

# Case Study at BHP Copper Inc. Copper Mine and Smelter, San Manuel, Arizona

**T. Braun** *SRK Consulting (U.S.) Inc., USA*

**J. Parker** *BHP Copper Inc., USA*

## 1 INTRODUCTION

After more than 50 years of activity, BHP Copper Inc. (BHP) suspended operation of the San Manuel Mine and Plant Sites on June 25, 1999. The former San Manuel Operation (SMO) includes approximately 9300 hectares and is located in southern Pinal County in the State of Arizona, USA (Figure 1). At the time of the suspension announcement, SMO employed in excess of 2600 people (direct) and provided the majority of community services for the company-founded town of San Manuel located adjacent to the integrated mill, smelter and refinery facility. Final closure of the Mine and Plant areas was announced in January 2002 and October 2003, respectively. This paper examines the process of decommissioning and the application of BHP Billiton's Sustainable Development Policy (Policy). The Policy objective is to create sustainable value for our shareholders, employees, contractors, suppliers, customers, business partners and host communities.

BHP Billiton's sustainable development principles are designed to ensure that business units remain viable and contribute lasting benefits to society through the consideration of social, environmental, ethical and economic aspects of an ongoing or proposed activity (BHP Billiton 2005). For San Manuel, these principals applied to a large-scale facility entering final decommissioning and closure. The Policy ensured that BHP did not compromise safety values, identified and managed risk and met or, in some cases exceeded applicable legal and other requirements.

## 2 PROJECT OVERVIEW

The San Manuel mine provided the majority of ore to the mill, smelting and refining complex. Sulfide ore from the San Manuel ore body tended to be low in arsenic and lead. BHP also toll smelted concentrates and other recoverable metals-bearing materials. The mill circuit was conventional flotation with a separate molybdenum recovery process. The smelting facility was progressive upgraded to the flash furnace design in 1988. BHP constructed an acid plant as part of a series of new air pollution control upgrade in the 1970's. About 35 to 40% of the copper production from the smelter was converted into continuous cast 7.9 mm wire rod for the wire and cable industry.

Decommissioning activities at San Manuel required extensive coordination with state and local authorities and community representatives. The State of Arizona administers a Voluntary Remediation Program to establish soil clean-up goals for industrial properties. Arizona also promotes Brownfields Development in conjunction with the U.S. Environmental Protection Agency. In conjunction with these and other established state and federal environmental programs, BHP worked to integrate sustainability principles with established governmental requirements and value-building property re-development strategies.

BHP decommissioned mining assets that retained little or no value with respect to re-development of the former Mine and Plant Areas. Former industrial operations such as the mill, smelter and refining facilities were subject to decontamination, demolition and disposal or recycling (where ever possible). Combined costs for demolition and reclamation activities for the Mine and Plant Site exceeded \$120 million USD. Assets that contributed to productive post-mining land use were identified through internal assessment, public consultation and market research. Asset review included assessment of state and federal sponsored incentive programs for economic development, regional planning activities and regulatory programs that support brownfields development. Further, demographic and associated economic trends for the region were reviewed to identify likely re-development scenarios.

Local factors that influenced the closure planning process include preservation and enhancement of the public views. Similarly, closure planning addressed preservation of existing infrastructure elements such as water supply and distribution systems, county airport services, railroad and highway access.

Post-mining land-use opportunities include a mixture of light industrial, residential (including retirement communities), recreational and open space/land conservation use. BHP and local public authorities revised the regional land use plan to promote re-development opportunities for the property. In March 2006, BHP entered into negotiations with a national property development firm to form a joint venture to develop land parcels adjacent to the former plant site.

