

Health Consultation

Vineland Chemical Company

**Vineland City, Cumberland County, New Jersey
Cercis No.: NJD002385644**

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Prepared By:

**Environmental Health Service
The New Jersey Department Of Health**

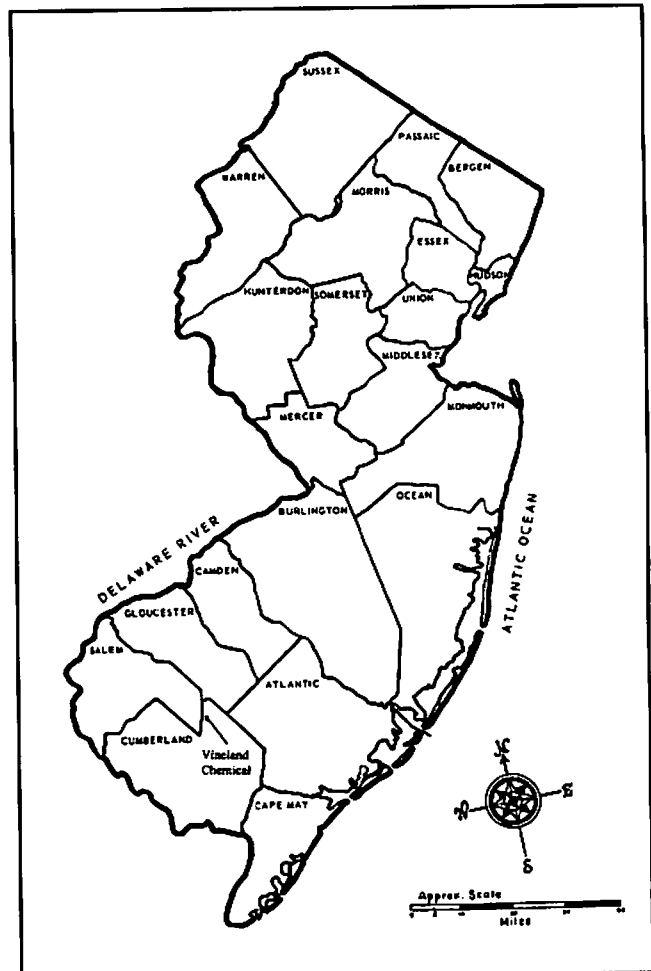
**Under A Cooperative Agreement With:
The Agency For Toxic Substances And Disease Registry**

Background and Statement of Issues

The Vineland Chemical Company (VCC) is located in the City of Vineland, Cumberland County, New Jersey (see inset). The site consists of approximately 54 acres in the northwestern corner of Vineland. Land use in the area is mixed residential and industrial. Access to the VCC site is along Wheat Road.

The VCC was a manufacturer of agricultural chemicals (herbicides, pesticides, fungicides) between 1947 and the late 1980's. Improper storage and disposal of raw material and wastes at the plant resulted in significant on-site and off-site arsenic contamination. The VCC also produced cadmium based herbicides, and used other inorganic chemicals including lead and mercury. The New Jersey Department of Environmental Protection (NJDEP) has reported that in 1966, the VCC was discharging untreated waste waters into unlined lagoons, and waste salts containing up to 2% arsenic were being stored in open piles without containment barriers, in an open concrete pit with cracked walls, and in empty chicken coops. Groundwater underlying the site became contaminated via leaching of the arsenic laden wastes which sporadically overflowed onto the soil.

Groundwater and soil are the primary contaminated media on-site. Migration of on-site contamination has occurred through surface water runoff and movement of groundwater, and has resulted in the contamination of nearby surface water bodies. Contaminated groundwater in the environs of the VCC site discharges into nearby wetlands associated with the Blackwater Branch and then flows into the Maurice River drainage system. Specifically, the Blackwater Branch of the Maurice River, the Maurice River below the confluence with the Blackwater Branch, and Union Lake exhibit significant site related arsenic contamination of surface water and sediments (Figure 1). The Draft Remedial Investigation reported that approximately six metric tons of arsenic per year are being discharged from the groundwater into the Blackwater Branch. Low levels of arsenic have been detected throughout the entire length of the Maurice River to its point of termination at the Delaware Bay approximately 25 miles downstream.



