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MINING & ENVIRONMENT RESEARCH NETWORK

Combined Report

Boliden Apirsa, Los Frailes Tailings Incident

25th April 1998

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Los Frailes Tailings Incident

Technical Report

Submitted by: Thomas W. Coleman

Executive Summary

The failure of the tailings storage facility at Boliden Ltd's, Los Frailes mine marked the 4th major international tailings failure since 1990 and the 2nd major European failure since 1980.

Media coverage of the incident has been widespread, with major implications for other operators in the region and internationally. Boliden Apirsa a wholly owned subsidiary of Boliden Ltd, Toronto which operates the Los Frailes zinc mine in southern Spain continues to deny liability and presently plans to reopen the mine within six months.

Introduction

This summary details the events surrounding the failure of the tailings dam at the Boliden Apirsa, Los Frailes mine in southern Spain. The failure occurred at 3.30am on Saturday 25th April 1998 when a 50m section of the tailings dam wall collapsed releasing approximately 6.5 million m³ acidic water into the adjacent Rio Agrio. A quantity of tailings material was also discharged containing sulphur, zinc, copper, iron, lead and other trace elements.

Dam Construction and Operation

Los Tailings Dam

Type of TSF:	Ring Dyke
Construction method	Downstream
Liner	Clay
Height of Dam Wall	approximately 30m
Paddock Dimensions	500m x 1000m (segmented)
Dam Wall Construction Materials	Waste rockfill and tailings with a clay liner
Method of Deposition	Spigotting along crest with water at the face of the dam

The main parameters of the dam failure were concerned with integrity of the ground beneath the dam wall (foundation). There have been a number of speculative ideas put forward by Boliden Ltd and other interested parties. These are listed below and will be discussed in further detail in the following paragraphs.

- Seismic activity (natural or anthropogenic) beneath the dam wall
- Deterioration of foundation due to acid water dissolution
- Loss of foundation integrity due to excessive water retrieval from perimeter bore holes

The photos over the page illustrate the breach in the dam wall and identify the visible construction characteristics.