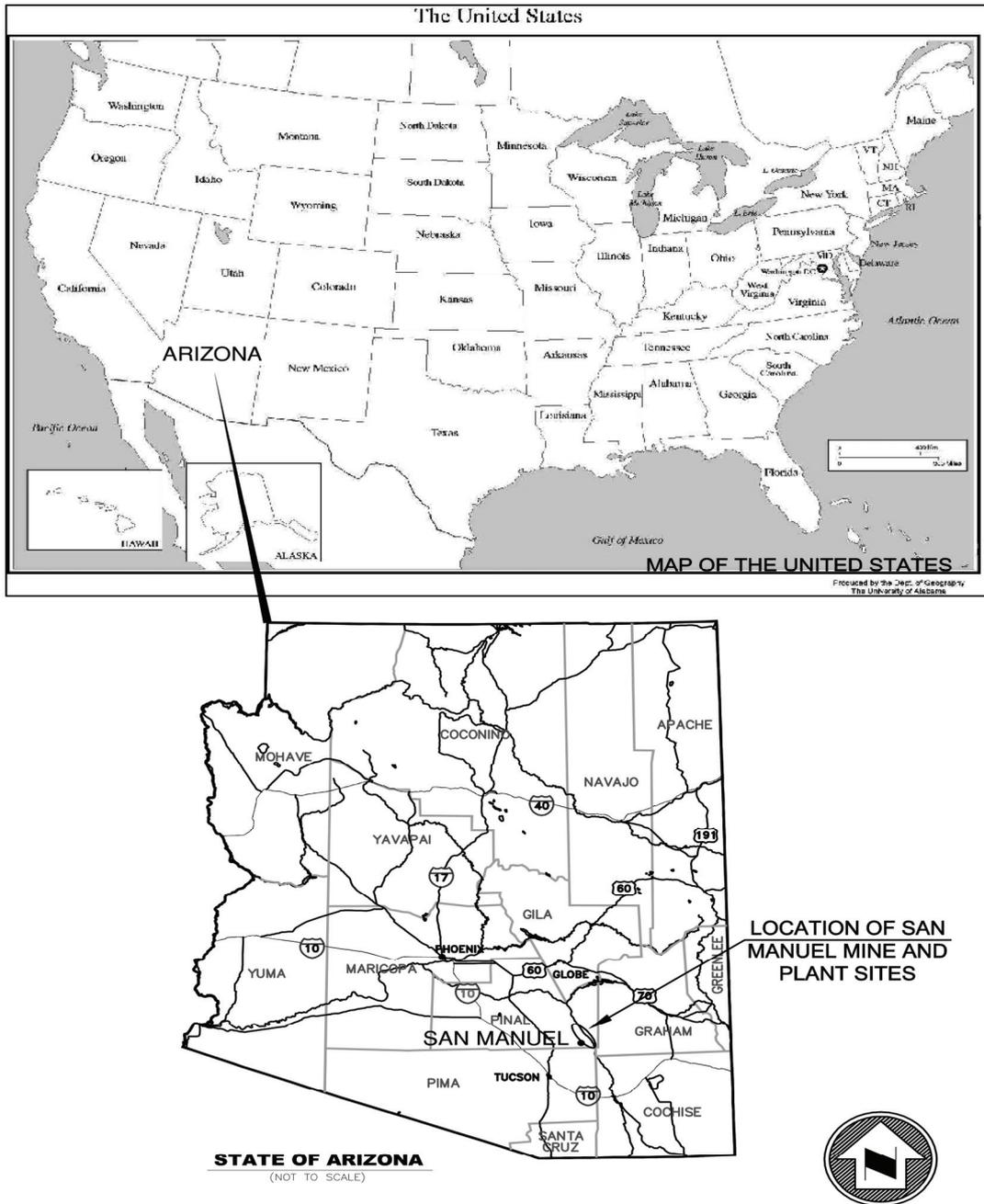


Figure 1 Project location

### 3 REGIONAL FACTORS INFLUENCING RE-DEVELOPMENT POTENTIAL

Regional factors influenced re-development options for the former open pit mine site and industrial plant area included the established political environment and legal context.

#### 3.1 Political Environment

The first regional factor is the political environment of Arizona. State and local governments fund a number of economic development initiatives to attract investors and business. State governments recognise that sustaining economic growth and job creation make good business sense particularly where local economies are adjusting to departure of major employers. County authorities collaborate with state agencies through planning documents which present strategies for economic growth and land development within the county.

