

POSITION PAPER: MANAGEMENT OF COMPLEX AREAS AND MEGASITES IN LATIN AMERICA

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Complex Areas and Megasites

Latin America is a privileged territory due to its breadth, abundance of natural resources and strategic position. Due to the economic development and population growth observed in recent decades, the region creates a favorable environment for industrial development, which is sometimes not properly controlled. This movement has significantly impacted the environment, in the most diverse aspects. Despite growing environmental awareness, there are several challenges to be faced in the region in order to rectify the environmental problems.

In this context, one of the impacts observed consist of the areas classified as contaminated, present in the main industrialized regions and which are targets of public concern. When found in urban centers, they can generate interest in reuse by the real estate market. Some of these areas, due to a range of specific characteristics, can represent a much more complex challenge when it comes to taking actions to repair environmental damage.

According to NRC (2013), Complex Sites are those “where remedial approaches are not anticipated to bring the site to closure or facilitate transitioning to sustainable long-term management within a reasonable time frame”. They typically have “multiple attributes that present remediation challenges and therefore take much longer to reach site objectives compared with typical sites”. ITRC (2017) identified the technical and nontechnical challenges that can result in a complex site, such as “Large-Scale” conditions.

The WELCOME Project was an initiative organized by the European Union between 2002 and 2004 that developed an Integrated

Management Strategy to enable the management of Megasites. The initial description that was adopted was that Megasites “are large conurbations of sites where contamination has arisen independently. However, often over time, as contamination has spread, these environmental problems caused by these sites have become inter-linked” (Bardos, 2003). Later in this project, according to Durant & Cox (2007), they were described as “a large (5 - 500 km²) area with multiple contaminant sources related to (former) industrial activities, with a considerable impact on the environment, through groundwater, surface water and/or air migration.” The United States the Environmental Protection Agency (USEPA) has only developed a monetary definition: “any hazardous waste site where the total cost of investigation and cleanup, excluding long-term care, equals or exceeds \$50 million (USEPA 2003).” Within an academic publication context, Schadler et al. (2011) defined them as “large, complex and prominent brownfields” .

This set of characteristics, makes the effective environmental management of Complex Site or Megasites to be challenging from a technical, economic, legal and temporal point of view. In these types of situations, traditional rehabilitation approaches can normally not achieve their intended goals.

The references above indicate that the management of these areas shall include the adoption of a global rehabilitation strategy, based on a long-term integrated and adaptive management program. This may be based on a system for ranking subareas and/or clusters according to existing risks, prioritizing expenditure and remediation actions for areas

where the greatest risks have been identified. In this methodology, the definition of a well developed Conceptual Model, which will be constantly updated, represents the central point for decision-making processes, since the degree of urgency is determined by the severity of the risks to human health and the environment. The goals for adopting an integrated Complex Site/Megasite management strategy may include:

- Prioritize investments and optimize costs related to rehabilitation actions;
- Set priorities (ranking) for the reduction of risk levels to the most sensitive potential receptors according to technical criteria;
- Set specific and realistic goals for the rehabilitation of these areas;
- Technical and economic sustainability throughout the project's life cycle;
- Social responsibility regarding the rehabilitation of areas impacted by industrial processes;
- Search for a solution that provides legal certainty.

Hart et al. (2023) evaluated data from the State of São Paulo and concluded that recognizing Complex Areas and applying Adaptive Management has the potential to assist the management of other sites in Brazil. This shall be done while taking into account local adaptations and considerations, such as: 1) including in the definition of Complex Areas that the challenges should demonstrably present high complexity and require atypical times for restoration or rehabilitation (more than 15 years, in São Paulo); 2) considering the extensive mantle of weathering of humid tropical regions; 3) considering the high number of unregistered catchment wells; 4) considering the existence of socioeconomic conflicts; 5) evaluating, including with isotopic studies, the possible presence of Combined Plumes.

Despite the efforts of regulatory entities in Latin America, there is still a gap in the guidelines and legislation on how to effectively manage these areas, in order to provide a real benefit in environmental terms, as currently the focus of actions is on a site scale and restricted to small portions of the impacted land. However, in the case of large complex contaminated areas, this may not provide the rehabilitation required at a regional level or within reasonable time frames.

As is common with developing technological innovations, several procedures as well as technical instructions for establishing an integrated and adaptive management program come from North America and Europe. Recent case studies that have been evaluated by the NICOLE Latin America indicate the feasibility of implementing these approaches in the region. However, it is important to highlight that the use of this knowledge alone is not enough, as these procedures were elaborated based on specific data from their respective countries, which may or may not be compatible with the Latin American scenario. Thus, notably, the use of this approach in Latin America may imply the assumption of a range of challenges, such as:

- Adhere to the concepts of the integrated and adaptive management strategy, those recommended in the regional legal framework and other standards related to the Contaminated Areas Management process;
- Overcome barriers in the exchange of information related to contaminated areas between different companies in the same region;
- Meet the expectations of different stakeholders;
- Make risk perception realistic;
- Adaptation of the methodology to the conditions of the regional physical and sociological environment, in accordance to the program and in order to distinguish the areas with the greatest risk potential.



Considering the above, the NICOLE Latin America network agrees that:

Considering the needs and the imminent challenges present in the region, NICOLE Latin America, through its specialized Technical Groups, proposes a change in this reality, positioning itself to study in detail the process of environmental management of Complex Areas and Megasites, taking into account the economic and technical availabilities of the industry in the region. By considering the best practices available worldwide, NICOLE Latin America aims to adapt these practices to ensure the actions taken are compatible with the regional scenario, while also being feasible within the economic and technical capabilities of the industry.

The members of the network agree and recognize that there is a need for this discussion to be fostered, through the production of specific publications on the topic, which will be prepared in order to provide a theoretical and pedagogical library, in order to contribute to the establishment of a regulatory framework adequate to the scale of the challenge.

Our next steps include the preparation of a Thematic Document and the dissemination of examples and initiatives being carried out at the regional level for the management of Complex Areas and Megasites. Considering the complexity and magnitude of these areas, as well as the socio-economic reality of Latin America, we are also proposing the establishment of a Taskforce committed to evaluate economic models for funding remediation of Complex Areas and Megasites in Latin America.

NICOLE Latin America

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