Risk Evaluation for the Intel Rio Rancho Facility

Chronic Risk Assessment
Catastrophic Risk Assessment
Chronic Risk Assessment Appendices
Catastrophic Risk Assessment Appendices

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Executive Summary

In Intel's continuing efforts to be responsive to environmental, health, and safety concerns, a set of risk assessments was conducted to investigate possible health and environmental impacts associated with their operations. This included an evaluation of both chronic and catastrophic risks as well as an evaluation of Intel's preparedness for compliance with Section 112(r), the Accidental Release Prevention provisions of the Clean Air Act. These focused risk assessment studies were conducted by Radian International LLC, an independent environmental consulting firm. The results of these risk assessment efforts clearly show the operations at the Intel Rio Rancho facility are safe.

In addition to the primary goal of assuring the safety of the people in the surrounding area, there are also other concerns that these assessments address. By demonstrating the certainty of the safeness of the facility, it follows that the quality of life for people living and working in and around the site will not be impacted. The risk assessment can also serve to help maintain home and land values in the surrounding community by clearly showing the facility is operating in a safe manner. This would be difficult to demonstrate without these risk assessments. These risk assessments constitute a body of work which can be relied on to assure there is no risk, human health or otherwise, attributable to the Intel's Rio Rancho facility.

Chronic Risk Assessment

The underlying goal of the chronic risk assessment was to assure that the most sensitive individuals and/or populations are protected. In most cases, the sensitive individuals are considered to be children and the elderly. Using these sensitive populations to drive the risk assessment assures that all of the individuals in the surrounding area are safe as well.

This assessment was conducted using the best available methods and were designed to be overly conservative and as such, are likely to overestimate any real risks. The methods used to conduct the risk assessment have been developed with input from academic institutions, private institutions, federal, state and local governments as well as comments from the general public.

In general, this assessment was conducted in accordance with the United States Environmental Protection Agency (USEPA) guidance titled Risk Assessment Guidance for Superfund and the USEPA guidance titled Proposed Guidance for Carcinogenic Risk Assessment. The methods laid out in these documents are designed to assess long-term health risks associated with the facility. The long-term health risks addressed include not only risks of developing cancer but also include an assessment of a large number non-cancer health risks such as skin irritation, headaches, emphysema, or other organ damage.

For cancer risks, those chemicals which are thought to cause cancer (i.e., carcinogens) are first evaluated as to whether they are direct acting carcinogens or if they are what is know as threshold carcinogens. Direct acting carcinogens are the chemicals that are believed to pose an incremental increase of cancer risk following exposure. Using this assumption, that there is an increase in risk after any exposure from these chemicals, necessarily requires that a level of acceptable risk be determined. The level of acceptable risk is generally accepted to be

anything less than one in a million. That is, if the risk of developing cancer from direct acting carcinogens is less than one in a million for a facility such as Intel, then there is high confidence that the facility poses no increased risk of developing cancer. It was determined during this risk assessment effort that none of the chemicals evaluated at the Intel site are considered to be direct acting carcinogens.

Threshold carcinogens on the other hand are those chemicals that are considered to not necessarily pose an increase risk of cancer at low dose levels. Threshold carcinogens are analogous to noncarcinogens in that both types of chemicals have a threshold of tolerance. That is, there is no increase health risk from exposure to these chemicals until a certain threshold of exposure has been reached. The cancers induced by threshold carcinogens are a secondary effect to some primary toxic effect, e.g., liver damage that may lead to liver cancer or skin or lung irritation that eventually may lead to skin or lung cancer.

Therefore, as a conservative approach, the exposure level of concern for these chemicals is the lowest level that produces an effect and not the higher levels that may eventually result in cancer. The risk of threshold carcinogens is quantified in a manner similar to noncarcinogens. This is accomplished by adding the risks of all chemicals classified as threshold carcinogens.

As discussed above, noncarcinogens are chemicals that have the potential for causing systemic health effects. Similar to the threshold carcinogen, the risks for all noncarcinogens are totaled. Finally, the risks of threshold carcinogens and noncarcinogens are added to derive the Hazard Index for the site. A Hazard Index of less than one indicates it is unlikely there is any risk of adverse health affects associated with the noncarcinogens or threshold carcinogens that could be released into the environment at the Intel site.

