ARCADIS

ARCADIS G&M, Inc.
88 Duryea Road
Melville
New York 11747
Tel 631 249 7600
Fax 631 249 7610

MEMO

To:
Dave Brayack
Tetra Tech NUS, Inc.
(TTNUS)

Copies:
Mike Wolfert
Carlo San Giovanni

From:
Robert Porsche / Doug Smolensky

Date:
11 April 2003

ARCADIS Project No.:
NY001369.0001.00004

Subject:
GM38 Design Simulation No. 2, TT/NUS Modeling

This memo has been prepared to summarize the results of GM38 Design Modeling Simulation No.2, conducted in support of TT/NUS's design efforts for the GM38 Area. ARCADIS had previously modeled the effects of relocating RW-1 to the center of South Herman Street (Simulation No. 1). The results of Simulation No. 1 were documented in a memo submitted to TT/NUS on December 2, 2002.

Purpose

This modeling effort was carried out to evaluate comments submitted by H2M and Dvirka & Bartilluci (D&B) on behalf of the New York Water Service and Bethpage, South Farmingdale and Massapequa Water Districts, regarding previously presented modeling results as they relate to the ongoing GM38 Area Design efforts. Specifically, the comments had requested that a third remedial well (RW-3) be incorporated in the remedial design, and placed west of Huntington Hospital. The comments suggested a pumping rate of 1,000 gallons per minute, but did not specify a screened interval.

Methodology

Although the comments submitted by H2M and D&B requested that RW-3 be placed west of Huntington Hospital (along Hempstead Turnpike), an evaluation of the plumes movement with time indicates that any

contaminant mass not captured by the currently proposed 2-well GM38 system moves to the southeast, and crosses Hempstead Turnpike east of the Seaford-Oyster Bay Expressway (Route 135). As a result, the existing groundwater model and specific GM38 model simulation was revised as follows:

- Recharge associated with the currently proposed 2-well remedial system was not re-injected through IW-1 and IW-2 (see Figure 2). Rather, the simulation was conducted under the assumption that the water would be returned to the aquifer at some significant distance from the remedial wells that would not interfere with the capture zone induced by the wells operation.
- Remedial Well RW-3 was added to the model, and placed approximately 800 ft east of the intersection of Hempstead Turnpike and Route 135.
- Recharge associated with RW-3 was modeled as being returned to the aquifer through a New York State Department of Transportation recharge basin (ST-109) located south of the intersection of Hempstead Turnpike and Route 135. The recharge was simulated by a series of shallow injection points approximating the footprint of the recharge basin, as shown on Figure 2.

The screen zones and pumping rates of remedial wells RW-1 and RW-2 were not changed for this assessment; the wells were simulated to pump 800 and 300 gpm, respectively. Remedial Well RW-3 was screened in model layer 6 (from 314 to 407 ft bls) and was simulated to pump 1,000 gpm. Consistent with previous modeling, 97% of the water extracted by RW-3 was simulated as recharge through ST-109. It is assumed that 3% of the water extracted by RW-3 is lost to the atmosphere through evaporation before being recharged to the aquifer. .

Several simulations were conducted to complete the assessment of the affect of these changes. Initially, backward particle tracking was conducted to determine if the capture zone developed by the combined pumping of RW-1, RW-2 and RW-3 (3-well system) differed significantly from that developed by RW-1 and RW-2 (2-well system). Following this determination, a solute transport simulation was performed with the GM-38 System in operation for a period of 30 years, in accordance with comments from H2M and D&B; the planned operating period for the GM38 hot spot remedy is currently anticipated to be approximately 10 years.

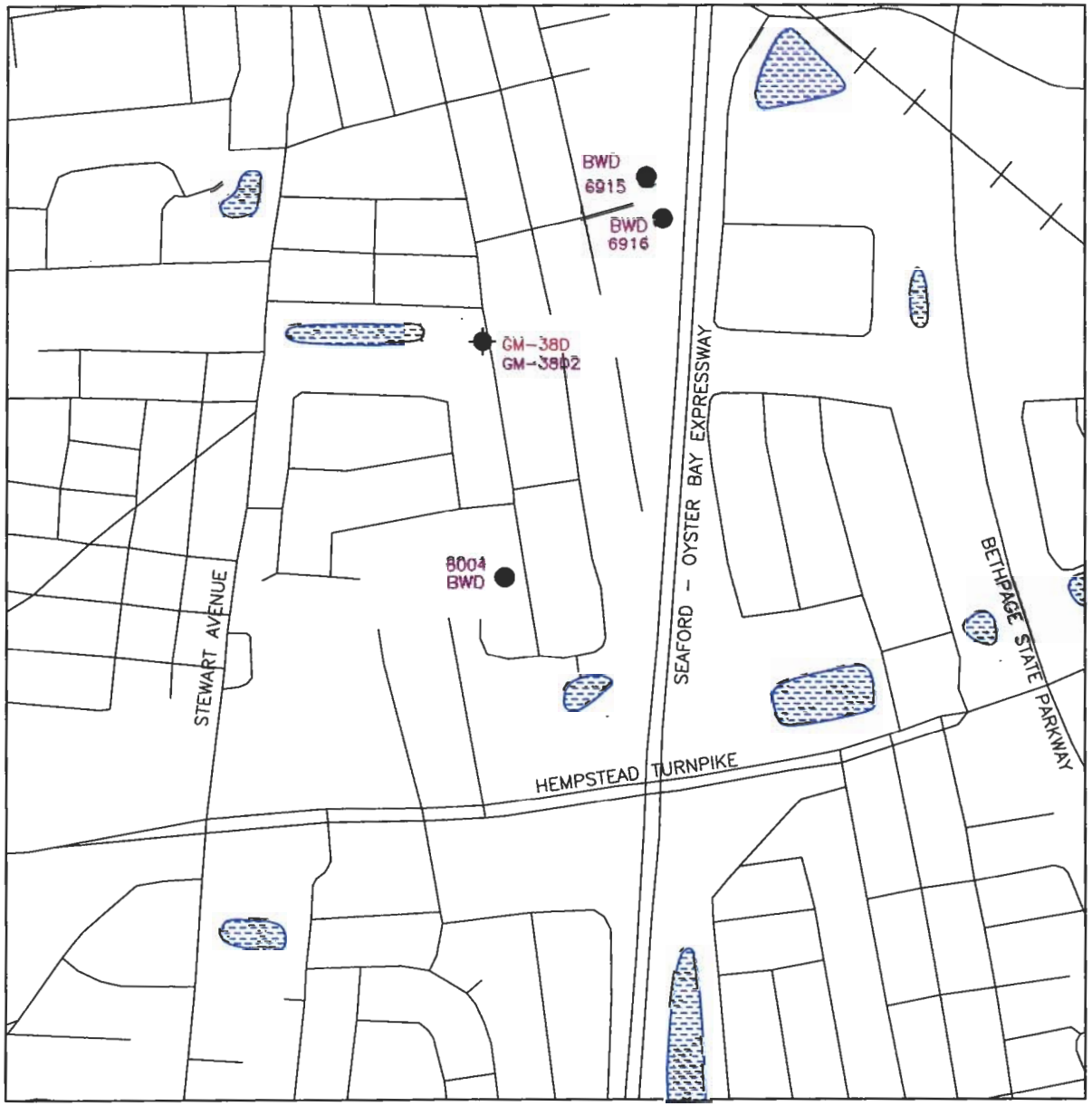
Results:

Figures 3, 4, and 5 show the capture zones and 1,000 and 500 µg/L TVOC contours in model layers 5, 6 and 7, respectively resulting from the operation of RW-1, RW-2, RW-3 and the injection wells (at ST-109). Layers 5, 6, and 7 are shown because they correspond to the most significantly impacted portion of the aquifer. Although other portions of the aquifer are also impacted in the vicinity of GM38, the concentrations associated with these impacts are lower than the 500 µg/L threshold used for this presentation. The pathlines are truncated to represent the area of capture over a 10-year pumping period. An interpretation of these plan view figures, along with a review of model results indicates that all TVOCs at concentrations greater than 500 µg/L in model layers 5, 6 and 7 will be captured by the 2-well system. . Figures 3, 4, and 5 show that the capture zone developed by RW-3 is located approximately 500 to 900 ft south of the 500 µg/L contour, depending on the model layer.

