greenbushes Spodumene	S01731	4	MES	I/S	SNPEGM	C	Y								
Mac–Parallel Ridge	S01615	1	MES	I/S	FEMM	P	Y	38.9	6	%	LOI	2.334	Mt	A22483	31/12/87
Mac–Parallel Ridge	S01615	1	MES	I/S	FEMM	P	Y	38.9	61.8	%	Fe	24.04	Mt	A22483	31/12/87
Mac–Parallel Ridge	S01615	1	MES	I/S	FEMM	P	Y	38.9	1.52	%	Al_2O_3	0.591	Mt	A22483	31/12/87
Kintyre	S03154	1	IND	DEV	UUNCF	P	N	5.333	1.5	kg/t	U_3O_8	7.999	Kt	AR CRA	30/06/93
Kintyre East	S03155	1	IND	DEV	UUNCF	P	N	3.333	1.5	kg/t	U_3O_8	4.999	Kt	AR CRA	30/06/93
Kintyre Group	S00963	2	INF	I/S	UUNCF	P	Y	7.333	1.5	kg/t	U_3O_8	10.999	Kt	CRA BROC	30/06/90
Kintyre Group	S00963	1	IND	I/S	UUNCF	P	Y	16	1.5	kg/t	U_3O_8	24	Kt	CRA BROC	30/06/90
Nerada	S03159	1	INF	I/S	UUNCF	P	N	0.33	1.5	kg/t	U_3O_8	0.495	Kt	CRA BROC	30/06/90
Pioneer–Kintyre	S03158	1	INF	I/S	UUNCF	P	N	3.333	1.5	kg/t	U_3O_8	4.999	Kt	AR CRA	30/06/93
Whale	S03156	1	INF	I/S	UUNCF	P	N	4	1.5	kg/t	U_3O_8	6	Kt	AR CRA	30/06/93
Whale East	S03157	1	IND	DEV	UUNCF	P	N	7.33	1.5	kg/t	U_3O_8	10.995	Kt	AR CRA	30/06/93

NOTES:
(a) Site name
(b) RES NUM is a computer-generated number to separate resources for a site
(c) Resource category is either measured (MES), indicated (IND), inferred (INF) or demonstrated (DEM)
(d) Resource type is either *In Situ*, developable (DEV) or mineable (MIN)
(e) For full description of mineralization type (MIN TYPE) see Appendix 2
(f) Resource status (STAT) is either Confidential (C) or Published (P)
(g) Indicates whether the resource is to be included in the total resources of the region or State
(h) Contained metal/mineral (CONT METAL) calculated from TONNAGE x GRADE
(i) Abbreviated source of the resource figure. For full description see Appendix 3
(j) The date of the resource estimate

Table 6. Sample of contents of RESOURCE_CUTOFF table/file

Site	*Site code*	*Res num*	*Mineral*	*Cutoff grade*	*Cutoff unit*
RAVENSTHORPE 1	S02333	1	Ni	0.5	%
RAVENSTHORPE 1	S02333	2	Ni	0.5	%
RAVENSTHORPE 1	S02333	3	Ni	0.75	%
RAVENSTHORPE 1	S02333	4	Ni	0.75	%
RAVENSTHORPE 1	S02333	5	Ni	0.75	%
RAVENSTHORPE 1	S02333	6	Ni	1	%
RAVENSTHORPE 1	S02333	7	Ni	1	%
RAVENSTHORPE 1	S02333	8	Ni	0.5	%
RAVENSTHORPE 1	S02333	9	Ni	1	%
RAVENSTHORPE 4 SULPHIDE	S02334	3	Ni	0.75	%
EASTERN PEGMATITE	S02357	1	DEP.T	20	m
LEEKS	S02373	2	Au	0.5	g/t
LEEKS	S02373	2	WIDTH	2	m
HORSESHOE – FORTNUM	S02407	1	DEP.F	80	m
HORSESHOE - FORTNUM	S02407	1	DEP.T	115	m
CUMMINS RANGE	S02531	1	DEP.T	50	m
CUMMINS RANGE	S02531	1	REO	0.5	%
SIRDAR OPEN PIT	S03946	1	Au	0.5	g/t
SIRDAR OPEN PIT	S03946	1	RL.F	357	m
SIRDAR OPEN PIT	S03946	1	RL.T	242.5	m
PILLARA	S01545	11	Zn EQU	3	%
PILLARA	S01545	12	Zn EQU	5	%
GOLDEN HIND	S02179	1	Ni EQU	0.8	%
GOLDEN HIND	S02179	2	Ni EQU	0.8	%