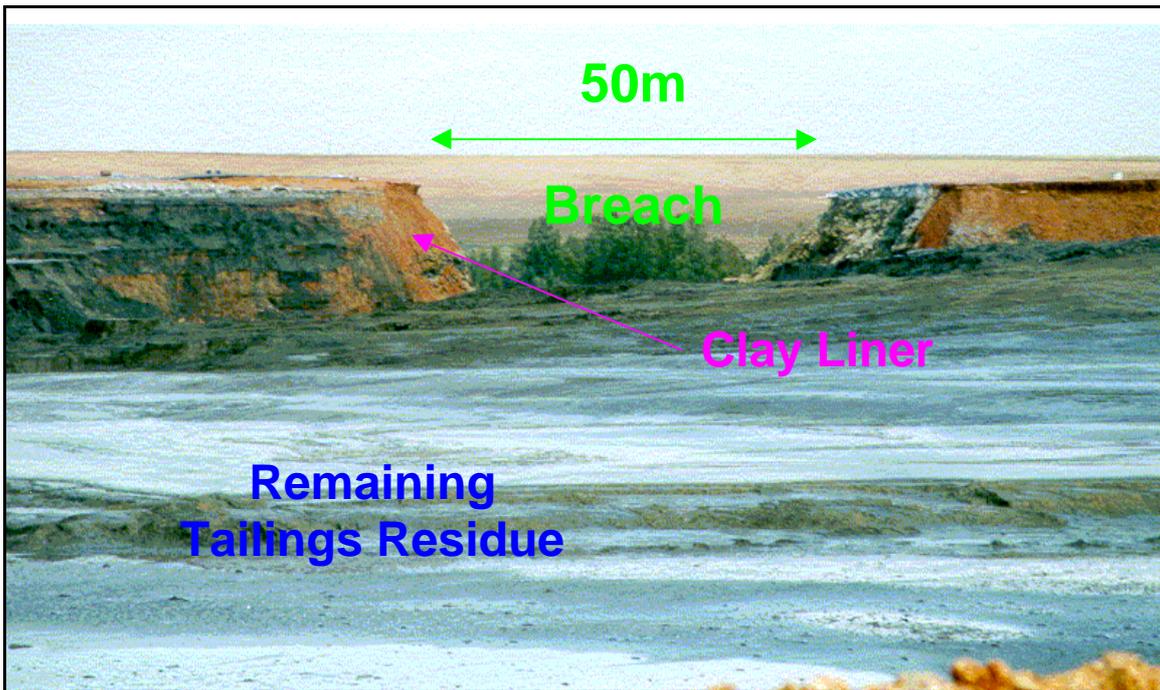


Figure 1 Photograph showing breached impoundment wall

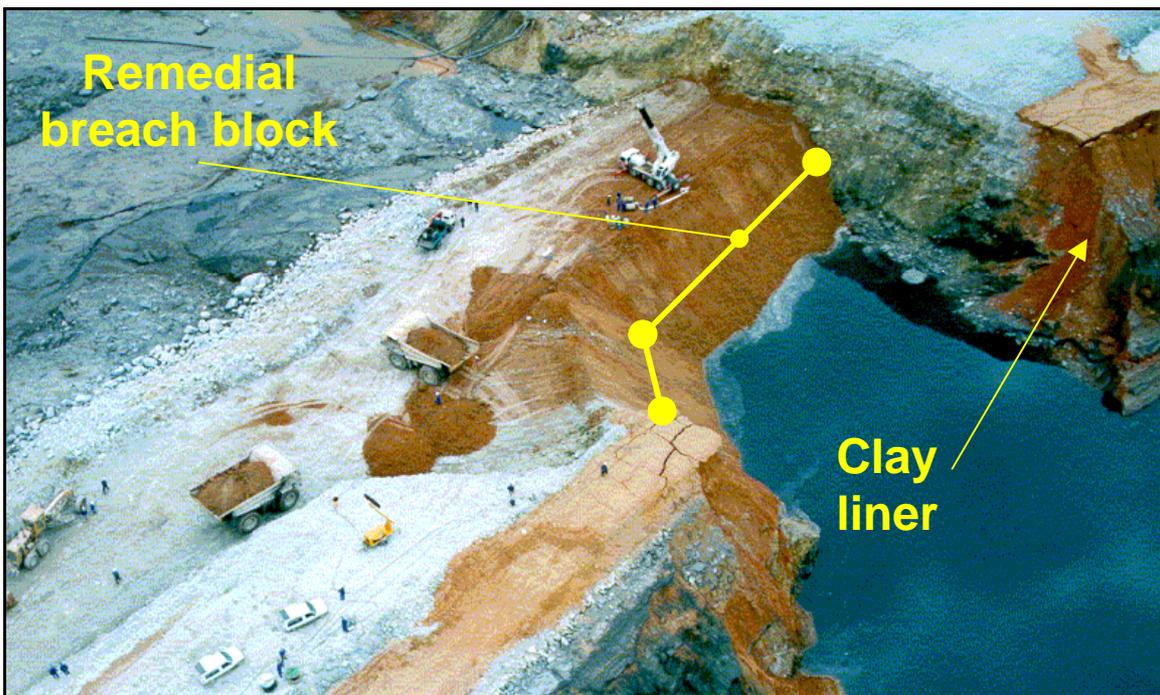


Figure 2 Photograph showing remedial breach blocking

- Seismic activity (natural or anthropogenic) beneath dam wall

A number of parties have speculated at seismic activity for the cause of the dam wall failure. Wall liquefaction under dynamic loading may cause loss of dam integrity and eventual failure. Other examples of this type of failure include the Cerro Negro and El Cobre range of dams in Chile following an earthquake in 1965. Seismic loading in the case of Los Frailes failure may have been either natural or anthropogenic (vibrations from mining activities/blasting)

Los Frailes Tailings Dam Incident Boliden Aspirsa Aznaicóllar – Seville Spain

Report on Spanish media coverage
June 1998

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List of government bodies, political parties and non-governmental organisations (NGOs) mentioned

European bodies
European Union (EU)
European Commission
European Parliament

National government bodies

Confederación Hidrográfica del Guadalquivir	-	Water Authorities
Ministerio de Agricultura	-	Ministry of Agriculture
Ministerio de Medio Ambiente	-	Ministry of the Environment
Ministerio de Trabajo	-	Ministry of Work
SEPRONA	-	Servicio de Protección de la Naturaleza (Environmental Police Body)

Regional government bodies

Junta de Andalucía	-	Regional central government body
Consejería de Industria	-	Regional Industry Council
Consejería de Medio Ambiente	-	Regional Environment Council
Agencia de Medio Ambiente	-	Environment Agency

Political groups

Izquierda Unida	-	Left-wing political party
Comisiones Obreras (CCOO)-	-	Trade Union

NGOS

Adena/Worldwide Fund
CEPA (Confederación Ecologista y pacifista de Andalucía)
CODA
Greenpeace

Executive Summary

The following report is a compilation of information, opinions and interpretations of the Boliden tailings disaster as covered by the Spanish national newspapers from the 26th April to 28th May. The report captures the interpretations made by the media and their sources of information, as well as the effect that those articles have had, or will have on the general public and the authorities.

The report is divided into eight sections. The first section introduces the main issues covered by the media. The following seven sections cover in more detail the topics that have received the greatest attention in the past month.

The threat to Doñana has been a paramount issue in this disaster. However, the majority of the articles are a series of speculation, information and misinformation reports, where it is difficult to separate the truth from exaggerations. This report therefore captures the sensationalism and sensitivity of the issue, together with the reaction of the authorities, the environmental organisations and the general public, as reported by the media. The sections on the tailings spill, the authorities' reaction and Boliden are more detailed as they are more comprehensively covered by the newspapers.

The section on legislation covers the legislative aspects regarding environmental protection and mining reported by the newspapers. These include legislation on the National Doñana Park, waste, European Union (EU) Directives and other relevant legislation in this disaster. It also captures the overall confusion both in the authorities and within companies over the division of roles and responsibilities between the national authorities and the regional ones.

The conclusion is divided into two sections, direct and indirect impacts of the disaster. The direct impacts the present economic, material and reputation implications of the disaster. Indirect impacts reflect the possible reactions of the public, authorities and environmental organisation to new projects in the future.

Overall, this incident has presented a challenge for authorities, environmentalists and companies. The most immediate challenge is the cleaning up process and the need to reduce the economic, social and environmental impact of the disaster as far as possible. In the near future, however, the challenge will be for companies, authorities and environmentalists to build up a trusting relationship and work together, rather than against each other. Furthermore, the challenge is for the mining industry in Spain to build up an image of care for the environment and safety that outlives the negative perception arising from this tailings disaster.

Introduction

The media coverage of the tailings spill on Aznalcóllar has been, and continues to be, very extensive. All the main national newspapers include at least two articles on the issue everyday since 26th April. The main issues covered have been:

- the threat to Doñana;
- the details of the tailings spill and possible causes of the breakage of the dam, as well as the extent of the clean up costs;
- economic and material impact of the disaster on different industries: mining, agriculture, fishing and tourism;
- the role of the authorities in the permitting of the dam and their reaction to the disaster;
- Boliden's present record on environmental issues, both in Spain and internationally; and,
- Boliden's financial situation and human resources issues.