The Maurice River and Union Lake are used for recreational purposes such as swimming,

fishing and watercraft. Completed human exposure pathways exist at the VCC site and are associated with swimming (ingestion of surface water and sediments), consumption of fish from Union Lake, and past contact with on-site contaminants by children.

The VCC plant had several manufacturing and storage buildings, a laboratory, a worker changing facility, a waste water treatment plant, and several lagoons (Figure 2). The manufacturing and parking areas are paved while the areas around the lagoons are unpaved and are presently devoid of vegetation.

Residential areas border the VCC to the east, west, south, and partially to the north. Martex Manufacturing, which produces packaging materials, is located to the north of the VCC. Eight residences are adjacent to the facility and several other residences are located close to the plant along Wheat, Orchard, Oak, and Mill Roads.

Remedial Progress

As early as 1966, the VCC was documented as discharging untreated waste waters directly into unlined lagoons. The VCC was subject to a series of Administrative Consent Orders starting in 1971. VCC instituted cleanup actions and modified production processes in 1979. These activities included installation of a non-contact cooling water system, lining of two lagoons, the removal of surface soils in the manufacturing area (and the subsequent paving of this area), installation of a storm water runoff collection system, disposal of the piles of waste salts, and installation of a waste water treatment system to treat arsenic-contaminated effluent. In 1982, the VCC was denied a New Jersey Pollutant Discharge Elimination System (NJPDES) permit thus ending the practice of discharging effluent from the waste water treatment unit to on-site lagoons. The company reportedly changed manufacturing processes so that water used in the manufacture of the herbicides was consumed by the process and was included as inherent moisture in the product. The treatment system implemented by the VCC was found to be ineffective by the NJDEP, and the waste water treatment operation was halted in July 1987.

A Record Of Decision (ROD) was signed between the USEPA (lead remedial agency) and the VCC on September 28, 1989 which presented the remediation plan for the site.⁽²⁾ The USEPA has divided the task of remediating the site into four Operable Units (OU's). OU1 is concerned with the VCC plant and requires on site soil consolidation and flushing, as well as groundwater remediation. OU2 deals with the wetlands (Blackwater Branch) immediately adjacent to the VCC facility, and proposes excavation of contaminated sediments. OU3 is concerned with the Maurice River area sediments. OU3 may not require a removal action; the decision regarding Maurice River sediments will be based upon a three year study of arsenic concentrations once the sources in OU 1&2 are remediated. Natural attenuation may preclude the need for sediment removal in the Maurice River. OU4 deals with Union Lake, and proposes lowering the level of the lake with the removal of contaminated sediments. The Remedial Investigation/Feasibility Study (RI/FS) was completed in 1989 for OU1, OU2, and OU3. The USEPA has also conducted investigations of the effects of site related contamination on Maurice River, and Union Lake flora and fauna.^(3,4,5,6)

Past ATSDR/NJDOH Activity

The ATSDR conducted a Health Assessment of the VCC site (May 1989) in which the site was evaluated to present a potential public health hazard.⁽⁷⁾ The Health assessment cited potential exposure pathways associated with ingestion of surface waters, sediments and biota. Recommendations to limit exposure included that access to the site be restricted to limit contact with contaminants, and that the areas of the Maurice River used for bathing be posted. Access to the VCC site has been restricted by the USEPA. Bathing areas of the Maurice River have not been restricted or posted. The conclusion of the Health Assessment that no known exposure is occurring through recreational use of the Blackwater Branch or Maurice River is not accurate under present site conditions and in light of current information.