NOTES:
WIDTH — Width of mineralization
DEP.F and DEP.T — Depths (from and to) below surface of top and bottom of the resource calculation
RL.F and RL.T — Relative levels (from and to) of top and bottom of the resource calculation
EQU — Metal equivalent grade

MINEDEX until the estimates are updated by new data, or all the resources are exhausted through mining.

Appendix 2 lists many of the standard reference codes used in the dataset. The data have been obtained from a variety of sources including stock exchange reports, newspaper and periodical articles, published technical papers, statutory exploration reports, and other correspondence submitted to DME. The largest source of information is reports to the Australian Stock Exchange (ASX). Data from these are generally taken at ‘face value’ as all resources reported to the ASX are supposed to comply with the Joint Ore Reserves Committee (JORC) code for reporting of identified mineral resources and ore reserves (Australasian Institute of Mining and Metallurgy et al., 1999) and its predecessors.

In essentially all cases, no attempt has been made by GSWA to verify or check the resource estimates. Inclusion of a resource estimate within MINEDEX should not be taken as endorsement

by DME of the resource estimate. Some interpretation of the data originally presented by companies is necessary in the circumstances where the resource estimate is old and pre-dates introduction of the JORC code, or where the JORC code has either not been used or followed only partially. Obviously, with time, and for both listed and unlisted companies, an increasing number of resource estimates that follow the JORC code will be provided.

The GSWA system for classification of resources and reserves largely follows the evolving JORC code. However, for the purpose of reporting all resources, and in view of various conventions used in the past (and, in some cases, still used) for which resource figures remain in the inventory, the exclusive use of the JORC terminology is impractical at this stage. Some recurrent examples of why the GSWA scheme varies slightly from the current JORC code are listed below:

- Some companies do not separate resources and reserves and, in some cases also quote measured plus indicated plus inferred resources as one figure.
- Some companies do not distinguish whether the estimates provided for mineral resources include or exclude the reserves.
- Some companies progressively update resource estimates for a specific site within a project, but provide no indication on how these figures change the earlier provided global resource estimate for a project. In such cases, the earlier global resource estimate for the project is flagged as 'In total', but the latest resource estimate for the one site is not included in the State's total. (see **Totalling of resources** section below)

The terminology being used by GSWA is set out in Table 7, and the following comments provide some explanatory notes.

Table 7. Classification of identified mineral resources

In situ (*I/S*)	*Developable* (*Dev*)	*Mineable* (*Min*)	
Inferred (INF)	–	–	
Indicated (IND)	Indicated (IND)	Indicated (IND)	Demonstrated (DEM) *DEM=MES+IND*
Measured (MES)	Measured (MES)	Measured (MES)	

An *in situ* resource is the total resource in the ground — dilution factors may not be taken into account. *In situ* resources are the same as 'identified mineral resources' in the JORC code. The *in situ* resources are the basis of the State's total resource estimates.

A developable resource is that part of the *in situ* resource that can be considered for development. Normally, it does not include dilution factors, but does discount satellite orebodies and extensions of the main orebodies outside reasonable pit or underground mine design. Developable resources are sometimes mistakenly reclassified as proved or probable ore reserves (mineable) under the JORC code. The developable category is not catered for in the JORC code and is largely a remnant from previous codes of reporting. Attempts are being made to minimize the use of this category in the inventory, and it will eventually be eliminated.