Threat to Doñana

The threat that the tailings spill imposes on the National Park Doñana appears to be the most paramount aspect of the disaster. The media highlights the following aspects in its coverage of the incident:

- the importance of the Doñana National Park, the second biggest Park in the Iberian peninsula and one of the most important in the world due to its ecological value. It is classified as a Biosphere Reserve by the UNESCO and Human Heritage;
- the possibility of Doñana being contaminated, particularly through the aquifer; and,
- the existence of legislation specific to the National Park to protect it from any industrial activities that may involve any danger to its flora and fauna, which could have been used to interrupt Boliden's activities so near the park;

The coverage of the media has been sensationalist in this aspect. During the first few days after the disaster the newspapers printed dramatic photographs of dead fish and birds affected by the spill. Furthermore, they included explanatory diagrams of the way in which the contamination would be integrated into the food chain, as well as the migration patterns of birds that are still to arrive at Doñana and be affected by the contamination disaster. The endangered Park appears to be the unifying theme that has brought environmentalists and media together against the authorities and Boliden.

One of the newspapers (EL País) includes an article written by an environmentalist who claims that after this incident nature environmentalists have become more radical. He states that they were talked into not opposing the mining activity in Aznalcóllar, but after experiencing what has happened he will not be so easily influenced in the future.

The environmental organisations (CEPA) have already called for the interruption of four projects on the limit with the National Park.

Information on the tailings spill and tailings dam

The media coverage on the tailings spill and its causes has been constantly fed by opinions of experts, environmentalists and authorities. The newspapers have been trying to provide updated news on the causes for the failure of the dam, the contents of the spill, the danger to Doñana, crops and human health. The matter has never been left unattended and everyday since the spill there has been news on some technical aspect of the disaster. The main issues covered have been:

- **the cause of the tailings dam failure**

This has increasingly been focused towards the most recent inspection of the dam, and the subsequent report informing of its stability, as well as the police investigation conducted by SEPRONA;

The initial information regarding the causes of the spill was sparse and based on what Boliden reported: a breach in the tailings dam caused by a landslide underneath the dam. Later information was based on a combination of opinions coming from experts and environmentalists, as well as statements from Boliden and the authorities.

The latest report from SEPRONA was that the breach was caused by a movement of the plates underneath the dam, caused by explosions in the mine or a natural disaster. This report however is only based on visual inspections. More detailed reports and an investigation will be carried out by engineers.

- **the contents of the spill and the effect on crops, the Doñana Park and human health;**

Experts' analysis of the tailings mud were reported in the middle of May (ABC 14.05). The Comité Superior de Investigaciones Científicas (CSIC) is quoted as the source of the details on Table 1. This information was mainly given to highlight the experts' advice that the cleaning up process should be carried out with masks and gloves due to the toxicity of the tailings.

Table 1: Contents of the tailings sludge

Metal	Content p/tonne:
Zinc	8,000g
Lead	8,000g
Arsenic	5,000g
Copper	2,000g
Cobalt	90g
Talium	55g
Bismuth	70g
Cadmium	28g
Mercury	15g
Pyrite content	68 – 78%

· **the cleaning up process**

The newspapers report on the differences in opinions between the experts, the environmental groups and the authorities. Environmental groups claim that the use of heavy trucks for the cleaning up process will have a negative impact on the contaminated land. The authorities said they were going to change this but have not done anything (El Mundo, 25.05.98).

With regard to the cleaning up rhythm, the CSIC recommends the intervention of the army. The Minister of the Environment declared that the army's help would not be required. The newspapers report that generally the recommendations from the experts have not been followed. According to the authorities that tailings spill will be cleaned up by the autumn. Greenpeace thinks that the clean up process should increase by 100 in order to finish in time.

The newspapers again give more importance to the opinion of the environmental groups and the experts than to the authorities.

· **the clean up costs**

Several newspapers report on the plan of action set up by the Junta de Andalucía where they outline the costs of clean up. The Consejería de Medio Ambiente declared that the responsible for the disaster, Boliden Aspirsa will have to pay for these costs. However, the Junta de Andalucía, the State and European Regional Funds will initially cover the costs until all responsibilities are defined. The plan is open to modifications and is an attempt to establish a starting point in order to amend the impact of the toxic spill.

This is one of the authorities' only actions that appears to be regarded in a favourable light by the media. It is important to highlight the emphasis on the fact that the authorities are not paying for the clean up, they are advancing the money until Boliden is told to pay up.

Table 2: Clean up costs (Source: El País 13.05.98)

Activity	Funding (Ptas per million)
Recovery of fishing and agricultural activities	5,090
Cleaning up the spill	3,116
Recovery of the mining activity	660
Environmental quality	587
Recovery of river banks	440
Public information	202
Monitoring of health and safety	80
Scientific investigation	20
Supporting voluntary work	15
Total	10,210

The newspaper quotes a total budget of Ptas10,244 million.

The European Parliament approved a resolution in which it demands that Boliden pays the compensation payments and finance the rehabilitation of the areas affected by the catastrophe. It has asked the European Commission to provide special help to the affected sectors until compensation payments are settled. It also calls for the strengthening of regulations on the authorisation of activities such as the Aznalcóllar mines and forbid those in "areas of serious risk for the population and the general ecosystem." (Source: ABC 15th May 1998).

Economic and material effects

Apart from the costs of cleaning up the spill there are negative economic, labour and material impacts as result of the spill. As a whole, trade unions estimate a loss of 5,000 jobs in agricultural, fishing, tourist and nature conservation activities. Comisiones Obreras estimated a possible loss of 1,000 jobs per year due to the contaminated land becoming obsolete.

· Agriculture

Agriculture in particular is the industry that has received the most attention. It is calculated that the spill has affected 3,600 hectares of agricultural land. This figure varies depending on which organisation is quoted. With respect to costs, the Minister of Agriculture said that the estimated losses were Ptas1,500 million, contrasting with the figure estimated by the agricultural organisations: Ptas12,00 million.

Boliden has demonstrated a reactive behaviour which has not been regarded in a favourable light. It has refused to make compensation payments to farmers until the Court evaluates the losses. Boliden's only positive decision on this issue has been to pay for the lost crops this year, which will be destroyed. However, the full recovery of the agricultural land and its international image will take a long time.