Figures 6 through 13 are time versus concentration plots comparing the concentrations of TVOCs in the remedial wells and various supply wells in the vicinity of the GM-38 area under the 2-well and 3-well remedial scenarios. Under both scenarios, the data presented are the model results for the respective systems operating for 30 years. Currently the estimated period of operation for the proposed 2-well GM-38 system is approximately 10 years. However, for the purposes of comparison the 2 and 3-well systems were simulated to operate for 30 years. With the exception of Figure 6, no significant difference in TVOC concentrations is noted in either the remedial wells or the supply wells for one scenario versus the other. The TVOC concentrations shown on Figure 6 appear to indicate that the addition of RW-3 results in additional mass being extracted by RW-1 over the first seven years of the 3-well simulation when compared to the results of the 2-well simulation. However, the difference in mass removal rates is attributable to the operation of the GM-38 injection well network shown on Figure 2. In the 2-well simulation IW-1 and IW-2 recharged treated water to the aquifer, and interfered with the RW-1 capture zone; as a result, the concentration of TVOCs in groundwater extracted by RW-1 declined. In the 3-well simulation, IW-1 and IW-2 were not operational; without interference from the recharge of treated groundwater the concentration of TVOCs extracted from RW-1 is higher under this simulation.

Conclusions:

The goals of the GM38 System are to provide capture, mass removal, and treatment of VOCs in groundwater from this area of elevated concentrations (i.e. greater than 500 µg/L). Both the 2 and 3-well remedial systems successfully achieve the goals of capture and mass removal of any TVOC impacted groundwater with elevated concentrations (greater than 500 µg/L) in the vicinity of GM38. The addition of a third remedial well in the vicinity of the intersection of Route 135 and Hempstead Turnpike offers no significant benefit to potential downgradient receptors through the removal of additional mass from the aquifer.



LEGEND

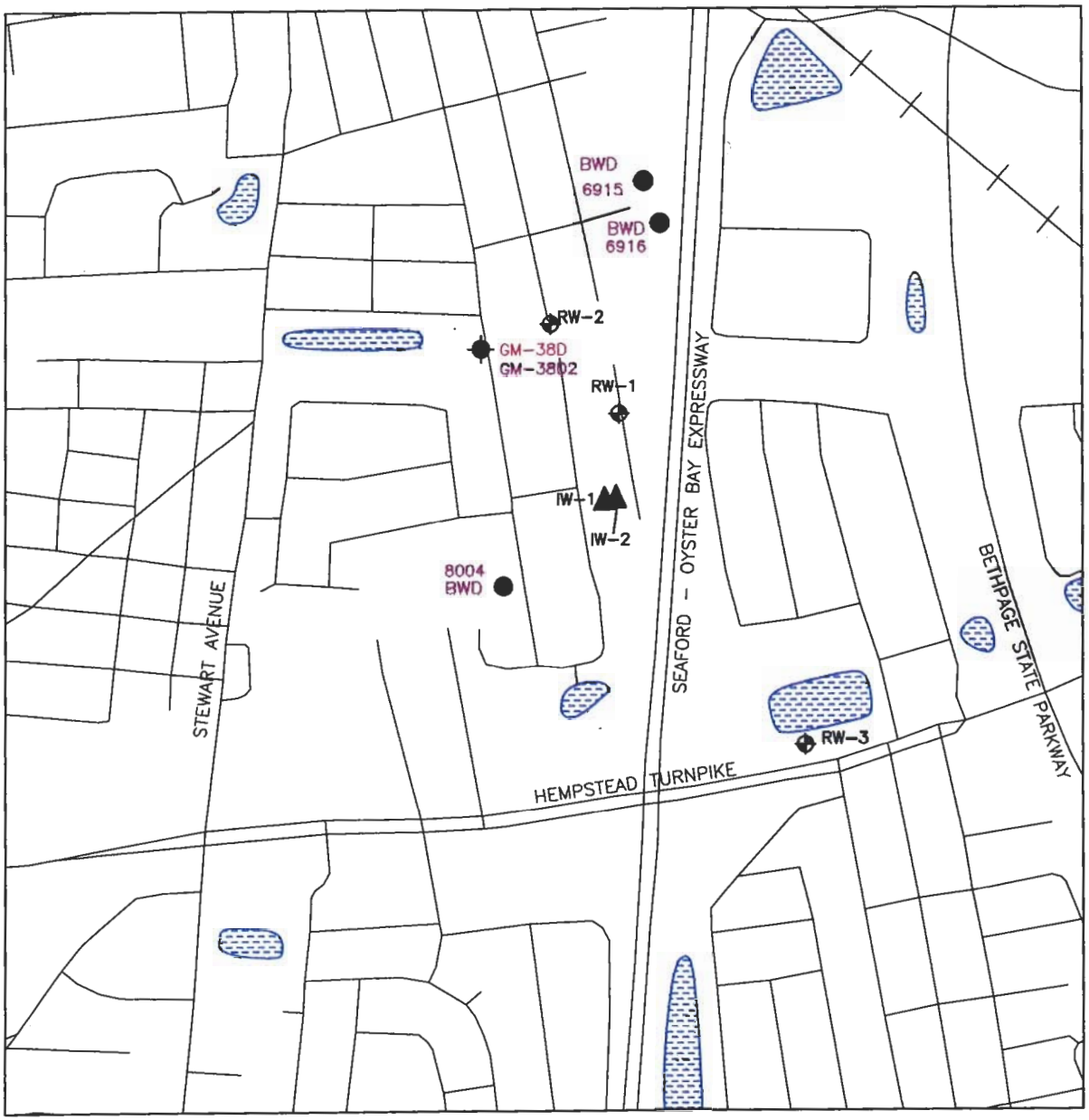
- BASINS
- PUBLIC SUPPLY WELL
- OBSERVATION, MONITORING WELL

0 800
SCALE IN FEET

NO.	DATE	REVISION DESCRIPTION	BY CKD

ARCADIS G&M

DRAWN	DATE	PROJECT MANAGER	DEPARTMENT MANAGER
LMC	3/27/03	R. PORSCHE	N. VALKENBURG
SUPPLY WELLS IN THE VICINITY OF THE GM38 AREA		LEAD DESIGN PROF.	CHECKED R. PORSCHE
		PROJECT NUMBER NY001369.0001.00004	DRAWING NUMBER 1