A mineable resource is that part of the *in situ* and/or developable resource for which mining recovery factors have been taken into consideration. It corresponds essentially to mineable tonnages and plant-feed head grades. Under the JORC code these would normally be considered either proved or probable ore reserves. The proved reserves category has been equated to measured resources, whereas the probable reserves category is equated to indicated resources.

Demonstrated resources (DEM) are the sum of measured and indicated resources. This provides a useful grouping of the two categories and has been extensively used by DME and the mining and exploration industry. Although 'demonstrated resources' is not part of the current JORC code, measured and indicated resources combined and undifferentiated have been, and still are, commonly quoted in publications and company reports. Hence it has been found convenient and necessary to use the DEM classification in order to capture the information published. The alternative would have been to capture the information, but at the lower level of confidence; that is, as 'indicated' only.

Resource tonnages, grades, and contained metal

The ore TONNAGE field has been set at millions of tonnes (Mt), but the mineral grade and contained metal/mineral units can vary according to the mineral. For each mineral, a unique unit is used irrespective of the type of ore or commodity group with which it is associated. The contained metal/mineral is automatically calculated in MINEDEX using the ore tonnage and grade.

Totalling of resources

The IN TOTAL field is one of the key fields for using the resources in calculations. A 'Y' in the IN TOTAL field/column indicates the resource is to be used in calculating total resources for the project, region, State, or any other combination of sites. An 'N' indicates the resource is included in another resource figure, either for the same site or for a group site within the project, or that the resource estimate has been superseded by a more recent estimate. The flagging of resource estimates in this way avoids double counting in the instances where multiple figures are quoted at different cutoffs or where reserve figures are included within resource estimates. Wherever feasible, the *in situ* resource figure is adopted as the 'in total' figure. If several resource estimates are published or released at the same time, the policy is to include all in the MINEDEX database, but make a subjective judgement as to which one should be marked as 'in total'. If no estimate is apparently favoured by the author(s) of the report, then GSWA policy is to flag as 'in total' either the estimate with the cutoff that is closest to the current economic cutoff for that style of deposit, or the estimate with the highest metal content.

Where current confidential 'in total' resources exist, the outdated published resource (if it exists) is retained and marked as not being 'in total' in order to give the user an idea of the tonnages and grade. As a result, totals of resources by area or region cannot be accurately or readily calculated from this dataset because of the absence of 'in total' confidential resources.

Mineralization types

The MIN TYPE field is the abbreviation for the mineralization type or style of mineralization for the resource. The basis of the mineralization classification is that adopted in Chapter 7 of the 'Geology and mineral resources of Western Australia' (Geological Survey of Western Australia, 1990). The abbreviated coding convention uses the first two or three letters to indicate the commodity group with which the mineralization type is associated, followed by three to four letters describing the style of mineralization. A complete list of the 152 mineralization types and their abbreviations, as used in MINEDEX, is included as Appendix 3, the MINERALIZATION_TYPE table and MINTYPE.CSV file.

Not all resource estimates have been assigned a mineralization type at this stage.

Historic gold production and tenements

The PRE-1985_GOLD_PRODUCTION and HISTORIC_TENEMENTS tables of the MS ACCESS database and the corresponding HISTPROD.CSV and HISTTEN.CSV files respectively contain historic (pre-1985) gold production and related historic tenement for all mines and deposits throughout the whole State. Production information since 1985 is held within the main MINEDEX database but is partially confidential, and hence is not released in this Record.

The pre-1985 gold production information, including tenements, is derived from Department of Mines (1954) and gold production records of 1954–85 held by DME.

Data on historic tenements are as recorded on the old production cards, and hence do not provide an exhaustive list of historic tenements for that site. Site names are also as recorded on the old production cards, and hence are a mixture of names of mines, individuals and companies. Tenements are recorded as a ten-character field, comprising three characters for the tenement type, two characters for the mining district, and five characters for the tenement number. Examples of the tenement type are gold mining lease (GML), mineral claim (MC), dredging claim (DC), and private property (PP).