· Mining

The Los Frailes mine has temporarily closed until the tailings dam is safely rebuilt. However, there been calls for the need to close the mine. Such a closure would have a negative impact on the socio-economic condition of the region. There have been demonstrations asking for the opening of the mine. The effects of the incident on employment have been immediate. After the incident 40 short term contracts have not been renewed. Out of the 520, only 130 miners are left working in the mine engaged in the cleaning up process of the tailings spill. In order to calm local fears, Boliden has guaranteed the net wages of 90 percent of its workforce.

However, 90 percent of the jobs in Aznalcóllar depend on the mine. 60 companies linked to Boliden are already initiating their own redundancy programmes. The closure of the mine would mean economic ruin for Aznalcóllar. Trade unions are calling for the setting up of a proper mechanism in place that will stop the incidents, as they cause an unreasonable degradation of the mining industry. The Ministry of Work has visited the area in an attempt to reassure the affected miners continuity in their jobs.

Authorities

The reaction of the authorities to the tailings disaster is one of the most thoroughly covered aspects of the incident. The division of responsibilities in the Spanish administrative systems has often led to confusion and overlapping roles of administrative bodies. The outcome is therefore a highly politicised debate over who is responsible when something goes wrong.

The aspects to which the media have given most attention have been:

- a lack of coordination when setting up an emergency plan and organising the cleaning up of the spill;
- an almost childish debate over which body was responsible for the permitting, monitoring and inspection of the dam, which in turn has resulted in a conflict between the national authorities (the Ministry of the Environment) and the regional bodies (Junta de Andalucía, Consejería de Industria and Consejería de Medio Ambiente);
- the apparent lack of action and concern from the regional authorities regarding the complaints about seepage from the dam since 1995 (these are referred to in more detail below);
- the call for the resignation of the heads of the above mentioned departments, including Isabel Tocino, the Environmental Minister, by both opposition parties (mainly Izquierda Unida) and environmental groups. The latter have organised a number of demonstrations, one of which ended in front of the Ministry of the Environment in Madrid, calling for resignations and acceptance of responsibilities. They not only targeted the Spanish authorities, but the European Commission and Boliden; and,
- the authorities' attempt at controlling the situation and shifting the emphasis from 'alarmist statements' to helping in the cleaning up process;

The angle taken by the newspapers is mainly that of the authorities being unable to protect the National Park Doñana. The issue has in a way become part of a pre-election campaign where the opposition parties are keen to highlight the present ruling parties' incompetence. The authorities in power do not take responsibility for the incident as the monitoring and inspection is done by Geocisa, a company employed by Boliden. They act on the reports they receive. They did not receive any that called for their intervention.

The newspapers show a clear bias against the authorities and their reaction to this issue. The media seems to fuel the politicisation of the issue and emphasize their apparent incompetence rather than present an impartial report on the incident. Several newspapers seem to call for the opinion of experts and environmentalists in order to discredit the authorities and have fostered the alarmist views.

Boliden

The main information provided by the media on Boliden is:

- Past record on filtration from the dam;
- Past environmental record on other international activities;
- Boliden's reaction regarding responsibilities and cleaning up costs; and,
- Boliden's financial record.

- **Past record on filtration from the dam**

This record dates back to 1995. Initially the newspapers highlighted the fact that in 1996 they had published a report on CEPA's denunciation to the authorities of filtration from the dam. On later days this was covered in a more comprehensive manner by all main national newspapers.

- 1995: a retired engineer who worked for Boliden informed the Consejería de Medio Ambiente that the mine's sewage plant was not even treating a 25 percent of the residual water coming from the mine. The rest was accumulated in permeable and badly built dams. This led to filtration into the Guadiamar. The Diario 16 quotes a member of CEPA saying that the company had tried to reduce costs rather than introduce safety measures.
- January 1996: CEPA reported that Boliden had contaminated the rivers Agrio and Guadiamar. They had detected filtration of heavy metals such as copper, zinc, lead and arsenic, which had affected several crops.
- February 1996: the Agencia de Medio Ambiente confirmed that one of the dams and the contents were discharged into the river Agrio.
- March 1997: the environmental groups sent a report to Aznalcóllar on the environmental threat of Boliden's mining operation. As a result the mayor wrote to Boliden and the Confederación Hidrográfica del Guadalquivir to ask about the safety of the dam. The response from Boliden stated that the dam held.
- August 1997: the investigation opened up by the European Commission following the complaints in February 1996 was filed after the commissioner judged that the solutions presented by the company were satisfactory.

The general tone presented by all the newspapers is a sense of incredulity at the lack of a clear reaction by the authorities to these incidents. There is an underlying message implying that the authorities should have seen this final incident coming and should have taken strong measures to avoid it. The newspapers clearly favour the environmentalists' side contrasting their willingness to express their opinions to the silence and disorientation within the authorities.

There are editorial articles written on this issue, highlighting the chain of events and denouncing the lack of prevision and enforcement of precautionary measures. These editorials are written by writers, journalists, environmentalists and university lecturers. The most extreme opinions express the concern over the fact that a mine was ever allowed to operate so near Doñana. Some of the titles reflect the widespread premonitory tone of the media.

"A spill announced two decades ago." (El Mundo 26.04.98).

"The sad experience of being an environmentalist." (El Mundo 27.04.98).

"Doñana: should never have happened." (ABC 01.05.98).

· **Past environmental record on other international activities**

The coverage of Boliden's activities was done in detail. The newspapers informed of the environmental record of Boliden Aspirisa in Spain and other environmental disasters Boliden has been involved with internationally. There are reports on the involvement of Boliden with the export of toxic waste by Boliden in Sweden to Arica in Chile, which led to the intoxication of local poor children. The media also briefly inform on two tailing dam incidents, one in Sweden and one in India.