LEGEND

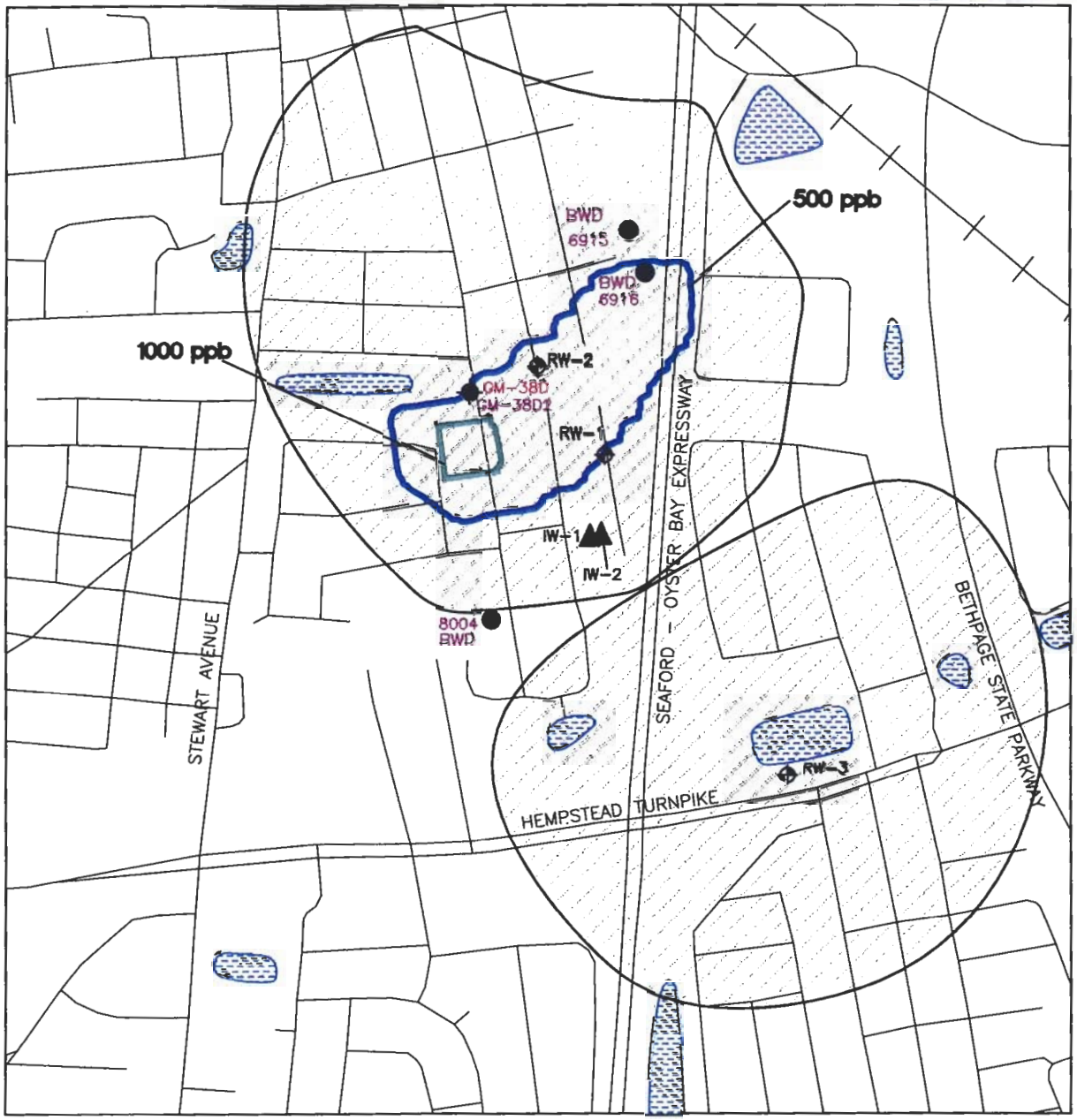
- BASINS
- PUBLIC SUPPLY WELL
- OBSERVATION, MONITORING WELL
- REMEDIAL WELL
- INJECTION WELL

0 800
SCALE IN FEET

NO.	DATE	REVISION DESCRIPTION	BY CKD

ARCADIS G&M

DRAWN LMC	DATE 3/27/03	PROJECT MANAGER R. PORSCHE	DEPARTMENT MANAGER N. VALKENBURG
LOCATIONS OF PROPOSED REMEDIAL WELLS IN THE GM38 AREA		LEAD DESIGN PROF.	CHECKED R. PORSCHE
		PROJECT NUMBER NY001369.0001.00004	DRAWING NUMBER 2



LEGEND

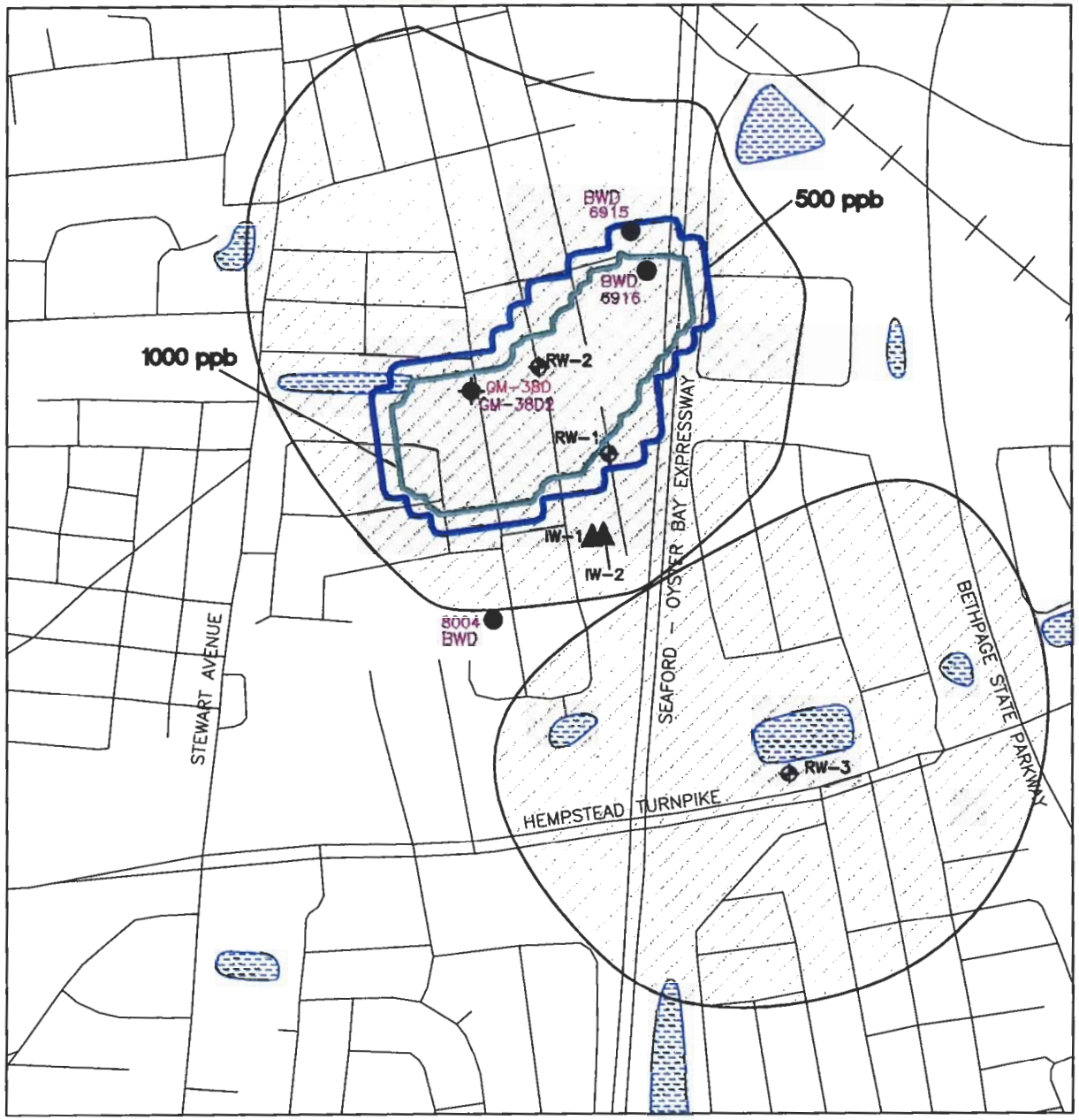
- BASINS
- PUBLIC SUPPLY WELL
- OBSERVATION, MONITORING WELL
- REMEDIAL WELL
- INJECTION WELL
- ZONE OF CAPTURE
- CONCENTRATION OF TVOCs – 500 PARTS PER BILLION
- CONCENTRATION OF TVOCs – 1000 PARTS PER BILLION

0 800
SCALE IN FEET

NO.	DATE	REVISION DESCRIPTION	BY CKD

ARCADIS G&M

DRAWN LMC	DATE 3/27/03	PROJECT MANAGER R. PORSCHE	DEPARTMENT MANAGER N. VALKENBURG
10 YEAR CAPTURE ZONE OF PROPOSED REMEDIAL SYSTEM AND TVOCs IN MODEL LAYER 5		LEAD DESIGN PROF.	CHECKED R. PORSCHE
		PROJECT NUMBER NY001369.0001.00004	DRAWING NUMBER 3



LEGEND

- BASINS
- PUBLIC SUPPLY WELL
- OBSERVATION, MONITORING WELL
- REMEDIAL WELL
- INJECTION WELL
- ZONE OF CAPTURE
- CONCENTRATION OF TVOCs – 500 PARTS PER BILLION
- CONCENTRATION OF TVOCs – 1000 PARTS PER BILLION