Production data are provided on a cumulative basis for each site, along with the period of production (START_DATE and END_DATE fields). Annual production data for each mine site are not provided. The product type and product code specifies whether it is normal gold ore or the less common cases of alluvial ore, dollied ore, or tailings retreatment. The gold produced or contained within the final product is also listed, together with the units.

Summary

The digital data available with this Record provide current, readily accessible mineral resources information and various other associated data including spatial distribution, development status, deposit/mine types, mineralization style, and commercial ownership of projects. In addition, historic (pre-1985) gold production is provided for all mines throughout the State in digital format for the first time.

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Appendix 1

Commodity groups and minerals

Commodity group	*Order*	*Mineral*	*Mineral abbreviation*
Alunite	10	Alunite	ALUM
	20	Potash	K_2O
	30	Gypsum	$CaSO_4$
Andalusite	10	Andalusite	AND
Antimony	10	Antimony	Sb
Arsenic	10	Arsenic	As
Asbestos	10	Asbestos	ASB
Barite	10	Barite	$BaSO_4$
Bauxite–alumina	10	Alumina (available)	ABEA
	20	Bauxite	BAUX
	500	Reactive silica	$RESIO_2$
Bismuth	10	Bismuth	Bi
Chromite–platinoids	10	Chromite	Cr_2O_3
	20	Platinum	Pt
	25	Palladium	Pd
	31	Rhodium	Rh
	40	Pge	PGE
	50	Pge + gold	PGEAu
	55	Gold	Au
	60	Nickel	Ni
	70	Copper	Cu
	100	Iron	Fe
Clays	10	Attapulgite	ATTAP
	20	Bentonite	BENT
	30	Kaolin	KAOLIN
	35	Saponite	SAPON
	40	Cement clay	C.CLAY
	60	White clay	W.CLAY
Coal	10	Coal	COAL
	20	Lignite	LIGN
Construction materials	10	Aggregate	AGGREG
	20	Gravel	GRAVEL
	30	Sand	SAND
	40	Rock	ROCK
	50	Soil	SOIL
	300	Vanadium	V_2O_5
	310	Titanium dioxide	TiO_2
	320	Iron	Fe
Copper–lead–zinc	10	Zinc	Zn
	20	Copper	Cu
	30	Lead	Pb
	40	Silver	Ag
	50	Gold	Au
	60	Molybdenum	Mo
	65	Cobalt	Co
	70	Barium	Ba
	80	Cadmium	Cd
	90	Tungsten	WO_3
Diamonds	10	Diamond	DIAM
Diatomite	10	Diatomite	DIATOM
Dimension stone	10	Dimension stone	DIM.ST
	20	Sandstone	SST
	30	Quartzite	QZTE
	40	Limestone	LST
	50	Black granite	B.GRAN
	55	Granite	GRAN
	60	Marble	MARBLE
	70	Dolerite	DOLER
	80	Slate	SLATE
	90	Spongolite	SPONG
Dolomite	10	Dolomite	DOLOM

