Overview of the Adaptive Pathways "Subway Maps" and Gantt Chart

draft of 4 Sept 2015

The subway maps are intended to provide a way to view the possible pathways moving forward, given the different water supply "Elements" that WSAC is considering. Each subway diagram shows pathways forward over time, as well as possible "decision nodes" and other information, as described below. The figures provide a simple visual representation of the information contained in the attached Gantt chart.

The Three Elements Potentially Added to the Water Supply Portfolio

In addition to the existing CIP projects and Water Conservation Master Plan (WCMP), as already planned for implementation in the years ahead (shown as "Element 0"), there are three additional elements portrayed:

- ***Element 1: In-Lieu***, which starts quickly as a small program relying on existing infrastructure to provide potable water to the Soquel Creek Water District (SqCWD), based on winter river flows and existing treatment and conveyance capacity. The program is intended to grow over time, if/as additional infrastructure is developed and additional agreements are reached with SqCWD and Scotts Valley Water District (SVWD).

- ***Element 2: Aquifer Storage and Recovery (ASR)***, which proceeds through the various evaluation and piloting steps as detailed in previous materials (e.g., the Pueblo Water Resources report) and, if all proceeds successfully, expands to a large-scale effort.

- ***Element 3 is a climate-independent supply option***, such as potable reuse or local desalination. WSAC has yet to decide which of these may be selected as Element 3. These are described in detail as Elements 3a and 3b in the attached Gantt chart. Three alternative timing variations are provided in the charts for Element 3, as described below.

Three Timing Sequences

The subway map figures are provided for three variations on how the timing of various Elements occurs.

- ***Staggered Implementation:*** This version portrays the timeline depicted in the Gantt chart, reflecting Elements 1, 2 and 3 starting at the same time and a relatively leisurely pace for Element 3 development that includes some "pauses" along the planning steps. The intent is to reflect an approach where Elements 1 and 2 are pursued as priorities, with the intention of having Element 3 as a back-up plan that is moved forward more expeditiously if the other elements do not perform as needed.

- ***Parallel Implementation:*** This version reflects a pursuit of Elements 1, 2 and 3 with all advancing at a similar pace reflective of the individual Element activities. All 3 Elements are

pursued in parallel, as three components of an integrated plan.

- ***Sequential Implementation:*** This version depicts an approach in which Elements 1 and 2 start at the same time and Element 3 is delayed and only pursued if there is some indication that Elements 1 and/or 2 will not perform as needed. There are no upfront efforts in the near future to invest in initial planning steps for Element 3.

Decision Nodes and Milestones

The figures contain various symbols along each pathway, and these are defined in the key. These include:

- ***Decision Nodes (triangles),*** depict points at which a decision may be made to either continue down the pathway for that Element, or to possibly "transfer" efforts to another Element.

- ***Transfer stations (circles),*** reveal the Element(s) to which efforts may be transferred, if a decision is made to leave a given Element's pathway. Arrowheads on the vertical transfer lines help indicate the direction of the transfer.

- ***Milestones (diamonds),*** indicate completion of a key step (e.g., facilities completed to expand ASR in Element 2, or CEQA is completed for the Element 3 option).

- ***Water delivery (squares),*** depict a <u>rough</u> guess on when a meaningful quantity of water may be available to the City, from a given Element. These are placed along each Element's timeline, but may in some instances be a bit optimistic. E.g.,:

    - The availability of water to the City from in-lieu will depend on numerous factors -- including precipitation patterns -- that influence how much water may be provided to neighboring Districts, how much those Districts reduce pumping, and how groundwater levels respond, among other factors.

    - Similar considerations may significantly impact when meaningful volumes of water from ASR efforts may be available for return to the City. For example, once all the desired ASR wells have been developed, the pace of aquifer restoration will depend on rainfall levels in the following years and the amount of available winter flows, hydraulic loss from the aquifers, the levels of groundwater pumping by SqCWD, SVWD and those with private wells, and other factors.

    - For Element 3, once the infrastructure is in place, the timing and volume of water available from the facilities are fairly immediate and relatively certain.

The table at the end of this document provides a description of what each node and milestone is intended to convey.