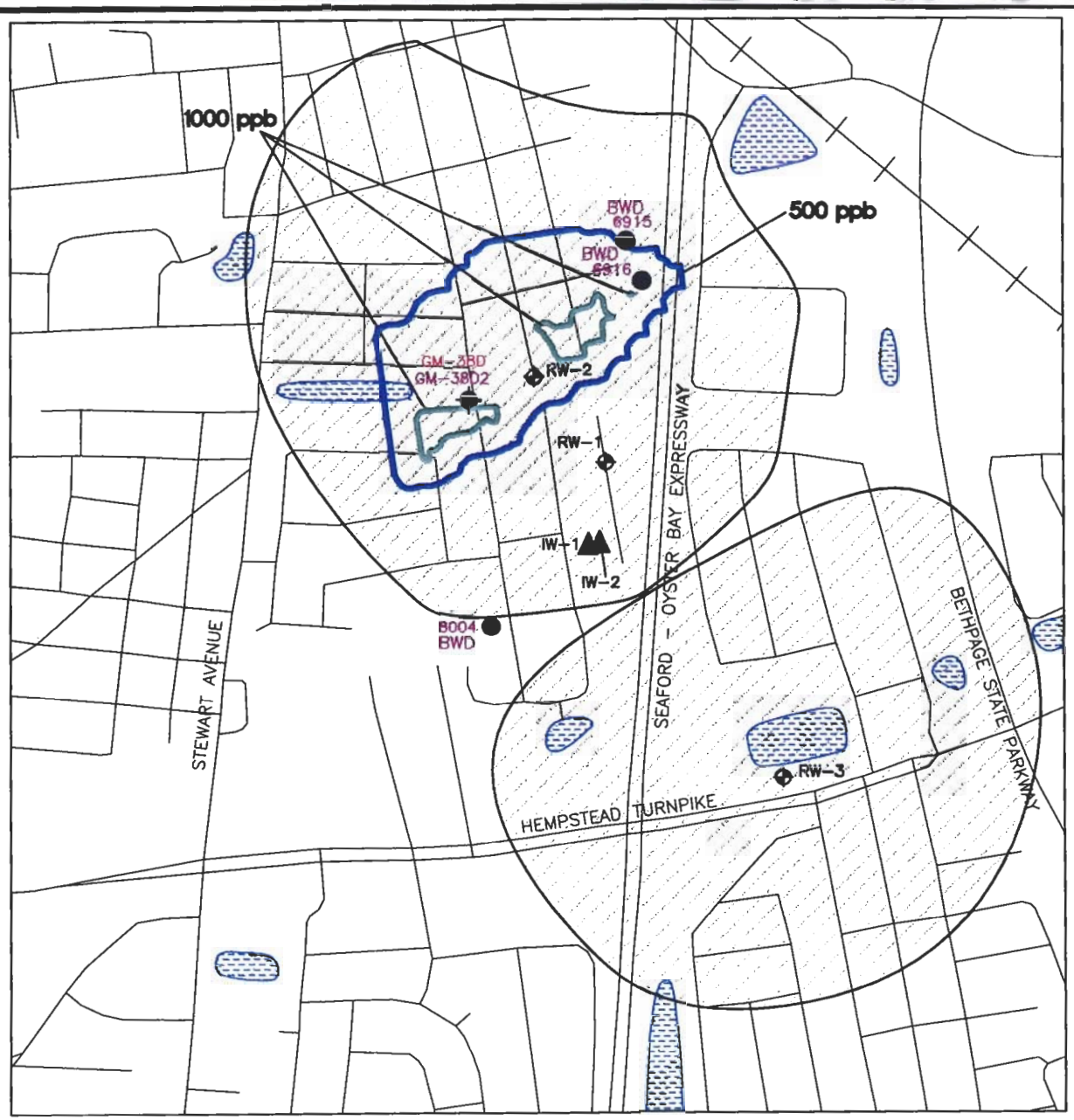
0 800
SCALE IN FEET

NO.	DATE	REVISION DESCRIPTION	BY CKD

ARCADIS G&M

DRAWN LMC	DATE 3/27/03	PROJECT MANAGER R. PORSCHE	DEPARTMENT MANAGER N. VALKENBURG
10 YEAR CAPTURE ZONE OF PROPOSED REMEDIAL SYSTEM AND TVOCs IN MODEL LAYER 6		LEAD DESIGN PROF.	CHECKED R. PORSCHE
		PROJECT NUMBER NY001369.0001.00004	DRAWING NUMBER 4

FILE: G:\PROJECT\YEARDIR MJS\NY001369.0001\CADD\LAYER6.DWG, DATE: 04/11/2003 10:14:37AM



LEGEND

- BASINS
- PUBLIC SUPPLY WELL
- OBSERVATION, MONITORING WELL
- REMEDIAL WELL
- INJECTION WELL
- ZONE OF CAPTURE
- CONCENTRATION OF TVOCs – 500 PARTS PER BILLION
- CONCENTRATION OF TVOCs – 1000 PARTS PER BILLION

0 800
SCALE IN FEET

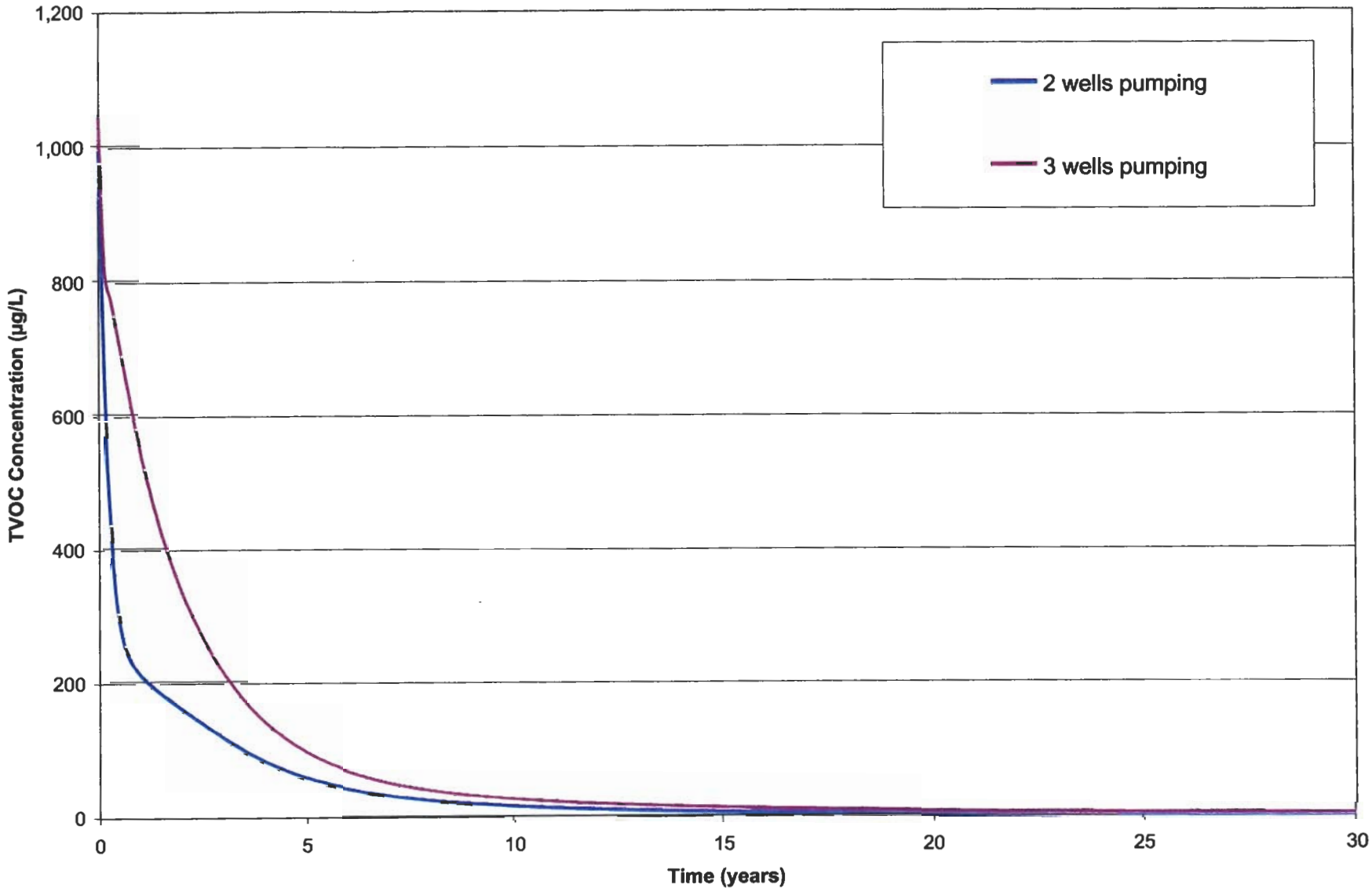
NO.	DATE	REVISION DESCRIPTION	BY / CKD

ARCADIS G&M

DRAWN	DATE	PROJECT MANAGER	DEPARTMENT MANAGER
LMC	3/27/03	R. PORSCHE	N. VALKENBURG
		LEAD DESIGN PROF.	CHECKED R. PORSCHE