Commodity group	*Order*	*Mineral*	*Mineral abbreviation*
Fluorite	10	Fluorite	CaF_2
Gem, semi-precious and ornamental stones	10	Amethyst	AMETH
	20	Emerald	EMER
	30	Opal	OPAL
	32	Tourmaline	TOURM
	35	Chrysoprase	CHRYSP
	37	Malachite	MALACH
	40	Tiger eye	T.EYE
	45	Jasper	JASPER
	50	Zebra rock	ZEBRA
	60	Chert (green)	CHERT
Gold	10	Gold	Au
	20	Silver	Ag
	30	Copper	Cu
	40	Nickel	Ni
	50	Cobalt	Co
	54	Lead	Pb
	55	Zinc	Zn
	60	Tungsten	WO_3
	70	Molybdenum	Mo
	500	Antimony	Sb
	510	Arsenic	As
Graphite	10	Graphite	GRAPH
	20	Carbon (fixed)	C
Gypsum	10	Gypsum	$CaSO_4$
	30	Alunite	ALUM
	500	Salt	SALT
Heavy mineral sands	10	Heavy minerals	HM
	20	Ilmenite	ILM
	30	Leucoxene	LEUCO
	50	Rutile	RUTILE
	60	Zircon	ZIRCON
	70	Monazite	MONAZ
	80	Xenotime	XENO
	90	Garnet	GARNET
	100	Kyanite	KYAN
	130	Synthetic rutile	SYN.R
	510	Slimes	SLIMES
	520	Titanium dioxide	TiO_2
	530	Zirconia	ZrO_2
Industrial pegmatite minerals	10	Mica	MICA
	20	Beryl	BERYL
	30	Feldspar	FELDS
	35	Alkalis	K+Na
	37	Alumina	Al_2O_3
	40	Quartz	QUARTZ
	505	Ferric oxide	Fe_2O_3
Iron ore	10	Iron	Fe
	20	Manganese	Mn
	500	Phosphorus	P
	510	Alumina	Al_2O_3
	520	Silica	SiO_2
	525	Sulfur	S
	530	Loss on ignition	LOI
Limestone–limesand	10	Calcium carbonate	$CaCO_3$
	20	Limestone–limesand	LIME
	50	Shell–grit	SHELL
	70	Chalk	CHALK
	100	Lime	CaO
	200	Magnesite	$MgCO_3$
	501	Silica	SiO_2

Appendix 1 (continued)

Commodity group	*Order*	*Mineral*	*Mineral abbreviation*
Magnesite	10	Magnesite	$MgCO_3$
	10	Manganese	Mn
	100	Iron	Fe
	510	Silica	SiO_2
	520	Alumina	Al_2O_3
	530	Phosphorus	P
Nickel	10	Nickel	Ni
	20	Copper	Cu
	25	Cobalt	Co
	30	Nickel + copper	Ni+Cu
	35	Nickel equivalent	Ni EQU
	40	Gold	Au
	50	Platinum	Pt
	55	Palladium	Pd
	70	Chromite	Cr_2O_3
	80	Silver	Ag
	90	Magnesia	MgO
	500	Silica	SiO_2
Other	10	Gold	Au
Peat	10	Peat	PEAT
Phosphate	10	Phosphate	P_2O_5
Pigments	10	Ochre	OCHRE
	20	Hematite pigment	HEM
Potash	10	Potash	K_2O
	10	Sulfur	S
	20	Iron	Fe
	30	Zinc	Zn
	40	Copper	Cu
	50	Lead	Pb
Rare earths	10	Rare earth oxides	REO
	20	Yttrium	Y_2O_3
	25	Lanthanides	LnO
	30	Tantalite	Ta_2O_5
	40	Columbite	Nb_2O_5
	50	Tin (cassiterite)	SnO_2
	60	Xenotime	XENO
Rare earths (cont.)	70	Gallium	Ga
	80	Zirconia	ZrO_2
	90	Hafnium	HfO_2
	100	Beryl	BERYL
	510	Alumina	Al_2O_3
Salt	10	Salt	SALT
	20	Gypsum	$CaSO_4$
Silica–silica sand	10	Silica	SiO_2
	20	Sand	SAND
	30	Quartzite	QZTE
	510	Ferric oxide	Fe_2O_3
	520	Titanium dioxide	TiO_2
	530	Alumina	Al_2O_3
	540	Heavy minerals	HM
Talc	10	Talc	TALC
Tin–tantalum–lithium	10	Tin (cassiterite)	SnO_2
	20	Tantalite	Ta_2O_5
	30	Columbite	Nb_2O_5
	40	Spodumene	Li_2O
	50	Kaolin	KAOLIN
	510	Ferric oxide	Fe_2O_3
Tungsten–molybdenum	10	Tungsten	WO_3
	20	Molybdenum	Mo
	30	Copper	Cu
	40	Antimony	Sb
	50	Vanadium	V_2O_5
	60	Gold	Au
Uranium	10	Uranium	U_3O_8
	20	Vanadium	V_2O_5
	30	Copper	Cu
Vanadium–titanium	10	Vanadium	V_2O_5
	20	Titanium dioxide	TiO_2
	30	Iron	Fe
	40	Gold	Au
Vermiculite	10	Vermiculite	VERMIC