The NJDOH conducted a Site Review and Update (SRU) for the VCC site in May 1995.⁽⁸⁾ This SRU evaluated the site to present a public health hazard based upon likely completed human exposures associated with ingestion of surface water, sediments, and biota. The SRU recommended that sections of the Maurice River utilized as beaches be evaluated to determine the public health significance of exposures to bathers, and that the impact of site related contamination upon the biota of the Maurice River and Union Lake be evaluated.

Site Visit

Representatives of the NJDOH (James Pasqualo) and the ATSDR (Steve Jones, Arthur Block, Gregory Ulirsch) visited the VCC site on June 20, 1995. NJDOH and ATSDR personnel were accompanied by the Remedial Project Manager of the USEPA. Conditions at the VCC facility were stable, with no visible evidence of trespassing or other non-authorized entry. There were observed no overt or obvious physical hazards at the VCC site.

Bathers (adults and children) were observed at the three beaches (locations 1-3) depicted in Figure 1. These locations are apparently utilized extensively by area residents during warm weather for bathing and wading. In addition, residents were observed utilizing canoes on the Maurice River.

At Union Lake, residents were observed fishing and there were a great number of watercraft and dock facilities present. Fishing advisory signs were present, but these were non-specific and apparently not associated with arsenic contamination of the VCC site.

The ATSDR and the NJDOH conducted an availability session on the evening of June 20, 1995 in an effort to document past and current community concerns regarding the VCC site. This availability session was attended by the Remedial Project Manager of the USEPA and the Health Officer for the City of Vineland.

Statement Of Issues

This consultation will evaluate the public health significance of the two assumed exposure pathways cited in the SRU for the VCC site: ingestion of surface water and sediments of the Maurice River and at the Union Lake Sailing Club beach by bathers, and the effect of site-related arsenic upon biota of the Maurice River and Union Lake.

In addition, this consultation will evaluate the community concerns of individuals who attended the Availability Session of June 20, 1995. These concerns related to the possible health effects of past exposures to adult residents who played on or near the on-site waste piles and lagoons as children.

Bathing in the Maurice River

Three areas of the Maurice River are used by residents for bathing. These are depicted in Figure 1. Location 1 is known locally as Almond Beach, locations 2 and 3 as Alliance and "BA" beach respectively. These three areas have been sampled by the USEPA as recently as May 1995.⁽⁹⁾ In an effort to accurately determine risk to bathers utilizing these bathing areas, disturbed water samples were secured by the USEPA and analyzed for the presence of arsenic. The maximum concentration of arsenic in disturbed waters found in May 1995 was 200 ug/l at location 1. Similarly at location 1, beach soils contained arsenic at 4 mg/kg, and sediments at 10 mg/kg. These values will be the basis for the toxicological evaluation of all beach locations within this consultation.

Union Lake Sailing Club Beach

The USEPA provided a sampling report to the NJDOH with resultant data from samples taken on June 29, 1995, regarding surface water and beach soil quality at the Union Lake Sailing Club beach (Figure 1; location 4). Undisturbed water samples indicated the presence of arsenic at 15 ug/l, and beach soil samples indicated the presence of arsenic at 2.9 mg/kg. These values will be the basis for the toxicological discussion of this location within this consultation.

Biota

The USEPA has attempted to evaluate the effects of the VCC site upon biota of the Maurice River and Union Lake. In 1993, these efforts were culminated in four reports which examined fish community structure, benthic community structure, aquatic plant community structure, and a determination of sub-lethal effects of arsenic upon fish.^(3,4,5,6) These investigations were intended to establish a reference where upstream (non-affected) biota could be compared to presently affected areas and ultimately to postremedial populations.

Community Concerns

At the Availability Session of June 20, 1995, a family who resides adjacent to the VCC site

expressed concern regarding the potential for adverse health effects among adult members who were likely exposed to on-site arsenic as children while playing on the site. In addition, residents related that the family maintained a garden in close proximity to contaminated chicken coops, ingested eggs from chickens occupying those coops, swept and removed wastes from these coops, and had contact with contaminated surface water.