10 YEAR CAPTURE ZONE OF PROPOSED REMEDIAL SYSTEM AND TVOCs IN MODEL LAYER 7

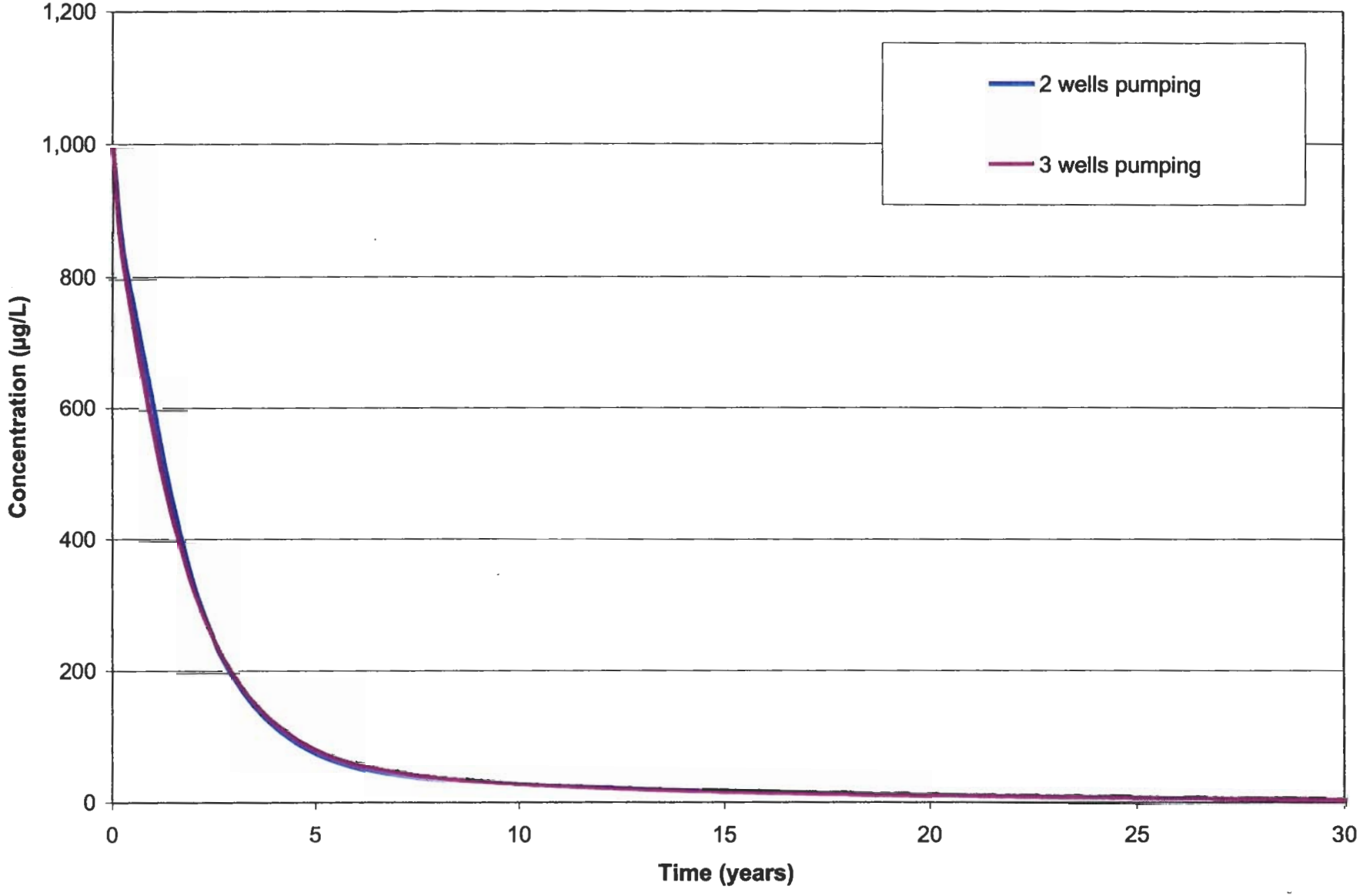
PROJECT NUMBER	DRAWING NUMBER
NY001369.000.00004	5



NO.	DATE	REVISION DESCRIPTION	BY / CKD

ARCADIS G&M

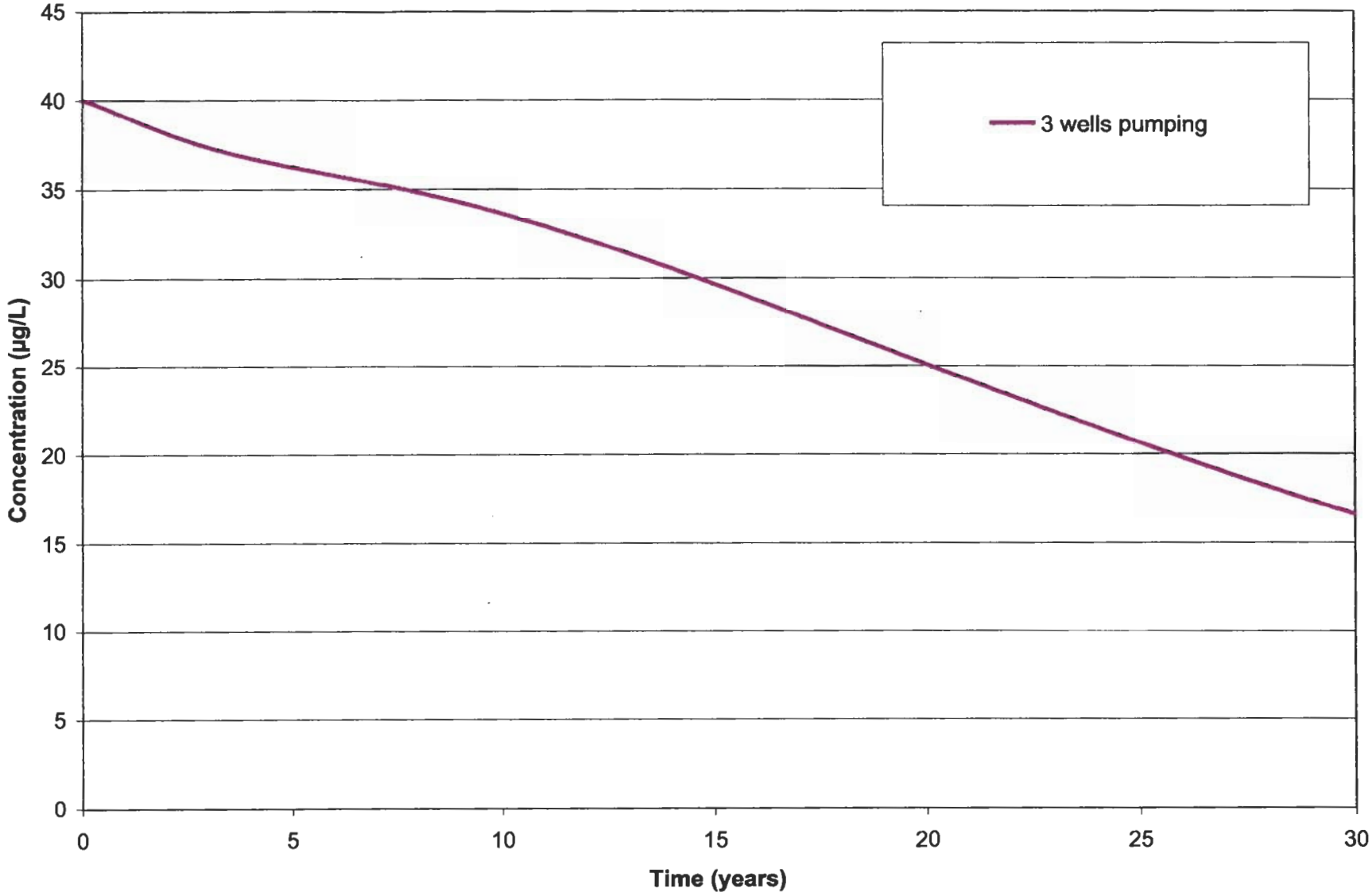
DRAWN LMC	DATE 3/27/03	PROJECT MANAGER R. PORSCHE	DEPARTMENT MANAGER N. VALKENBURG
MODEL PREDICTED TVOC CONCENTRATIONS IN PROPOSED REMEDIAL WELL 1 GM38 AREA		LEAD DESIGN PROF.	CHECKED R. PORSCHE
		PROJECT NUMBER NY001369.0001.00004	DRAWING NUMBER 6