Notes:

Mineral order represents the sequence of relative importance within the specific commodity group
Contaminant or gangue minerals in potential products have an order of 500 or greater

Appendix 2

Source references (Tables.doc)

Source	*Full title*
02208/93	DME mines file number
?	Unknown source
A_____	Open file mineral exploration report in WAMEX database
AIMM PRO	Australasian Institute of Mining and Metallurgy proceedings
AMH	Australian Mining Handbook
AMIQ	Australian Mineral Industries Quarterly
AR(CO)	Annual Report to Shareholders (abbreviated company name)
ASX(CO)	Report to Shareholders (abbreviated company name)
AUSIMM	Australasian Institute of Mining and Metallurgy report
AUSIMM14	Australasian Institute of Mining and Metallurgy bulletin and number
BHP	BHP correspondence
BMR	Bureau of Mineral Resources report
BMR RR 1	Bureau of Mineral Resources Resource Report and number
BMR59/24	Bureau of Mineral Resources Record and number
BULL(NO)	GSWA Mineral Resource Bulletin (number)
CO CORR/REP	Company report to shareholders
CO(CO)	Company report to shareholders (abbreviated company name)
CSIROPUB	CSIRO publication
DN	Daily News newspaper
EMP (NO)	Environmental-management report (number)
ER	M series report
ERMP	Environmental Review and Management Program
F.NOTE	DME file note
FR	Financial Review newspaper
GG	Gold Gazette
GS BULL	GSWA Bulletin
GS REP	GSWA Report
GSWA AR	GSWA Annual Report
HI CORR/REP	Hamersley Iron correspondence/report
HOGAN	Hogan and Partners Investor's Sharewatch
HOMESWES	HomesWest report
HY (CO)	Half-year report to shareholders (abbreviated company name)
I(NO)	M series open file Item (number)
IND MIN	Industrial Minerals
KAL MIN	Kalgoorlie Miner newspaper
M(NO)	Open file mineral exploration group report in WAMEX database
MB SYMP	Metals Bulletin Symposium
MEM 3	GSWA Memoir and number
MG	Metals Gazette
MINER	Miner
MINMET	MINMET report
MJ	Mining Journal
MM	Mining Monthly
MRR(NO)	GSWA Mineral Resources Report (number)
NOI(NO)	Notice of Intent to mine (number)
PAYD	Paydirt
PER	Public Environmental Review
PERS COM	Personal communication
PRO(CO)	Company prospectus (abbreviated company name)
QR(CO)	Quarterly report to shareholders (abbreviated company name)
REC(N0)	GSWA Record (number)
REP 33	GSWA Report (number)
ROY REP	DME Royalty Report
STAT DEC	Statutory Declaration submitted to DME
WEST A	West Australian newspaper

Appendix 3

Mineralization types (Tables.doc)