To begin the evaluation of chronic risk, information on both the processes and chemicals used by Intel were reviewed to produce a comprehensive list of chemicals that potentially could be released to the environment. The result was a list of 72 chemicals either used or emitted as a by-product of Intel's processes. Further review of this initial list, taking into consideration chemical use, potential for release, chemical reactivity, and previous evaluations to meet environmental standards reduced the list to 22 chemicals.

To evaluate chemicals of concern, routes of exposure were developed based on the types of chemicals and emissions from the facility. Inhalation of ambient air, ingestion/ inhalation of soil and ingestion of local produce were determined to be the primary routes of exposure.

As discussed previously, the more sensitive populations, such as children, are included in the risk evaluations along with all other potentially exposed populations such as workers and residential adults. The risks associated with these exposure rates were quantified for the following groups of people:

- Adult residents;
- Child residents;
- Adult workers; and
- Children attending a nearby daycare center or school.

An initial risk-based screening process evaluated whether the chemicals exceeded 10% of the USEPA-approved risk-based concentrations. USEPA guidance requires that chemicals without USEPA-approved toxicity values must be evaluated in the subsequent comprehensive

risk evaluation. Fourteen chemicals were included in the comprehensive evaluation because they lacked USEPA-approved toxicity values.

Following the risk-based screening, the 14 chemicals are evaluated in the comprehensive risk analysis. Of the 14 chemicals included in the comprehensive risk analysis, twelve are considered noncarcinogens and two (silicon dioxide and sulfuric acid) are considered to be threshold carcinogens. As described previously, these threshold carcinogens have adverse noncarcinogenic health effects at levels much lower than those that lead to cancer. Because of these systemic effects, silicon dioxide and sulfuric acid were evaluated using the more conservative threshold.

Following the risk-based screening, the 14 chemicals are evaluated in the comprehensive risk analysis which includes: modeling to determine the range and extent of public exposure and the methodology developed for determining uptake of the chemicals in adults, children and sensitive populations. Two of the 14 chemicals included in the comprehensive risk analysis have the potential to be carcinogenic. However, these chemicals, silicon dioxide and sulfuric acid, are threshold carcinogens and have adverse noncarcinogenic health effects at levels much lower than those which lead to cancer. Because of these systemic effects, silicon dioxide and sulfuric acid were evaluated using the more conservative threshold.

The cumulative hazard index for the 14 chemicals included in the comprehensive analysis (noncarcinogenic compounds and threshold carcinogens silicon dioxide and sulfuric acid) was less than one. The quantified cumulative hazard indices for the groups of compounds that target the same organs ranged form 0.18 to 0.48. These hazard indices indicate that adverse health effects are highly unlikely at the Intel facility and that the Intel operation is safe.

Catastrophic Risk Assessment

Catastrophic risks were evaluated in response to public concerns about the potential for catastrophic releases of hazardous chemicals. The main focus of this risk assessment was toxic gas releases but it also considered risks from compressed toxic gases, bulk liquid storage and transportation incidents.

Catastrophic risks were evaluated by comparing Intel's process safety management practices with those of the Occupational Safety and Health Administration's Process Safety Management Rule (OSHA PSM) and the USEPA's accidental release prevention rule. Even though Intel does not have sufficient quantities of chemicals on site to require compliance with these regulations, the company's procedures were compared with the regulatory requirements as a method of benchmarking the effectiveness of their risk management practices.

The catastrophic evaluation followed this four-step process:

- An evaluation of Intel process safety and risk management practices;
- A hazard evaluation to identify and estimate the potential for various catastrophic release scenarios;
- A consequence analysis to estimate community impacts of releases; and
- A risk evaluation to calculate risk and rank various release scenarios.

The evaluation of Intel process safety management practices considered both direct and indirect control measures for preventing and mitigating incidents. Direct control measures are equipment design and other engineering controls. Indirect controls are various

administrative procedures and practices that govern the safe handling of materials, and the training and certification of personnel handling materials.

Because of the strict direct and indirect controls employed by Intel and their chemical suppliers, development of large catastrophic release scenarios are limited. The hazard evaluation identified the following four major scenario categories for an accidental release:

- Off-site transportation incident involving compressed gases or bulk chemicals;
- On-site transportation incident involving compressed gases or bulk chemicals;
- Outdoor fixed facility incident with compressed gases, or bulk chemicals; and
- Indoor fixed facility incident with compressed gases.