##### 3.1.1 Economic development initiatives

The former BHP operations in southern Pinal County required employees and vendors from the neighbouring communities of San Manuel, Mammoth and Oracle, as well as longer-distance commuters (e.g., Tucson and Florence). The Pinal County population is expected to grow at an average annual rate of 2.3% between 2000 (179727) and 2020 (281710). This rate exceeds the corresponding forecast for Arizona (2.1%) and the United States (1.0%) (Arizona Department of Economic Security, 2002). On a state-wide basis, service-sector jobs are expected to increase by an average of 25% between 2003 and 2013 while mining and manufacturing positions are expected to increase by a more modest 5% during the same period.

Since 1993, per capita personal income in Pinal County has been on a consistent decline (Pollack, 2003). ADC speculates that the reasons for lower and declining per capita income include: 1) a larger than average portion of the population is retired and 2) the mix of jobs has shifted from high wage mining to typically lower paying State and local government-related, trade and service jobs. In 2002, estimated unemployment in Pinal County was 8.1%. These factors motivate political interests to promote and pursue economic development opportunities for the affected area.

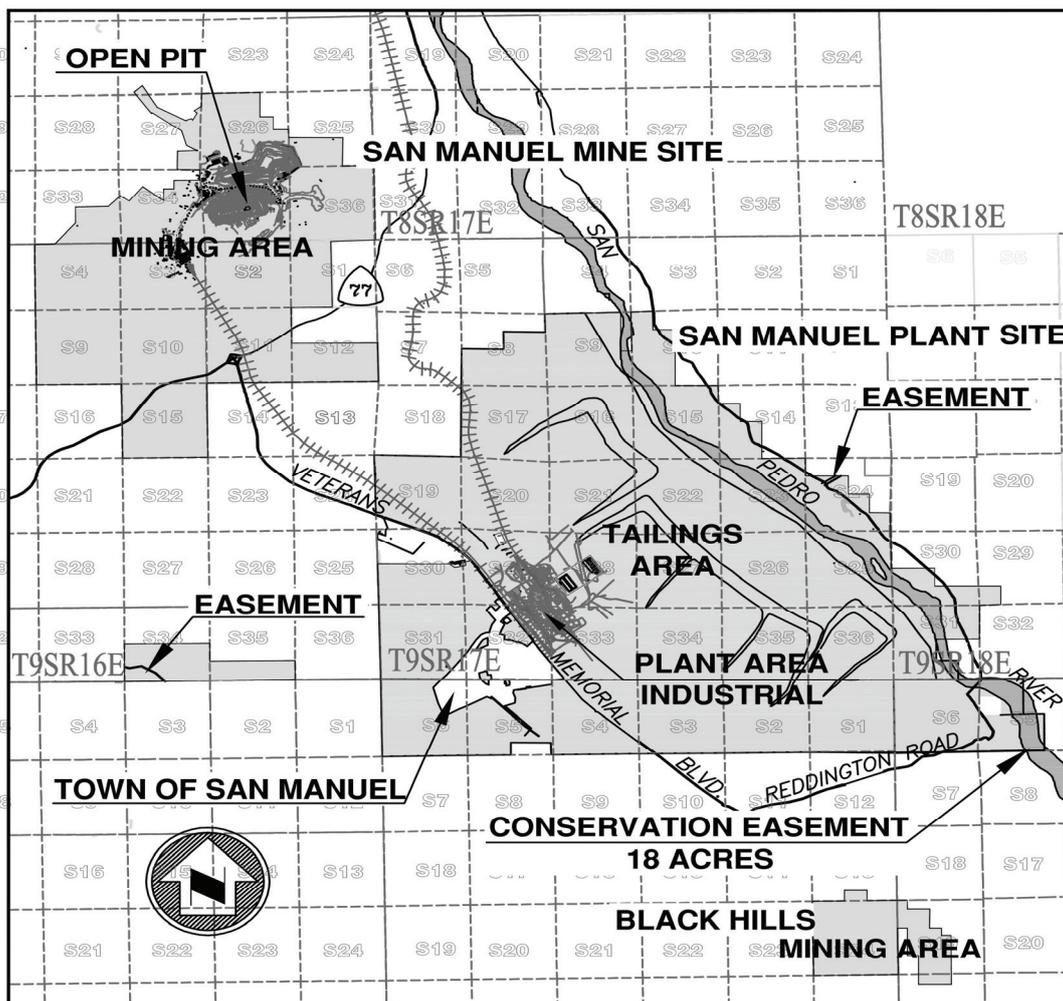
The Arizona Department of Commerce (ADC) studies a variety of economic development opportunities on behalf of the state. The ADC established the Pinal County Enterprise Zone Program in 1991. Subsequent re-authorizations and expansions resulted in designation of two enterprise zone areas including the incorporated municipality of Mammoth. The goals for each enterprise zone include enhancing economic diversification and strengthening the economic base of local economies (Pinal County, 2004a) by offering certain tax advantages. This economic initiative is consistent with sustainable development policy and seeks outcomes similar to BHP's strategic objectives for re-development. In addition, the Central Association of Governments (CAAG) focused on strategic planning to identify and assess economic development infrastructure issues, strategies to enhance business and expansion activities (CAAG, 2000). These efforts were focused directly on long-term sustainability in the San Manuel Region and are relevant to the successful transition of the region to a 'post mining' economic base.