Abbreviation	*Mineralization type*
ALLAKE	Alunite in lake sediments
ANDSED	Andalusite in metasedimentary rocks
ASBAMP	Metasomatic asbestos deposits in amphibolites
ASBBIF	Asbestos deposits in banded iron-formations
ASBDLM	Asbestos deposits in dolomite intruded by dolerite
ASBSER	Asbestos deposits in serpentinites
ASBUM	Asbestos veins in ultramafic rocks
ASMASS	Stratiform massive arsenopyrite in metasediments
ASQTZV	Arsenic associated with auriferous quartz veins
AUALL	Alluvial/eluvial gold deposits
AUBIF	Gold in banded iron-formation and related sediments
AUCONG	Gold in conglomerate within greenstones
AUEPI	Epigenetic gold deposits in precambrian terrains
AUFVOL	Felsic volcanic rocks and/or volcanogenic sediments containing auriferous quartz veins and/or shear zones
AUGRAN	Gold deposits along granite–greenstone contacts and in granitoid rocks
AULAT	Lateritic gold deposits
AUPLAC	Precambrian placer gold deposits
AUPOR	Gold associated with felsic porphyry within greenstones
AUSHER	Basalt and/or dolerite containing auriferous quartz veins along faults or shear zones
AUSTOK	Dolerite or gabbro containing auriferous quartz stockworks or veins
AUSYN	Syngenetic gold deposits in precambrian terrains
AUUM	Gold deposits in ultramafic rocks
BABED	Stratabound bedded barite deposits
BACAV	Vein and cavity fill deposits
BAPEGM	Pegmatite-hosted barite deposits
BAUKAR	Karstic bauxite deposits
BAULAT	Lateritic bauxite deposits
BIPEGM	Bismuth in quartz-rich pegmatites
BIQTZV	Bismuth associated with gold mineralization
BMMASS	Volcanogenic Cu–Zn deposits
BMMISS	Mississippi valley type Pb–Zn deposits
BMPOR	Porphyry Cu–Mo deposits
BMSED	Sedimentary Cu–Pb–Zn deposits
BMSHER	Base metal deposits in quartz veins and/or shear zones
CADUNE	Limesand in coastal dune sands
CALAKE	Calcareous material in lake sediments
CALIME	Limestone deposits
CASEA	Offshore limesand deposits
CLBED	Bedded sedimentary clay deposits
CLRES	Residual clay deposits
CLTRAN	Transported clay deposits
COJSBT	Jurassic sub-bituminous coal
COLIGN	Eocene lignite deposits
COPBIT	Permian bituminous coal
COPSBT	Permian sub-bituminous coal
CRLAT	Lateritic chromium deposits
CRPGLY	PGEs and/or chromium in layered mafic/ultramafic intrusions
CRPGUM	PGEs and/or chromium in metamorphosed mafic–ultramafic rocks
DIAALL	Alluvial/eluvial diamond deposits
DIALAM	Lamproitic diamond deposits
DLMBED	Dolomite deposits in sedimentary sequences
DLMKAN	Residual kankar (dolomite) deposits

Abbreviation	*Mineralization type*
DLMLAK	Dolomite deposits associated with lake sediments
DLMSOM	Metasomatic dolomite deposits
DTMLAK	Diatomaceous lake deposits
FEBIF	Primary banded iron-formation deposits
FEBR	Iron ore deposits in the Brockman Iron Formation
FEGGT	Iron ore deposits in granite–greenstone terrains
FEMM	Iron ore deposits in the Marra Mamba Iron Formation
FEPIS	Pisolitic iron ore deposits
FESCRE	Scree and detrital iron ore deposits
FESED	Sedimentary basin iron ore deposits
FGRAN	Fluorite deposits associated with granitic rocks
FPEGM	Pegmatite-hosted fluorite deposits
FVEIN	Vein fluorite deposits
GEMMET	Gem and/or semi-precious stones in high-grade metamorphic rocks
GEMPEG	Pegmatite-hosted gem and/or semi-precious stones
GEMSED	Sediment-hosted gem and/or semi-precious stones
GEMUM	Ultramafic-hosted gem and/or semi-precious stones
GEMVOL	Gem and/or semi-precious stones in volcanic rocks
GRMETA	Graphite deposits in metamorphic rocks
GRPEG	Pegmatite-hosted graphite deposits
GRQTZV	Graphite deposits quartz veins
GRUM	Graphite as segregations in ultramafic rocks
GYBBAS	Gypsum in coastal barred-basin deposits
GYDUNE	Dunal gypsum deposits
GYLAKE	Gypsum in lake sediments
HMSCAP	Heavy mineral deposits in the Capel shoreline
HMSDON	Heavy mineral deposits in the Donnelly shoreline
HMSDUN	Heavy mineral deposits in the Quindalup shoreline
HMSEN	Heavy mineral deposits in the Eneabba shoreline
HMSGIN	Heavy mineral deposits in the Gingin shoreline
HMSHV	Heavy mineral deposits in the Happy Valley shoreline
HMSMES	Heavy mineral deposits in mesozoic formations
HMSMIL	Heavy mineral deposits in the Milyeaanup shoreline
HMSMIS	Heavy mineral deposits — miscellaneous
HMSMUN	Heavy mineral deposits in the Munbinea shoreline
HMSWAR	Heavy mineral deposits in the Warren shoreline
HMSWRN	Heavy mineral deposits in the Waroona shoreline
HMSYOG	Heavy mineral deposits in the Yoganup shoreline
KBRINE	Potash deposits in brines and surface evaporites
KEVAP	Potash deposits in buried evaporite sequences
KGLAUC	Potash in glauconitic sediments
KLAKE	Potash associated with lake sediments
MGUM	Mafic/ultramafic rocks
MNCAV	Joint/cavity-fill manganese deposits
MNRES	Residual manganese deposits
MNSED	Sedimentary manganese deposits
MNSUPR	Precambrian supergene enrichment of manganiferous sediments
MOPOR	Porphyry Cu–Mo deposits
NABRIN	Salt in brines and surface evaporites
NAVAP	Salt deposits in buried evaporite sequences
NIINTR	Nickel in dunite phase of thick komatiite flows
NILAT	Lateritic nickel deposits
NISED	Nickel deposits in metasedimentary rocks
NITHOL	Nickel deposits in the gabbroic phase of layered tholeiites