NO.	DATE	REVISION DESCRIPTION	BY / CKD

ARCADIS G&M

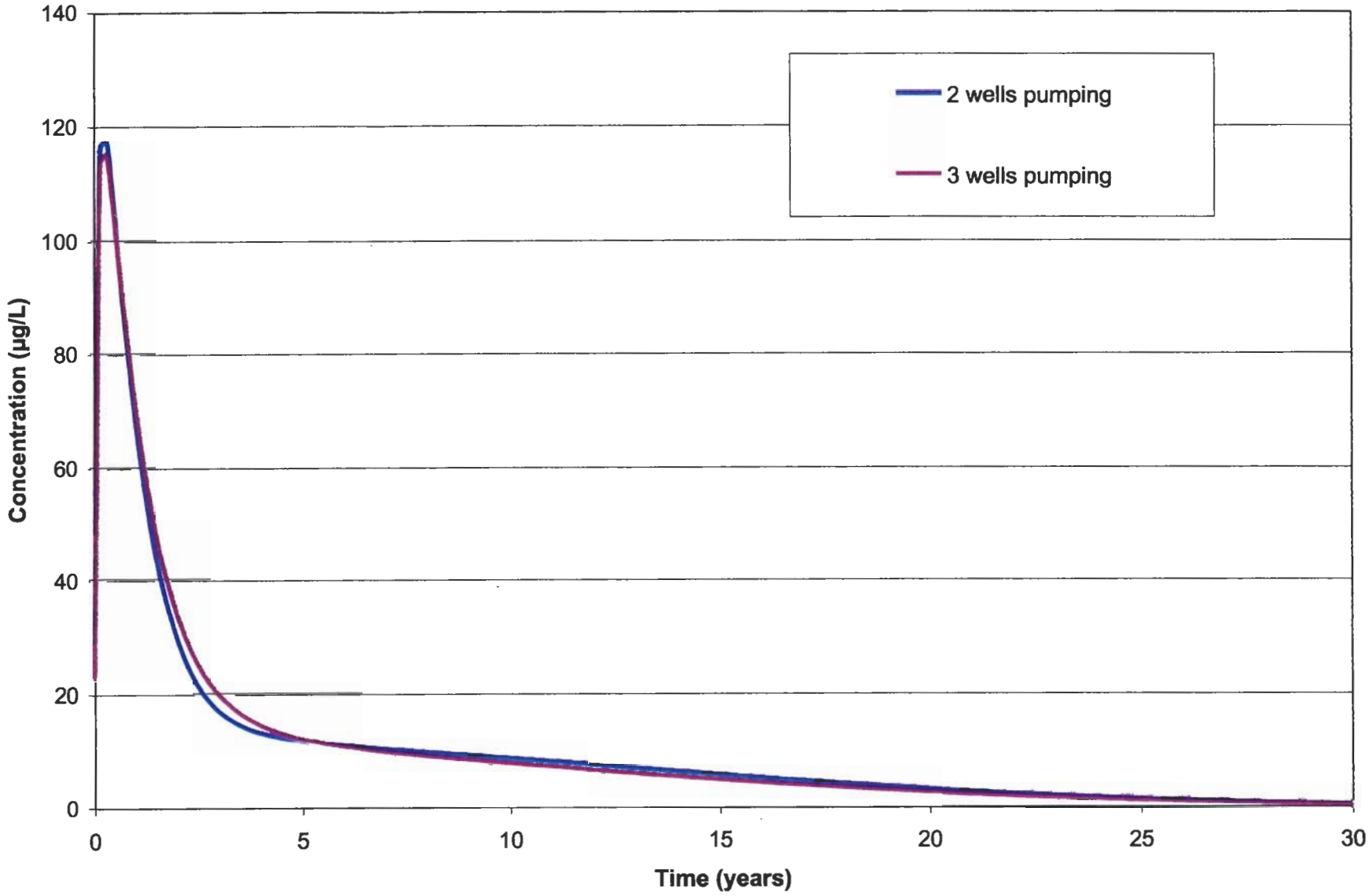
DRAWN LMC	DATE 3/27/03	PROJECT MANAGER R. PORSCHE	DEPARTMENT MANAGER N. VALKENBURG
MODEL PREDICTED TVOC CONCENTRATIONS IN PROPOSED REMEDIAL WELL 2 GM38 AREA		LEAD DESIGN PROF.	CHECKED R. PORSCHE
		PROJECT NUMBER NY001369.0001.00004	DRAWING NUMBER 7



NO.	DATE	REVISION DESCRIPTION	BY / CKD

ARCADIS G&M

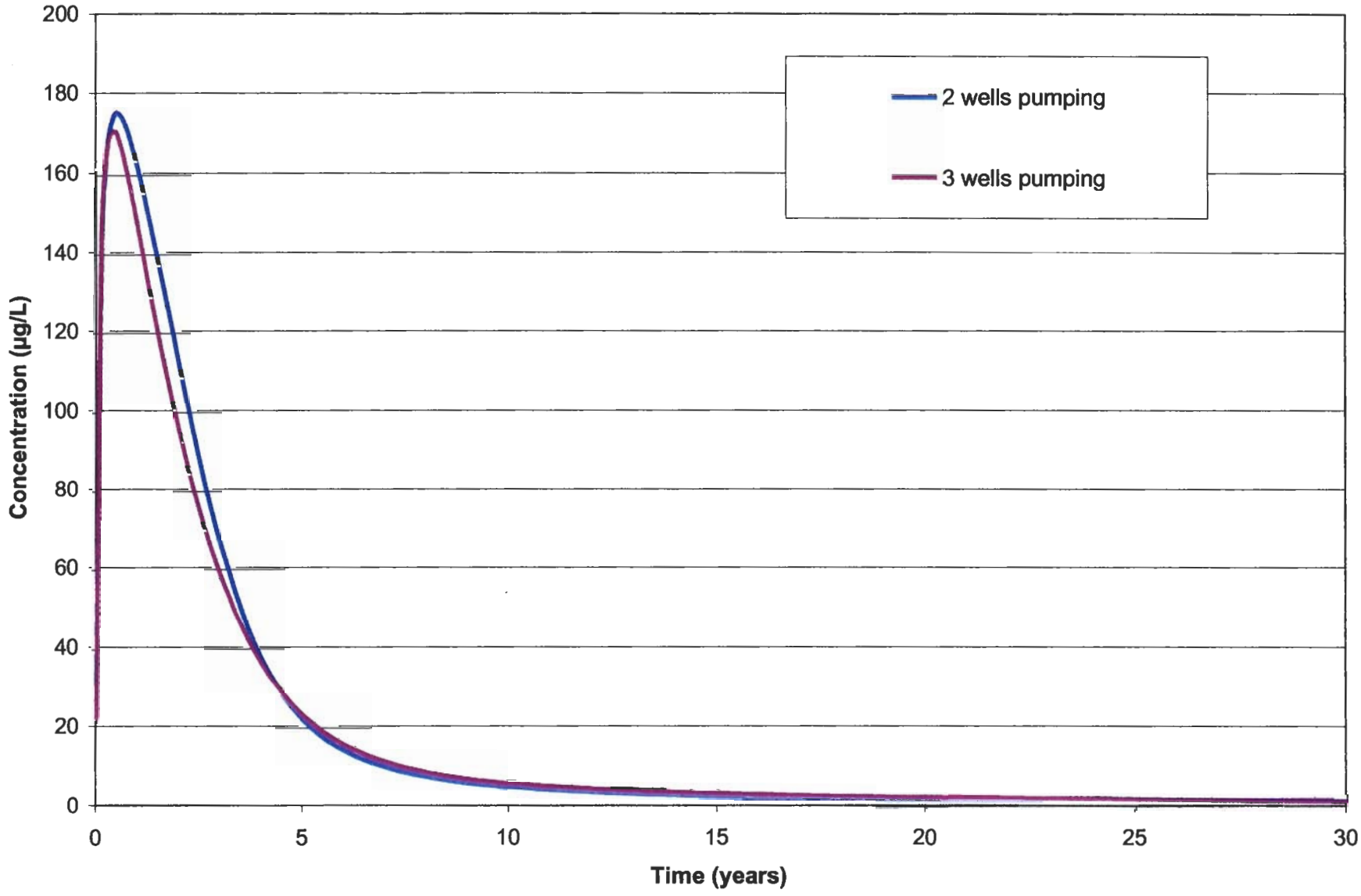
DRAWN	DATE	PROJECT MANAGER	DEPARTMENT MANAGER
LMC	3/27/03	R. PORSCHE	N. VALKENBURG
MODEL PREDICTED TVOC CONCENTRATIONS IN PROPOSED REMEDIAL WELL 3 GM38 AREA		LEAD DESIGN PROF.	CHECKED R. PORSCHE
		PROJECT NUMBER NY001369.0001.00004	DRAWING NUMBER 8