Linked to these reports the newspapers introduce the idea that multinational companies come to Spain to take the income and leave the toxic waste. Although this is not a general approach taken by all newspapers, it is implied in some of the articles and the form in which information is presented.

· **Boliden's reaction regarding responsibilities and cleaning up costs**

The media's interest on Boliden's reaction to the disaster was biased towards whether it would pay for the cleaning up costs and compensation payments or not.

Boliden initially downplayed the long term effects of the spill and declared that media coverage on the event had exaggerated the facts (Reuters, 11.05.98). Boliden initially denied all liability and announced that it would pay the compensation sums set by the Court. (El Mundo, Cinco Días, 30.04.98). However, a couple of days later Boliden agreed with the Junta de Andalucía to start making compensation payments for the crops lost. Boliden will also pay the costs of the clean up operations.

There is more emphasis on the past record of the company and the reaction of the authorities to the disaster than to Boliden's reaction to the disaster. According to the media the authorities should have pressed criminal charges against Boliden instead of reaching an agreement with them.

- **Boliden's financial record**

The news on Boliden's financial record are sparse and vary from newspaper to newspaper. There is a general concern about the employment record and the financial conditions of Boliden Aspirsa. Only one newspaper has informed about the effect of the disaster on Boliden's share price in Toronto. A third concern has been the insurance details.

- ***Boliden's financial record***

The newspapers inform about Boliden Aspirsa's poor financial records. Francisco Vázquez, the president of the Boliden committee is quoted saying that Boliden has run a deficit of Ptas7,000 million. They expected that the opening of the new mine last year would bring the first benefits to the company. However, this tailings incident has delayed that objective.

The total investment of Boliden on the new mine is of Ptas31,388 million. The newspapers highlight the fact that in 1997 Boliden received Ptas5,000 million of financial aid funded by the European Union through the Junta de Andalucía. There seems to be an implicit question mark as to how and why was the funding approved after the list of denunciations made by the NGOs to the authorities, both in Andalucía and in Europe.

Such a weak financial track record is followed by an unstable employment record. The newspapers inform of the labour relations problems that Boliden has had in the recent past. There is information about the strikes and protests against Boliden's redundancy plans. There is also information about accidents resulting in death within Boliden's premises.

- ***Effect on stock markets***

The news of the tailings disaster led to a 28 percent decrease in the value of Boliden in the Toronto stock exchange in the space of five days. The financial markets were said to be 'punishing' Boliden for the disaster and its statement of waiting until the courts decided to pay compensation. Boliden later launched an information campaign through the Internet about it cleaning up to which the markets reacted well and the share value increased by 4.92 percent. The share value price reached a bottom of \$9.05 and recuperated up to \$9.60. Their highest value had been \$12.45 days before the incident.

- ***Insurance coverage***

The main concern regarding insurance details is whether the insurance policy will cover the cleaning up costs. Boliden has two insurance policies with two different companies.

- \$66m in property and business interruption insurance with Storebrand. This covers covering damage to the property and suspension of the extraction activity.
- \$13 million for third party liability insurance covered by Trygg Hansa. It is calculated that this is only an eighth of the costs of the incident.

As a whole Boliden Aspirsa's credibility has been greatly damaged. They are portrayed as incompetent, non-caring, and inefficient. Only trade unions, workers in Aznalcollar and the Ministry of Work seem to be concerned about the need for the mine to remain open. Public opinion (as reflected in the media) appears to be too concerned for the National Park and the crop losses to care for the mine.

Legislation

The newspapers report on several aspects of legislation relevant to this disaster that have either been ignored or violated, or should be improved in order to avoid these incidents from ever happening again. Furthermore, there are references to the implication of the European Union in the complaints made against Boliden's activities. The newspapers make the following references:

- **Ley de Aguas:** One of the articles highlights the importance of the Law on Water. In order to obtain the permits for “the discharge of water and waste products likely to contaminate continental water” and “for dams or excavations by means of evacuation, injection or deposit” there needs to be a hydrological study that demonstrates the inoquity of the water. It therefore questions whether Boliden had the permits, and if it had, what did the hydrological study cover and was it accurate. (Source: R. Martín Mateo, El País 2nd May 1998).
- **Ley de Residuos:** The Law on Waste¹ specifically states that “those causing the land contamination will have to carry out the cleaning up and rehabilitation operations. Each Autonomous Community will have to establish an inventory of contaminated land, upon which priorities for clean up will be established”.
- **Ley del Parque Nacional de Doñana:** The importance of this legislation is that it encloses an article whereby the Patronato de Doñana can call for the banning of any activity that can affect the waters that flow into the National Park. This article was included particularly because of the mining operations in Aznalcollar.
- **Criminal environmental offence:** Environmental NGOs (Greenpeace, Adena/WWF, CODA, CEPA) call for an immediate action from the State attorney to investigate who incurred in negligence and who is responsible of environmental offence. There has been a call for the need to accelerate the Ley de Responsabilidad Civil as the present Spanish criminal code is insufficient to prevent and repair environmental offence. The current Spanish criminal code states that environmental offence can be punished with sentences from a minimum of 6 months up to 4 years.
- **Complicated environmental legislation:** All newspapers emphasize the problem that the present environmental legislative framework presents due to the number of permits that one operation requires. There is a reference to the need to accelerate the transcription of the EU Integrated Pollution Prevention Control (IPPC) Directive which reduces the number of permits to one, once all the environmental impacts of a new installation have been studied.

¹ Ley de Residuos: published in the BOE 22nd April 1998.