Risk Scenarios

There are several risks and uncertainties that may impact the viability of each Element. Some of these factors are relatively *endogenous*, meaning that the City has some control over them. These include developing a resolution on water rights issues, and forging working agreements with neighboring water districts. These types of risks and uncertainties are reflected in the decision nodes.

There are also numerous *exogenous* risks and uncertainties – meaning factors that are largely beyond the control of the City. These include watershed wildfires, earthquakes, and similar events. We have reflected these exogenous risks by creating two risk scenarios:

- ***Risk Scenario A*** pertains to wildfire, extended severe drought, earthquake, mudslides, and other events that, should they occur, might significantly impact the watershed in a significant adverse manner. These types of exogenous risks would have a potentially significant impact on the Elements that rely on precipitation, the filling of Loch Lomond, and general watershed health. These risks in Scenario A thus may have a profound adverse impact on the success of in-lieu and ASR approaches reliant on winter flows.

- ***Risk Scenario B*** pertains to largely exogenous risks and uncertainties that may have a significant adverse impact on Element 3, including an inability to obtain regulatory approvals and/or facing a broad lack of public acceptance. These risks could significantly impede efforts to implement potable reuse or desal, for example.

To provide a simple visual portrayal of the potential impacts of these risk scenarios, versions of the adaptive pathway diagrams are provided for each risk scenario. In these charts, dashed pathway lines are used to depict those Elements that are most susceptible to the applicable risks. (Note that the timing of the risk events is not relevant in how the risk is portrayed, such that the place along the timeline when an Element's path is depicted as turning to a dashed line is not meant to depict when a wildfire might occur, for example – it could occur at any point in the future).

Overview of Decision Nodes and Related Milestones along Adaptive Pathway Diagrams