NO.	DATE	REVISION DESCRIPTION	BY / CKD

ARCADIS G&M

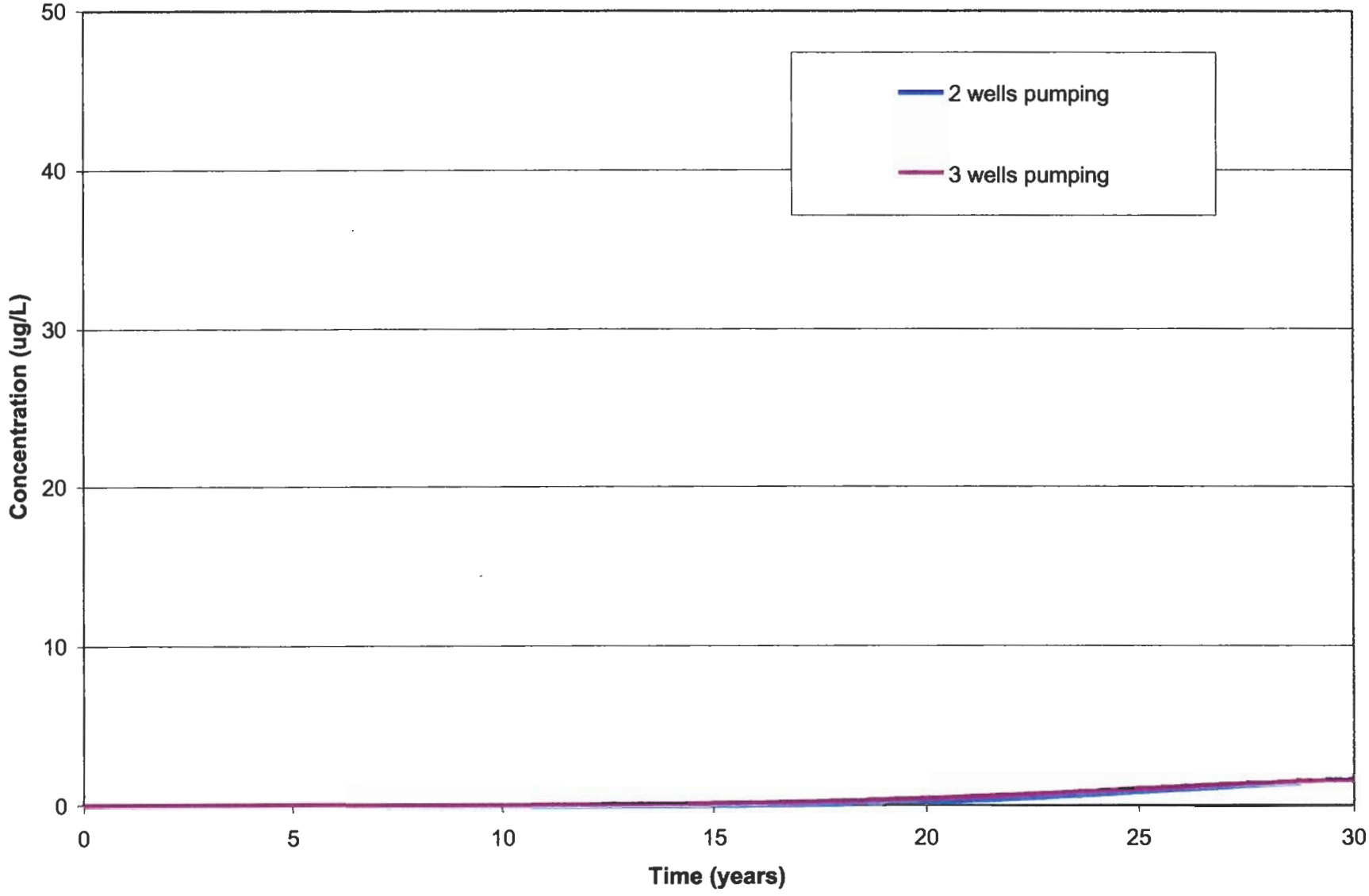
DRAWN	DATE	PROJECT MANAGER	DEPARTMENT MANAGER
LMC	3/27/03	R. PORSCHE	N. VALKENBURG
		LEAD DESIGN PROF.	CHECKED R. PORSCHE
MODEL PREDICTED TVOC CONCENTRATION IN BWD WELL 4-1 (6915) GM38 AREA		PROJECT NUMBER NY001369.0001.00004	DRAWING NUMBER 9