- **Mining legislation and the environment:** Further to the complex environmental legislative framework in Spain, the mining industry seems to present a further complication. There seems to have been a traditional favoritism towards the mining industry when it comes to applying environmental protection measures. The magnitude of the investment required to get mines to meet the environmental standards required by environmental legislation has allowed them to be exempt from certain legislations (Law on Toxic and Dangerous Waste and Law on the Collection of Solid Urban Waste). Instead environmental protection measures are covered by the Mining Law which does not include technical details on minimum requirements to reduce environmental impact. The incident in Doñana is seen as a reminder of the need to revise the environmental protection measures demanded to the mining industry.
- **Proposal for an updated mining law:** In March 1997 the Consejo Superior de Ingenieros de Minas published a study on the mining situation in order to co-operate in the design of a new mining policy in Spain that would make the activity compatible with environmental protection. The current legislation is out of date and does not correspond to the present Administrative system of Autonomies in Spain. The General Director of Mines, Paloma Sendín, announced in January 1998 that they would work on a new law on the mining industry, which she defined as very liberal. However, there has not been any other information on this issue. (Source: Cinco Días, 27.04.98).

Conclusion

The tailings disaster in Aznalcóllar has been the subject of undivided media attention which appears to reflect a sudden uprise in concern for environmental protection. One could argue that the triggering factor for this reaction has been the threat that the spill represents to the Doñana National Park. This has led to a domino effect where no party has been excluded from the media coverage.

Direct impacts of the disaster

- Dire economic impact on the agriculture industry, the fishing industry, the mining community in Aznalcóllar, and the tourist industry in the region.
- Discredit on the environmental authorities (Ministry of the Environment and Consejería de Medio Ambiente), the mining authorities (Consejería de Industria) and the water authorities (Confederación Hidrográfica del Guadalquivir) as they are seen as partly responsible for the disaster, as well as lacking in emergency plan, and uncoordinated in their reaction.
- Discredit on the existing environmental legislation on the mining industry, and the complex system of permitting and authorisations required for one operation.
- Negative impact for Boliden, both in Spain and internationally: loss of credibility; sued for environmental offence; delayed in its mining operations; economic losses from the accident and compensation payments to third parties; international projection of its poor environmental record; antagonism with environmental

organisations; and loss in share value.

- Threat of contamination of the Doñana National Park.
- Public opinion turned against mining activity near the Doñana National Park, as well as growing suspicion of the safety of other dams in Spain.
- Higher profile for environmental NGOs such as CEPA, Greenpeace and ADENA due to the attention and preferential treatment they have received from the media.

Indirect impacts of the disaster

- Defensive attitude from the regional authorities on new projects with a high environmental profile due to the nature of the activity and/or the location. This response could imply delays in permitting processes, due to reluctance to be involved directly with any project.
 - Possible requests from the authorities for more detailed information, specifically related to safety and environmental protection measures, as well as risk assessment.
 - Possible proposals for more restrictive environmental protection measures in the mining industry, as well as a change in the permitting procedure based on the IPPC Directive from Europe.
 - The lack of a definitive explanation for the tailings spill is likely to have a negative impact on the reputation of the mining industry in Spain. This is because the public could perceive Boliden as the representative of the industry.
 - Greater public awareness and sensitivity on environmental protection issues, which increases pressure on authorities and environmental organisations as they are likely to be the centre of attention if any other incidents take place.
 - Increased alertness from environmental organisations on new projects likely to have high environmental impact.
 - Possible reaction against multinationals setting up activities of high environmental impact in Spain. Possible difficulty in balancing the benefits of having a powerful head company, combined with a fairly independent Spanish project in the eyes of public opinion.
 - The reaction from the businesses and trade unions in Aznalcóllar reflects the local attitude favouring the creation of employment rather than environmental protection with no development.
-

Appendix 1: Reference list of newspaper articles

Date	Paper	Section	Article
26.4.94	ABC	Ecología	Un gran vertido tóxico de las minas de Aznalcollar pone en peligro a Doñana Tocino : "No hay peligro evidente que pueda alterar la vida humana."
	El Mundo	Sociedad	Un desastre ecológico amenaza a Doñana Un vertido anunciado desde hace dos décadas
	Diario 16	Titulares	Catástrofe ecológica en Doñana
		Sociedad	Doñana, en peligro Greenpeace pide la actuación de oficio de la Fiscalía del Estado
27.4.98	El Mundo	Sociedad	Tanto Doñana como el entorno van a quedar gravemente contaminados durante años La penosa experiencia de ser ecologista
	Diario 16	Titulares	Teníamos una bomba de relojería en Doñana
		Sociedad	Greenpeace dice que Doñana "ya está hipotecada por muchos años" La minera afirmó hace un mes que la presa aguantaba
	Expansión	Contenidos	Tocino asegura que Doñana se ha salvado de una catástrofe ecológica
	Cinco Días	Economía/ Medio Ambiente	Boliden reconoce la gravedad del desastre de Doñana pero continuará operando la mina Una legislación obsoleta
28.4.98	El Mundo	Sociedad	Medio Ambiente a petición de la Junta permite otro vertido en Doñana El derrame tendrá efectos marginales sobre Doñana Reacciones de indignación Doñana envenenada
	Diario 16	Sociedad	La Fiscalía investiga con qué se construyó la presa de Doñana Alerta sanitaria a los pueblos afectados
	Expansión	Opinión	Aznalcóllar
		Empresas	La catástrofe de Aznalcóllar agrava la crisis financiera de la minera Boliden en España
	Cinco Días	Economía/ Medio Ambiente	La Fiscalía pone manos a la obra para imputar responsabilidades en Doñana La ley obliga a los responsables del vertido a pagar la limpieza El desastre ecológico tardará, al menos 50 años en superarse Aznalcóllar, el talón de Aquiles de Boliden