##### 3.1.2 Pinal County comprehensive development plan

Pinal County is required by state law to prepare a Comprehensive Plan "to conserve the natural resources of the county, to insure efficient expenditure of public funds and to promote the health, safety, convenience and general welfare of the public" (Pinal County, 2004b). The document provides guidance for management and land planning decisions related to public and private land in the county. BHP and Pinal County recognize the plan as a valuable resource in terms of attracting and negotiating with incoming investors for land development and conservation.

Figure 2 presents the boundary for land owned or controlled by BHP as part of the former San Manuel Operations. Designated land use based on the Comprehensive Plan is also shown. The immediate Mine Site is classified as a Mining Area which recognizes the rights of future exploration, mining and processing mineral resources. The majority of land surrounding the Mine Site is designated as "development-sensitive" with the goal of preserving the natural environment and open space characteristics in the area. Destination

resorts and associated facilities may be allowed upon adherence to strict environmental and design requirements (Pinal County, 2004b).



**Figure 2 Site layout**

The town of San Manuel is classified as a Rural Community Area with the planning goal of slow to moderate growth based on availability and capacity of public services, facilities and infrastructure. The San Pedro River is a development-sensitive riparian zone. Current open space between San Manuel and Highway 77 is designated as a Natural Resource Area. Such an area includes private and public lands which contain one or more natural resources that are enhanced by maintaining the parcels in large, undivided holdings. Land south of San Manuel is classified as Rural, suitable for low density development including agriculture, grazing, mining, sand and gravel operations, large acreage homesites, small farms, open space and selected industrial uses.

A local Citizens Advisory Committee, working with Pinal County planning authorities, identified additional policies for future development in the southeastern portion of Pinal County (including San Manuel):

- Generate opportunity for Mammoth, San Manuel, Oracle and all new developments to be economically self-sufficient and accommodate diversified economic development.
- Preservation of environmentally sensitive and natural resource areas.
- Order and efficient development in terms of land use, public infrastructure and services.
- Encourage water conservation.

These express goals are consistent with the sustainable development policy adopted by BHP for closure of the Mine and Plant Sites. In 2005, the Pinal County Board of Supervisors approved BHP's request to redesignate the company's approximately 9300 surrounding hectares to be used for more than mining (Arizona Daily Star, 2006). The new designation allows development for homes, industrial buildings and retail centres within the guidelines of the Comprehensive Plan.

## **3.2 Legal Context**

Closure planning and re-development scenarios are subject to normal real estate transaction provisions and applicable environmental regulations. In conjunction with BHP Billiton corporate standards, the closure plan process for San Manuel incorporated elements of strategic business practices and detailed evaluation of environmental obligations. In anticipation of post-mining re-development, BHP reviewed and summarized the legal status of lands owned and controlled by BHP to identify potential restrictions in post-mining land use or limitations on future business transactions. Applicable environmental regulations included conventional compliance programs as well as innovative, voluntary remediation programs.