Of primary concern, residents related that as children, they experienced frequent, direct contact with lagoon sediments and waste piles which were estimated by the USEPA to contain approximately 350 mg/kg of arsenic. This pathway will be the basis for the toxicological evaluation of this consultation.

Residents questioned whether arsenic exposure could contribute to the occurrence of illnesses experienced by the family including: genetic and reproductive effects (ovarian cancer), lung cancer and other respiratory problems, renal effects, and cardiovascular effects.

Discussion

This section discusses the potential for health effects in persons exposed to arsenic contaminated surface water, sediments and biota found near the Vineland Chemical site. Estimates regarding the potential for adverse health effects are made by estimating the amount (or dose) of those contaminants that a person might come in contact with on a daily basis. This estimated exposure dose is then compared to established health guidelines. Persons who are exposed for some crucial length of time to contaminants of concern at levels above established guidelines are more likely to have associated illnesses or disease.

Health guidelines are developed for contaminants commonly found at hazardous waste sites. Examples of health guidelines are the ATSDR's Minimal Risk Level (MRL) and the USEPA's Reference Dose (RfD). When an exposure dose is below the MRL or RfD, then non-carcinogenic adverse health effects are not likely to occur. MRLs are developed for each duration of exposure, such as acute (less than 14 days), intermediate (15 to 364 days), and chronic (365 days and greater). The ATSDR presents these MRLs in Toxicological Profiles. These chemical-specific profiles provide information on health effects, environmental transport, human exposure, and regulatory status.

The toxicological effects of the arsenic detected in environmental media has been considered singly. The cumulative or synergistic effects of mixtures of contaminants may serve to enhance their public health significance. Additionally, individual or mixtures of contaminants may have the ability to produce greater adverse health effects in children as compared to adults. This situation depends upon the specific chemical being ingested or inhaled, its pharmacokinetics in children and adults, and its toxicity in children and adults.

Bathing in The Maurice River

To evaluate the public health significance of the data collected regarding the Maurice River beaches, exposure doses for inorganic arsenic and subsequent lifetime excess cancer risk estimates (LECRs) were calculated. Maximum concentrations of arsenic cited in the *Field Investigation Report* were utilized for pertinent media: disturbed water (200 ug/l), beach soil (4 mg/kg), and sediments (10 mg/kg).⁽⁹⁾ The human exposure pathway is assumed to be ingestion of arsenic contaminated surface water, beach soils, and sediments. Toxicological estimates were calculated for adults assuming a 70 kg body weight, an ingestion rate of 50 ml/day for surface water, 100 mg/day for beach soils, and 100 mg/day for sediments. Additionally it was assumed that an adult would swim 4 days a week for four months a year, over a duration of 40 years. For children, a body weight of 10 kg was assumed with ingestion rates of 50 ml/day for surface water, 200 mg/day for beach soils, and 200 mg/day for sediments over a ten year duration.

The ATSDR has established a minimal risk level for chronic oral exposure (duration > 1 year) of 0.0003 mg/kg/day which is equivalent to the USEPA chronic oral reference dose. At media concentrations cited above, adult exposure doses for the three potential human exposure pathways (combined) were below the chronic oral MRL for inorganic arsenic. At such concentrations non-carcinogenic health effects among adults are not generally expected. Exposure doses for children were estimated to be less than (but in the same order of magnitude as) the chronic oral MRL. Estimated exposure doses for children are below all the no observed adverse effect levels (NOAELs) cited in the ATSDR Toxicological Profile for Arsenic⁽¹⁰⁾. For both adults and children, there would be no apparent (10 E-5) increased carcinogenic risk based upon calculated exposure doses.