29.4.98	El Mundo	Sociedad	La contaminación en Doñana quedará para la eternidad Tocino minimiza el desastre Suecia se avergüenza de su empresa El acuífero 27, hipoteca del parque
	Diario 16	Sociedad	Además de Doñana Manifestaciones de protesta Bruselas pide explicaciones a Tocino por el suceso de Doñana
	Cinco Días	Economía/ Medio Ambiente	La Junta Andaluza carga contra Boliden y rechaza indemnizar a los afectados
30.4.98	El Mundo	Editorial	Doñana, el desastre ecológico del 98
		Chistes	Ricardo y Nacho (MoE & NY) Gallego y Rey (Boliden and MoE)
		Sociedad	La marisma se cubre de peces muertos Los ecologistas piden la creación de un comité de emergencia Tocino busca 'solidaridad' en Nueva York Boliden: Pagaremos lo que digan los tribunales Los científicos proponen utilizar la biotecnología para salvar a Doñana Riesgo de alimentos contaminados Primeras pérdidas de nidos y aves Los frutales pierden sus hojas por el veneno Las tierras de cultivo: 10 años sin producción
	Diario 16	Sociedad	Los ecologistas piden que alguien se responsabilice del desastre
	Expansión	Opinión	Quién paga el pato en Doñana
	Cinco Días	Economía/ Medio Ambiente	Esto es jauja! Ander Bulow: "El juez determinará la responsabilidad de cada uno".
01.5.98	ABC	Opinión	¿Quién responde ?
		Tribuna Abierta	Doñana: nunca debió suceder
		Titulares	Isabel Tocino: "El Estado es Damnificado en el desastre ecológico de Doñana" El gobierno expedienta a la empresa sueca Boliden como responsable de la catástrofe de Doñana
		Ecología	El Gobierno culpa de la responsabilidad civil a la empresa: "El Estado es Damnificado en el desastre ecológico de Doñana" Chaves: "Las Administraciones han dado una mala imagen".
	El Mundo	Opinión	Ahora todos quieren desfilan por la pasarela Doñana Doñana o las carencias de una política hidrológica

		Titulares	El gobierno nombra un coordinador para Doñana seis después del desastre
		Sociedad	Doñana : seis días después se nombre un coordinador Borrell : "Ahora hay que buscar soluciones, no culpables." Las claves del mayor desastre medioambiental Trabajadores de Boliden se enfrentan a ecologistas El coste para la empresa sueca será de unos 600 millones Optimismo en el CSIC por el bajo contenido de mercurio hallado Marchando una de langostinos CCOO advierte de que el desastre afectará a unos 5.000 empleados
	El País	Titulares	El Gobierno y la Junta andaluza firman la paz para colaborar en Doñana
		Sociedad	Recogidos 6.500 kilos de peces muertos y 715 huevos de ave dañados Prohibida la pesca en el Guadiamar y en gran parte de las marismas Los ecologistas piden la retirada, urgente pero con garantías, de los lodos contaminados Gobierno y Junta de Andalucía se coordinan tras cinco días de desastre en Doñana El CSIC realizará el informe científico sobre el vertido tóxico
	Diario 16	Sociedad	Creado un gabinete de crisis siete días después del desastre
	Cinco Días	Titulares	Boliden y la Junta pactan indemnizar ya
		Editorial	Responsabilidades en Doñana
		Economía	Boliden y Junta pactan indemnizar a los afectados sin esperar la decisión judicial
02.5.98	El País	Titulares	La empresa minera pagará los daños de Doñana sin esperar a una orden judicial

		Sociedad	La empresa que causó el vertido de Doñana pagará las cosechas y eliminará los lodos Boliden implicada en daños en Suecia y Chile Garantizan la continuidad de los 520 empleados de la explotación Ninguna empresa española se considera capaz de limpiar las tierras de contaminadas 500 voluntarios de ofrecen para paliar el desastre Un milagro en forma de piedra Andalucía es la comunidad con más terrenos contaminados Jacob Soderman : Investigaré Doñana si se plantea una queja de la Comisión
		Opinión	La balanza y la espada (Ramón Martín Mateo)
	ABC	Titulares	Boliden retirará los lodos tóxicos a la zona minera
		Ecología	Doce toneladas de peces muertos han sido recogidas ya en el entorno de Doñana La ministra de Agricultura comió ayer langostinos de Sanlúcar Los agricultores exigen máxima urgencia en el adelanto de indemnizaciones
	El Mundo	Opinión - Chiste	Especies protegidas
		Sociedad	Boliden pagará la limpieza del entorno de Doñana El Guadalquivir no tiene ningún problema Manuel Repetto : "Me preocupa Doñana pero también la salud" Doñana convertida en una gigantesca "morgue" acuática "Al feria de abril que llegó el puente."
	Diario 16	Sociedad	Más de 12 toneladas de peces muertos, retiradas de Doñana Arenas garantiza los puestos de trabajo Andalucía es la comunidad con más suelos contaminados
03.5.98	El Mundo	Sociedad	Empieza la limpieza de los lodos de Doñana sin consultar a los expertos Una semana con el paso cambiado Después de la catástrofe IU denuncia que el PSOE y el PP quieren "desviar la responsabilidad"
	Diario 16	Sociedad	Comienza la retirada de los lodos de la riada tóxica

04.5.98	El Mundo	Sociedad	Tocino y Chaves critican el “alarmismo injustificado” Los acuíferos a salvo En el interior del Parque nacional la vida salvaje sigue su ritmo Soluciones para Doñana
	El País	Sociedad	Los ecologistas tenían razón
	Diario 16	Sociedad	Los productos contaminados no llegarán al mercado Los ecologistas piden más medidas
	Cinco Días	Titulares	Doñana: Gobierno, Junta y Boliden rebajan la alarma
		Sociedad	Gobierno, Junta y empresa minimizan los daños y esperan que pare la “excesiva alarma”. Boliden mantendrá el empleo en la mina
05.5.98	El Mundo	Sociedad	Los mercados financieros ‘castigan’ a Boliden
	El País	Chiste	Forges
		Sociedad	El partido Los Verdes denuncia a los políticos y a la empresa Boliden La lluvia paraliza la recogida de lodo procedente de la presa rota cerca de Doñana En peligro el desarrollo de la comarca La catástrofe empezó hace mucho tiempo
	Diario 16	Opinión	Doñana después de la tragedia
		Sociedad	Los alcaldes piden justicia “La alarma no es buena, pero la prudencia sí”.
	Expansión	Empresa y medio ambiente	Legislación ambiental en el sector minero
	Cinco Días	Economía/ Medio Ambiente	Los diez Ayuntamientos afectados por el vertido piden un PER extraordinario
06.5.98	El Mundo	Ecología	Aviones y bacterias contra los lodos tóxicos Queja ante Europa La trama política ¿Quién limpia Doñana ?
	Diario 16	Ecología	Doñana supera en cuatro veces su límite de toxicidad
	Cinco Días	Economía/ Medio Ambiente	Los agricultores reclaman daños a 2.000 hectáreas