### **3.2.1 Land position**

BHP undertook a comprehensive inventory of the legal status of all land parcels owned or controlled by BHP. The review included compilation of updated legal descriptions of each land parcel, mapping of legal boundaries and identification of easement and right of way agreements. The purpose of the comprehensive review was to understand legal obligations (financial and otherwise) to non-BHP parties and to identify potential restrictions on future land use.

Scaled maps based on legal property boundary descriptions were regenerated to assist BHP management in decision-making related to land management. In some cases, property boundaries were re-surveyed in the field to verify agreement with original mapped boundaries. Prior to this point, land maps were typically in hard copy form and either of sufficiently large scale that minor mapping discrepancies were negligible or on a local scale that depicted clusters of adjacent land parcels at a high level of detail. BHP elected to consolidate the various land maps into an integrated, scaleable AutoCAD drawing, suitable for various presentation formats for the public or BHP management. This effort allowed BHP to efficiently negotiate with various interested parties with respect to inquiries and other land management issues.

### **3.2.2 Environmental compliance programs**

Conventional environmental compliance programs address potential groundwater, surface water, air, and waste issues for general industrial activity. These programs are compulsory based on the proposed industrial activity. The State of Arizona regulates groundwater resources under the Aquifer Protection Permit (APP) Program, surface water under the Clean Water Act (in conjunction with EPA), air quality under the federal Clean Air Act and waste under the authority of the federal Resource Conservation and Recovery Act. Surface mine reclamation activities are subject to approval by the Arizona State Mine Inspector under the Mined Land Reclamation Act. Other state and federal environmental programs were also reviewed accordingly.

BHP entered into proactive discussions with each responsible regulatory authority. The issuance of a closure permit under the APP was managed over a three year period by conducting monthly meetings to discuss issues, concerns and reviewing the data submitted by BHP. The result was a streamlined process that included transparency and cooperation between state regulators and BHP.

### **3.2.3 Voluntary environmental programs**

Environmental rehabilitation of heavy industrial areas can be subject to substantial risk for the property owner or land developer (with or without equity stakes). This risk is somewhat reduced under "Brownfields-style" programs that promote re-development of environmentally-impaired properties. A typical brownfields property is a land parcel where previous commercial activities resulted in some degree of environmental liability. The land parcel retains commercial value in terms of re-development potential; however, the value is off-set by environmental remediation costs. Public sector incentives for brownfield properties may include grant funding for environmental assessment and/or remediation. Alternatively, private-sector companies and

investment groups in the U.S. specialize in the purchase, remediation and re-development of brownfields properties.

The Arizona Department of Environmental Quality (ADEQ) and the U.S. Environmental Protection Agency (EPA) collaborate through EPA Brownfields Site Assessment Pilot grants and the ADEQ Voluntary Remediation Program (VRP), respectively. In 1997, Tucson, Arizona was one of the first cities to receive a Brownfields grant from EPA. This federal program increased the awareness of state and local regulatory authorities with respect to risk-based corrective action. The state VRP allows proponents a method to reduce environmental liabilities in property transfers involving former industrial operations.

Given the state of Arizona's familiarity with Brownfields programs and the VRP, BHP successfully pursued a Declaration of Environmental Use Restriction (DEUR). A DEUR is a form of institutional control that restricts future land use. BHP prepared an engineered control plan to manage residual soil contamination within a 600 acre area of the Plant Site. The control plan formed the basis for the DEUR.

## **4 LOCAL FACTORS INFLUENCING RE-DEVELOPMENT**

After the June 25, 1999 suspension of operations, BHP pursued a number of re-development opportunities for the Mine and Plant Sites, including re-start of mining operations. When BHP announced final closure of the San Manuel Operations, the detailed closure planning effort focused on achieving environmental requirements (including BHP Billiton Closure Standards) and on closing the property in a manner that would facilitate re-development. During this process, the BHP closure team identified property assets that retained value for future re-development. In summary, the asset categories include:

- Physical Setting.
- Water Supply and Sanitation Systems.
- Regional San Manuel Airport.
- Infrastructure.