Union Lake Sailing Club Beach

To evaluate the public health significance of the data collected regarding the Union Lake Sailing Club Beach, exposure doses for inorganic arsenic and subsequent lifetime excess cancer risk estimates (LECRs) were calculated. Maximum concentrations of arsenic reported to the NJDOH by the USEPA were utilized for pertinent media: undisturbed water (15 ug/l), beach soil (2.9 mg/kg). Sediment data for this location were not available. The human exposure pathway is assumed to be ingestion of arsenic contaminated surface water, and beach soils. Toxicological estimates were calculated for adults assuming a 70 kg body weight, an ingestion rate of 50 ml/day for surface water, and 100 mg/day for beach soils. For children, a body weight of 10 kg was assumed with ingestion rates of 50 ml/day for surface water, and 200 mg/day for beach soils. Additionally it was assumed that adult would swim 4 days a week for four months a year, over a duration of 40 years, while children would swim with the same frequency over a duration of 10 years.

The ATSDR has established a minimal risk level for chronic oral exposure (duration > 1 year) of 0.0003 mg/kg/day which is equivalent to the USEPA chronic oral reference dose. At media concentrations cited above, exposure doses for adults and children for the two potential human exposure pathways (combined) were below the chronic oral MRL for inorganic arsenic. At such concentrations non-carcinogenic health effects among adults or children are not generally expected.

For both adults and children, there would be insignificant or no ($< 10 \text{ E-6}$) increased carcinogenic risk based upon calculated exposure doses.

Biota

The USEPA has, as part of the remedial process for the VCC site, investigated the status of the ichthyofauna, aquatic flora, and benthic invertebrate communities in the upper Maurice River and Union Lake. General trends indicate that arsenic concentrations have negatively affected the abundance and diversity of macroinvertebrate and plant species.^(4,5) As part of the investigation for the *Report to Study Sublethal Effects of Arsenic on Fish*, a study of bioaccumulation in species likely to enter the human food chain was conducted.⁽³⁾ However, all data from two sample collecting episodes failed validation. There are presently no data describing bioaccumulation of arsenic in fish from which exposure doses may be estimated. Union Lake is presently the subject of a fishing advisory for mercury contamination unrelated to the VCC site. This advisory recommends that pregnant women, women planning pregnancy within one year, nursing mothers, and children refrain from consuming fish from the lake. Other individuals are advised to limit consumption of fish (large mouth bass and pickerel) to once a week. In the absence of specific arsenic bioaccumulation data, this advisory indirectly serves to minimize the potential for exposure through the pathway associated with ingestion of biota from Union Lake.

Community Concerns

Health concerns expressed at the Availability Session by a family who resided directly adjacent to the VCC site included questions regarding ingestion of potentially contaminated vegetables and eggs. There were no data or other information available to the NJDOH by which to evaluate this potential exposure pathway. There are sufficient data to evaluate the completed exposure pathway associated with ingestion of contaminated soils and/or sediments.

To evaluate the public health significance of past exposure to on site soils/sediments as related to the NJDOH during the availability session of June 20, 1995 exposure doses for inorganic arsenic and subsequent lifetime excess cancer risk (LECR) estimates were calculated. Concentrations of arsenic were estimated by the USEPA for pertinent media: waste piles (350 mg/kg), and lagoon sediments (350 mg/kg). The human exposure pathway is assumed to be the ingestion of arsenic contaminated soils or sediments. Toxicological estimates were calculated for children assuming a 20 kg body weight, and an ingestion rate of 200 mg/day for either soils or sediments. Additionally, it was assumed that a child would play in either on-site soils or lagoon sediments 4 days per week, for nine months per year, over a duration of 5 years.