draft of 3 Sept 2015

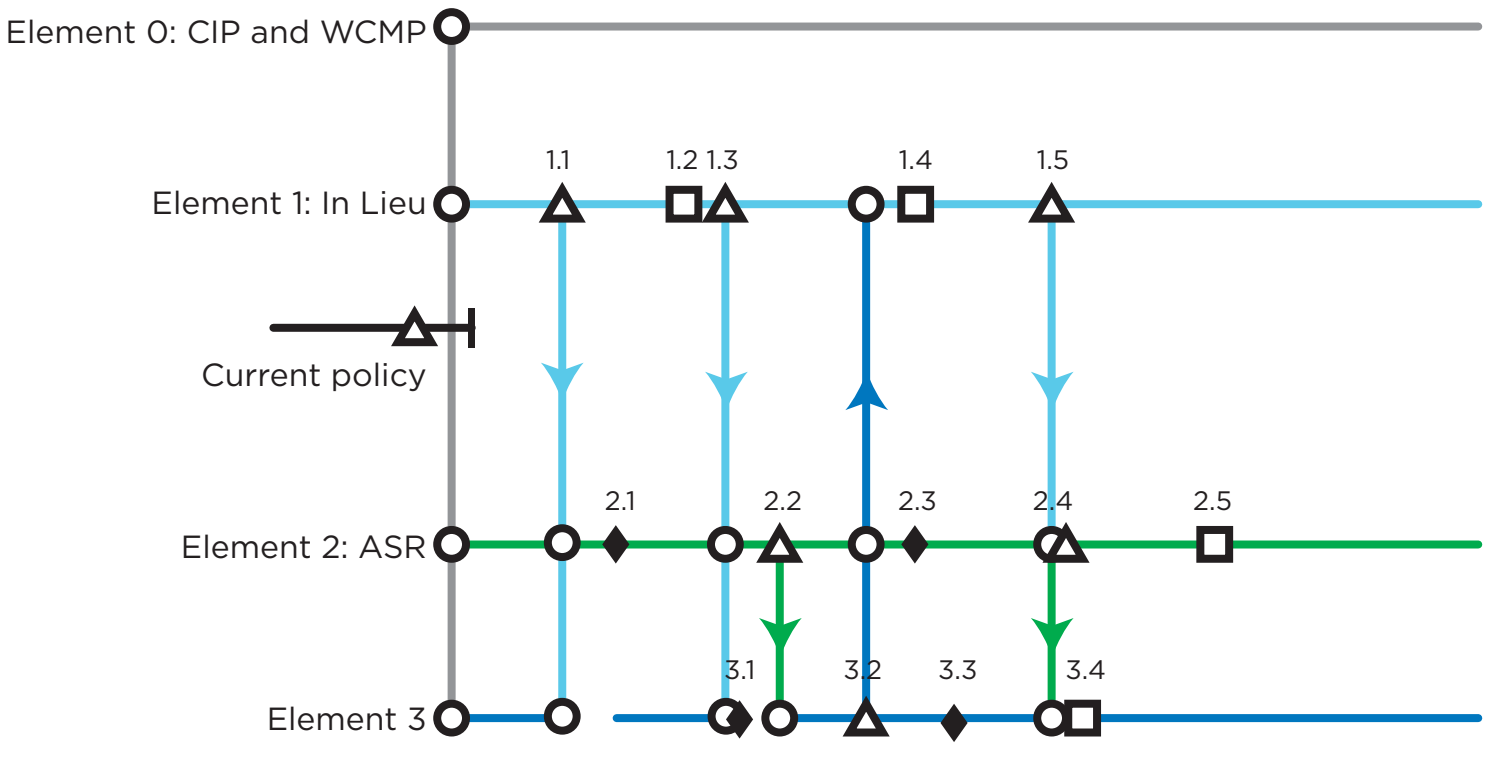
Node # and type[1]	Abbreviated Description	Timing[2]
In-Lieu (Element 1)		
1.1 D[1]	Agreements, water rights, and planning complete for existing infrastructure to SqCWD	<1 year
1.2 W[1]	Potential for some return of in-lieu water from SqCWD to Santa Cruz	*3+ years*[2]
1.3 D	Agreements, rights, planning, infra., and CEQA in place for in-lieu to SV and expanded to SqCWD	4 years
1.4 W	Potential for some additional return of in-lieu water from SqCWD, and/or SVWD, to Santa Cruz	*7+ years*
1.5 D	Assess in-lieu performance: amount to SqC and SV, reduced gw pumping,… return flows to SC	*10+ years*
ASR (Element 2)		
2.1 M[1]	High level feasibility planning and modeling	2 years
2.2 D	Pilot testing set up and executed, results evaluated, go-no go decision	5 years
2.3 M	Develop/construct ASR wells, ready to operationalize	8 years
2.4 D	Assess ASR performance	*10+ years*
2.5 W	Aquifer storage target of 3 BG attained (ability to sustain return flows to SC at desired levels)	*15+ years*
Climate-Independent Option (Element 3) [3]		
3.1 M	Feasibility studies, preliminary design and demonstration testing, public outreach and education	4 years
3.2 D	Permitting, CEQA, project description, alternatives analysis	7 years
3.3 M	Complete EIR and final design, initiate construction	9 years
3.4 W	Complete construction, plant start-up, water production begins	11 years

[1] Node types: D = decision node (triangle in subway chart); M = milestone (diamond on the subway chart), and W = water production potentially available (squares on the subway chart).

[2] Timing refers to number of years, from end of 2015, until completion or outcome, based on Gantt chart version as of Sept 3. Values shown in *RED italics* are guesstimate placeholders, and may depend to a large extent on volumes of water available due to winter precipitation levels (which may limit amount of in-lieu and ASR) and other factors over the preceding years.

[3] I.e., Element 3 likely to be either potable reuse or local desalination. Milestones shown in this table reflect some hiatus (pause) periods for Element 3 while ASR and In-lieu efforts unfold. Variations on this timeline have been developed and shown in several subway maps to reflect delayed initiation of the process, and/or a more aggressive parallel development of Element 3 without pauses between the phases.