BHP engaged various community interests and organizations throughout the closure planning process in order to gain the community perspective on asset preservation and future re-development (Parker and Braun, 2006). Upward population trends, increased demand for developed land and the proximity of two major urban cities raised interest in the local and nation-wide investment community for alternative development of the San Manuel property. The national development company currently in negotiations with BHP intends to capitalize on these demographic trends and other economic indicators by proposing a destination-style resort community which will cater to leisure and retirement activities. The resort community would then create a variety of service-sector opportunities throughout the existing community of San Manuel. As of June 2006, discussions between BHP and the property developer remain preliminary.

### **4.1 Physical Setting**

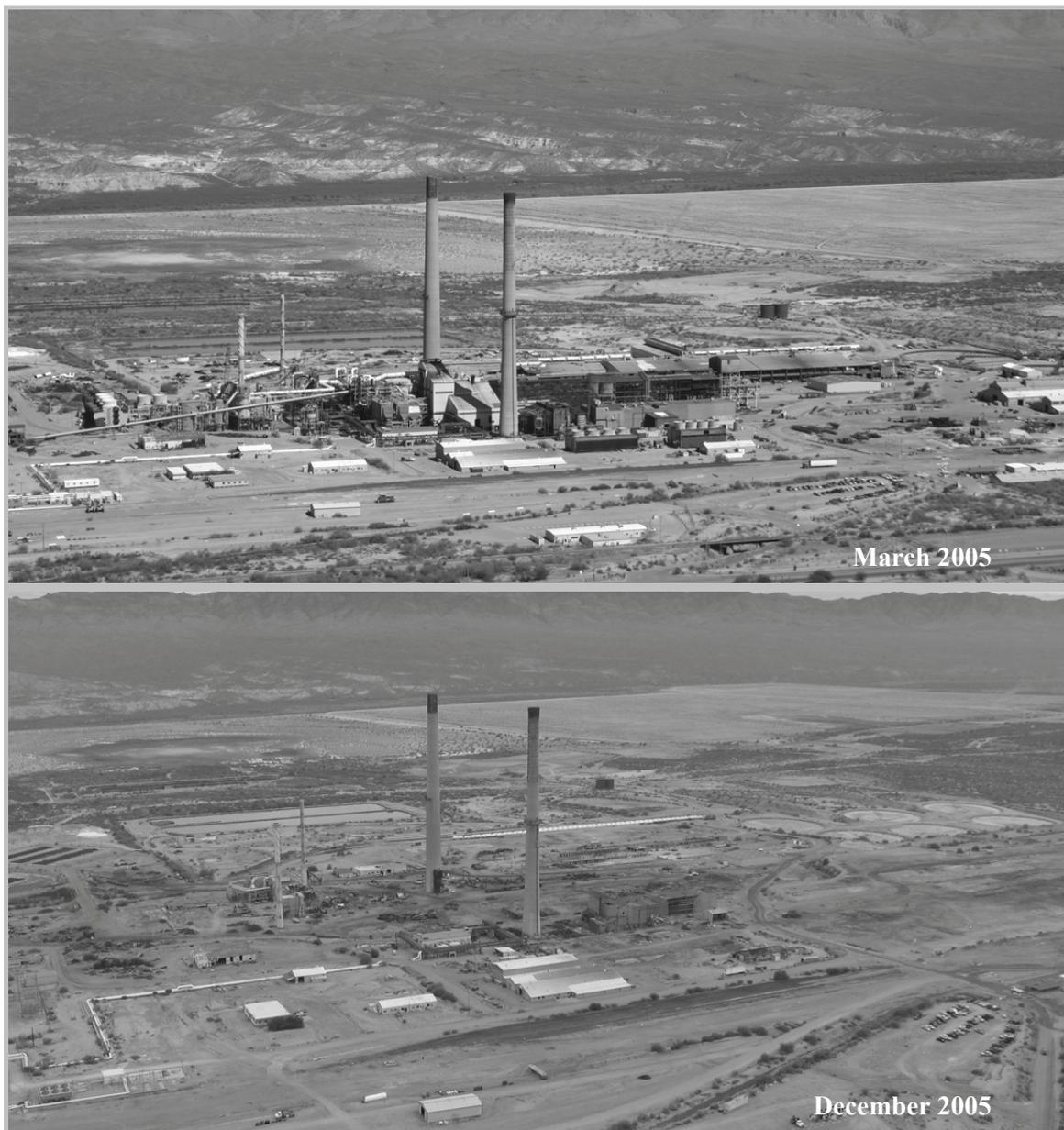
The portion of the San Pedro River Valley that includes the former San Manuel Operations is bounded by the Catalina Mountains on the west and the Galiuro Mountains to the east. The town of San Manuel is surrounded by rural open space and is approximately 230 km southeast of Phoenix and 75 km northeast of Tucson. The 1000 m elevation provides some climate relief from the major population centres at lower elevation. Neighbouring Highway 77 offers access to a number of scenic drives that offer largely undisturbed Arizona landscape that is attractive to tourism.