NO.	DATE	REVISION DESCRIPTION	BY CKD

ARCADIS G&M

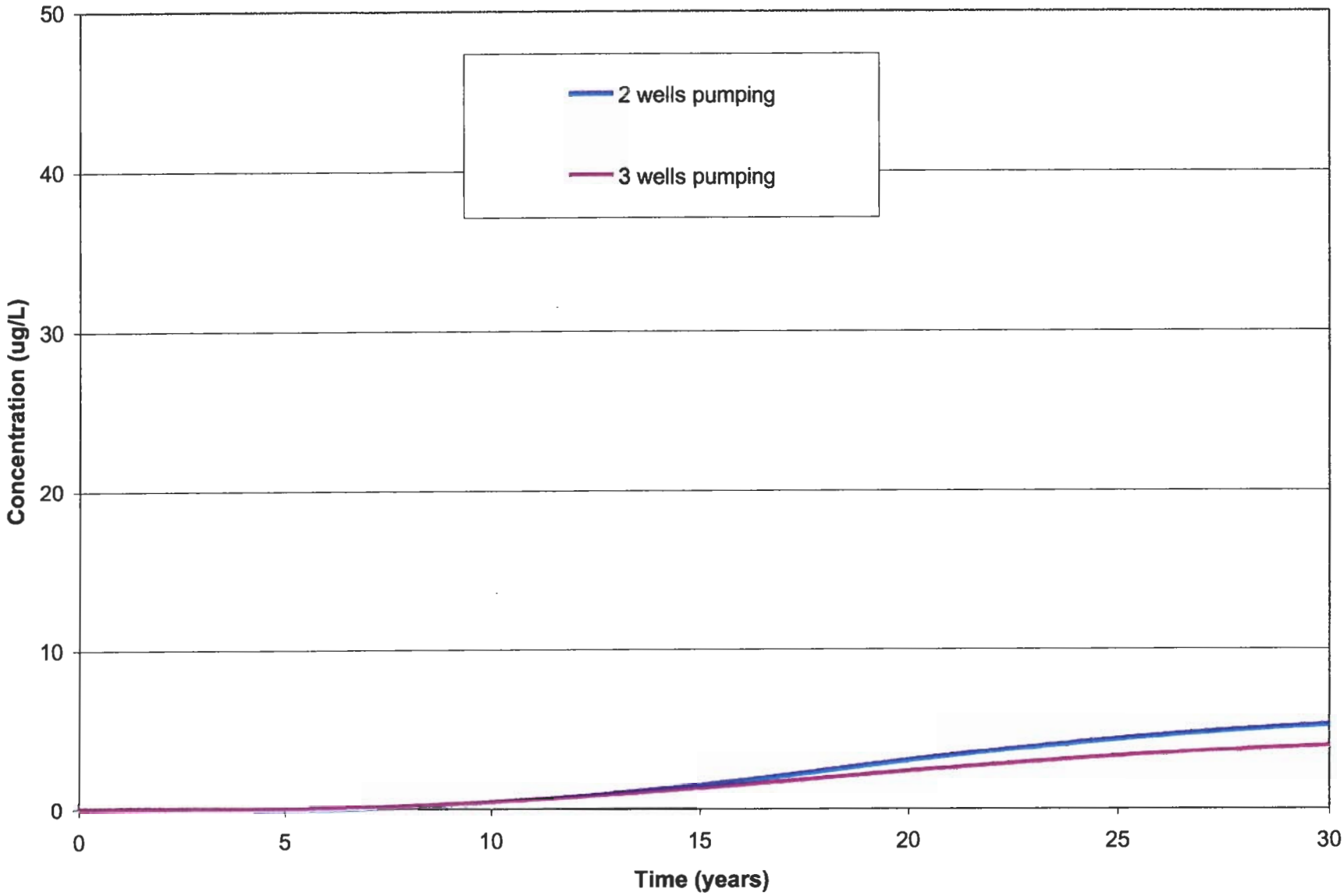
DRAWN LMC	DATE 3/27/03	PROJECT MANAGER R. PORSCHE	DEPARTMENT MANAGER N. VALKENBURG
MODEL PREDICTED TVOC CONCENTRATION IN BWD WELL 4-2 (6916) GM38 AREA		LEAD DESIGN PROF.	CHECKED R. PORSCHE
		PROJECT NUMBER NY001369.0001.00004	DRAWING NUMBER 10



NO.	DATE	REVISION DESCRIPTION	BY / CKD

ARCADIS G&M

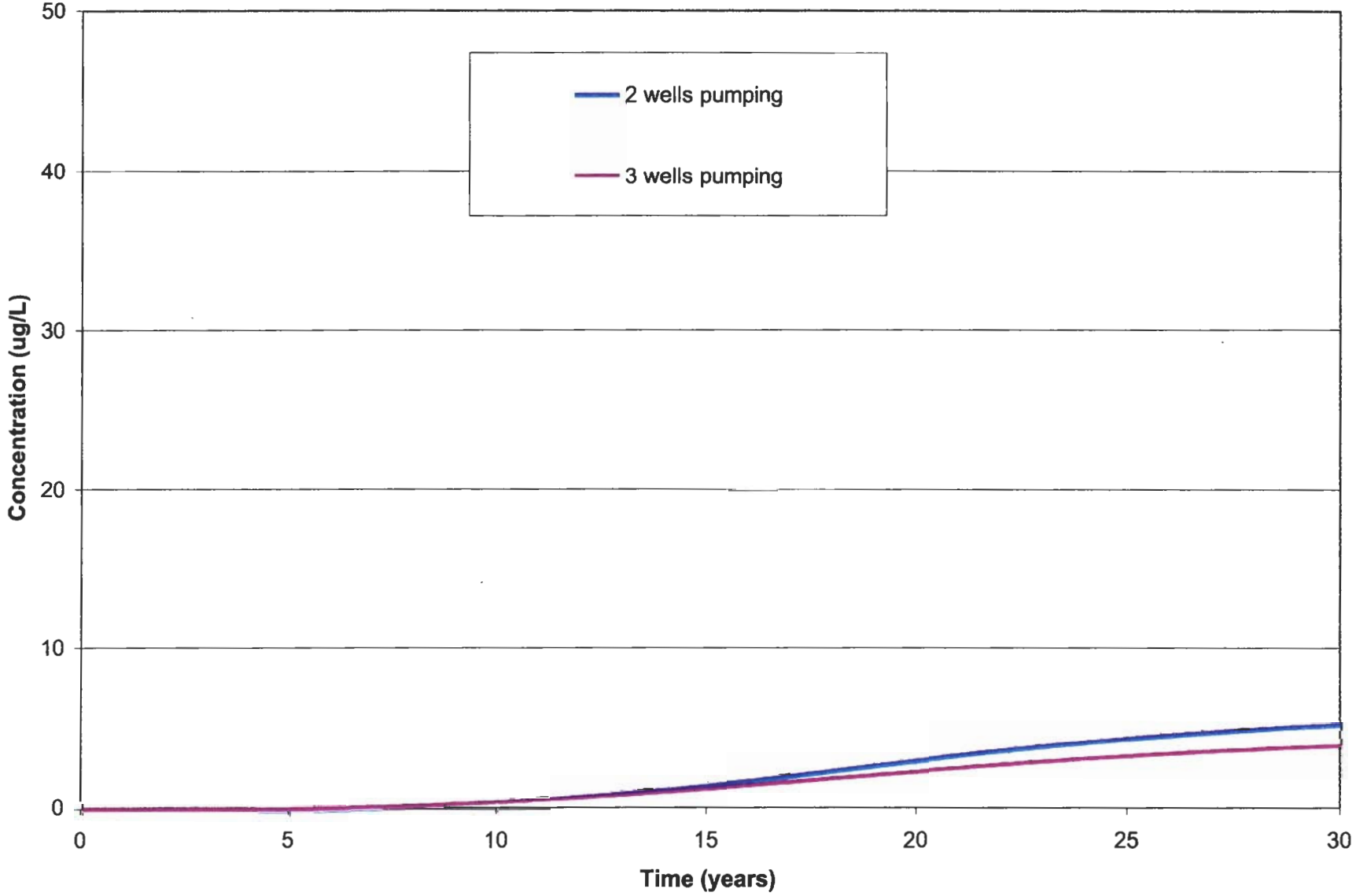
DRAWN LMC	DATE 3/27/03	PROJECT MANAGER R. PORSCHE	DEPARTMENT MANAGER N. VALKENBURG
MODEL PREDICTED TVOC CONCENTRATION IN BWD WELL 5 (8004) GM38 AREA		LEAD DESIGN PROF.	CHECKED R. PORSCHE
		PROJECT NUMBER NY001369.0001.00004	DRAWING NUMBER 11



NO.	DATE	REVISION DESCRIPTION	BY / CKD

ARCADIS G&M

DRAWN	DATE	PROJECT MANAGER	DEPARTMENT MANAGER
LMC	3/27/03	R. PORSCHE	N. VALKENBURG
MODEL PREDICTED TVOC CONCENTRATION IN SFD WELL 1-2 (4043) GM38 AREA		LEAD DESIGN PROF.	CHECKED R. PORSCHE
		PROJECT NUMBER NY001369.0001.00004	DRAWING NUMBER 12



NO.	DATE	REVISION DESCRIPTION	BY CKD

ARCADIS G&M

DRAWN LMC	DATE 3/27/03	PROJECT MANAGER R. PORSCHE	DEPARTMENT MANAGER N. VALKENBURG
MODEL PREDICTED TVOC CONCENTRATION IN SFD WELL 3 (6150) GM38 AREA		LEAD DESIGN PROF.	CHECKED R. PORSCHE
		PROJECT NUMBER NY001369.0001.00004	DRAWING NUMBER 13