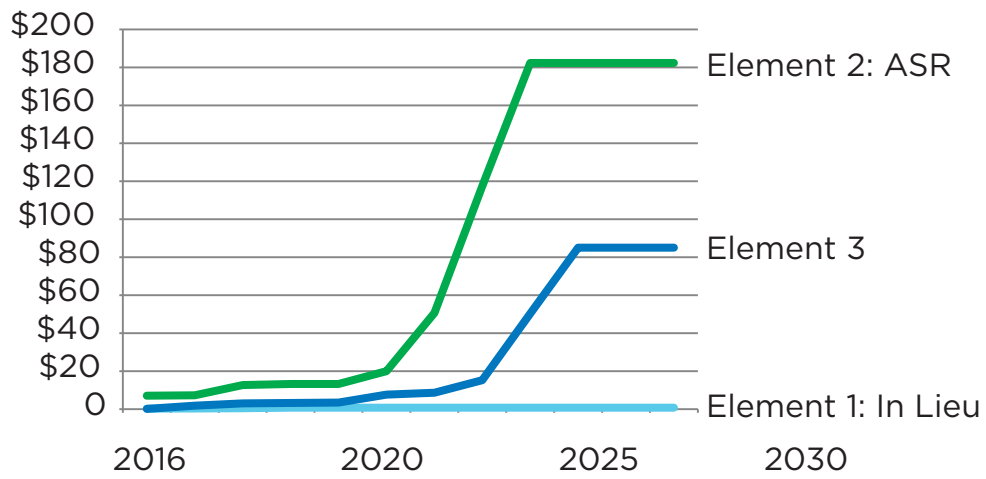
Staggered Development Approach



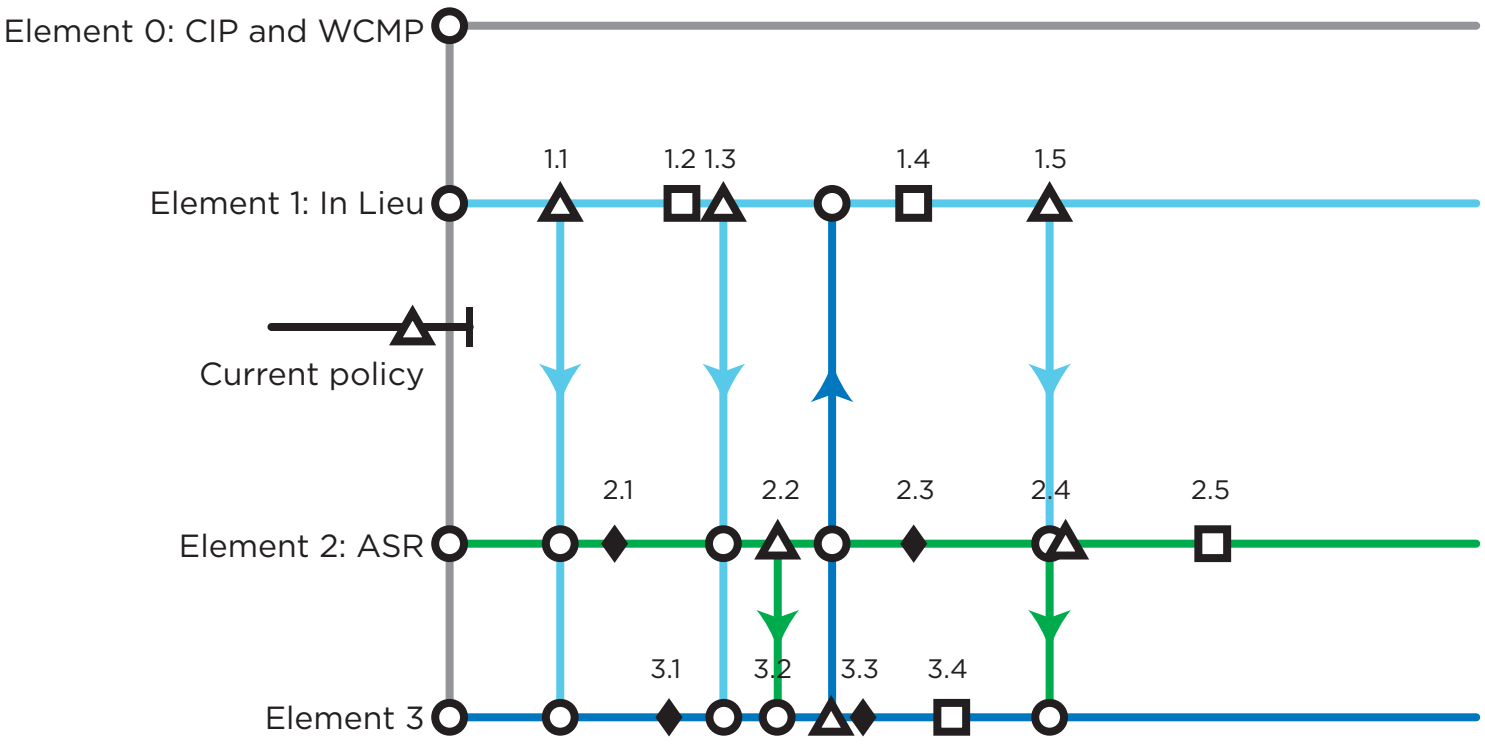
- Decision node/possible transfer
- Transfer station to new action
- Terminal
- Water delivery
- Milestones