BHP recognized the high value the local community placed on preserving riparian habitat along the San Pedro River and on promoting the overall natural aesthetics of the San Pedro River Valley in this area. At the Mine Site, the former 88900 kilotonne heap leach pad was a prominent feature visible from the towns of Mammoth and San Manuel as well as travellers on Highway 77. BHP invested significant capital in a regrade and cover plan for the former heap leach facility in order to achieve corporate and state environmental standards. A key corporate strategy for the heap leach facility was to minimize the geometric lines and grades conducive to production and to re-shape the stockpile in a manner that compliments the surrounding landscape (Figure 3).



**Figure 3 Heap leach facility before reclamation (top) and near completion (bottom)**

At the Plant Site, the public viewshed looking eastward from the town of San Manuel was obstructed by the large structures associated with the milling, smelting and refining operations. The decontamination, decommissioning and demolition plan for the Plant Site achieved BHP safety and environmental compliance objectives with the added benefit of a dramatic improvement in the public viewshed (at least to non-mining viewers) (Figure 4). Further, the closure plan for the 1335 hectares of tailing impoundments features recontouring to gentler slopes, placement of a one foot cover layer, rock armouring, and revegetation to sustain plants and trees. Property values in the town of San Manuel steadily rose over recent years (estimated at 40 to 50%) as BHP's closure program for the Plant Site became public.



**Figure 4** Plant site before demolition (top) and in progress (bottom)

## 4.2 Water Supply and Sanitation Systems

Future commercial or residential development will be controlled by access to a sustainable water supply. The State of Arizona governs groundwater and surface water use within the State (Hydrologic Consultants 2001). In 1980, Arizona State Legislature created four groundwater Active Management Areas (AMAs) within which the use of groundwater would be strictly regulated. The San Manuel Mine and Plant Sites are not within an existing AMA; however, these areas are subject to reporting requirements under the 1980 Groundwater Management Act. Future development outside of AMAs is contingent on a voluntary demonstration of a 100 year water supply. During normal operations, BHP maintained a series of production wells adjacent to the San Pedro River capable of supplying more than 633 liters per second of water to the Plant Site. Therefore, demonstration of a 100 year water supply at the former San Manuel Plant Site is a key asset for future land development.

BHP maintains rights to substantive groundwater supplies along the San Pedro River. BHP maintained groundwater pumping wells, pipelines and distribution systems at the Plant Site. Detailed closure planning for the Plant Site included an assessment of the remaining productivity for each production well. Based on

this assessment, BHP invested capital in rehabilitating the production wells for extended use. The rehabilitation effort included well-screen maintenance, replacement pumps and motor controls.