The ATSDR has established a minimal risk level for chronic oral exposure (duration > 1 year) of 0.0003 mg/kg/day which is equivalent to the USEPA chronic oral reference dose. At the media concentrations cited above, the estimated exposure dose for a child for the potential exposure pathway cited exceeded the chronic oral MRL for arsenic. At such concentrations the no observed adverse effect level (NOAEL) cited in the ATSDR Toxicological Profile for Arsenic for

gastrointestinal, hematological, dermal/ocular, and neurological effects is achieved or exceeded. With regard to specific health issues expressed by residents, oral exposure to arsenic at the dose cited above may contribute to the incidence of systemic cancers and cardiovascular problems. According to the Toxicological Profile for Arsenic, chronic oral exposure is not generally associated with adverse genetic and renal health effects.

Concerns regarding the potential for adverse health effects relating to inhalation of arsenic containing dusts were expressed to the NJDOH and the ATSDR during the Availability Session. Although there are insufficient data to quantify an accurate exposure dose from inhalation of arsenic contaminated dusts, the ATSDR Toxicological Profile does report that lung cancer and other respiratory effects (mucosal damage, decreased lung function) are consistent with chronic inhalation exposure to inorganic arsenic at the concentration presumed to be present at the time of exposure (approximately 350 mg/kg). In addition, chronic inhalation exposure may be associated with adverse cardiovascular effects. Renal health effects were not cited in the Toxicological Profile associated with chronic inhalation exposure. Although chronic inhalation exposure may serve to decrease the average birth weight of infants born to exposed mothers, there was no evidence of genetic or other reproductive effects (i.e. ovarian cancer) cited in the ATSDR Toxicological Profile for Arsenic.

Based upon chronic oral exposure at the concentrations cited above, estimated exposure dose estimates would represent a low (10^{-4}) increased carcinogenic risk. The cancer risk associated with chronic inhalation exposure could not be directly quantified, but could be of public health significance with regard to systemic and lung cancers based upon arsenic concentrations presumed to be present at the time of exposure and information presented in the ATSDR Toxicological Profile for Arsenic.

Conclusions

Under the assumptions utilized for the toxicological evaluation of the potential exposure pathways associated with the Maurice River beaches, exposure doses for children approach but do not exceed the chronic oral MRL for arsenic. However, chosen assumptions used in toxicological estimates imply a worst case scenario. Actual exposure potential is likely to be significantly less than "worst case", with a consequent reduction in resultant exposure doses. Reduced exposure potential would also serve to lower the calculated LECR to insignificant levels. In light of current data and information, it is unlikely that bathing at the Maurice River beaches indicated in Figure 1 would result in adverse carcinogenic or non-carcinogenic health effects among non-hypersensitive individuals. (The ATSDR and the NJDOH have evaluated the Vineland Chemical Company site to represent no apparent public health concern for bathers using the Maurice River Beaches based upon current data and information.)

Based upon current data and information, and under the assumptions utilized for the toxicological evaluation of the potential pathways associated with the Union Lake Sailing Club beach, exposure doses for adults and children were not at levels where adverse carcinogenic or non-carcinogenic health effects are likely among non-hypersensitive individuals. (The ATSDR and the NJDOH have evaluated the Vineland Chemical Company site to represent no apparent public health concern for bathers using the Union Lake Sailing Club Beaches.)

There are insufficient data by which to evaluate the public health significance of arsenic bioaccumulation of Union Lake biota. The general fish advisory in place for Union Lake, while not a result of contamination from the VCC site, will serve to interrupt this exposure pathway if it is observed. The ATSDR and the NJDOH have evaluated the Vineland Chemical Company site to present an indeterminate public health hazard with respect to Union Lake biota.

Residents living next to the VCC site who related exposure to on-site arsenic as children may have experienced exposure doses at levels of public health significance. Based upon the assumptions utilized for toxicological evaluation of the pathway associated with on-site soils and sediments, adverse carcinogenic and non-carcinogenic outcomes are or were possible. Resident's concerns with adverse cardiovascular and pulmonary effects are plausible with respect to reported exposure circumstances. In addition, the estimated carcinogenic risk to children represents a significant public health concern. The ATSDR and the NJDOH have evaluated the Vineland Chemical Company site to have represented a public health hazard in the past with respect to the exposure circumstances expressed by residents at the availability session of June 20, 1995.