Cumulative capital costs

(millions of dollars)

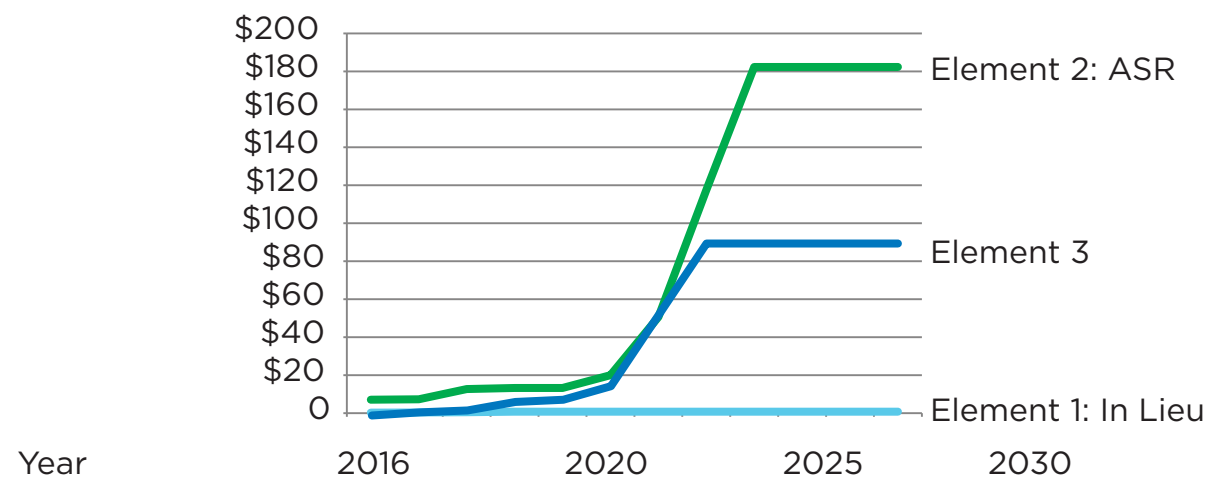


Parallel Development Approach

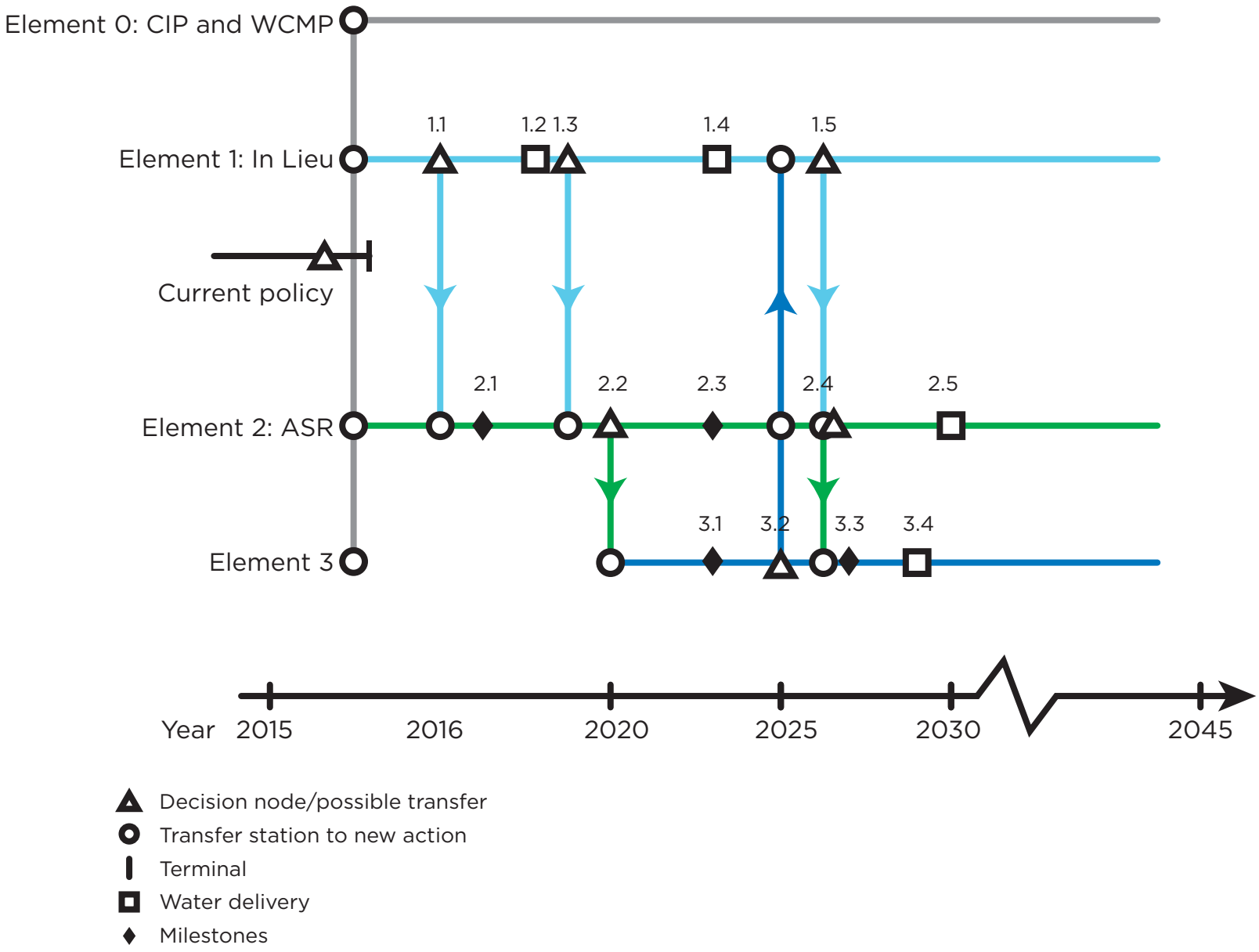


Cumulative capital costs

(millions of dollars)