BHP supplies water to the Arizona Water Company (AWC) for potable water distribution to the local community. This distribution system includes approximately 15 km of pipelines that deliver water to four large capacity tanks. This water supply includes delivery of irrigation water to the San Manuel Golf Course. AWC is the certified public utility authorized to manage distribution of the potable water supply. BHP and AWC are pursuing options with respect to creating a long-term potable water supply and distribution system that promotes sustainable development of the property.

The typical sanitary sewer system for the Mine Site was a septic tank/leach field arrangement located adjacent to the mining production area. These localized facilities were closed in-place in accordance with state and local requirements. In contrast, the sanitary sewer system for the Plant Site and the town of San Manuel were fully integrated. One of BHP's goals was to transition the ownership and operation of the wastewater treatment facility to a qualified operator with a proven track record in Arizona to ensure continued service. Therefore, BHP Copper entered into an agreement to sell its' waste water treatment facilities to a third party.

### **4.3 Regional San Manuel Airport**

The San Manuel Airport located east of Highway 76 and north of the Plant Site (Figure Reference). The airport was originally constructed in 1953 by Pinal County in support of the original Plant Site construction. The 62 hectare property is owned by BHP and is currently under a 35 year lease to Pinal County (expiring in 2030). Currently, the airport includes a single 1284 m east-west runway and limited support facilities. The un-manned facility caters to largely day-time use by private aviation enthusiasts.

Pinal County prepared a revised Airport Master Plan for the San Manuel facility in 2003 (Coffman Associates 2003). The Master Plan includes expansion of the facility to serve projected demand for aviation services. The stated goals of the Master Plan are to promote state and federal funding of capital improvements to the facility based on anticipated demand. Part of the Airport Master Plan is for Pinal County to purchase the leased property and to acquire additional buffer land (approximately 18.2 hectares) from BHP. To the extent that the Airport Master Plan goals meet BHP's sustainability objectives for the Plant Site, BHP will engage Pinal County authorities and promote a positive outcome.

### **4.4 Infrastructure**

As a major industrial operation, the San Manuel Operation required substantial railroad and highway access and transportation capacity. These infrastructure elements were assessed during the detailed closure planning process with the objective of maximizing future re-development potential.

BHP maintained a dedicated 8.3 km rail line for transport of copper ore from the mine to the Plant Site. In addition, BHP operated a rail spur that connected the Plant Site to off-site shipping destinations via the Copper Basin Railroad (owned by Union Pacific). In the absence of mining at San Manuel, the dedicated ore transport line was of limited alternative use. BHP proceeded with decommissioning plans of this rail line in 2006.

The rail connection to Union Pacific Railroad retains future asset value due to the access to alternative markets. Federal regulation for operation and maintenance of this rail spur is prescriptive and elaborate. BHP's goal is to transfer ownership of this rail line to a qualified, new industrial operator at the Plant Site. If future re-development of the Plant Site does not require rail access, BHP will proceed with termination of the existing railroad agreements and decommissioning of the rail line under applicable regulatory and risk management programs.

State Highway 77 provides paved two lane access to Highway 76 which connects to San Manuel. Highway infrastructure is suitable for tractor-trailer traffic with adequate local access to the former Plant Site. Highway construction and maintenance is the responsibility of the Arizona Department of Transportation and Pinal County.

## 5 CONCLUSION

The San Manuel Case Study offers insight into the multi-dimensional aspects of sustainable development and final closure of a large industrial operation. When it comes to final closure, mining personnel are not typically commercial real-estate agents and land development companies are not educated with respect to the scale and nature of mining-related disturbances. Sustainable development principles call for consideration of social, environmental, ethical and economical aspects of a proposed action with the goal of lasting benefits to society. BHP's experience with San Manuel reinforces the success that can be achieved by implementing the Sustainable Development Policy and forming partnerships with local host communities and stakeholders to provide lasting social, environmental and economic benefits to society. In the end this approach will significantly enhance the 'license to operate' of BHP in the US and worldwide.

## ACKNOWLEDGEMENTS

Application of sustainable development principles during near term implementation of a large closure program required extensive participation by local BHP Copper staff as well as BHP Billiton corporate resources. Significant effort by BHP to solicit community input during this process resulted in multiple community stakeholder participation.

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