07.5.98	ABC	Ecología	Doñana : el CSIC advierte que la eliminación mecánica de los lodos tóxicos "no será total". Los ecologistas denuncian que los lodos se entierran en vez de ser trasladados UGT pide un PER especial para los jornaleros afectados
		Andalucía	Chaves, dispuesto a asumir todas las responsabilidades, ya que fue elegido 'para lo bueno y para lo malo'.
	El Mundo	Sociedad	La empresa Boliden se compromete a indemnizar a los agricultores
	Diario 16	SOS	Entierran el lodo contaminado Paros y mineros
08.5.98	ABC	Breves	Accidente en Aznalcollar Tocino responsabiliza a la Consejería andaluza de Industria de los vertidos en Doñana
		Ecología	Tocino responsabiliza a la Consejería andaluza de Industria de los vertidos en Doñana El Gobierno a favor de crear una comisión de investigación
	El País	Sociedad	La juez decreta la libertad del representante de la mina
	Diario 16	SOS	Detectan niveles de arsénico en los lodos de Doñana "No concibo responsabilidad política en lo que no tenemos competencia".
	Cinco Días	Las City	Un desastre ecológico con antecedentes
09.5.98	El Mundo	Titulares	El acuífero 27 de Doñana está contaminado según un informe de la Confederación Hidrográfica
		Sociedad	El acuífero de Doñana está contaminado La contaminación baña continuamente la reserva
	Diario 16	SOS	El arsénico no conlleva riesgo, dice Rodriguez Greenpeace detecta talio, empleado en raticidas en los lodos
10.5.98	El Mundo	Sociedad	Una nueva presa trata de evitar que el agua de Boliden pase por encima de los lodos tóxicos La Confederación niega que el acuífero está contaminado

11.5.98	Diario 16	SOS	Los agricultores de Doñana denuncian que les boicotean Anulaciones hoteleras con pérdidas de 120 millones
	Cinco Días	Empresas	Boliden regula empleo hasta septiembre y asegura el 90% del sueldo neto.
11.5.98	Reuters		Embattled Boliden downplays impact of Spanish spill
12.05.98	ABC	Ecología	Doñana: la presa de Entremuros que retiene el agua contaminada no ofrece garantías
13.05.98	ABC	Ecología	El Parque Nacional de Doñana en grave peligro tras las lluvias caídas en la zona.
		Sociedad	El seguro por daños a terceros de Boliden sólo cubre 2.000 millones de pesetas
	El País	Sociedad	PSOE y PA rechazan crear una comisión de investigación. Agricultores de Doñana impiden la entrada de maquinas hasta recibir sus indemnizaciones.
14.05.98	El Mundo	Sociedad	'Tocino, dimite por Doñana'
	ABC	Sociedad	La Guardia Civil investiga si la riada tóxica se debió a explosiones en la mina
	ABC	Andalucía	Los científicos insisten en la necesidad de usar mascarillas porque los lodos contienen cinco kilos de arsénico y ocho de plomo por tonelada.
	El País	Sociedad	Las pesquisas de la Guardia Civil apuntan al movimiento de tierras como causa del vertido.
15.05.98	ABC	Sociedad	El Parlamento Europeo exige que Boliden pague los costes del desastre de Doñana
16.05.98	El País	Sociedad	Aznácollar se echa a la calle para reclamar la reapertura de la mina.
17.05.98	El Mundo	Sociedad	Boliden era la presa más vigilada.
	ABC	Sociedad	Doñana: Tocino confirma la aprobación de un decreto ley de 'expropiación temporal' de las fincas afectadas
	EL País	Sociedad	Plan para convertir en corredor verde el suelo tóxico de Doñana
18.05.98	El Mundo	Sociedad	Presentan una denuncia que pide prisión preventiva para los directivos de Boliden
	ABC	Andalucía	Boliden pidió permiso para aliviar la blasa de residuos cincuenta días antes de que se produjera el reventón del muro.
	El País	Opinión	Sensores ciegos

19.05.98	El Mundo	Sociedad	Medio Ambiente tenía competencias directas en la balsa de Boliden
	El País	Sociedad	La empresa Boliden se resiste a pagar la limpieza del desastre de Doñana
20.05.98	ABC	Andalucía	La Fiscalía de Huelva abre diligencias por le vertido de pirita de Aznalcóllar en escombreras de Tharsis
22.05.98	ABC	Sociedad	Para los ecologistas, la retirada de residuos va despacio
24.05.98	ABC	Sociedad	Benigno Blanco: 'No es momento de buscar culpables, sino de resolver el problema.'
25.05.98	El Mundo	Sociedad	La rotura de la presa: un mes de preguntas sin solución Doñana, un lodalzal de problemas
	ABC	Nacional	PP e IU pedirán a Chaves esta semana en el Parlamento que destituya a los consejeros de Industria y Medio Ambiente.
27.05.98	El Mundo	Sociedad	Izquierda Unida se querrela contra Boliden y Tocino
28.05.98	El País	Sociedad	La mina Boliden hizo vertidos durante 12 años con autorizaciones provisionales