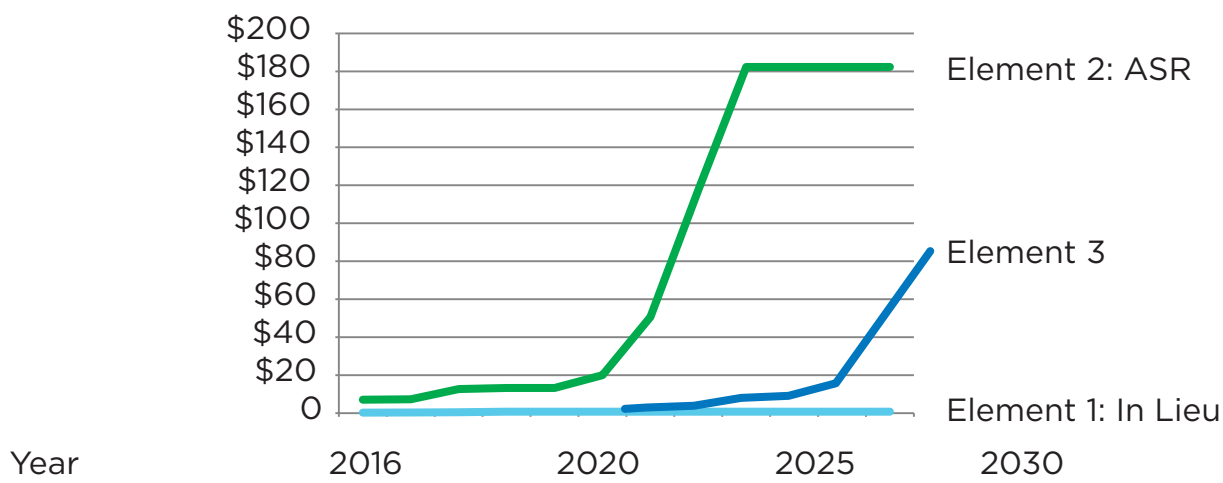


Sequential Development Approach



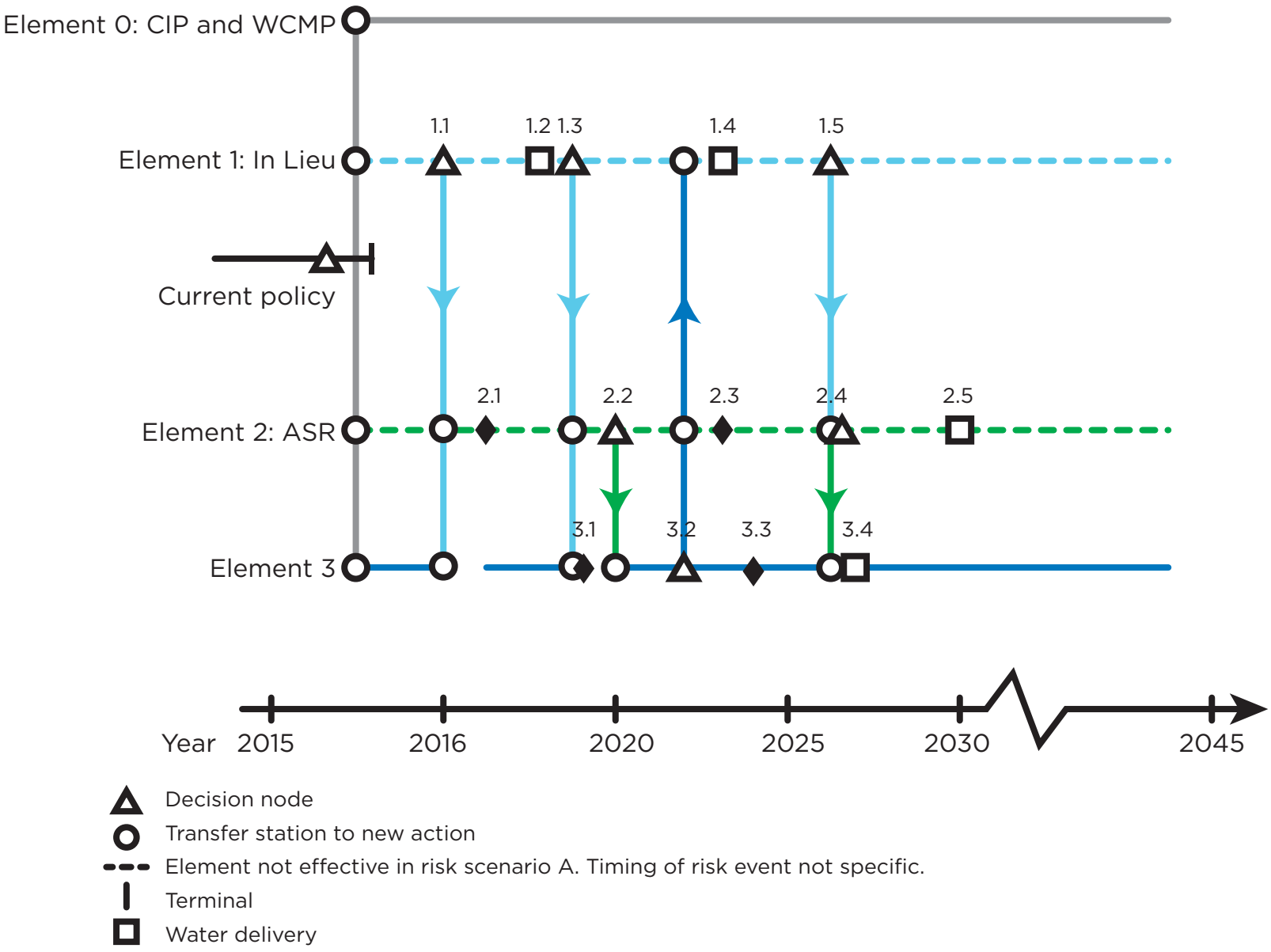
Cumulative capital costs

(millions of dollars)



Staggered Development Approach
Risk Scenario A

Watershed fire; Extended severe drought; Inability to negotiate agreements or water rights; Earthquake



Staggered Development Approach
Risk Scenario B

Lack of regulatory approval or public acceptance