A consequence analysis for specific scenarios in each of these categories was prepared by modeling the potential off-site impacts. Modeling of ammonia, chlorine, and hydrogen fluoride showed the greatest impact for outdoor releases. If compressed gases were released indoors, Intel's controls and containment procedures would eliminate ground-level impacts. Releases of bulk gases and liquids were determined to pose little threat of off-site consequences because of the localized nature of the release and the containment procedures that Intel applies.

The risk evaluation combines the probability of an incident occurring with the possibility of off-site consequences to produce a ranking of the risks. Event frequency for facilities handling compressed gases such as chlorine, ammonia, and hydrogen fluoride range from one in 10,000 years to one in 1,000,000,000 years. At Intel, event frequencies less than one in 1,000,000 years were calculated for releases of compressed gases. The event frequency for other bulk materials such as hydrochloric acid are once in 100 years. However, the potential for off-site impact is very low for this type of release because of Intel's controls. The overall ranking for possible events is:

- On-site outdoor bulk liquid release;
- Off-site transportation bulk liquid release;
- On-site transportation bulk chemical release;
- Off-site transportation compressed gas release;
- On-site outdoor compressed gas release; and
- On-site indoor compressed gas release.

In addition to evaluating the more probable release events, Intel modeled a multiple cylinder release to respond to public concerns. The results of this release scenario impact neighbors at distances as far as 2 miles from the facility. The distances of impact for this type of release are comparable with the potential release from other sources such as municipal drinking water treatment facilities.

The catastrophic evaluation demonstrated that Intel has in place many of the recommended process safety management practices in both the OSHA PSM rule and the accidental release prevention rule. In some areas, Intel's practices exceed the requirement of these standards. Furthermore, Intel already has in place many of the required practices for compliance with Section 112(r) that does not go into effect until June 1999.

In conclusion, the Chronic Risk Assessment and the Catastrophic Risk Assessment clearly demonstrate that the Intel facility is safe. It is highly unlikely that any adverse health effects could result from the Intel site given the safety and control measures already in place at the Rio Rancho facility.

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Introduction

Intel Corporation initiated a risk assessment to examine chemical emissions from the company's Rio Rancho, New Mexico facility and to provide an independent review of Intel's risk management procedures. This risk assessment focused on the chemicals that pose the greatest risk and are of most concern to the general public. The risk evaluation reviews the chronic risk posed by exposure to the chemicals of concern. The catastrophic evaluation reviews the impacts posed by a catastrophic event on the public and measures Intel takes to mitigate and reduce these risks. As part of the process of focusing this risk assessment, the public concerns, as expressed by the Community Advisory Panel (CAP), were considered in developing the risk scenarios and chemical selection process.

Intel's facility is located adjacent to New Mexico Route 528 in Rio Rancho, NM. It is a 180-acre complex that is high on a bluff overlooking Corrales, NM to the east. The facility has commercial buildings to the north and west of the facility. The area is mostly suburban with houses and apartments dominating the area surrounding the facility. Figure 1-1 shows the facility location and Figure 1-2 is an aerial photograph of Intel and the surrounding area.

Intel has been producing semiconductor wafers in New Mexico for 14 years at its present location. The Intel facility consists of three fabrication facilities, Fabs 7, 9, and 11 and a variety of support buildings. Fab 7, built in 1983, is the oldest production facility and is located on the northern end of the facility. Fab 9 which contains several modular production facilities began operation in 1988 and reached full production in 1991. Fab 11 is the newest of the facilities which started operation in 1994. Fab 11 produces Intel's most recent products including the Pentium® microprocessor. Fab 11 continues to expand to house new production technologies for Intel.

Each of these facilities produces semiconductor wafers for Intel using a variety of chemicals in its production processes. Intel has incorporated its environmental health and safety activities into how it manages and uses chemicals in its production processes. Formal training programs and extensive documentation of procedures help maintain operations in a way that does not adversely affect the community's air, water, and land. Part of Intel's strategic planning requires that new processes reduce environmental burden with an emphasis on reduction of chemical use per wafer produced. This risk assessment is an independent evaluation of the procedures in place at Intel for managing use of chemicals and minimizing environmental releases and their impact on the surrounding community.