Appendix 3 (continued)

Abbreviation	*Mineralization type*
NIVEIN	Vein-type nickel deposits
NIVOLC	Nickel associated with volcanic peridotites
PCARB	Carbonatite-hosted phosphate deposits
PEGPEG	Pegmatite-hosted industrial minerals
PGALL	Alluvial/eluvial platinoid deposits
PGUANO	Quaternary guano (phosphate) deposits
PIGHEM	Specular hematite pigment
PNOD	Seafloor (nodular) phosphate deposits
PSED	Phosphate deposits in phanerozoic sediments
PVEIN	Vein phosphate deposits
REALL	Alluvial/eluvial rare earth deposits
RECARB	Carbonatite-hosted rare earth deposits
REFELS	Felsic volcanic-hosted rare earth deposits
REHMS	Rare earths in heavy mineral sands
REPPEG	Pegmatite-hosted rare earth deposits
RESST	Xenotime in sandstones
SBQTZV	Antimony associated with auriferous quartz veins
SIDUNE	Mesozoic dune and bedded silica sands
SIQTZ	Silica in vein quartz
SIQZTE	Silica in quartzite and/or chert
SMASS	Sulfur in massive sulfides
SNALL	Alluvial/eluvial tin–tantalum deposits
SNGREI	Tin–tantalum deposits in greisen zones
SNPEGM	Pegmatite tin–tantalum–lithium deposits
SNVEIN	Vein tin–tantalum deposits
SSEDQZ	Sulfur in sediments and/or quartz veins
TALDLM	Talc deposits associated with dolomite
TALUM	Talc deposits in ultramafic rocks
UCALC	Calcrete-related uranium deposits
UCAV	Secondary (cavity-fill) vein-like uranium deposits
UCONG	Conglomerate-hosted deposits
ULIGN	Lignite-hosted uranium deposits
UPEG	Pegmatite-hosted uranium deposits
USST	Sandstone-hosted uranium deposits
UUNCF	Unconformity-related uranium deposits
UVEIN	Uranium in veins associated with base metals
VCALC	Calcrete-related vanadium deposits
VERUM	Vermiculite deposits associated with weathered mafic and ultramafic bodies
VTIALL	Alluvial/eluvial vanadium–titanium deposits
VTILAT	Lateritic vanadium–titanium deposits
VTIMAG	Titaniferous magnetite deposits
VTIVN	Vanadium–titanium vein deposits associated with base metals
WMOGRE	Tungsten–molybdenum deposits in greisen zones
WMOPEG	Pegmatite tungsten–molybdenum deposits
WSKARN	Tungsten–molybdenum skarn deposits