The remedial plan for the VC site, when implemented, will serve to interrupt current human exposure pathways associated with Maurice River beaches, the Union Lake Sailing Club beach, and Union Lake biota, and is protective of the public health.

Recommendations

Cease/Reduce Exposure Recommendations

- 1) Edible species of fish in Union Lake should be sampled to determine the degree of bioaccumulation of arsenic. The ATSDR/NJDOH should review these data for public health significance upon availability.
- 2) Remedial plans specified in the Record of Decision should be implemented according to plan. Of particular public health significance is the need to remediate upstream areas in such a manner as to not increase the arsenic concentration of sediments at bathing areas.

Site Characterization Recommendations

- 1) The ATSDR and the NJDOH concur with the USEPA in recognizing the need to sample Maurice River beaches prior to the seasonal onset of warm weather as a precautionary measure to insure concentrations of arsenic do not exceed levels of public health concern.

Health Activities Recommendation Panel Determinations

The data and information developed in the health consultation for the Vineland Chemical Company site, Vineland City, New Jersey, has been evaluated by the ATSDR's Health Activities Recommendation Panel (HARP) for appropriate follow-up with respect to health activities. The panel determined that community health education and health professional education are indicated. Specifically, this education effort should be focused upon those individuals who were exposed in the past to on-site contaminants and expressed concerns regarding this exposure to arsenic contaminated wastes. The panel suggests that these persons who were exposed in the past should be evaluated by a physician with specialty in environmental health to determine appropriate health follow-up. No other follow-up actions are indicated at this time.

Public Health Actions

The Public Health Action Plan (PHAP) for the Vineland Chemical Company site contains a description of the actions to be taken by the ATSDR and/or the NJDOH at or in the vicinity of the site subsequent to the completion of this Public Health Consultation. The purpose of the PHAP is to ensure that this consultation not only identifies public health hazards, but provides a plan of action designed to mitigate and prevent adverse human health effects resulting from exposure to hazardous substances in the environment. Included is a commitment on the part of the ATSDR and the NJDOH to follow-up on this plan, to ensure that it is implemented. The ATSDR will provide an annual follow-up to this PHAP, outlining the actions completed and those in progress. This report will be placed in repositories that contain copies of this consultation, and will be provided to persons who request it. The public health actions to be implemented by the ATSDR/NJDOH are as follows:

Actions Undertaken

- 1) Residents who related probable exposure to arsenic as children have been provided the ATSDR's *Case Study for Arsenic Toxicity*, to be provided to personal physicians. In addition, the resources of the ATSDR and the NJDOH have been made available for consultation regarding health implications of past exposures.
- 2) Environmental data and proposed remedial activities have been evaluated within the context of human exposure pathways and relevant public health issues.

Actions Planned

- 1) A physician newsletter will be prepared by the NJDOH for distribution to those areas potentially impacted by the site to provide information regarding possible environmental exposure to arsenic.
- 2) A community education project is being planned by the NJDOH for the VCC site.
- 3) The ATSDR and the NJDOH will coordinate as deemed necessary, with the appropriate environmental agencies to develop plans to implement the cease/reduce exposure and site characterization recommendations contained in this consultation.

Certification

This Public Health Consultation for the Vineland Chemical Company site was prepared by the New Jersey Department of Health under a cooperative agreement with the Agency For Toxic Substances and Disease Registry (ATSDR). It is in accordance with approved methodology and procedures existing at the time the public health consultation was initiated.

Technical Project Officer, SPS, SSAB, DHAC

The Division of Health Assessment and Consultation (DHAC), ATSDR has reviewed this Public Health Consultation and concurs with its findings.

Division Director, DHAC, ATSDR

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