Chronic Risk Evaluation

A chronic risk assessment consists of several evaluations that together determine the risk of long-term exposure to chemicals. The first evaluation is a review of all possible emissions from the facility to determine those that should be considered in the analysis. Then dispersion modeling is performed to determine the potential exposure to the public. The potential routes of exposure to the chemicals are evaluated and estimates of intake are developed based on the modeling. The toxicology of the modeled chemicals is reviewed and toxicity profiles for the plausible exposure routes are developed through the use of available toxicological

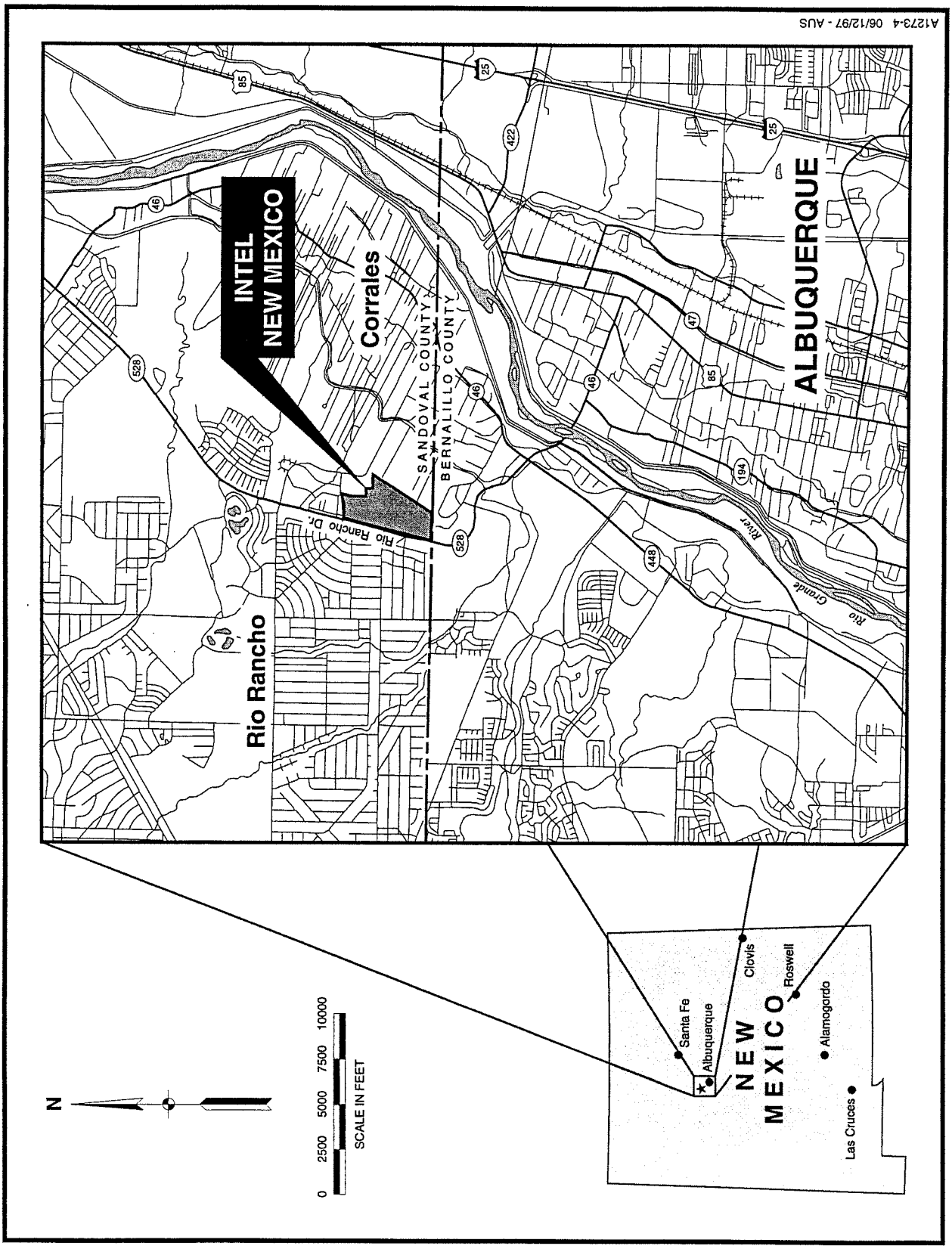

Figure 1-1. Location Map of Intel, New Mexico

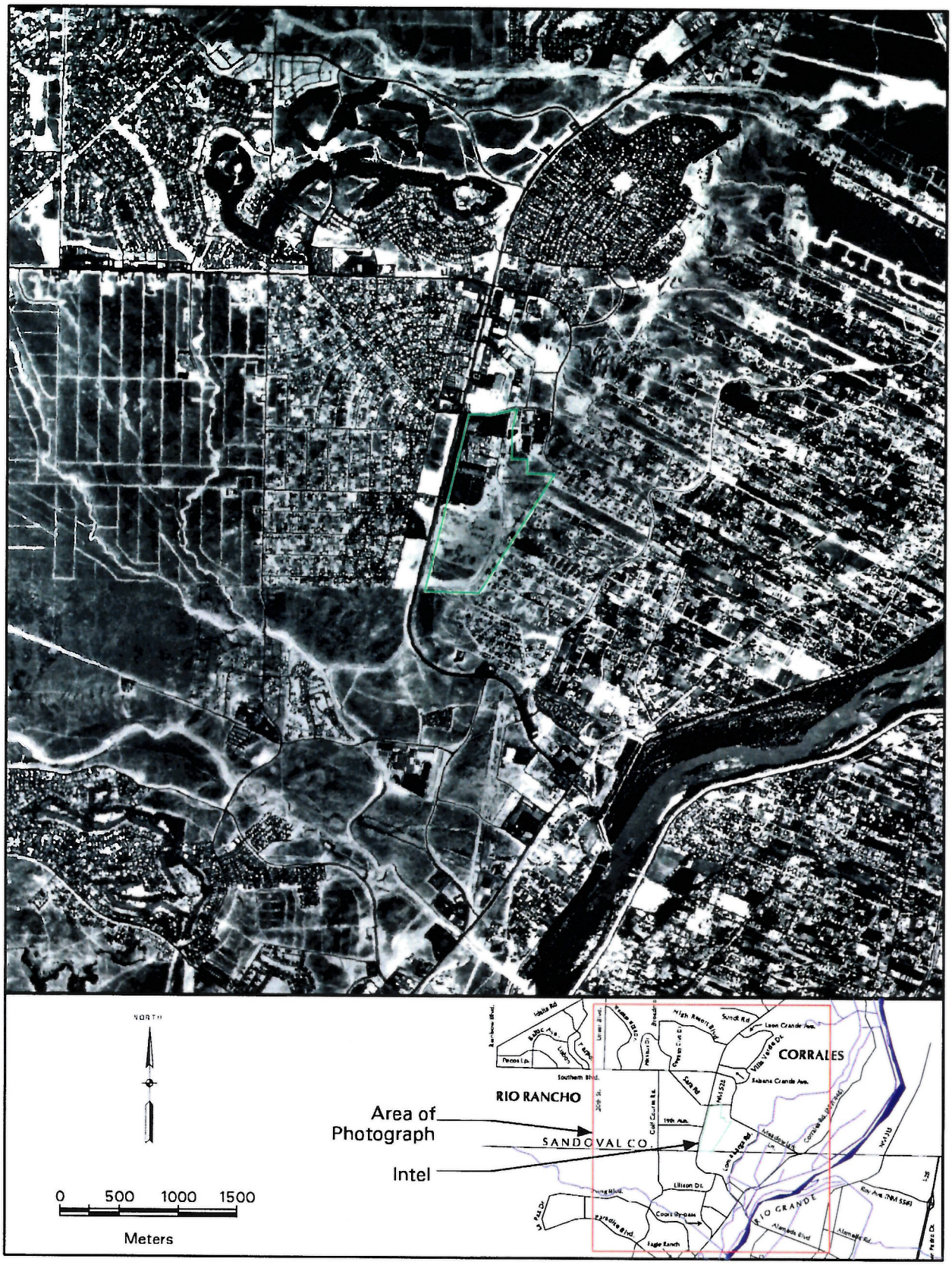

Figure 1-2. Aerial Photograph of the Intel Facility and Surrounding Area (1991)

literature. Finally, the risks associated with each exposure are quantified based on USEPA methodology for evaluating risks.

The overall risk analysis process consists of an initial screening phase and a comprehensive phase. The screening phase considers all possible chemical emissions and exposure pathways. The screening analysis often includes a review of all chemicals used at a facility and any available monitoring data. The screening portion of the analysis is designed to focus the analysis on those chemicals whose toxicity and concentration warrant inclusion in the comprehensive phase. The focus of this risk assessment is on chemicals that are likely to be emitted to the ambient air and could potentially affect the public. The comprehensive phase of the analysis evaluates the potential for these chemicals to produce adverse health effects.

Catastrophic Risk Evaluation

The catastrophic risk evaluation consists of several evaluations to determine the overall impact and probability of a catastrophic event. The first portion of the evaluation consists of a review of all of the chemicals and operations at the site. As a result of this evaluation, a list of possible catastrophic events is developed. The events are ranked on the basis of quantity of the chemicals and their toxicity. Following this ranking, work practices and controls are evaluated to determine how they prevent or mitigate the consequences of an accident. A consequence analysis is performed using dispersion modeling to estimate the off-site areas affected by the accidental release. Finally, a risk evaluation is conducted to estimate both the frequency and consequences of the release events.

Input from the Community Advisory Panel

In September 1995, Intel presented its plans to prepare this site-wide risk assessment to the CAP. The panel raised a number of concerns related to Intel's operations. Because this is a focused risk assessment and some of those concerns could not be addressed by this assessment, some issues were not included. Table 1-1 summarizes the concerns raised by the CAP and notes the concerns that are addressed in the risk assessment.

Table 1-1
Community Advisory Panel Concerns Addressed by the Risk Assessment

Concern	Addressed by Assessment	Comments
Intel property could become a Superfund site.	Partially	This issue is not the primary focus of the risk assessment but review of Intel's procedures for handling chemicals is included.
Possibility of an explosion	Yes	The potential impacts of an explosion are included.
Intel is a complex industry—Who knows what could happen?	Yes	Possible accidental release conditions were determined and evaluated.
Intel could use its money to buy a solution to the risks.	Partially	Intel's procedures and risk management are reviewed in this study.
EEP in the air	Yes	Specific risks from EEP are addressed.
Toxic chemicals and gases flowing down the hill.	Yes	Both the catastrophic and chronic risk assessments evaluated potential off-site impacts.
Accidents and toxic clouds	Yes	The catastrophic risk assessment reviews both the possibility of accidents and the potential areas of impact.
Polluting the aquifer	Partially	This issue is not the primary focus of the risk assessment but review of Intel's procedures for handling chemicals is included.
Intel may take the water and go.	No	The primary focus of the study is the risk that Intel's operations pose to the public.
Earthquakes, plane crashes, and internal accidents	Yes	The catastrophic risk assessment reviews both the possibility of accidents and the potential areas of impact.
Vulnerable people, e.g., elderly, sick	Yes	The risk assessment included the evaluation of risk to sensitive populations such as the elderly and children.
The closer to the site, the bigger the risk.	Yes	The risk assessment evaluated the risk to the public within a 10-square-mile area surrounding Intel.
Toxicity of chemicals used, e.g., hydrogen fluoride.	Yes	The risk assessment reviewed the toxicity of chemicals used at Intel.
Wind direction makes some people more vulnerable.	Yes	Meteorological data were used to model the effect of wind on potential exposures.
Intel employees get paid to take risk but the public doesn't.	Yes	The primary focus of the study is the risk that Intel's operations pose to the public.

Overall Conclusions

Both the chronic and catastrophic risk assessments have shown that Intel does not pose additional risks to the community. Intel's management and their philosophy not only support the reduction in risks to as low as reasonably possible, but include this reduction process in the design, construction, and operation of its facilities. The independent review has shown that the safeguards included in Intel's facility combined with its chemical selection process have minimized both the chronic and catastrophic risk to the community.

The results of the chronic risk evaluation indicate that the potential for carcinogenic and noncarcinogenic health effects is negligible. The chronic risk assessment has demonstrated that the cancer risks posed by Intel's routine emissions are negligible when compared to National Contingency Plan goals. The off-site exposure to chemicals which could have systemic health effects are orders of magnitude less than concentrations which would be the minimum level that could result in adverse health effects. The combined hazard index for all noncarcinogenic chemicals, which is a method to gauge the potential for health effects from all chemicals and pathways, is half of the minimum level recommended in the National Contingency Plan for protection of human health.

Like the chronic risk assessment results, the catastrophic results demonstrate that Intel does not pose any risks beyond those which are reasonable. The probability of catastrophic events occurring at Intel is less than the published incidence probability for similar industries. Intel's risk management practices both meet and exceed any applicable safety regulations which apply to their management of catastrophic risks. Intel has in place the safety management practices that exceed those required for facilities with maximum on-site storage of much greater quantities of chemicals.

Even though the catastrophic risk assessment identified a number of areas that Intel could further improve its risk management program, many of these program refinements were already being considered by Intel's safety professionals. Intel has started to meet some of the additional documentation recommendations by preparing this risk assessment because the information contained in the study will be used as a basis for consolidation of process safety documentation. Intel's philosophy of continuous improvement makes it easier as an organization to implement the risk assessment recommendations.